



63 Wessel Road, Rivonia, 2128 PO Box 2597, Rivonia, 2128 South Africa  
Tel: +27 (0) 11 803 5726 Fax: +27 (0) 11 803 5745 Web: [www.gcs-sa.biz](http://www.gcs-sa.biz)

# **Application for Integrated Environmental Authorisation: Wastewater Treatment Plant and Co-Disposal Facility for Maquasa East Operations.**

## **Draft Environmental Impact Report**

**Version - Draft for Public Comment**

**12 September 2024**



**Kangra Coal (Pty) Ltd**

**GCS Project Number: 22-0161**

**DMR Reference: MP 30/5/1/23/2/1/133 EM**

**Client reference: KC/003/22**





# Integrated Environmental Authorisation Application: Wastewater Treatment Plant and Co-Disposal Facility for Maquasa East Operations

Draft for Public Review



12 September 2024

## DOCUMENT ISSUE STATUS

Report Issue	Draft Environmental Impact Report for Public Review		
GCS Reference Number	22-0161		
Client Reference	KC/003/22		
Title	Integrated Environmental Authorisation Application: Wastewater Treatment Plant and Co-Disposal Facility for Maquasa East Operations.		
	Name	Signature	Date
Author	Renee Steele <i>Pr. Sci. Nat: 008920</i> <i>EAPASA: 2022/4847</i>		12 September 2024
Environmental Manager	Gerda Bothma <i>Pr. Sci. Nat: 117348</i>		12 September 2024

## LEGAL NOTICE

This report or any proportion thereof and any associated documentation remain the property of GCS until the mandator effects payment of all fees and disbursements due to GCS in terms of the GCS Conditions of Contract and Project Acceptance Form. Notwithstanding the aforesaid, any reproduction, duplication, copying, adaptation, editing, change, disclosure, publication, distribution, incorporation, modification, lending, transfer, sending, delivering, serving or broadcasting must be authorised in writing by GCS.

In compliance with the Protection of Personal Information Act, No. 37067 of 26 November 2013, please ensure the following:

- Any personal information provided herein has been provided exclusively for use as part of the public participation registration process, and may therefore not be utilised for any purpose, other than that for which it was provided.
- No additional copies may be made of documents containing personal information unless permission has been obtained from the owner of said information.
- All documentation containing personal information must be destroyed as soon as the purpose for which the information was collected has run out.

## EXECUTIVE SUMMARY

The applicant, Kangra Coal (Pty) Ltd (Kangra), holds approved Environmental Management Programmes (EMPr) for their Maquasa East, Maquasa West, and Nooitgesien mining areas, situated approximately 40km west of the town of Piet Retief, Mpumalanga Province. These documents were combined into one EMPr during the application process undertaken by GCS (Pty) Ltd (GCS) in terms of Section 102 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA) in 2013.

Kangra intends to construct a wastewater treatment plant (WWTP) for the treatment of contaminated water, and a new co-disposal facility (CDF), including supporting and associated infrastructure, at their Maquasa East (MQE) operations (Department of Mineral Resources and Energy (DMRE) reference number: MP 30/5/1/23/2/1/133 EM).

An overview of the proposed projects is provided below:

### Wastewater Treatment Plant

The purpose of the proposed WWTP is to treat decant water as well as surplus contaminated water within the mining operations. MQE is currently decanting clear groundwater from old underground workings at an average rate of 1 800m<sup>3</sup>/d. The WWTP will employ active treatment of the wastewater as it was found that passive treatment is not feasible nor possible due to the decant point's location, the high flow rates, and the discharge quality required. Treated effluent from the WWTP will be discharged to the Heyshope Dam via an underground pipeline. Access to the WWTP and associated pipelines will be via existing roads. The implementation of the proposed active treatment of decant will entail the following:

- Upgrade of the decant/contamination dam: Formalising the dam wall to increase the storage capacity and lining the dam to prevent seepage;
- Upgrade of the decant point by drilling a row of eight (8) boreholes into the new dam wall at the decant dam in order to create a borehole well curtain (cut off) to cut off ground seepage water potentially entering the Heyshope Dam;
- Constructing a WWTP to treat decant and other mine-contaminated water; and
- Constructing a Brine Pollution Control Dam (Brine PCD) and a Brine Treatment Plant.

Brine produced at the WWTP will initially be pumped to the proposed new Brine PCD. The Brine PCD was initially proposed for the evaporation of brine from the WWTP. However, during the detailed design process currently being undertaken, it became evident that naturally evaporating brine at the site would not be efficient due to the projected inflow rate of brine to the proposed PCD/evaporation dam. It is therefore necessary to construct a Brine Treatment Plant to remove water from the brine, thereby converting it to a dry filter cake that can be disposed of on the proposed CDF.

### Brine Treatment Plant

A Brine Treatment Plant, with an anticipated throughput of 15m<sup>3</sup>/hr, or 285m<sup>3</sup>/day if pumping 19 hrs/day, will be constructed. The modular plant will cover an area of less than 0.06ha and will be skid mounted or containerized. The modular system allows for simpler expansion or alterations in the future should it be required.

The addition of the proposed Brine Treatment Plant to the development will reduce the risk of insufficient storage space for brine, reduce the risk of overflows from the Brine PCD and allows for sludge/filter cake quantities to be disposed of to be accurately quantified each month.

The proposed technology is a system that comprises a combined evaporator and crystallizer in a single step. Brine which is pumped into the Brine Treatment Plant will first pass through a pre-heating stage to raise the temperature before entering the brine recirculation system. The process removes water from the brine through the creation of water vapour, which exits at the top. Brine is continuously recirculated in the system causing the concentration of the recirculated brine to gradually rise until it crystallizes and forms solids. It is anticipated that the clean water produced will comply with the SANS 241 potable water limits before being discharged. The remaining salts/filter cake will be directly transported to the CDF for disposal.

### Co-Disposal Facility (CDF)

The proposed co-disposal facility (CDF) falls within the exact footprint of the previously authorized (MDARDLEA Ref: 17/2/3/GS-240) MQE Discard Dump (DD). A WML was issued for this DD and associated PCD and stormwater management infrastructure on 23 February 2024 (DMR Ref: (MP) 30/5/1/3/3/1/ (133) EA). This WML, however, authorises the disposal of discard only.

The CDF will accommodate discard produced at the beneficiation plant, slurry/filter cake, and potentially brine from the WWTP.

The CDF's design will be like the authorised discard dump: a three-compartment side hill-type facility with a footprint of approximately 65ha. A phased development approach, over a period of 20 years, is envisaged: Phase 1 - 7 years; Phase 2 - 7 years and Phase 3 - 6 years capacity. Associated and supporting infrastructure includes haul roads, PCDs, stormwater management measures, various pipelines, etc.

### Environmental Authorisation Applications

To enable the implementation of the proposed projects, Kangra needs to acquire the necessary environmental approvals. GCS Water and Environment (Pty) Ltd (GCS) has been appointed as the independent Environmental Assessment Practitioner (EAP) to compile and

submit the required documentation for the Integrated Environmental Application by Kangra Coal (Pty) Ltd for:

- An Integrated Environmental Authorisation (IEA) and Waste Management License (WML) through a Scoping and Environmental Impact Reporting (S&EIR) process and the compilation of an Environmental Management Programme (EMPr), in terms of the NEMA, National Environmental Management: Waste Act, 2008 (Act 59 of 2008) (NEMWA), and Environmental Impact Assessment (EIA) Regulations (2014, as amended) (IEA Application);
- An Integrated Water Use License (IWUL), in terms of the National Water Act, 1998 (Act 36 of 1998) (NWA).

### **Scoping and Environmental Impact Report Process**

A S&EIR process has two (2) distinct phases: The Scoping Phase and the Environmental Impact Assessment (EIA) Reporting Phase (S&EIR Process). The Scoping Phase has been concluded with the acceptance of the Final Scoping Report by the Competent Authority on the 13th of August 2024.

This report, the Draft Environmental Impact Report (DEIR) illustrates the risk assessment undertaken of potential biophysical and socio-economic aspects and impacts of the proposed development on the receiving environment. This report summarises the risks and findings of various specialist studies undertaken and outlines avoidance, mitigation and management actions which will assist in minimising the impact of the project during construction and operations as far as possible.

The Environmental Impact phase starts with the Draft Environmental Impact Assessment Report (DEIR) which is made available to Interested and Affected Parties (I&APs) for review after which the comments, questions and concerns will be investigated and included in the submission of the Final Environmental Impact Assessment Report (FEIR) to the Competent Authority (CA) for consideration, thereafter the application will be assessed by the CA and decision will be communicated to the applicant.

### **Public Participation Process**

All interested and affected parties (I&APs) are encouraged to register as stakeholders to enable them to comment during the Public Participation Process (PPP) of the entire project. This PPP provides an opportunity to comment and raise any concerns or suggestions with respect to the project.

All comments received during the Scoping PPP has been recorded and addressed within the Scoping Comments and Responses Report (CRR), which forms part of the Public Participation Report (PPR); and will be further addressed as needed during the EIA phase of the project. The DSR was available for comment for 30 days from 24 November 2023 to 16 January 2024.

As per the requirements of the NEMA EIA Regulations (2014, as amended), this DEIR has been

issued for public participation from **18 September to 18 October 2024**, as stipulated by the NEMA EIA Regulations (2014, as amended).

### **Environmental Impact Statement**

The assessments undertaken during the EIA process have not identified any fatal flaws which would preclude the authorisation of the proposed Project. The EAP is confident that all major negative impacts associated with the proposed development has been adequately described and can be mitigated to acceptable levels.

The goal of the proposed Project is to mitigate the negative impacts of decant on the environment and continue contributing to the local economy by allowing the full Life of Mine (LoM) to be realised.

It is the opinion of the EAP that the proposed WWTP and CDF and related infrastructure should be authorised, provided that the proposed mitigation measures are implemented effectively and in line with the EMPR and any site-specific conditions outlined within the IEA and WML.

### **Your comment on the Draft EIA Report**

This DEIR is available to all registered I&APs for public review and comment from **18 September 2024** (comment period ending **18 October 2024**) as follows:

Printed Copies	
Piet Retief Library, 10B Retief Street	Maquasa East Security Office and Main Access Gate, Maquasa East Mine
Thusong Service Centre, Driefontein Community	
Electronic Copy	
Website Download	<a href="https://www.gcs-sa.biz/public-documents/">https://www.gcs-sa.biz/public-documents/</a>

Stakeholder meeting(s) will be held between **1 and 3 October 2024**, to discuss the contents of the DEIR to discuss the contents of the DEIR. Should you wish to attend a meeting, please register your attendance by contacting GCS to obtain details regarding the various opportunities for engagement.

Any comments on the DEIR must be submitted in writing or email (including any additional supporting material) on or before **18 October 2024** directly to GCS Water and Environment (Pty) Ltd by means of the following:

Attention: Anelle Lötter / Gerda Bothma  
 Tel: 011 803 5726  
 E-mail: [anellel@gcs-sa.biz](mailto:anellel@gcs-sa.biz) /  
[gerdab@gcs-sa.biz](mailto:gerdab@gcs-sa.biz)

PO Box 2597  
 Rivonia  
 Johannesburg  
 2128



## CONTENTS PAGE

<b>1</b>	<b>INTRODUCTION .....</b>	<b>1</b>
1.1	BACKGROUND .....	1
1.2	PROJECT OVERVIEW .....	2
1.2.1	Wastewater Treatment Plant .....	2
1.2.2	Brine Treatment Plant.....	3
1.2.3	Co-disposal Facility .....	3
1.3	AUTHORISATIONS RELATED TO THE PROJECT .....	4
1.4	DETAILS OF APPLICANT AND ENVIRONMENTAL ASSESSMENT PRACTITIONER .....	5
1.4.1	Applicant.....	5
1.4.2	Environmental Assessment Practitioner .....	5
1.5	PROJECT LOCATION .....	6
<b>2</b>	<b>PROJECT DESCRIPTION .....</b>	<b>10</b>
2.1	PROPOSED WWTP & ASSOCIATED INFRASTRUCTURE .....	10
2.1.1	Overview of the proposed WWTP.....	10
2.1.2	Description of the proposed WWTP & Associated Infrastructure .....	13
2.1.3	Location of the proposed WWTP & Associated Infrastructure .....	19
2.2	PROPOSED CO-DISPOSAL FACILITY & ASSOCIATED INFRASTRUCTURE .....	22
2.2.1	Description of Proposed Co-disposal Facility .....	22
2.2.2	Location of proposed Co-disposal Facility & Associated Infrastructure .....	24
<b>3</b>	<b>LEGAL FRAMEWORK.....</b>	<b>30</b>
3.1	GENERAL OVERVIEW .....	30
3.2	NEMA EIA REGULATIONS 2014 (AS AMENDED).....	46
3.2.1	Applicable Listed Activities.....	47
3.2.2	The S&EIR Process.....	53
<b>4</b>	<b>PROJECT MOTIVATION NEED AND DESIRABILITY.....</b>	<b>54</b>
<b>5</b>	<b>PROJECT ALTERNATIVES .....</b>	<b>67</b>
5.1	PROPERTY/LOCATION ALTERNATIVES.....	68
5.1.1	WWTP.....	68
5.1.2	CDF.....	69
5.2	DESIGN/LAYOUT ALTERNATIVES .....	72
5.2.1	WWTP.....	72
5.2.2	CDF.....	74
5.3	NO-GO ALTERNATIVE.....	75
5.4	CONCLUDING STATEMENT OF PREFERRED ALTERNATIVES.....	76
<b>6</b>	<b>ENVIRONMENTAL BASELINE .....</b>	<b>77</b>
6.1	GEOLOGY .....	77
6.1.1	Regional Geology.....	77
6.1.2	Local Geology.....	77
6.2	TOPOGRAPHY .....	80
6.3	CLIMATE .....	82
6.3.1	Temperature .....	82
6.3.2	Rainfall and Evaporation .....	82
6.3.3	Wind.....	83
6.4	LAND COVER .....	84
6.5	LAND MORPHOLOGY AND SOILS .....	87
6.5.1	Soil Types .....	87
6.5.2	Soil Permeability.....	92
6.5.3	Hydrological Soil Types (HST).....	92
6.5.3.1	Hillslope 1.....	93
6.5.3.2	Hillslope 2.....	94
6.5.3.3	Hillslope 3.....	96
6.5.3.4	Hillslope 4.....	97

6.5.4	<i>Flow Drivers</i> .....	101
6.6	LAND CAPABILITY.....	103
6.7	TERRESTRIAL BIODIVERSITY .....	105
6.7.1	<i>Flora</i> .....	105
6.7.1.1	Vegetation Unit .....	105
6.7.1.2	Conservation Status and Sensitivity .....	107
6.7.1.3	Protected Areas.....	107
6.7.1.4	Critical Biodiversity Areas (CBA) .....	107
6.7.1.5	Plant and Tree Species of Conservation Concern .....	107
6.7.2	<i>Fauna</i> .....	110
6.7.2.1	Mammals.....	110
6.7.2.2	Avifauna .....	111
6.7.2.3	Reptiles.....	114
6.7.2.4	Amphibians .....	115
6.7.2.5	Invertebrate Species of Conservation Concern .....	115
6.8	SURFACE WATER .....	117
6.8.1	<i>Water Management Area</i> .....	117
6.8.2	<i>Surface Water Hydrology</i> .....	117
6.8.3	<i>Surface Water Quality</i> .....	121
6.8.4	<i>Mean Annual Runoff</i> .....	125
6.8.5	<i>Floodlines</i> .....	126
6.8.6	<i>Resource Class and River Health</i> .....	128
6.8.6.1	Determining Current Management Class for the Water Resource .....	128
6.8.6.2	Determining Sensitivity of the Water Resource in the vicinity of the Mine .....	129
6.8.7	<i>Receiving Water Quality Objectives</i> .....	131
6.8.8	<i>Surface Water User Survey</i> .....	131
6.8.9	<i>National Freshwater Ecosystem Priority Area (FEPA)</i> .....	131
6.8.10	<i>Sensitive Areas (Wetlands)</i> .....	133
6.8.10.1	Wetland Delineation and Description.....	136
6.8.10.2	Aquatic Features Functional Assessment .....	138
6.8.10.3	Wetland Ecological Function.....	140
6.8.10.4	Present Ecological State (PES) of the Delineated Wetlands.....	141
6.8.10.5	Ecological Importance and Sensitivity (EIS) of the Delineated Wetlands .....	142
6.8.10.6	Buffer Determination.....	143
6.9	GROUNDWATER .....	145
6.9.1	<i>Aquifer Characterization</i> .....	145
6.9.1.1	Aquifer Type and Aquifer Zones .....	145
6.9.1.2	Preferential Flow Paths .....	147
6.9.1.3	Primary Groundwater Occurrence .....	147
6.9.2	<i>Groundwater Levels and Direction</i> .....	148
6.9.3	<i>Groundwater Recharge</i> .....	149
6.9.4	<i>Aquifer Yield</i> .....	150
6.9.5	<i>Groundwater Quality</i> .....	150
6.9.5.1	Maquasa West and Nooitgesien .....	150
6.9.5.2	Maquasa East .....	153
6.9.6	<i>Hydrocensus</i> .....	156
6.9.7	<i>Conceptual Groundwater Model</i> .....	158
6.9.7.1	Pollution Sources.....	158
6.9.7.2	Pathway.....	159
6.9.7.3	Receptors .....	160
6.9.8	<i>Numerical Groundwater Model</i> .....	160
6.9.8.1	Calibrated Flow Model .....	160
6.9.8.2	Calibrated 2022 Sulphate Plumes (ZOlp).....	161
6.9.8.3	Simulated Aquifer Drawdown .....	161
6.10	AIR QUALITY.....	165
6.11	NOISE.....	166
6.12	HERITAGE AND ARCHAEOLOGY .....	166
6.13	SOCIO-ECONOMIC ENVIRONMENT .....	166
6.13.1	<i>Regional Context</i> .....	166

6.13.2	<i>Local Context</i> .....	167
6.13.2.1	Demographic profile .....	167
6.13.2.2	Economic Profile .....	168
6.13.3	<i>Neighbouring Community/Sensitive Receptors</i> .....	169
6.14	VISUAL ASPECTS .....	169
6.15	TRAFFIC .....	170
<b>7</b>	<b>SUMMARY OF SPECIALIST INVESTIGATIONS</b> .....	<b>171</b>
7.1	ECOLOGICAL ASSESSMENT .....	171
7.1.1	<i>Specialist Details</i> .....	171
7.1.2	<i>Scope of Work</i> .....	171
7.1.3	<i>Findings</i> .....	172
7.1.4	<i>Recommendations</i> .....	173
7.1.5	<i>Conclusion</i> .....	173
7.2	WETLAND ASSESSMENT .....	173
7.2.1	<i>Specialist Details</i> .....	173
7.2.2	<i>Scope of Work</i> .....	173
7.2.3	<i>Findings</i> .....	174
7.2.4	<i>Recommendations</i> .....	174
7.2.5	<i>Conclusion</i> .....	175
7.3	HYDROLOGICAL ASSESSMENT .....	175
7.3.1	<i>Specialist Details</i> .....	175
7.3.2	<i>Scope of Work</i> .....	175
7.3.3	<i>Findings</i> .....	176
7.3.4	<i>Recommendations</i> .....	176
7.3.5	<i>Conclusion</i> .....	177
7.4	GEOHYDROLOGICAL ASSESSMENT .....	177
7.4.1	<i>Specialist Details</i> .....	177
7.4.2	<i>Scope of Work</i> .....	178
7.4.3	<i>Findings</i> .....	179
7.4.4	<i>Recommendations</i> .....	180
7.4.5	<i>Conclusion</i> .....	181
7.5	HYDROPEDOLOGICAL ASSESSMENT .....	181
7.5.1	<i>Specialist Details</i> .....	181
7.5.2	<i>Scope of Work</i> .....	181
7.5.3	<i>Findings</i> .....	182
7.5.4	<i>Recommendations</i> .....	183
7.5.5	<i>Conclusion</i> .....	183
<b>8</b>	<b>PUBLIC PARTICIPATION PROCESS</b> .....	<b>184</b>
8.1	PURPOSE OF PUBLIC PARTICIPATION .....	184
8.2	COMPETENT AUTHORITY CONSULTATION .....	184
8.3	PUBLIC CONSULTATION PROCESS .....	185
8.3.1	<i>Stakeholder database</i> .....	185
8.3.2	<i>Preapplication and Announcement of the Application Process</i> .....	185
8.3.3	<i>Application Process Notifications</i> .....	186
8.3.4	<i>Public Review of Draft Scoping Report</i> .....	186
8.3.5	<i>Public Review of the DEIR and DEMPR</i> .....	187
8.3.6	<i>Availability of the FEIR and EMPr</i> .....	187
8.3.7	<i>Public Participation following the Competent Authority Decision</i> .....	187
8.3.8	<i>Comments and Response Report</i> .....	187
<b>9</b>	<b>EIA PROCESS AND APPROACH</b> .....	<b>188</b>
9.1	IMPACT ASSESSMENT METHODOLOGY .....	188
9.2	IMPACT MANAGEMENT .....	191
<b>10</b>	<b>ENVIRONMENTAL IMPACT ASSESSMENT</b> .....	<b>192</b>
10.1	ASSESSMENT OF CONSTRUCTION PHASE IMPACTS .....	192

10.1.1	Potential Impacts on Air Quality and Climate.....	192
10.1.2	Potential Impacts on Terrestrial Ecology.....	193
10.1.3	Potential Impacts on Freshwater Ecology.....	194
10.1.4	Potential Impacts on Soils, Land Capability and Land Use.....	194
10.1.5	Potential Impact on Geohydrology.....	196
10.1.6	Potential Impact on Hydrology.....	196
10.1.7	Potential Visual Impacts.....	197
10.1.8	Potential Noise Impacts.....	198
10.1.9	Potential Cultural Heritage and Paleontological Impacts.....	198
10.1.10	Potential Traffic Impacts.....	198
10.1.11	Potential Socio-Economic Impacts.....	198
10.2	ASSESSMENT OF OPERATIONAL PHASE IMPACTS.....	199
10.2.1	Potential Impacts on Air Quality and Climate.....	199
10.2.2	Potential Impacts on Terrestrial Ecology.....	199
10.2.3	Potential Impacts on Freshwater Ecology.....	200
10.2.4	Potential Impacts on, Soils, Land Capability and Land Use.....	200
10.2.5	Potential Impact on Geohydrology.....	201
10.2.6	Potential Impact on Hydrology.....	202
10.2.7	Potential Visual Impacts.....	202
10.2.8	Potential Noise Impacts.....	203
10.2.9	Potential Cultural Heritage and Paleontological Impacts.....	203
10.2.10	Potential Traffic Impacts.....	203
10.2.11	Potential Socio-Economic Impacts.....	203
10.3	ASSESSMENT OF DECOMMISSIONING PHASE IMPACTS.....	203
10.3.1	Potential Impacts on Air Quality and Climate.....	204
10.3.2	Potential Impacts on Terrestrial Ecology.....	205
10.3.3	Potential Impacts on Freshwater Ecology.....	205
10.3.4	Potential Impacts on Soils, Land Capability and Land Use.....	205
10.3.5	Potential Impact on Geohydrology.....	206
10.3.6	Potential Impact on Hydrology.....	206
10.3.7	Potential Visual Impacts.....	207
10.3.8	Potential Noise Impacts.....	207
10.3.9	Potential Cultural Heritage and Paleontological Impacts.....	207
10.3.10	Potential Socio-Economic Impacts.....	207
10.4	POTENTIAL CUMULATIVE AND RESIDUAL IMPACTS.....	208
10.4.1	Air Quality Assessment.....	208
10.4.2	Terrestrial Ecological Impacts.....	208
10.4.3	Freshwater Ecological Impacts.....	208
10.4.4	Potential Impacts on Soils, Land Capability and Land Use.....	209
10.4.5	Geohydrological Impacts.....	209
10.4.6	Hydrology Impacts.....	209
10.4.7	Visual Impacts.....	210
10.4.8	Cultural Heritage and Paleontological Impact Assessment.....	210
10.4.9	Noise Impacts.....	210
10.4.10	Socio Economic Impact Assessment.....	210
11	KNOWLEDGE, GAPS AND LIMITATIONS.....	211
12	ENVIRONMENTAL IMPACT STATEMENT.....	212
12.1	KEY FINDINGS OF THE IMPACT ASSESSMENT.....	212
12.2	OPINION REGARDING AUTHORIZATION OF ACTIVITY/IES.....	219
12.3	ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT (EMPr).....	219
12.4	PROPOSED CONDITIONS OF AUTHORISATION.....	220
13	CONCLUSION AND WAY FORWARD.....	221
13.1	CONCLUSION.....	221
13.2	WAY FORWARD.....	221

<b>14</b>	<b>EAP DECLARATION AND UNDERTAKING .....</b>	<b>222</b>
<b>15</b>	<b>REFERENCES .....</b>	<b>223</b>

## LIST OF FIGURES

Figure 1-1: Regional Locality of Kangra Operations.....	8
Figure 1-2: Property Details: MQE Projects. ....	9
<b>Figure 2-1: Unlined contamination/decant dam .....</b>	<b>11</b>
<b>Figure 2-2: Decant point and Contamination/Decant Dam layout. ....</b>	<b>11</b>
<b>Figure 2-3: MQE Water Treatment Master Layout Plan. ....</b>	<b>12</b>
<b>Figure 2-4: Borehole Implementation Installation. ....</b>	<b>13</b>
<b>Figure 2-5: RO Plant Process (Nafasi Water Technologies,2023). ....</b>	<b>15</b>
<b>Figure 2-6: WWTP &amp; BTP layout.....</b>	<b>16</b>
<b>Figure 2-8: Brine PCD and pipeline layout. ....</b>	<b>18</b>
<b>Figure 2-8: Locality overview of proposed WWTP, BTP and pipelines.....</b>	<b>21</b>
<b>Figure 2-10: CDF Conceptual Layout.....</b>	<b>26</b>
<b>Figure 2-11: Locality of proposed Co-disposal Facility .....</b>	<b>27</b>
<b>Figure 2-12: Dirty and Clean Water Catchments .....</b>	<b>28</b>
<b>Figure 2-13: Conceptual SWMP .....</b>	<b>29</b>
<b>Figure 5-1: Existing PCD Complex at MQE .....</b>	<b>68</b>
<b>Figure 5-2: WWTP Pipelines .....</b>	<b>69</b>
<b>Figure 5-3: Existing Discard Dump and Proposed CDF at MQE.....</b>	<b>70</b>
<b>Figure 5-4: Discard Dump Site Alternatives.....</b>	<b>71</b>
Figure 6-1: Geology of the project area .....	79
Figure 6-2: Topography of the project area.....	81
Figure 6-3: Average yearly temperatures (Meteoblue, 2022).....	82
Figure 6-4: Average rainfall for Station 0407639W & WR2012 evaporation.....	83
Figure 6-5: Wind rose (Meteoblue, 2022) .....	84
Figure 6-6: Landcover of the Study Area .....	85
Figure 6-7: Sub-catchments and surface slope rise %.....	86
Figure 6-8: Land morphology concept (Almond, 2016) .....	87
Figure 6-9: Bb62.....	88
Figure 6-10: Land types associated with the project area .....	90
Figure 6-11: Estimated soil distribution for sub-catchments associated with the project	91
Figure 6-12: Hillslope 1 - conceptual hydrology flow regimes .....	94
Figure 6-13: Hillslope 2 - conceptual hydrology flow regimes .....	96
Figure 6-14: Hillslope 3 - conceptual hydrology flow regimes .....	97
Figure 6-15: Hillslope 4 - conceptual hydrology flow regimes .....	98
Figure 6-16: Hydrological soil types in the study area and soil flow paths .....	99
Figure 6-17: Conceptualisation of hydrological soil flow paths .....	100
Figure 6-18: Natural flow drivers.....	102
Figure 6-19: Altered flow drivers - built-up area for a lines TSF/Landfill.....	103
Figure 6-20: Vegetation Units of the Study Area .....	106
<b>Figure 6.21 Sensitivity of the study area .....</b>	<b>108</b>
Figure 6-22: Terrestrial CBA and ESA surrounding the proposed development. ....	109
Figure 6-23: Water Management Area and Quaternary Catchments for Kangra Maquasa Operations .....	119
Figure 6-24: Maquasa Hydrology Sub Catchments .....	120
Figure 6-25: Surface Water Monitoring Points in the vicinity of CDF and WWTP .....	122
Figure 6-26: Maquasa East logarithmic surface water TDS graph .....	124
Figure 6-27: Maquasa East logarithmic surface water sulphate graph .....	125
Figure 6-28: Simulated natural (unmodified) runoff for W51B .....	126
Figure 6-29: Floodline Map of the Project Area .....	127
Figure 6-30: Location of the NFEPA Rivers identified in the NFEPA Database for Quaternary Catchment W51B.....	132
Figure 6-31: Location of the wetland features identified in the NFEPA Dataset (shown in green) in relation to a 500m radius (shown in yellow) of the project site.....	133



Figure 6-32: Location of the wetland features identified during the field assessment (in blue) within a 500m radius (in yellow) of the project site .....	137
Figure 6-33: Conceptual illustration of a Seep wetland, showing the typical landscape setting and the dominant inputs, throughputs and outputs of water (Ollis et al. 2013).....	138
Figure 6-34: Conceptual illustration of a Unchannelled Valley Bottom wetland showing the typical landscape setting and the dominant inputs, throughputs and outputs of water (Ollis et al. 2013) .....	139
Figure 6-35: Conceptual illustration of a Channelled Valley Bottom wetland showing the typical landscape setting and the dominant inputs, throughputs and outputs of water (Ollis et al. 2013) .....	140
Figure 6-36 <i>Location and extent of the applicable 40m construction buffer (in red) around the wetland within the study site.....</i>	144
Figure 6-37 <i>Location and extent of the applicable 20m operational buffer (in purple) around the wetland features within the study site.....</i>	145
Figure 6-38: Conceptualisation of the study area aquifer zone .....	146
Figure 6-39: Borehole water strike depths .....	148
Figure 6-40: Groundwater elevation vs topographic elevation .....	149
Figure 6-41: Measured blow yields for boreholes drilled in the Maquasa and Kusipongo areas .....	150
Figure 6-42: Maquasa West groundwater pH graph .....	152
Figure 6-43: Maquasa West groundwater TDS graph .....	152
Figure 6-44: Maquasa West groundwater sulphate graph .....	153
Figure 6-45: Maquasa East groundwater pH graph .....	155
Figure 6-46: Maquasa East logarithmic groundwater sulphate graph.....	155
Figure 6-47: Hydrocensus boreholes in the vicinity of the Study Area .....	157
Figure 6-48: Calibrated flow model for the Kusipongo and Maquasa operations .....	162
Figure 6-49: Calibrated sulphate plume for the year 2022 - MQE.....	163
Figure 6-50: Predicted aquifer drawdown (ZOlif)- MQE opencast operations.....	164
Figure 12-1: MQE CDF and WWTP Project Composite Environmental Sensitivity Map.....	218

## LIST OF TABLES

Table 1-1: Details of the Applicant.....	5
Table 1-2: Details of the EAP.....	5
Table 1-3: Property, SG & Ownership details.....	7
Table 2-1: Recommended Effluent Quality.....	17
Table 2-2: WWTP and Associated Infrastructure Coordinates. ....	20
Table 2-3: Dimensions of the proposed CDF. ....	23
Table 2-4: CDF and Associated Infrastructure Coordinates. ....	25
Table 3-1: Legislation applicable to the proposed projects at MQE. ....	31
Table 3-4: Listed activities in terms of the 2014 NEMA EIA regulations, as amended.....	47
Table 3-5: Listed activities in terms of the 2013 NEMWA Waste Listed Activities, as amended. ....	52
Table 4-1: Assessment of the proposed MQE projects in terms of securing ecological sustainable development and use of natural resources. ....	56
Table 4-2: Assessment of the proposed MQE projects in terms of promoting justifiable economic and social development.....	60
Table 5-1: MQE DD Location Alternatives assessed by Hatch in 2011.....	71
Table 6-1: Lithostratigraphic Sequence.....	78
Table 6-2: MAP of nearest rainfall stations .....	82
Table 6-3: Soil permeability classes for agriculture and conservation (Food and Agriculture Organization (FAO, 1980).....	92
Table 6-4: Hydrological soil types .....	92
Table 6-5: Land Capability Classes- Description and Suitability.....	104
Table 6-6: List of Red Listed Plant Species under QDS 2730AB.....	107
Table 6-7: Mammal species identified to occur in QDS 2730AB .....	111
Table 6-8: Avifauna species identified to occur in QDS 2730AB.....	111

Table 6-9: Reptile species identified to occur in QDS 2730AB.....	114
Table 6-10: Amphibian species identified to occur in QDS 2730AB .....	115
Table 6-11: Butterfly species identified to occur in QDS 2730AB .....	116
Table 6-12: Summary of sub-catchment characteristics .....	117
Table 6-13: MQE surface water sampling sites.....	121
Table 6-14: Resource Classes at set out by the DWS.....	128
Table 6-15: Short Term PES and EIS for W51B .....	129
Table 6-16: Short Term PES and EIS for W52A .....	129
Table 6-17: Long Term PES and EIS for W51B.....	130
Table 6-18: Long Term PES and EIS for W51A.....	130
Table 6-19: Sensitivity of the Water Resource.....	130
Table 6-20: Wetland hydrogeomorphic (HGM) types typically supporting inland wetlands in South Africa (Ollis et al., 2013) .....	134
Table 6-21: Wetland classification as per SANBI guideline (Ollis <i>et al.</i> 2013).....	136
Table 6-22: Ecosystem service provision by the Channelled Valley Bottom Wetlands associated with the project site .....	140
Table 6-23: Present Ecological Status of the System .....	141
Table 6-24: Ecological importance and sensitivity of the aquatic system .....	142
Table 7-1: Site Sensitivities (based on the property description) from the DFFE Screening Tool. ....	171
Table 9-1: Severity or magnitude of impact .....	188
Table 9-2: Spatial Scale of activity.....	189
Table 9-3: Duration of activity.....	189
Table 9-4: Frequency of activity (how often the activity is undertaken) .....	189
Table 9-5: Frequency of incident/impact (how often activity impacts environment) .....	189
Table 9-6: Legal Issues - governance of activity by legislation.....	189
Table 9-7: Detection (how quickly/easily impacts/risks of activity on environment, people, and property are detected) .....	189
Table 9-8: Impact significance ratings.....	190
Table 9-9: Irreplaceability of resource caused by impacts .....	191
Table 9-10: Reversibility of impacts .....	191
Table 12-1: Key Impacts: Construction Phase .....	212
Table 12-2: Key Impacts: Operational Phase.....	214
Table 12-3: Key Impacts: Decommissioning Phase .....	215

## LIST OF APPENDICES

APPENDIX A: Project Specific Information.....	225
APPENDIX B: EAP Information .....	228
APPENDIX C: Public Participation Report .....	229
APPENDIX D: Impact Assessment Matrix .....	230
APPENDIX E: Specialist Study Report .....	231
APPENDIX E-1: Ecological Assessment.....	232
APPENDIX E-2: Wetland Assessment .....	233
APPENDIX E-3: Hydrological Assessment .....	234
APPENDIX E-4: Geohydrological Assessment .....	235
APPENDIX E-5: Hydropedological Assessment .....	236
APPENDIX E-6: Heritage Assessment.....	237
APPENDIX E-7: Waste Classification .....	238
APPENDIX F: Draft EMPR .....	239

## ABBREVIATIONS AND ACRONYMS

<b>BID</b>	Background Information Document
<b>CDF</b>	Co-disposal facility
<b>EMP</b>	Environmental Management Plan
<b>EMPr</b>	Environmental Management Programme
<b>ESR</b>	Environmental Scoping Report
<b>DMRE</b>	Department of Mineral Resources and Environment
<b>DSR</b>	Draft Scoping Report
<b>DWS</b>	Department of Water and Sanitation
<b>EAP</b>	Environmental Assessment Practitioner
<b>DFFE</b>	Department of Forestry, Fisheries and the Environment
<b>EIA</b>	Environmental Impact Assessment
<b>ELWU</b>	Existing Lawful Water Use
<b>EMP</b>	Environmental Management Plan
<b>GA</b>	General Authorisation
<b>GSDM</b>	Gert Sibande District Municipality
<b>GNR</b>	Government Notice Regulation
<b>HGM</b>	Hydrogeomorphic
<b>I&amp;AP</b>	Interested and Affected Parties
<b>IBA</b>	Important Bird and Biodiversity Areas
<b>IHAS</b>	Invertebrate Habitat Assessment System
<b>IWULA</b>	Integrated Water Use License Application
<b>IWWMP</b>	Integrated Wastewater Management Plan
<b>LOM</b>	Life of Mine
<b>MAE</b>	Mean Annual Evaporation
<b>mamsl</b>	Metres above mean sea level
<b>MAR</b>	Mean Annual Runoff
<b>mbgl</b>	Metres below ground level
<b>MDEDET</b>	Mpumalanga Department of Economic Development and Eco Tourism
<b>MPRDA</b>	Minerals and Petroleum Resource Development Act
<b>MRA</b>	Mining Right Area
<b>Mtpa</b>	Million tons per annum
<b>NEM: WA</b>	National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)
<b>NEMA</b>	National Environmental Management Act, 1998 (Act No. 107 of 1998)

---

<b>NHRA</b>	National Heritage Resources Act, 1999 (Act 25 of 1999)
<b>NWA</b>	National Water Act, 1998 (Act No. 36 of 1998)
<b>PPP</b>	Public Participation Process
<b>PCD</b>	Pollution Control Dam
<b>PES</b>	Present Ecological Status
<b>PSLM</b>	Pixley ka Seme Local Municipality
<b>ROD</b>	Record of Decision
<b>RoM</b>	Run of Mine
<b>SAHRA</b>	South African Heritage Resources Agency
<b>SANS</b>	South African National Standards
<b>SASS</b>	South African Scoring System
<b>SAWS</b>	South African Weather Service
<b>SAWQG</b>	South African Water Quality Guidelines
<b>SWMP</b>	Storm Water Management Plan
<b>TDS</b>	Total Dissolved Solids
<b>WWTP</b>	Waste Water Treatment Plant

## STRUCTURE AND CONTENT OF THIS REPORT

This Environmental Impact Assessment Report has been prepared in compliance with Appendix 3, Regulation 28 of the EIA Regulations (2014, as amended) and is divided into various chapters and appendices, the contents of which are outlined below.

REFERENCE	CONTENTS OF THE ENVIRONMENTAL IMPACT REPORT	RELEVANT SECTION IN THE REPORT
<b>1(a)</b>	<b>Details of:</b>	See below
(i)	<i>The EAP who prepared the report; and</i>	Section 1.4
(ii)	<i>The expertise of the EAP, including a curriculum vitae</i>	Section 1.4 & Appendix A & B
<b>1(b)</b>	<b><i>The location of the development footprint of the activity on the approved site as contemplated in the accepted scoping report, including:</i></b>	Section 1.5
(i)	<i>the 21-digit Surveyor General code of each cadastral land parcel;</i>	Section 1.5
(ii)	<i>where available, the physical address and farm name; and</i>	Section 1.5
(iii)	<i>where the required information in items (i) and (ii) is not available, the coordinates of the boundary of the property or properties</i>	Section 1.5
<b>1(c)</b>	<b><i>A plan which locates the proposed activity, or activities applied for as well as the associated structures and infrastructure at an appropriate scale, or, if it is—</i></b>	Section 1.5: Figure 1-2
(i)	<i>a linear activity, a description and coordinates of the corridor in which the proposed activity or activities is to be undertaken;</i>	N/A
(ii)	<i>on land where the property has not been defined, the coordinates within which the activity is to be undertaken;</i>	Section 1.5: Figure 1-2
<b>1(d)</b>	<b><i>A description of the scope of the proposed activity, including—</i></b>	See below
(i)	<i>all listed and specified activities triggered and being applied for; and</i>	Section 3.2
(ii)	<i>a description of the associated structures and infrastructure related to the development;</i>	Section 2
<b>1 (e)</b>	<b><i>A description of the policy and legislative context within which the development is located and an explanation of how the proposed development complies with and responds to the legislation and policy context;</i></b>	Section 3
<b>1 (f)</b>	<b><i>A motivation for the need and desirability for the proposed development, including the need and desirability of the activity in the context of the preferred development footprint within the approved site as contemplated in the accepted scoping report;</i></b>	Section 4
<b>1 (g)</b>	<b><i>A motivation for the preferred development footprint within the approved site as contemplated in the accepted scoping report;</i></b>	Section 5.1
<b>1 (h)</b>	<b><i>A full description of the process followed to reach the proposed development footprint within the approved site as contemplated in the accepted scoping report, including:</i></b>	See below
(i)	<i>details of the development footprint alternatives considered;</i>	Section 5.1
(ii)	<i>details of the public participation process undertaken in terms of regulation 41 of the Regulations, including copies of the supporting documents and inputs;</i>	Section 9 & Appendix C
(iii)	<i>a summary of the issues raised by interested and affected parties, and an indication of the manner in which the issues were incorporated, or the reasons for not including them;</i>	Appendix C
(iv)	<i>the environmental attributes associated with the development footprint alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects;</i>	Section 6



REFERENCE	CONTENTS OF THE ENVIRONMENTAL IMPACT REPORT	RELEVANT SECTION IN THE REPORT
(v)	<i>the impacts and risks identified including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts—</i> (aa) <i>can be reversed;</i> (bb) <i>may cause irreplaceable loss of resources; and</i> (cc) <i>can be avoided, managed or mitigated;</i>	Section 9.2
(vi)	<i>the methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks;</i>	Section 9.1
(vii)	<i>positive and negative impacts that the proposed activity and alternatives will have on the environment and on the community that may be affected focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects;</i>	Section 9.2
(vii)	<i>the possible mitigation measures that could be applied and level of residual risk;</i>	Section 9.2 & Appendix D
(ix)	<i>if no alternative development footprints for the activity were investigated, the motivation for not considering such; and</i>	Section 5
(x)	<i>a concluding statement indicating the location of the preferred alternative development footprint within the approved site as contemplated in the accepted scoping report;</i>	Section 5.6
1 (i)	<b><i>A full description of the process undertaken to identify, assess and rank the impacts the activity and associated structures and infrastructure will impose on the preferred development footprint on the approved site as contemplated in the accepted scoping report through the life of the activity, including—</i></b>	Section 9
(i)	<i>a description of all environmental issues and risks that were identified during the environmental impact assessment process; and</i>	Section 10 & Appendix D
(ii)	<i>an assessment of the significance of each issue and risk and an indication of the extent to which the issue and risk could be avoided or addressed by the adoption of mitigation measures;</i>	Section 10 & Appendix D
1 (j)	<b><i>An assessment of each identified potentially significant impact and risk, including—</i></b>	Section 10 & Appendix D
(i)	<i>cumulative impacts;</i>	Section 10 & Appendix D
(ii)	<i>the nature, significance and consequences of the impact and risk;</i>	Section 10 & Appendix D
(iii)	<i>the extent and duration of the impact and risk;</i>	Section 10 & Appendix D
(iv)	<i>the probability of the impact and risk occurring;</i>	Section 10 & Appendix D
(v)	<i>the degree to which the impact and risk can be reversed;</i>	Section 10 & Appendix D
(vi)	<i>the degree to which the impact and risk may cause irreplaceable loss of resources; and</i>	Section 10 & Appendix D
(vii)	<i>the degree to which the impact and risk can be mitigated;</i>	Section 10 & Appendix D
1 (k)	<b><i>Where applicable, a summary of the findings and recommendations of any specialist report complying with Appendix 6 to these Regulations and an indication as to how these findings and recommendations have been included in the final assessment report;</i></b>	Section 7
1 (l)	<b><i>An environmental impact statement which contains—</i></b>	Section 12
(i)	<i>a summary of the key findings of the environmental impact assessment;</i>	Section 12.1

REFERENCE	CONTENTS OF THE ENVIRONMENTAL IMPACT REPORT	RELEVANT SECTION IN THE REPORT
(ii)	<i>a map at an appropriate scale which superimposes the proposed activity and its associated structures and infrastructure on the environmental sensitivities of the preferred development footprint on the approved site as contemplated in the accepted scoping report indicating any areas that should be avoided, including buffers; and</i>	Figure 12-1
(iii)	<i>a summary of the positive and negative impacts and risks of the proposed activity and identified alternatives;</i>	Section 12
1 (m)	<b><i>Based on the assessment, and where applicable, recommendations from specialist reports, the recording of proposed impact management outcomes for the development for inclusion in the EMPr as well as for inclusion as conditions of authorisation;</i></b>	Sections 7, 9 & 12
1 (n)	<b><i>The final proposed alternatives which respond to the impact management measures, avoidance, and mitigation measures identified through the assessment;</i></b>	Section 5.6
1 (o)	<b><i>Any aspects which were conditional to the findings of the assessment either by the EAP or specialist which are to be included as conditions of authorisation;</i></b>	Section 12.4
1 (p)	<b><i>A description of any assumptions, uncertainties and gaps in knowledge which relate to the assessment and mitigation measures proposed;</i></b>	Section 11
1 (q)	<b><i>A reasoned opinion as to whether the proposed activity should or should not be authorised, and if the opinion is that it should be authorised, any conditions that should be made in respect of that authorisation;</i></b>	Section 12.2
1 (r)	<b><i>Where the proposed activity does not include operational aspects, the period for which the environmental authorisation is required and the date on which the activity will be concluded, and the post construction monitoring requirements finalised;</i></b>	N/A Inclusive of Operational Phase
1 (s)	<b><i>An undertaking under oath or affirmation by the EAP in relation to—</i></b>	Section 15
(i)	<i>the correctness of the information provided in the reports;</i>	Section 15
(ii)	<i>the inclusion of comments and inputs from stakeholders and I&amp;APs;</i>	Section 15
(iii)	<i>the inclusion of inputs and recommendations from the specialist reports where relevant; and</i>	Section 15
(iv)	<i>any information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested or affected parties;</i>	Section 15
1 (t)	This was deleted by GN 517 of 11 June 2021	N/A
1 (u)	<b><i>An indication of any deviation from the approved scoping report, including the plan of study, including—</i></b>	Section 2.1.2
(i)	<i>any deviation from the methodology used in determining the significance of potential environmental impacts and risks; and</i>	N/A
(ii)	<i>a motivation for the deviation;</i>	N/A
1 (v)	<b><i>Any specific information that may be required by the competent authority; and</i></b>	Section 13
1 (w)	<b><i>Any other matters required in terms of section 24(4)(a) and (b) of the Act.</i></b>	N/A

## 1 INTRODUCTION

### 1.1 Background

Kangra Coal (Pty) Ltd.'s (Kangra) Maquasa mining operation is located near Piet Retief within the Mpumalanga Province. The mining area is situated approximately 45km west of Piet Retief and just off the N2 national road on a secondary road leading to the Heyshope Dam. The Maquasa mining operations is made of the following mining areas:

- Maquasa East;
- Maquasa West; and
- Nooitgesien.

All these activities are undertaken and authorised under Mining Right (MR) MP30/5/1/23/2/1/133EM from the Department of Mineral Resources and Energy (DMRE).

Refer to Figure 1-1 for a regional locality map.

All mining and project related infrastructure is located at Maquasa East (MQE) and includes a coal washing plant and associated infrastructure. This plant is used for the processing of all coal mined from Twyfelhoek and Balgarthen mining area. No mining is taking place at Maquasa East and west as all of the coal reserves have already been mined.

The following infrastructure is located at MQE:

- Offices;
- Workshop and ancillary buildings;
- Existing Discard Dump;
- Beneficiation Plant;
- ENPROTEC Plant;
- Diesel Storage Facilities;
- Dirty water containment facilities;
- Maquasa East Adit;
- Haul roads;
- Powerlines;
- Conveyors and associated service roads (transporting mined coal to the Maquasa East processing plant);
- Access Roads;

- Pipeline (transporting water to the Maquasa East underground storage area);
- Crushers;
- Washing and screening plant; and
- Overburden and stockpile (i.e. topsoil, run of mine ore, product) dumps.

Kangra intends to construct a wastewater treatment plant (WWTP) for the treatment of contaminated water, and a new co-disposal facility (CDF), including supporting and associated infrastructure, at their MQE Operations.

To enable the implementation of the proposed projects, Kangra needs to acquire the necessary environmental approvals. GCS Water and Environment (Pty) Ltd (GCS) has been appointed as the independent Environmental Assessment Practitioner (EAP) to compile and submit the required documentation for the Integrated Environmental Application (IEA) by Kangra Coal (Pty) Ltd for:

- An IEA and Waste Management License (WML) through a Scoping and Environmental Impact Reporting (S&EIR) process and the compilation of an Environmental Management Programme (EMPr), in terms of the National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA), National Environmental Management: Waste Act, 2008 (Act 59 of 2008) (NEMWA), and Environmental Impact Assessment (EIA) Regulations (2014, as amended) (IEA Application); and
- An Integrated Water Use License (IWUL), in terms of the National Water Act, 1998 (Act no, 36 of 1998) (NWA).

## 1.2 Project Overview

An overview of the proposed projects is provided below.

### 1.2.1 Wastewater Treatment Plant

The purpose of the proposed WWTP is to treat decant water as well as surplus contaminated water within the mining operations. MQE is currently decanting clear groundwater from old underground workings at an average rate of 1 800m<sup>3</sup>/d. The WWTP will employ active treatment of the wastewater as it was found that passive treatment is not feasible nor possible due to decant point's location, the high flow rates and the discharge quality required.

The implementation of the proposed active treatment of decant will entail:

- Upgrade of the decant/contamination dam: Formalising the dam wall to increase the storage capacity and lining the dam to prevent seepage;

- Upgrade of the decant point by drilling a row of eight (8) boreholes into the new dam wall at the decant dam in order to create a borehole well curtain (cut off) to cut off ground seepage water potentially entering the Heyshope Dam;
- Constructing a WWTP to treat decant and other mine contaminated water; and
- Constructing a Brine Pollution Control Dam (PCD) and a Brine Treatment Plant.

Treated effluent from the WWTP will be discharged to the Heyshope Dam via an underground pipeline. Access to the WWTP and associated pipelines will be via existing roads.

Brine produced at the WWTP will initially be pumped to the proposed new Brine PCD. The Brine PCD was initially proposed for the evaporation of brine from the WWTP. However, during the detailed design process currently being undertaken, it became evident that naturally evaporating brine at the site would not be efficient due to the projected inflow rate of brine to the proposed PCD/evaporation dam. It is therefore necessary to construct a Brine Treatment Plant to remove water from the brine, thereby converting it to a dry filter cake that can be disposed of on the proposed CDF.

#### **1.2.2 Brine Treatment Plant**

A Brine Treatment Plant, with an anticipated throughput of 15m<sup>3</sup>/hr, or 285m<sup>3</sup>/day if pumping 19 hrs/day, will be constructed. The modular plant will cover an area of less than 0.06ha and will be skid mounted or containerized. The modular system allows for simpler expansion or alterations in the future should it be required.

The addition of the proposed Brine Treatment Plant to the development will reduce the risk of insufficient storage space for brine, reduce the risk of overflows from the Brine PCD and allows for sludge/filter cake quantities to be disposed of to be accurately quantified each month.

The proposed technology is a system that comprises a combined evaporator and crystallizer in a single step. Brine which is pumped into the Brine Treatment Plant will first pass through a pre-heating stage to raise the temperature before entering the brine recirculation system. The process removes water from the brine through the creation of water vapour, which exits at the top. Brine is continuously recirculated in the system causing the concentration of the recirculated brine to gradually rise until it crystallizes and forms solids. It is anticipated that the clean water produced will comply with the SANS 241 potable water limits before being discharged. The remaining salts/filter cake will be directly transported to the CDF for disposal.

#### **1.2.3 Co-disposal Facility**

The proposed co-disposal facility (CDF) falls within the exact footprint of the previously authorized (MDARDLEA Ref: 17/2/3/GS-240) MQE Discard Dump (DD). A WML was issued for this DD and associated PCD and stormwater management infrastructure on 23 February 2024



(DMR Ref: (MP) 30/5/1/3/3/1/ (133) EA). This WML, however, authorises the disposal of discard only.

The CDF will accommodate discard produced from the beneficiation plant, slurry, filter cake from the brine treatment plant and potentially brine from the WWTP.

The CDF's design will be like to the authorised discard dump: a three-compartment side hill-type facility with a footprint of approximately 65ha. A phased development approach, over a period of 20 years, is envisaged: Phase 1 - 7 years; Phase 2 - 7 years and Phase 3 - 6 years capacity.

### 1.3 Authorisations Related to the Project

The following list is a summary of the authorizations currently held by Kangra in respect of the MQE Operations. (Please note, other, non-related authorizations have not been included in this list):

- Kangra Maquasa Operations MR (Reference No.: MP30/5/1/23/2/1/133EM) issued by the Mpumalanga DMRE on the 13<sup>th</sup> of August 2014.
- An Integrated Water Use License (License No. 11/W51B/ACGIJ/4718) issued in terms of the NWA, by the Department of Water and Sanitation (DWS), on the 23<sup>rd</sup> of October 2017 for:
  - Section 21(a) - Taking of water from a water resource;
  - Section 21(b) - Storing of water;
  - Section 21(c) - Impeding or diverting the flow of water in a watercourse;
  - Section 21(g) - Disposing of waste in a manner which may detrimentally impact on a water resource;
  - Section 21(i) - Altering the bed, banks, course or characteristics of a watercourse; and
  - Section 21(j) - Removing, discharging or disposing of water found underground.
- An IWUL (License No. 11/W51B/CGI/4938) issued in terms of the NWA, by the DWS on the 4<sup>th</sup> of April 2018 for the new discard dump for:
  - Section 21(c) - Impeding or diverting the flow of water in a watercourse;
  - Section 21(g) - Disposing of waste in a manner which may detrimentally impact on a water resource;

- Section 21(i) - Altering the bed, banks, course or characteristics of a watercourse.
- Environmental Authorisation (EA) (Reference No.: 17/2/3 GS-240) for the MQE Discard Dump, issued by the Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs (MDARDLEA) on the 14<sup>th</sup> of June 2016.
- A WML was issued for the disposal of discard onto the DD, as well as the associated PCD and stormwater management infrastructure on 23 February 2024 (DMR Ref: (MP) 30/5/1/3/3/1/ (133) EA).

## 1.4 Details of Applicant and Environmental Assessment Practitioner

### 1.4.1 Applicant

The details of the Applicant are provided in **Table 1-1** below.

**Table 1-1: Details of the Applicant.**

ITEM	DETAILS
Company Name	Kangra Coal (Pty) Ltd
Company Representative	Paul Redelinghuys
Contact Person	Mahlatse Monareng
Telephone No.	+27 (17) 730 6200
Facsimile No.	+27 (17) 826 5284
E-mail Address	mahlatse.monareng@kangracoal.co.za
Postal Address	Kangra Group (Pty) Ltd, P.O. Box 745, Piet Retief

### 1.4.2 Environmental Assessment Practitioner

GCS has been appointed as the independent Environmental Assessment Practitioner (EAP) by Kangra Coal (Pty) Ltd to undertake the environmental applications required for the proposed projects on behalf of the Applicant. The contact details of the EAP are provided in **Table 1-2** and the EAP's CV is attached as **Appendix B**.

**Table 1-2: Details of the EAP.**

ITEM	DETAILS
Company Name	GCS Water and Environmental (Pty) Ltd
Company Representative	Gerda Bothma
EAP	Reneé Steele
Telephone No.	+27 (0)11 803 5726
Facsimile No.	+27 (0)11 803 5745
E-mail Address	<a href="mailto:gerdab@gcs-sa.biz">gerdab@gcs-sa.biz</a>
Postal Address	PO Box 2597, Rivonia, 2128

Mrs Bothma is the Environmental Unit Manager at GCS since 2019 has over 25 years' experience within the environmental and waste management field. Mrs Bothma has been involved in several engineering projects as the EAP as well as the Environmental Control Officer during construction, working closely with the Occupational Health and Safety Officer. She also has been involved in projects where waste licensing and water use licensing processes formed an integral part of the services offered and has extensive experience in environmental auditing and compliance monitoring. Mrs Bothma is the Project Manager overseeing the quality control in respect of the application processes.

Renee Steele is an Environmental Scientist, registered as a Professional Natural Scientist (Pri. Sci. Nat. 008920) with the South African Council for Natural Scientific Professions (SACNASP). Renee is registered EAP (Reg. No. 2022/48470 with the Environmental Assessment Practitioners Association of South Africa (EAPSA).

Ms Steele has 17 years' experience as an EAP. Renee has been involved in a wide range of environmental related projects, including environmental impact assessments; mining right, mining permit, prospecting permit applications; water use licence applications; environmental performance auditing and Environmental Control Officer (ECO) work.

GCS has no conflict of interest related to the contents of this Report. GCS has no personal financial interests in the property and/or activity being assessed in this report. GCS has no personal or financial connections to the relevant property owners, developers, planners, financiers or consultants of the property or activity, other than fair remuneration for professional services rendered for this Report to the CA. GCS declares that the opinions expressed in this Report are independent and a true reflection of their professional expertise. As such, GCS meets the requirements of an independent EAP as per the EIA Regulations 2014.

## 1.5 Project Location

As mentioned previously, MQE Operations is located within the Mpumalanga Province and operates under one (consolidated) MR, within which the proposed projects are located. The MR area fall within the jurisdiction of the Mkhondo Local Municipality (MLM) and Pixley Ka Seme Local Municipality (PSLM) of the Gert Sibande District Municipality (GSDM). Refer to Figure 1-1 below. Table 1-3 provide further information regarding the location of the proposed projects and their affected properties including the Surveyor-general (SG) 21-digit site information for the parent farms, whilst Figure 1-2 provides a visual representation of their location.

**Table 1-3: Property, SG & Ownership details**

Project	Property	SG Code	Local Municipality
Wastewater Treatment Plant (WWTP), Brine Treatment Plant, Brine PCD & pipeline	Remaining Extent (RE) of the farm Roodekraal 21HT	TOHT00000000002100000	Mkhondo LM
WWTP discharge pipeline	Farm Roodekraal 21 HT	TOHT00000000002100000	Mkhondo LM
	RE of the farm Roodekraal 21HT	TOHT00000000002100000	
Co-Disposal Facility (CDF)	RE of the farm Rooikop 18HT	TOHT00000000001800000	Pixley Ka Seme LM
	RE of the farm Maquasa 19HT	TOHT00000000001900000	
CDF pipelines & external haul roads	RE of the farm Rooikop 18HT	TOHT00000000001800000	Pixley Ka Seme LM
	RE of the farm Roodekraal 21HT	TOHT00000000002100000	Mkhondo LM

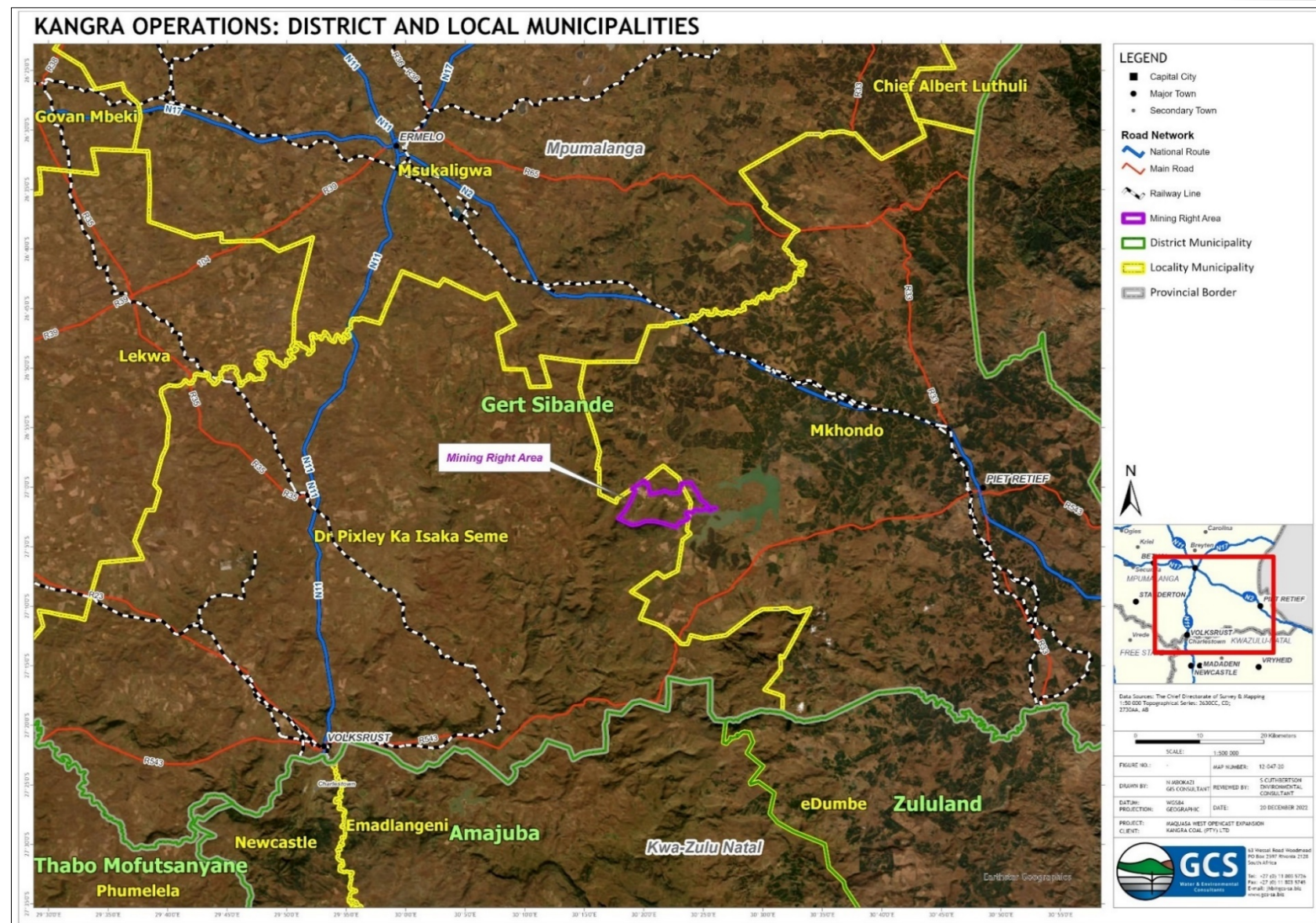


Figure 1-1: Regional Locality of Kangra Operations.



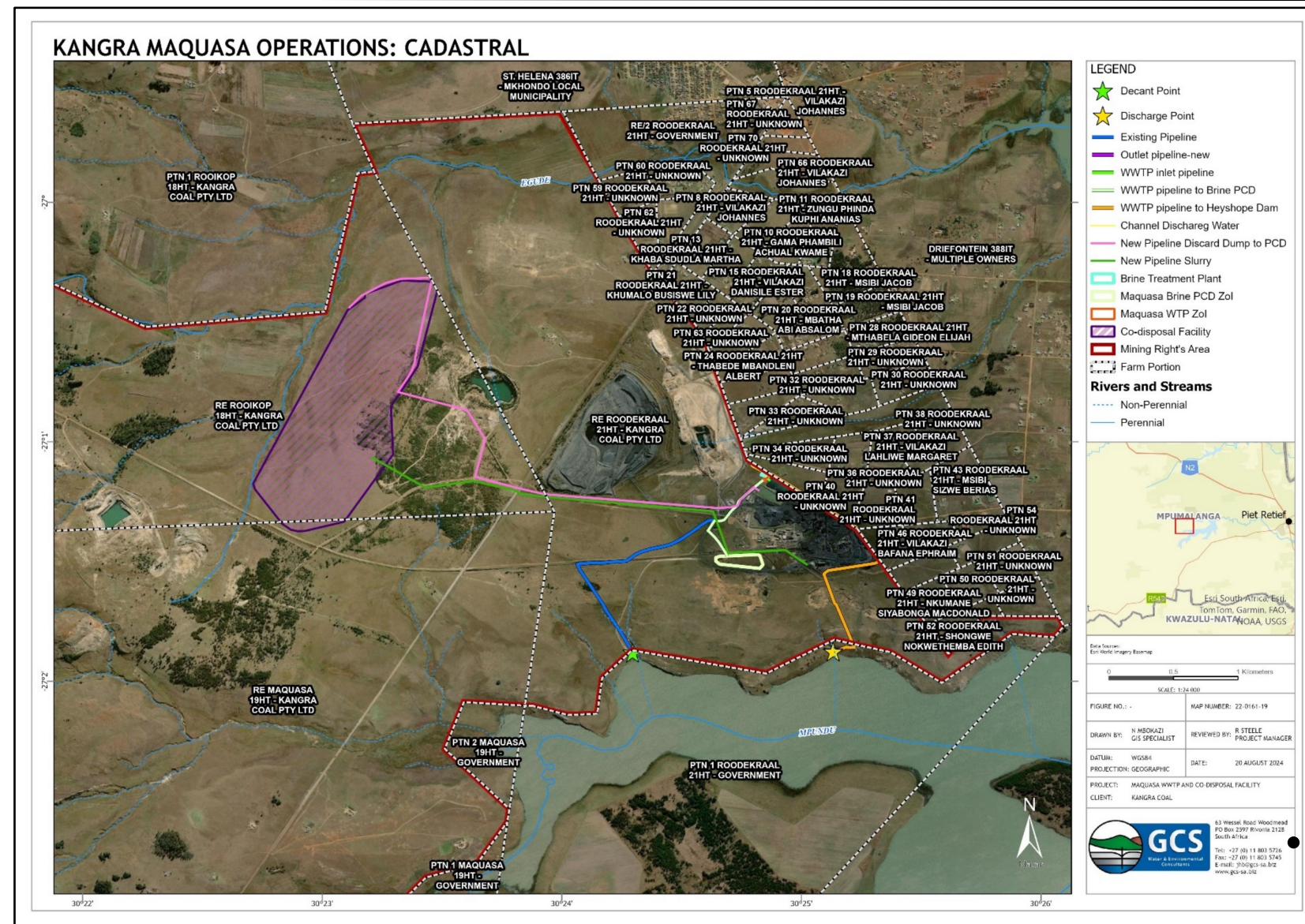


Figure 1-2: Property Details: MQE Projects.

## 2 PROJECT DESCRIPTION

As indicated in Section 1.2, MQE intends to construct a WWTP and CDF, with associated infrastructure, at their MQE site. Further details are provided below.

### 2.1 Proposed WWTP & Associated Infrastructure

The information regarding the proposed WWTP and associated infrastructure has been obtained from the design reports compiled by GFK Consulting Engineers, attached under Appendix A2 and A3.

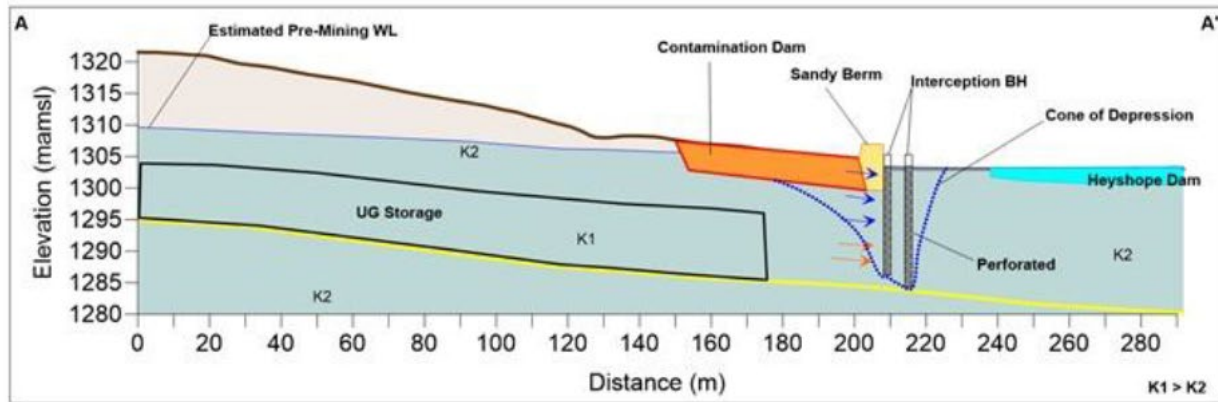
#### 2.1.1 Overview of the proposed WWTP

Decant is currently occurring via borehole “GCS016” in the form of clear groundwater, which has elevated sulphate levels, emanating from the old underground workings at MQE. This decant is observed at an elevation range of approximately 1303 to 1306 mamsl. Currently, the decanting water collects in an unlined contamination/decant dam next to the Heyshope Dam, depicted in **Figure 2-1** and **Figure 2-2** below. This dam is created by an existing earth berm to the south of the decant point, which allows for the collection of decant water and the diversion of the majority of clean water around the dam. Water from this dam is continuously pumped to PCDs to prevent overflows into the Heyshope Dam. The 2018 Numerical Model Update (GCS, 2018) indicated that there is seepage entering the Heyshope Dam in addition to the decant currently taking place.

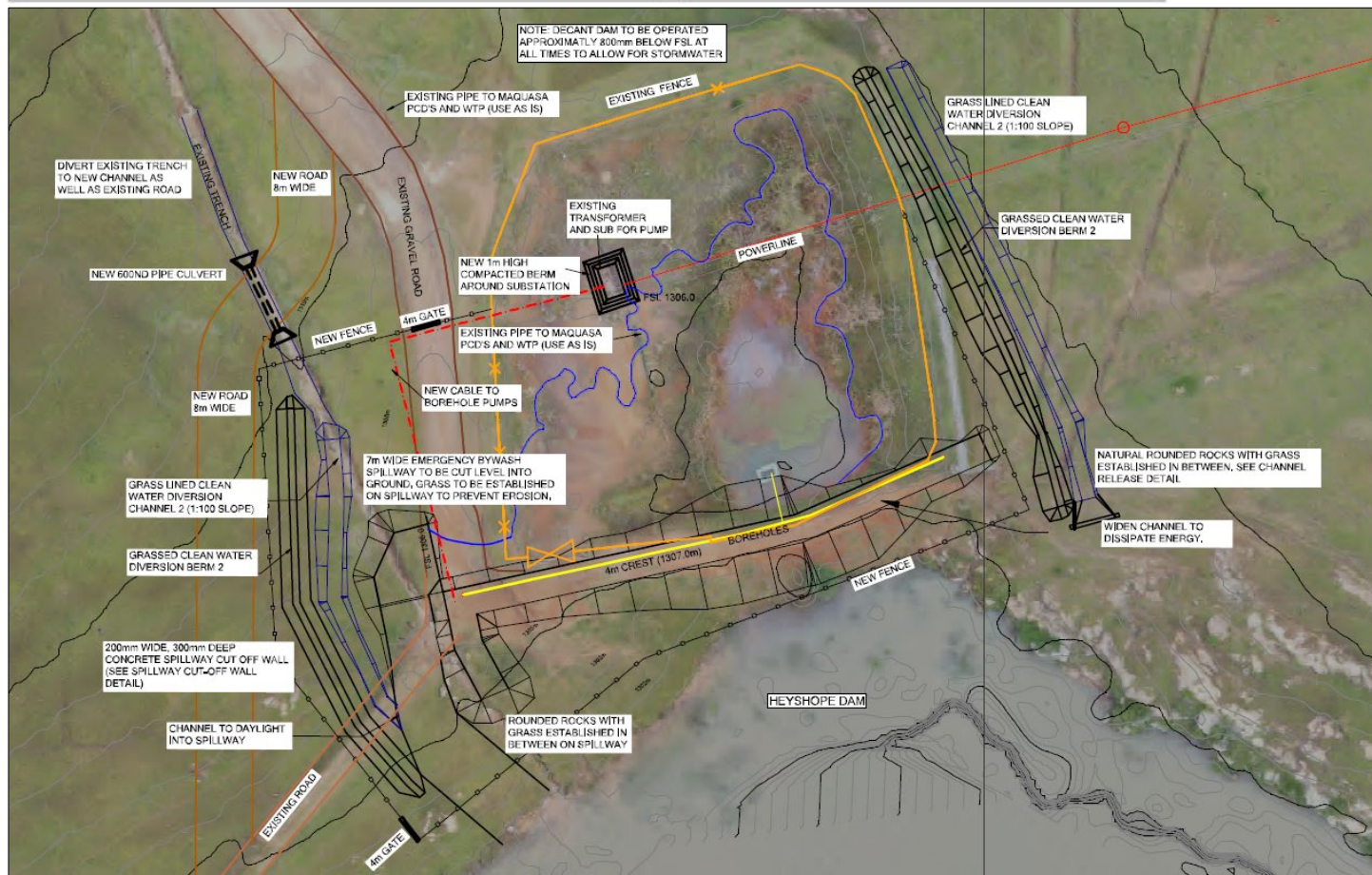
The 2018 Numerical Model Update report identified potential decant management actions, namely: passive treatment (constructed wetland system), evaporation over PCDs and active treatment. Active treatment is considered the most feasible solution due to the decant point location, high contaminated water flow rates and required discharge water quality. Refer to section 5.2.1 for a detailed assessment of the alternatives.

The implementation of the proposed active treatment of decant will entail upgrading the decant point and decant dam; constructing a WWTP, a Brine PCD and a Brine Treatment Plant. A Brine PCD was initially proposed for the evaporation of brine from the WWTP. However, during the detailed design process currently being undertaken, it became evident that naturally evaporating brine at the site would not be efficient due to the projected inflow rate of brine to the proposed PCD/evaporation dam. It is therefore necessary to construct a Brine Treatment Plant to remove water from the brine, thereby converting it to a dry filter cake that can be disposed of on the proposed CDF. The proposed Brine Treatment Plant will be a modular plant within the proposed development footprint, covering an area of less than 600m<sup>2</sup> (0.06ha) and will be phased in a later stage of the development.





**Figure 2-1: Unlined contamination/decant dam**



**Figure 2-2: Decant point and Contamination/Decant Dam layout.**



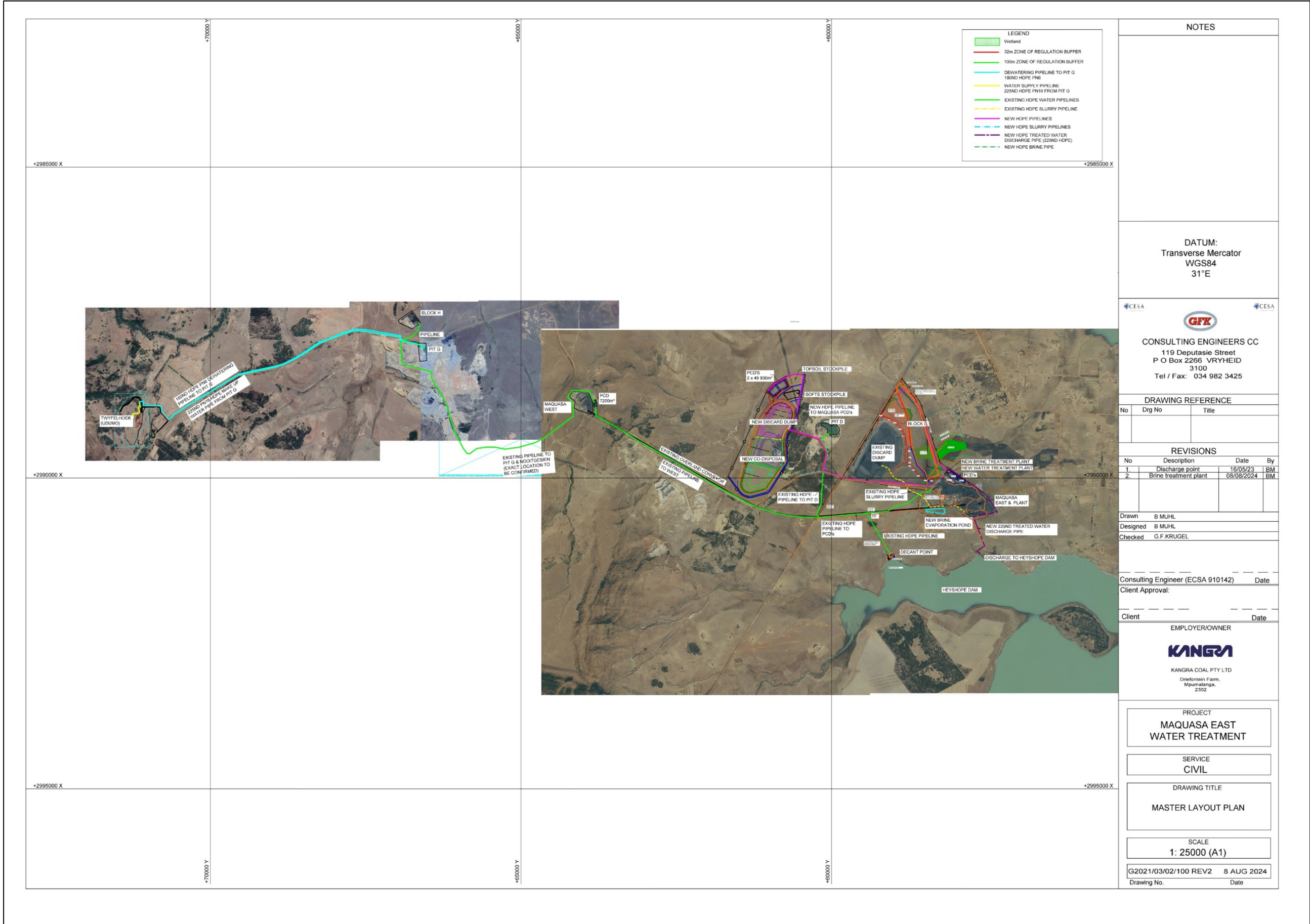


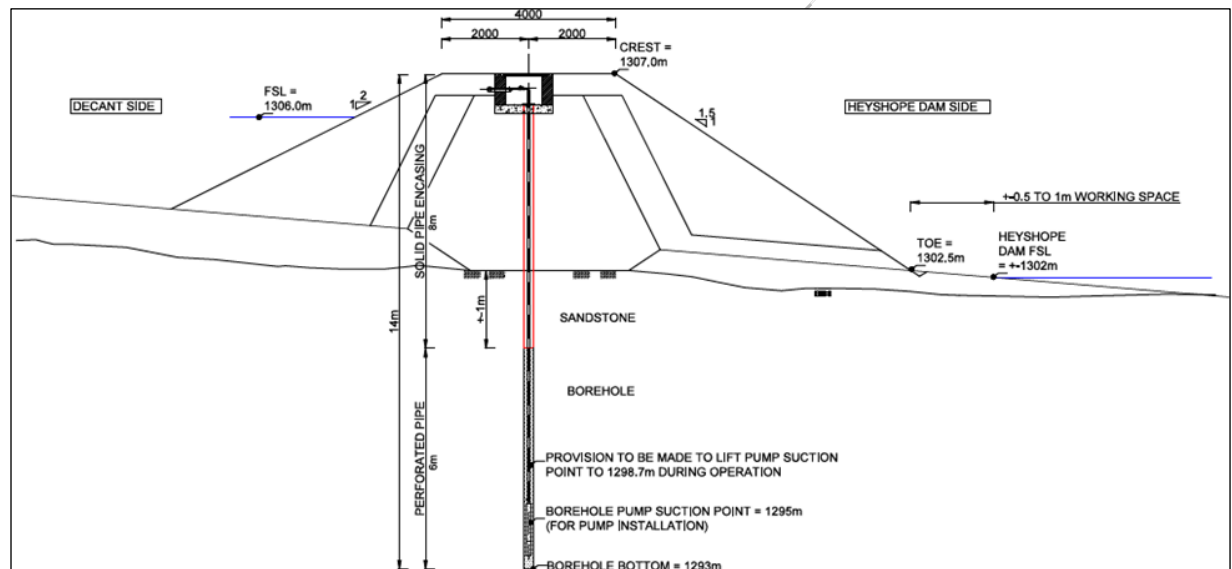
Figure 2-3: MQE Water Treatment Master Layout Plan.

### 2.1.2 Description of the proposed WWTP & Associated Infrastructure

#### Decant Point

The decant point will be upgraded by creating a borehole well curtain (cut off) to cut off ground seepage water potentially entering the Heyshope Dam, as indicated on **Figure 2-1** and **Figure 2-4** below. As mentioned previously, the decant dam is created by an existing earth berm to the south of the decant point (refer to **Figure 2-1**). This berm will be upgraded to form a dam wall. Boreholes will be installed in this dam wall and drilled into the underground sandstone. A row of eight (8) boreholes will be installed, spaced at 10m centres. Due to the close proximity to the Heyshope Dam, the risk exists that clean water can also be dewatered. Therefore, only one row will be drilled, as far as practically possible from the Heyshope dam.

To further reduce the risk of dewatering of the clean water in the Heyshope Dam, a concrete wall approximately 15m deep is proposed between the boreholes and the Heyshope Dam.



**Figure 2-4: Borehole Implementation Installation.**

All the boreholes will be connected by a 75ND HDPE pipe running along the top of the dam wall. Each borehole will be fitted with a stainless-steel submersible pump and level probes set to start pumping when the water in the borehole reaches the following conditions.

- Starting condition: the pump will start when the liquid level in the water well is at 1299.7m, which is above Lower probe; and
- Stop condition: the pump will stop when the liquid level in the water well is at 1295.5m, which is below the Lower probe.

The level probes will prevent continuous pumping and subsequent dewatering of clean water from the Heyshope dam. A pump flow rate of 5l/s has been used in the design.

A water meter will be installed to measure quantities pumped from the borehole. This meter functions separately from the water meter already installed at the decant point which measures how much surface decant water is pumped out on a monthly basis.

The existing gravel road will continue to be used for access to the decant point. A small portion approximately 110m long will be diverted from the existing road where a new road will be constructed. The new diverted road will be 8m wide with standard v-drains (500mm deep) on either side. This diverted road will cross an existing trench, where a 600ND pipe culvert will be installed.

### **Decant Dam/Contamination Dam**

The upgrade of the decant dam will entail increasing the capacity to prevent overflow and lining the dam in accordance with any conditions imposed by the DWS in order to prevent seepage into the Heyshope Dam.

The additional capacity will be created by increasing the dam wall. A portion of the existing earth berm indicated on **Figure 2-1** and **Figure 2-2** and the existing fence on the northern side of the decant dam will be kept as is, with a new dam wall and two diversion channels to be constructed. All clean stormwater and dirty decant water will be separated. With the stormwater diversion channels and berms in place, only direct rainfall and the actual decanting water will be stored in the decant dam.

Additionally, the dam wall will serve as protection to prevent cross-contamination of clean and dirty water during flooding periods and peak rainfall seasons. The Full Supply Level (FSL) of the decant dam (1360m) is 3m higher than the FSL of the Heyshope dam (1303m). The following details are applicable to the raised dam wall and upgraded decant dam:

- Full Supply Level (FSL): 1306m;
- Crest Level: 1307ml and
- Dam capacity at FSL: 1530m<sup>3</sup>

The stormwater diversion channels will be constructed in accordance with the design report, which sized them using predicated 1:50 year flood intensities (refer to Table 4 of the design report attached under Appendix A2). Siltation of the stormwater diversion channels is expected to be minimal as the clean stormwater runoff area is mostly from grasslands. The channels will be lined with Kikuyu or grass of similar properties. Kikuyu grass can handle a velocity up to 2.3m/s which is in line with the channel design velocities of 2m/s. The channels are to be constructed at a slope of 1:150 or flatter to ensure subcritical flow conditions are maintained.

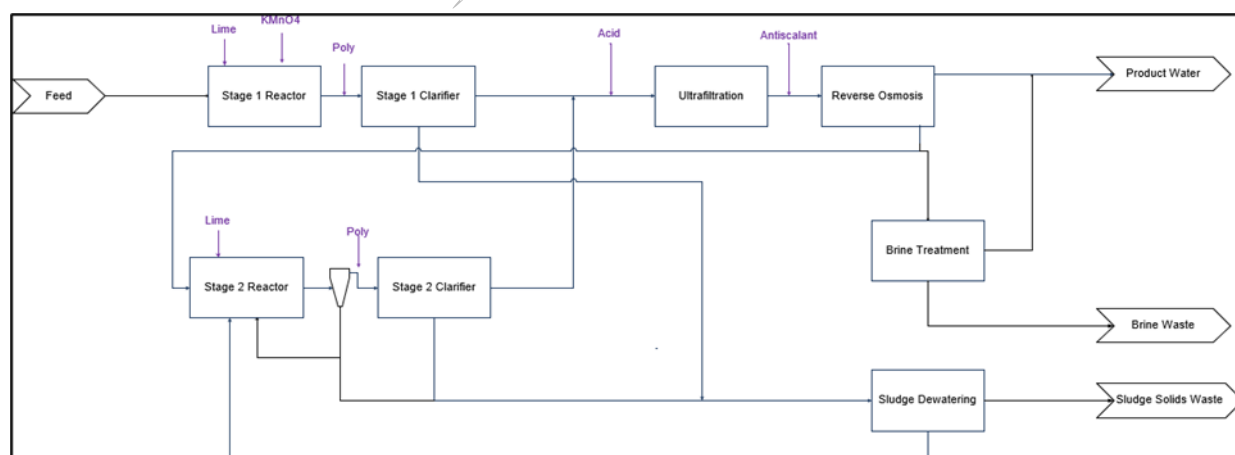
Fairly clean stormwater will discharge into the Heyshope dam via dispersion and erosion control structures downstream of the channels. Shallow sandstone is observed near the water edge of the Heyshope dam. Erosion at the stormwater outlets is thus expected to be minimal.

### WWTP

The detailed design of the proposed WWTP is currently being undertaken and a containerised reverse osmosis (RO) package plant is proposed; located next to the existing MQE PCDs. Refer to the proposed layout in **Figure 2-6** below. Access to the WWTP and associated pipelines will be via existing roads.

The WWTP needs to accommodate surplus contaminated water from the entire mining operation. In accordance with the mine wide water balance, flow rates of 4 500m<sup>3</sup> per day (52l/s) of contaminated water is to be treated at the WWTP to limit spills from the existing and proposed PCDs to less than once in 50 years, in compliance with Government Notice (GN) 704 of the NWA. Refer to **Figure 2-3** above for an overview of the site-wide MQE water treatment as depicted in the MQE Master Layout Plan compiled by GFK Consulting Engineers (DWG Reference No.: G2021/03/02/100 REV1).

The general RO process is provided in the diagram in **Figure 2-5**. The WWTP will produce treated water, which will be treated to the proposed quality provided in Table 2-1 of this report, dewatered primary sludge, dewatered gypsum sludge and brine. The treated/product water will be discharged into the Heyshope Dam, the dewatered sludge will be disposed of on the CDF and the brine will be pumped to the Brine PCD.



**Figure 2-5: RO Plant Process (Nafasi Water Technologies,2023).**



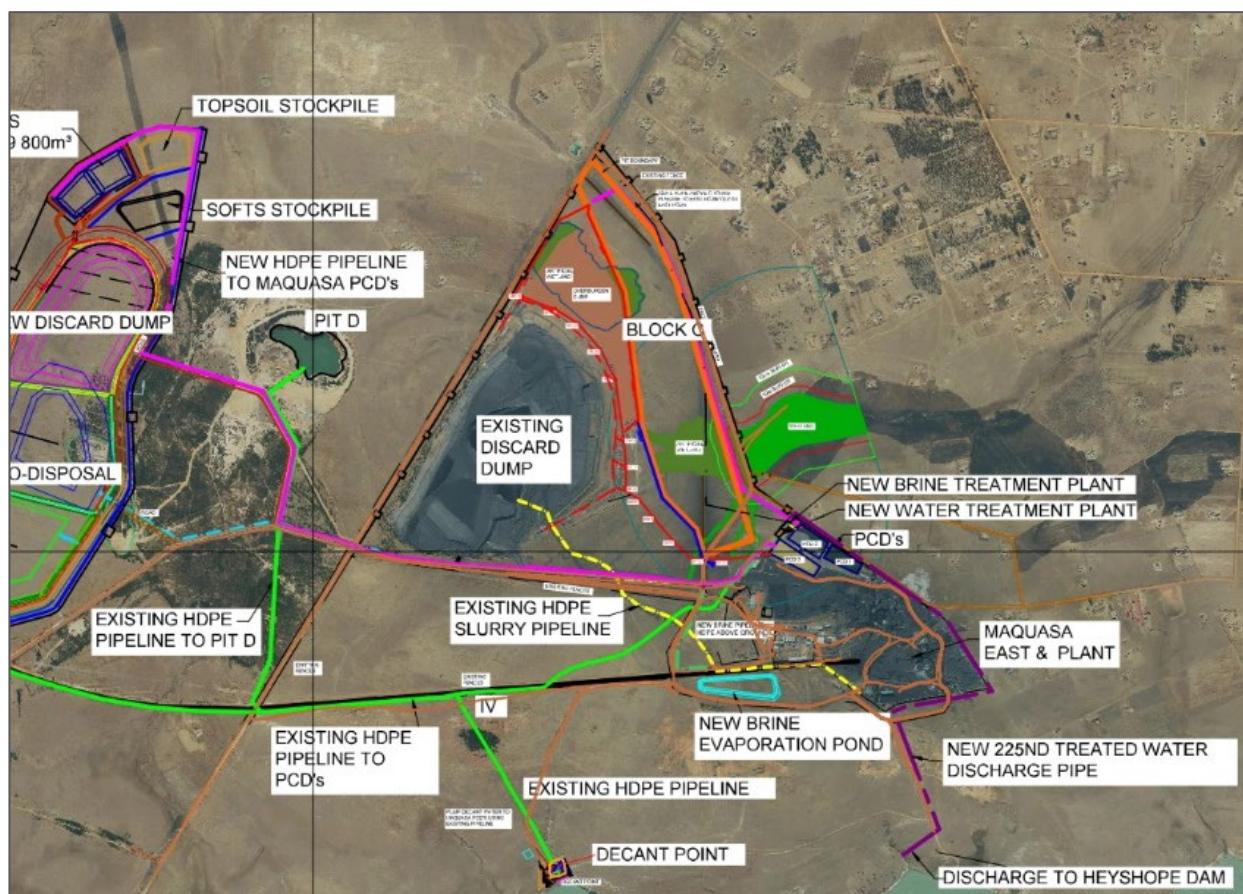


Figure 2-6: WWTP & BTP layout.

### Treated Water

Due to the high volumes of contaminated water being treated, discharging the treated effluent directly at the WWTP location is not feasible as it will potentially result in significant erosion, disturbance to human settlements in close proximity and significant ecological degradation of the sensitive wetland ecosystems identified within 500m from the WWTP.

It is therefore proposed that treated effluent be discharged to the Heyshope Dam via an underground pipeline, with erosion protection and energy dissipation in the form of a concrete and stone pitching headwall at the point of inflow into the dam. Refer to **Figure 2-6** above.

As there are currently no Resource Quality Objectives (RQO) for the Usuthu Catchment Management Area, the proposed discharge water quality as tabulated in Table 2-1 below, for the design of the WWTP has been based on the following:

- South African Water Quality Guidelines (DWS, 1996).
- SANS 241:2015.

- World Health Organisation (WHO) standard.
- Aquatic standard EPA.
- Baseline river quality in nearby streams not affected by mining.
- Current Heyshope dam water quality.
- Block C WUL as a guideline to what has previously been approved by DWS for the Kangra operations.
- Maquasa East WUL as a guideline to what has previously been approved by DWS for the Kangra operations.

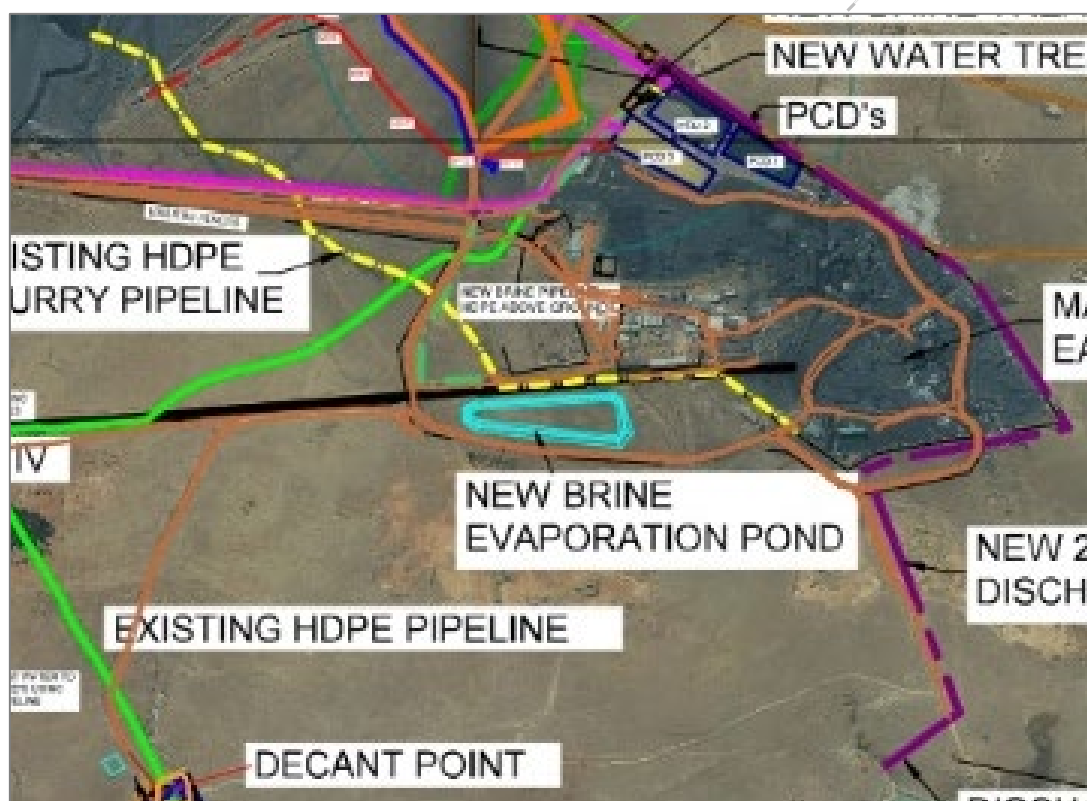
Table 2-1: Recommended Effluent Quality.

DETERMINANT	UNITS	DOMESTIC STANDARDS		Maquasa Operations WUL water quality (groundwater)	Block C WUL water quality (groundwater). Table 3	Baseline river at Balgarthen (Based on data range from 2010-2020 at monitoring points 963,966)	Heyshope dam point	MAXIMUM RECOMMENDED FOR DAM.
		SANS 241	WHO					
pH	pH units	5-9.7		6.5-8	6.5-9	5.7-8.9	7.5	6.5-8
Dissolved Oxygen (DO)/BOD	mg/ℓ					80% -120% of saturation		80% -120% of saturation
Electrical Conductivity	mS/m	170		27	23	22	14.72	40
Chloride	mg Cl/ℓ	300	250	3	3	14	7.04	100
Ammonia as N	mg N/ℓ	1.5	1.5			0.11	0.05	0.9
Ammonia	mg NH <sub>3</sub> /ℓ					N/A		0.2
Ammonium	mg NH <sub>4</sub> /ℓ					N/A		Test not required
Chromium IV	µg CR IV/ℓ					N/A		7
Cyanides Free and Total	µg Cn/ℓ	200	70			200		2
Dissolved Aluminium	µg Al/ℓ	300		620		2230	1.26	10
Dissolved Antimony	µg Sb/ℓ	20	20			N/A		20
Dissolved Arsenic	µg As/ℓ	10	10	1		N/A		10
Dissolved Beryllium	µg Be/ℓ	700				N/A		700
Dissolved Barium	µg Ba/ℓ					N/A		100
Dissolved Boron	µg B/ℓ	2400	2400			N/A		500
Dissolved Cadmium	µg Cd/ℓ	3	3	10		N/A		0.2
Dissolved Calcium	mg Ca/ℓ	150		29	27	73	10.54	58
Dissolved Cobalt	µg Co/ℓ	500				N/A		5
Dissolved Copper	µg Cu/ℓ	50	50			N/A		0.3
Dissolved Chromium	µg Cr/ℓ	2000	2000			N/A		100
Dissolved Iron	µg Fe/ℓ	2000	2000	2330	300	380	310	300
Dissolved Lead	µg Pb/ℓ	10	10	10		N/A		10
Dissolved Lithium	µg Li/ℓ					N/A		2500
Dissolved Manganese	µg Mn/ℓ	400	400	220	200	470	10	180
Dissolved Magnesium	mg Mg/ℓ			9	82	9.22	6.54	82
Dissolved Mercury	µg Hg/ℓ	6	6			6		1.3
Dissolved Nickel	µg Ni/ℓ	70	70			N/A		30
Dissolved Potassium	mg K/l	50		3		3.2	2.44	50
Dissolved Selenium	µg Se (vi)/ℓ	40	10			10		10
Dissolved Sodium	mg Na/ℓ	200	50	21		9.1	7.57	50
Dissolved Uranium	µg U/ℓ	30				30		30
Dissolved Vanadium	µg V/ℓ	200				200		200
Dissolved Zinc	µg Zn/ℓ	5000	3000	20				2
Fluoride	mg F/ℓ	1.5	1.5	0.31	0.3	0.92	0.07	0.75
Nitrogen as N	mg N/ℓ					0.5		0.5
Nitrate	mg NO <sub>3</sub> /ℓ	11	50	0.24	0.5	1.1	0.26	11
Nitrite	mg NO <sub>2</sub> /ℓ	0.9				0.7		0.9
Phosphorus as P	mg P/ℓ					N/A		0.03
Phosphate (ortho phosphate)	mg PO <sub>4</sub> /ℓ					N/A		0.1
Sulphate	mg SO <sub>4</sub> /ℓ	500		45	25	45	16.9	45
Total Alkalinity	mg CaCO <sub>3</sub> /ℓ			100	93	68	50.86	100
Total Dissolved Solids	mg/ℓ 180°C	1200		177	130	148	97.43	130

### Brine Disposal

The brine resulting from the WWTP will be pumped to the proposed new Brine PCD (lined with Class C liner), located in a previously disturbed area (**Figure 2-8**). As mentioned previously, naturally evaporating brine at the site would not be efficient due to the projected inflow rate to the proposed PCD/evaporation dam. This would require an unrealistically large dam to be constructed. A Brine Treatment Plant is therefore required as a long-term management measure.

The Brine PCD will be constructed as a complex of adjacent ponds, which will allow for the cleaning of a pond while the others are in use. The Brine PCD area will make provision for a year's worth of brine before the ponds would need to be emptied to accommodate more brine.



**Figure 2-7: Brine PCD and pipeline layout.**

A Brine Treatment Plant, with an anticipated throughput of 15m<sup>3</sup>/hr, or 285m<sup>3</sup>/day if pumping 19 hrs/day, will be constructed. The modular plant will cover an area of less than 0.06ha and will be skid mounted or containerized. The modular system allows for simpler expansion or alterations in the future should it be required.

The addition of the proposed Brine Treatment Plant to the development will reduce the risk of insufficient storage space for brine, reduce the risk of overflows from the Brine PCD and

allows for sludge/filter cake quantities to be disposed of to be accurately quantified each month.

The proposed technology is a system that comprises a combined evaporator and crystallizer in a single step. Brine which is pumped into the Brine Treatment Plant will first pass through a pre-heating stage to raise the temperature before entering the brine recirculation system. The process removes water from the brine through the creation of water vapour, which exits at the top. Brine is continuously recirculated in the system causing the concentration of the recirculated brine to gradually rise until it crystallizes and forms solids. It is anticipated that the clean water produced will comply with the SANS 241 potable water limits before being discharged into the Heyshope Dam via a pipe. The remaining salts/filter cake will be loaded onto dump trucks to be transported to the CDF for disposal.

### ***2.1.3 Location of the proposed WWTP & Associated Infrastructure***

The WWTP and associated infrastructure will be located on the farm Roodekraal 21 HT and the Remaining extent of the farm Roodekral 21HT, within the Mkhondo Local Municipal area, which falls under the current MQE MR and is owned by Kangra Coal (Pty) Ltd. The Surveyor-general 21-digit site information for the affected properties are provided in Table 1-3.

The Global Positioning System (GPS) coordinates for the proposed WWTP and associated infrastructure is provided in the Table 2-2 and the approximate location is presented in **Figure 2-8**.

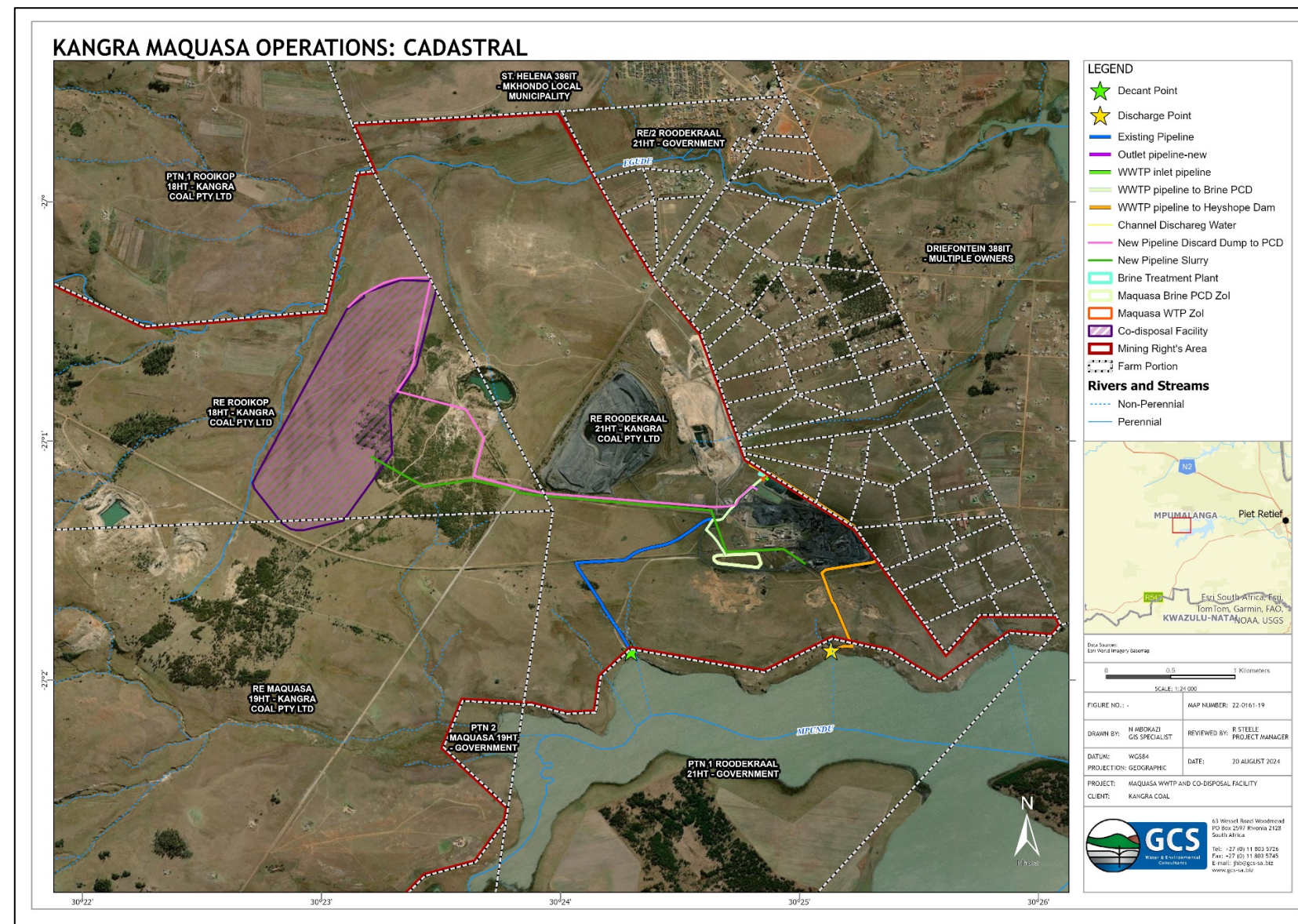
The proposed location was selected based on the following:

- The proximity to the PCDs: The existing network of pipes conveys water from the decant dam, Pit D, Block C and other operations on the greater Maquasa operations to the existing MQE PCD's;
- The existing pipe network allows all water to be managed at a centralised location, which will allow for better control and monitoring;
- The WWTP will be in close proximity to the mine offices allowing for easy maintenance access and closely controlled security; and
- Electricity is already available at the proposed location, with only minor upgrades to meet the plant's electrical requirements.



**Table 2-2: WWTP and Associated Infrastructure Coordinates.**

	Latitude	Longitude
WWTP Corner Point 1	27° 1'8.67"S	30° 24'51.19"E
WWTP Corner Point 2	27° 1'9.11"S	30° 24'51.72"E
WWTP Corner Point 3	27° 1'9.93"S	30° 24'50.83"E
WWTP Corner Point 4	27° 1'9.51"S	30° 24'50.32"E
WWTP Centre Point	27° 1'9.28"S	30° 24'51.05"E
WWTP Inlet Pipeline Start	27° 1'9.76"S	30° 24'52.19"E
WWTP Inlet Pipeline End	27° 1'9.24"S	30° 24'51.51"E
WWTP Outlet Pipeline Start	27° 1'8.76"S	30° 24'51.23"E
WWTP Outlet Pipeline End	27° 1'7.95"S	30° 24'52.59"E
Pipeline to Brine PCD Start	27° 1'9.61"S	30° 24'50.43"E
Pipeline to Brine PCD Middle	27° 1'15.99"S	30° 24'43.92"E
Pipeline to Brine PCD Turn Point	27° 1'22.31"S	30° 24'36.59"E
Pipeline to Brine PCD End	27° 1'28.73"S	30° 24'41.40"E
Brine PCD Corner Point 1	27° 1'28.23"S	30° 24'49.05"E
Brine PCD Corner Point 2	27° 1'28.53"S	30° 24'49.62"E
Brine PCD Corner Point 3	27° 1'30.79"S	30° 24'50.40"E
Brine PCD Corner Point 4	27° 1'31.76"S	30° 24'49.54"E
Brine PCD Corner Point 5	27° 1'30.65"S	30° 24'39.48"E
Brine PCD Corner Point 6	27° 1'29.94"S	30° 24'38.57"E
Brine PCD Corner Point 7	27° 1'29.06"S	30° 24'38.51"E
Brine PCD Corner Point 8	27° 1'28.71"S	30° 24'39.43"E
Brine Treatment Plant	27° 1'09.61"S	30° 24'51.12"E
WWTP & BTP Treated Water Discharge Pipeline Start	27° 1'7.95"S	30° 24'52.59"E
WWTP & BTP Treated Water Discharge Pipeline Turn Point 1	27° 1'21.20"S	30° 25'13.86"E
WWTP & BTP Treated Water Discharge Pipeline Turn Point 2	27° 1'30.56"S	30° 25'20.19"E
WWTP & BTP Treated Water Discharge Pipeline Turn Point 3	27° 1'32.04"S	30° 25'8.19"E
WWTP & BTP Treated Water Discharge Pipeline Turn Point 4	27° 1'33.55"S	30° 25'5.56"E
WWTP & BTP Treated Water Discharge Pipeline Turn Point 5	27° 1'48.44"S	30° 25'12.42"E
WWTP & BTP Treated Water Discharge Pipeline End	27° 1'51.45"S	30° 25'7.53"E



## 2.2 Proposed Co-disposal Facility & Associated Infrastructure.

The proposed 75ha CDF will be designed to accommodate 20 million tonnes of discard, comprising a volume of 10 million m<sup>3</sup> over a period of 20 years. The proposed new CDF complex will be approximately 131ha in extent and include the disposal facility, various material stockpiles, a PCD, haul roads, new slurry and contaminated water pipelines, and stormwater management infrastructure such as trenches, channels and berms.

Further details are provided within this section and was extracted from the “Kangra Coal (Pty) Ltd Maquasa East Proposed New Discard Dump: Environmental Scoping Report” (DD ESR) compiled by GCS in August 2014; and the GFK Consulting Engineers’ Conceptual Design for the CDF (DWG Reference: G2023/06/05-100). Construction and operation of the discussed infrastructure will trigger listed activities that will require authorisation.

### 2.2.1 Description of Proposed Co-disposal Facility Layout and required infrastructure:

The conceptual layout of the proposed CDF is presented in **Figure 2-10**. The CDF complex footprint extent and locality are provided in **Figure 2-11** and it presents the preliminary boundary fence of the entire CDF complex.

At this stage, it is envisaged that the following infrastructure will be required:

- Boundary fence;
- Internal haul roads;
- Lined Discard Dump;
- Catchment Paddocks;
- Two (2) compartment, lined Pollution Control Dam (one compartment to be operated as empty);
- HDPE Slurry pipeline;
- HDPE Contaminated water pipeline;
- Topsoil & Softs Stockpiles; and
- Stormwater management infrastructure, such as berms and trenches.

### Dimensions and life of the facility

The dimensions of the proposed new CDF which will be applied to the detailed design of the facility are presented in Table 2-3.

**Table 2-3: Dimensions of the proposed CDF.**

	Description
Life of facility	20 years
Extent of Discard Dump	75 ha
Capacity of discard dump	5 280 000m <sup>3</sup>
Final Volume of fines (slimes)	1 896 000m <sup>3</sup>
Final height of Discard Dump	30-32m
Deposition rate	≅ 50ton/hour, 620 operating hours/month*
Estimated required capacity of PCD	100 000m <sup>3</sup>

\*Preliminary estimation based on figures obtained from MQE.

### **Proposed Disposal Methodology**

According to the conceptual designs, the preferred disposal methodology (refer to the project alternatives in section 5 of this report) is integrated 'dry' disposal.

This involves mixing the low moisture "filter cake" fine discard material with the coarse discard material in layers as per the conventional disposal methods. The integrated discard "dry" technique will reduce the permeability of the coarse discard and therefore have a reduction in acid mine drainage (AMD). The discard material will be trucked to the dump via the gravel haul road to be constructed.

### **Seepage Control**

Seepage control will be required to prevent groundwater contamination from the proposed CDF:

- The CDF will be lined with a Class C type liner, in accordance with the stipulations of the WUL, once issued by the DWS;
- The coarse discard material will be graded and shaped to obtain controlled run-off for the collection of dirty water;
- Rehabilitation of the dump will be ongoing to reduce the dirty water catchment areas;
- A filter drain will be contracted around the perimeter of the dump to collect seepage, which will be directed to the lined PCD.

The efficiency of the seepage control system will be monitored by means of groundwater monitoring.

### **Access to the facility**

The CDF complex will be accessed via a 16m wide gravel haul road around the perimeter of the facility leading back to the coal washing plant at MQE.

### **Concurrent Rehabilitation**

The rehabilitation of the dump will be ongoing during the operation of the proposed new CDF.

Rehabilitation will include the placement of topsoil and grass on the dump side slopes. The soil cover required will be specified in the final design report to be included in the EIA Report. The CDF will be graded and shaped to achieve a suitable long-term profile. Following the completion of topsoiling and vegetating, the dirty water drainage from the exposed discard step-ins will be modified to clean water drainage.

### **Stormwater Management**

A conceptual stormwater management plan (SWMP) has been compiled GCS. A total of five (5) small stormwater sub-catchments were delineated for the project area, three (3) of which are considered potentially dirty water areas (i.e. areas associated with the PCDs, and runoff from the co-disposal facility) (refer to **Figure 2-12**).

Considering the proposed activities, the calculated peak flows and the ecological sensitivity of the project area, a mixture of free drainage from upstream catchments, interception of clean runoff water and capturing of poor quality runoff and seepage from the co-disposal facility and PCDs, as well as dedicated stormwater conveyance and capture systems, is proposed.

As the draft designs already have these systems in place, it is only recommended that the outlet drains of the clean water diversion trench be regulated by rock rip rap or vegetated covers, to decrease peak flows and capture sediment that makes it into the trench. The conceptual stormwater system is shown in **Figure 2-13**.

As the proposed WTP and brine pond are situated in areas with existing stormwater systems, as well as in dirty areas, these were not included in this investigation.

#### ***2.2.2 Location of proposed Co-disposal Facility & Associated Infrastructure***

The proposed CDF and its associated infrastructure will be located on the Remaining extent of the farms Rooikop 18HT and Maquasa 19HT within the Pixley Ka Seme Local Municipal area, both properties falling under the current MQE MR, owned by Kangra Coal (Pty) Ltd. The Surveyor-general 21-digit site information for the affected properties are provided in Table 1-3.

The GPS coordinates for the CDF are provided in Table 2-4, and the approximate locations are shown **Figure 2-10**.

**Table 2-4: CDF and Associated Infrastructure Coordinates.**

	Latitude	Longitude
CDF Corner Point 1	27° 0'18.91"S	30° 23'26.69"E
CDF Corner Point 2	27° 0'21.26"S	30° 23'28.09"E
CDF Corner Point 3	27° 0'42.04"S	30° 23'23.57"E
CDF Corner Point 4	27° 0'51.76"S	30° 23'17.42"E
CDF Corner Point 5	27° 1'4.23"S	30° 23'17.83"E
CDF Corner Point 6	27° 1'19.90"S	30° 23'6.71"E
CDF Corner Point 7	27° 1'22.52"S	30° 22'55.23"E
CDF Corner Point 8	27° 1'11.55"S	30° 22'42.71"E
CDF Corner Point 9	27° 0'26.60"S	30° 23'5.23"E
CDF Corner Point 10	27° 0'23.12"S	30° 23'9.65"E
CDF Corner Point 11	27° 0'22.21"S	30° 23'9.30"E
CDF Corner Point 12	27° 0'18.89"S	30° 23'18.64"E
CDF Centre Point	27° 0'49.19"S	30° 23'6.74"E
CDF Slurry Pipeline Start	27° 1'30.81"S	30° 25'1.46"E
CDF Slurry Pipeline Turn Point 1	27° 1'27.07"S	30° 24'55.93"E
CDF Slurry Pipeline Turn Point 2	27° 1'27.92"S	30° 24'41.55"E
CDF Slurry Pipeline Turn Point 3	27° 1'17.45"S	30° 24'37.78"E
CDF Slurry Pipeline Turn Point 4	27° 1'9.78"S	30° 23'37.78"E
CDF Slurry Pipeline Turn Point 5	27° 1'11.49"S	30° 23'25.68"E
CDF Slurry Pipeline End	27° 1'3.91"S	30° 23'12.40"E
CDF Contaminated Water Pipeline (CWP) Start	27° 0'26.40"S	30° 23'6.76"E
CDF CWP Turn Point 1	27° 0'18.95"S	30° 23'27.57"E
CDF CWP Turn Point 2	27° 0'47.52"S	30° 23'19.00"E
CDF CWP Turn Point 3	27° 0'52.03"S	30° 23'36.22"E
CDF CWP Turn Point 4	27° 0'59.48"S	30° 23'40.85"E
CDF CWP Turn Point 5	27° 1'8.76"S	30° 23'38.33"E
CDF CWP Turn Point 6	27° 1'13.20"S	30° 23'55.71"E
CDF CWP Turn Point 7	27° 1'16.03"S	30° 24'43.98"E
CDF CWP Turn Point 8	27° 1'11.46"S	30° 24'47.94"E
CDF CWP End	27° 1'12.17"S	30° 24'49.10"E
CDF External Haul Road 1 Start	27° 1'11.28"S	30° 23'24.10"E
CDF External Haul Road 1 End	27° 1'6.46"S	30° 23'15.27"E
CDF External Haul Road 2 Start	27° 1'8.87"S	30° 23'38.00"E
CDF External Haul Road 2 Middle	27° 0'54.75"S	30° 23'37.52"E
CDF External Haul Road 2 End	27° 0'47.88"S	30° 23'18.41"E



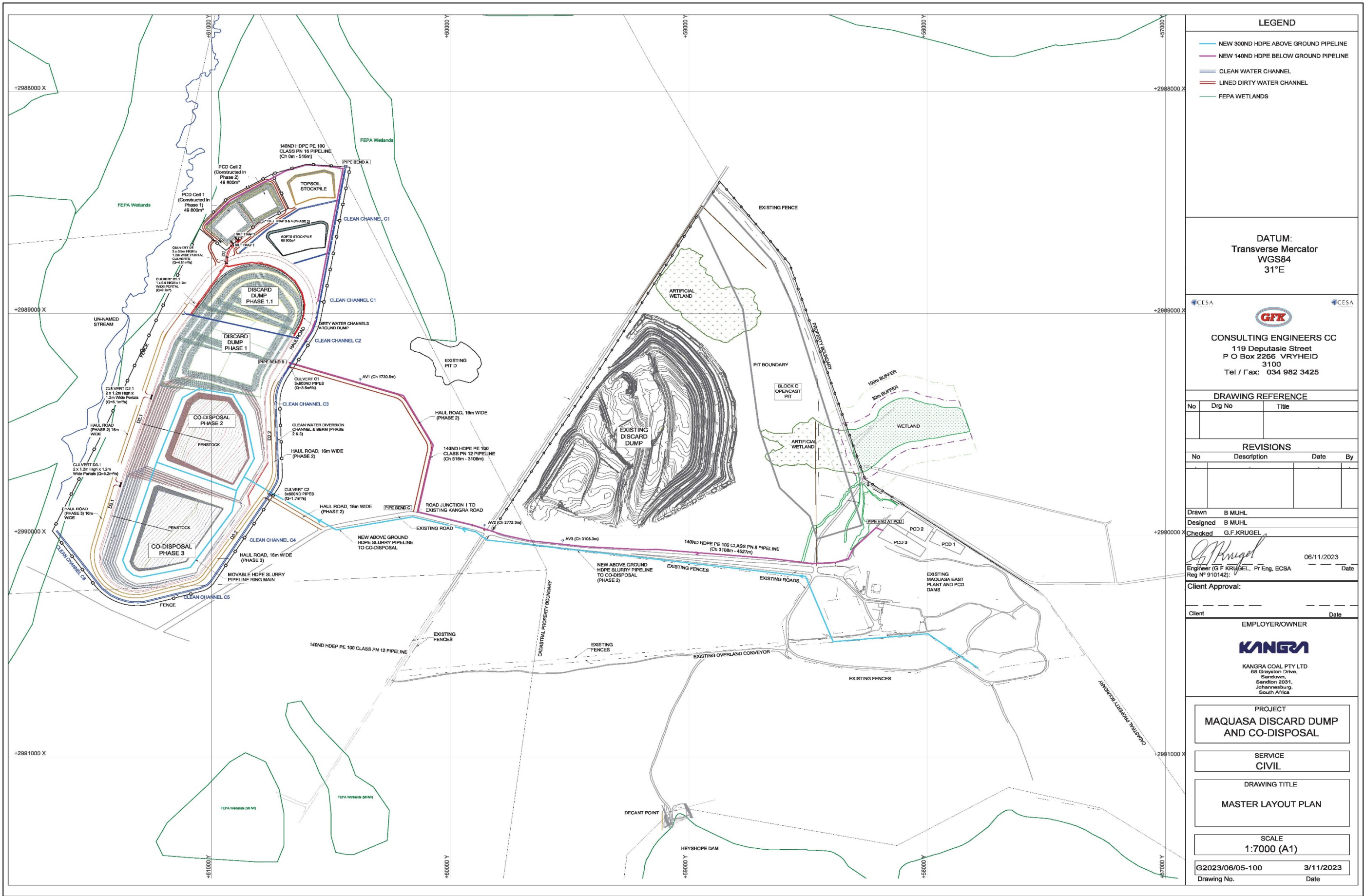


Figure 2-9: CDF Conceptual Layout



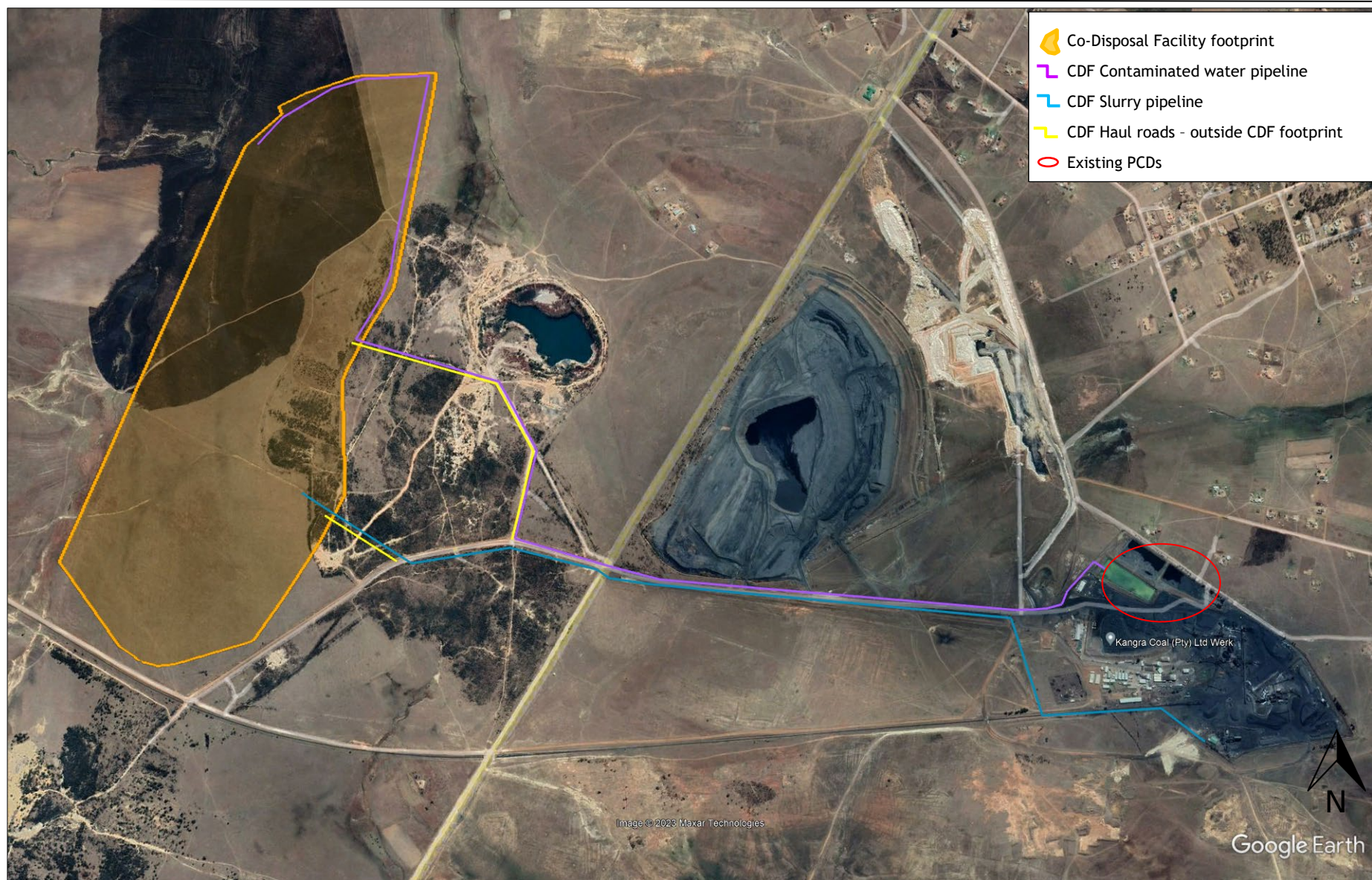


Figure 2-10: Locality of proposed Co-disposal Facility



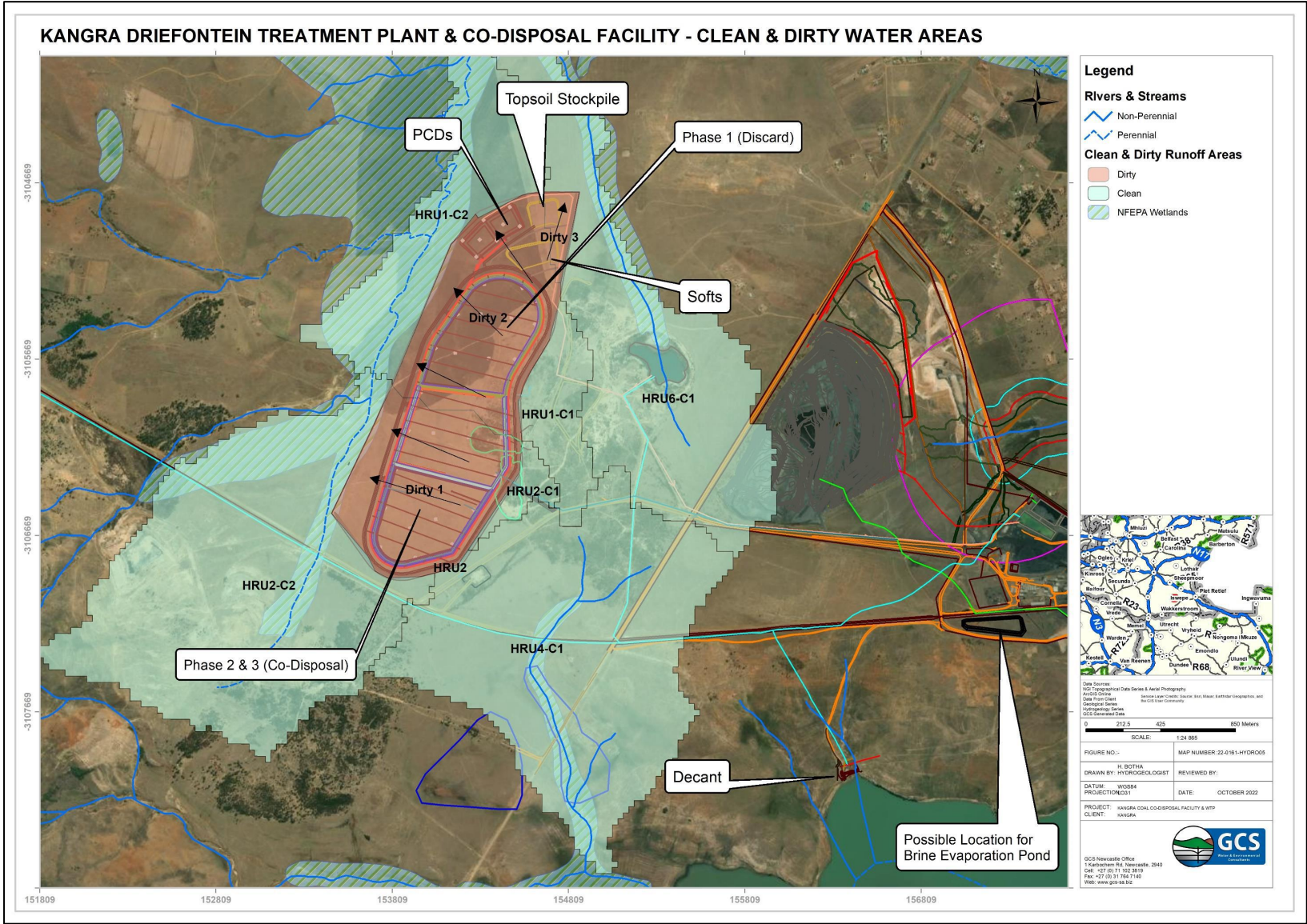


Figure 2-11: Dirty and Clean Water Catchments



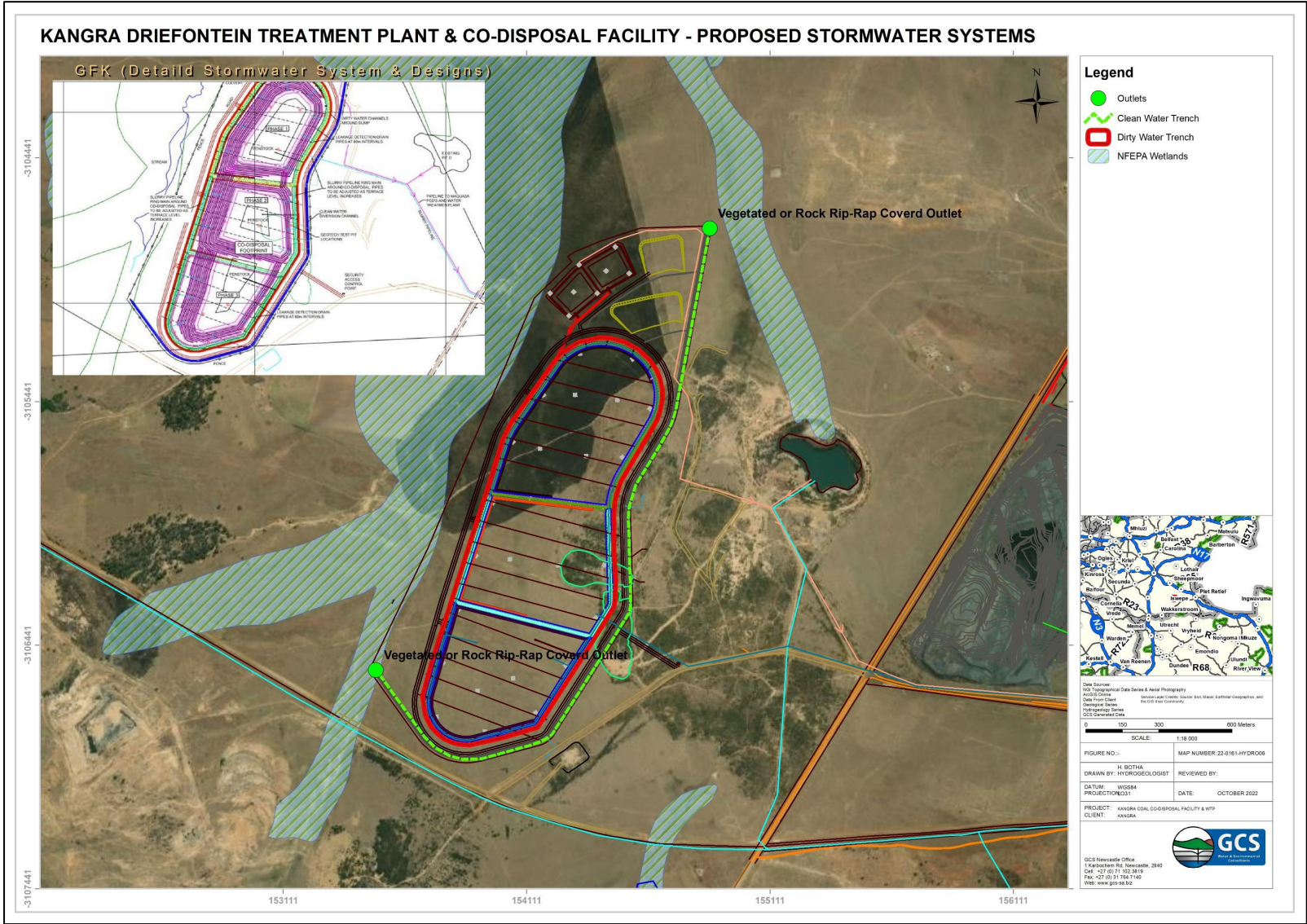


Figure 2-12: Conceptual SWMP

### **3 LEGAL FRAMEWORK**

This chapter details applicable legal provisions and aims to provide a review of relevant national and provincial legislation and regulations, and policy documents, which apply to, or have implications for, the proposed activities.

#### **3.1 General Overview**

The policy and legislative context applicable to MQE and the proposed projects is summarised in **Table 3-1**.

Table 3-1: Legislation applicable to the proposed projects at MQE.

LEGISLATION/GUIDELINE	OBJECTIVE & RELEVANCE
LEGISLATION	
Constitution of the Republic of South Africa (Act 108 of 1996)	<p>The Constitution is the supreme law governing all other legislation. Environmental legislation is shaped by the Bill of Rights set out in the Constitution. It sets out the rights for every citizen of South Africa and aims to address past social injustices. With respect to the environment, section 24 of the Constitution states that:</p> <p><i>“Everyone has the right:</i></p> <ol style="list-style-type: none"> <li><i>a) To an environment that is not harmful to their health or well-being.</i></li> <li><i>b) To have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that:</i> <ol style="list-style-type: none"> <li><i>i. Prevent pollution and ecological degradation;</i></li> <li><i>ii. Promote conservation; and</i></li> <li><i>iii. Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development”.</i></li> </ol> </li> </ol> <p>In fulfilment of its constitutional mandate to take reasonable legislative measures that give effect to Section 24, the government has promulgated several environmental laws. These laws provide a legal framework that embodies internationally recognised legal principles. The principal act governing activities that affect the environment is NEMA.</p> <p>The Constitution itself has no permitting requirements. However, the way the environmental right is applied implies that environmental impacts associated with developments should be considered separately and cumulatively. Furthermore, Section 24 includes the notion that justifiable economic and social development should be promoted, through using natural resources and ecologically sustainable development.</p> <p><b><i>MQE must ensure that significant environmental impacts are avoided; and where impacts cannot altogether avoided, they must be minimised and mitigated throughout the lifecycle of the proposed projects.</i></b></p>
Promotion of Administrative Justice Act, 2000 (Act No. 3 of 2000)	<ul style="list-style-type: none"> <li>• Administrative law is all about the pursuit of administrative justice - it is a subset of constitutional law, and an instance of the public law.</li> <li>• Administrative justice connotes the idea that in the implementation of legislation, the public administration (making up a large part of the executive branch of government) must act within the law, fairly and reasonably, and must be able to justify their decisions, including by providing written reasons therefore on request. <ul style="list-style-type: none"> <li>○ The right to administrative justice is protected in section 33 of the Constitution.</li> <li>○ The right to administrative justice is given effect by the Promotion of Administrative Justice, 2000 (Act 3 of 2000) (PAJA).</li> </ul> </li> <li>• To act lawfully, as required by the right to administrative justice, officials who make administrative decisions must act within the powers given to them by the relevant legislation. For instance: <ul style="list-style-type: none"> <li>○ The official must consider relevant considerations and not take into account considerations that are irrelevant;</li> <li>○ The correct official must act (the official to whom the power has been given);</li> </ul> </li> </ul>

LEGISLATION/GUIDELINE	OBJECTIVE & RELEVANCE
	<ul style="list-style-type: none"> <li>○ The official must follow any processes required by the law; and</li> <li>○ The official must correctly interpret the powers given to him/her.</li> <li>• When officials fail to act within the powers given to them by the relevant legislation (they act ultra vires) their conduct may be declared invalid and reviewed and set aside by a court on one or more of the grounds provided for in s 6 of PAJA.</li> <li>• To act reasonably in administrative decision-making about the environment as required by the right to administrative justice, officials must act rationally (there must be a link between a legitimate purpose of the decision and the decision itself, as well as a rational link between the information and the decision on which it was based) and reasonably, the decision should not have a disproportionate impact on environmental rights.</li> <li>• When officials act irrationally or unreasonably in their administrative actions, their conduct may be declared invalid, and reviewed and set aside by a court on one or more of the grounds provided for in s 6 of PAJA.</li> </ul> <p><b><i>As with the Constitution, all environmental officials must act lawfully. Should the decisions not be lawful, administrative justice i.e. their decisions be declared invalid and be set aside by the court.</i></b></p>
Promotion of Access to Information Act, 2000 (Act No. 2 of 2000)	<ul style="list-style-type: none"> <li>• Access to information is a right, not a privilege.</li> <li>• S 32 of the Constitution protects the right to access to information, and applies vertically, in that it imposes a duty on the state to provide access to information to someone requesting the information, and horizontally, in that it imposes a duty on natural and juristic persons to provide access to information.</li> <li>• In the case of natural and juristic persons, the information must be required by the requester for the protection of the right, but this restriction does not apply where information is requested from the state.</li> <li>• The Promotion of Access to Information Act, 2000 (Act 2 of 2000) (PAIA) was enacted to give effect to the right, in pursuit of a culture of openness, transparency and justification in South Africa, shifting away from a culture of secrecy and authoritarianism.</li> </ul> <p><b><i>The act assists the public in requesting information, and all have the right to access information.</i></b></p>
Environmental Conservation Act, 1989 (73 of 1989) (ECA), as amended	<p>The ECA has now largely been replaced by the NEMA but certain provisions remain in force.</p> <p>The National Noise Control Regulations<sup>1</sup> (NCR) were promulgated in terms of Section 25 of the ECA, relating to noise, vibration and shock. The NCRs were revised.<sup>2</sup> to make it obligatory for all authorities to apply the regulations. Under the ECA, the following SANS for assessing and controlling noise include:</p> <ul style="list-style-type: none"> <li>• 10328:2008 “Methods for environmental noise impact assessments”; and</li> <li>• 10103:2004 “The measurement and rating of environmental noise with respect to annoyance and speech communication”.</li> </ul> <p><b><i>The proposed projects are likely to increase ambient noise levels during the construction (temporary) and operational phases. Noise impacts are closely related to construction activities and heavy traffic volumes. The SANS published under ECA will be consider for the purposes of the noise impact assessment in the EIA and the EMPr will include mitigation measures relating to the mitigation of noise impacts.</i></b></p>

<sup>1</sup> GNR 154 in Government Gazette No. 13717 dated 10 January 1992

<sup>2</sup> Under GN155 of 10 January 1992

LEGISLATION/GUIDELINE	OBJECTIVE & RELEVANCE
National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA), as amended.	<p>NEMA is the framework law giving effect to the constitutional environmental right and for regulatory tools with respect to environmental impacts.</p> <p>Section 28(1) includes a statutory duty of care, providing that <i>“Every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment”</i>.</p> <p>In terms of sections 24(2) and 24D of NEMA, the then Minister of Environmental Affairs promulgated certain listed activities that may not commence without an EA. Activities promulgated in terms of GN983 and GN9835 require a basic assessment process, while activities promulgated in terms of GN984 require that a full scoping and EIA process be conducted.<sup>3</sup></p> <p>Section 24C(2A) of NEMA indicates that <i>“where listed activities are directly related to the extraction and primary processing of a mineral resource”</i> the Minister of Mineral Resources and Energy is the CA or official/s at the DMRE and which power he has delegated to the relevant Regional Managers (RMs).</p> <p>The National Environmental Laws Amendment Act, 2022 (Act 2 of 2022) (NEMA Amendment Act) was promulgated on 24 June 2022. It will introduce a major shift in South Africa’s environmental legislation on a date to be fixed and proclaimed by the President (which has yet to occur). This includes:</p> <ul style="list-style-type: none"> <li>• Residue stockpiles and residue deposits (RS) will be excluded from NEMWA and will therefore no longer be regarded as waste for which a WML is required. Instead, RS and deposits will be regulated under NEMA.</li> <li>• The RMs will be the CA <i>“where the listed or specified activity is a mining activity”</i>.</li> </ul> <p><b>Please refer to Table 3-4 in Section 3.2.1 for identified listed activities applicable to the proposed projects.</b></p> <p><b>Note that, should the NEMA Amendment Act commence prior to construction, Kangra would no longer require a WML for the CDF and it would be governed under NEMA.</b></p>
NEMA EIA Regulations, 2014 (GNR 326, as amended)	<p>Chapter 6 of the 2014 EIA Regulations provides for the requirements for public participation, which must be carried out as part of the EA and WML application process. In terms of Regulations 21 and 23, the outcome of the PPP must be reported in the FSR and EIR submitted to the CA. The PPP, <i>“must give all potential or registered parties (I&amp;APs), including the CA, a period of at least 30 days to submit comments on each of the EMPR, S&amp;EIRs, and where applicable the closure plan, as well as the report contemplated in regulation 32, if such reports or plans are submitted at different times”</i> (Regulation 40 (1)).</p> <p>PPP will be undertaken in accordance with Chapter 6 of the EIA Regulations, 2014. It must:</p> <ul style="list-style-type: none"> <li>• provide access to all information that reasonably has or may have the potential to influence any decision regarding an application;</li> <li>• involve consultation with the CA, every state department that administers a law relating to the environment relevant to the application, all relevant organs of state, and all I&amp;APs; and</li> <li>• provide an opportunity for I&amp;APs to comment on reports and plans prior to submission of an application and once an application has been submitted to the CA.</li> </ul> <p>The process must include:</p> <ul style="list-style-type: none"> <li>• notification of the application to all I&amp;APs, as stipulated in Regulation 41;</li> </ul>

<sup>3</sup> GNs 983, 984 and 985 are promulgated under NEMA in GG 38282 of 4 December 2014 (as amended).

LEGISLATION/GUIDELINE	OBJECTIVE & RELEVANCE
	<ul style="list-style-type: none"> <li>• registration of all I&amp;APs, as required in Regulations 42 and 43; and</li> <li>• a CRR and records of meetings of and with I&amp;APs, as outlined in Regulation 44.</li> </ul> <p>Regulation 39 of the EIA Regulations, 2014 requires that:</p> <p><i>"(1) If the proponent is not the owner or person in control of the land on which the activity is to be undertaken, the proponent must, before applying for an environmental authorisation in respect of such activity, obtain the written consent of the landowner or person in control of the land to undertake such activity on that land.</i></p> <p><i>(2) Sub regulation (1) does not apply in respect of—</i></p> <p><i>(b) activities constituting, or activities directly related to prospecting ... of a mineral ...resource or extraction and primary processing of a mineral...resource."</i></p>
NEMA and MPRDA: Financial Provision (FP)	<p>NEMA requires <i>inter alia</i> mining right holders to hold in place FP for the rehabilitation, closure and ongoing post decommissioning management of negative environmental impacts.</p> <p>FP assessments were previously governed by the MPRDA and the quantum calculated according to the DMRE published rates.</p> <p>On 20 November 2015, the NEMA Financial Provisioning Regulations, 2015<sup>4</sup> (2015 FP Regulations) were promulgated, resulting in significant changes from the MPRDA's requirements. Five (5) further draft updated iteration's of the 2015 NEMA FP Regulations were published by the DFEE, with the last iteration published in 2022. The 2015 FP Regulations were immediately applicable to applicants for a new mineral right but not to mineral rights holders where the right was granted before the commencement of the 2016 FP Regulations. Under the 2015 FP Regulations' transitional provisions, holders of a mineral right granted prior to the commencement of the 2015 NEMA FP Regulations (Existing Holders) were able to elect to comply either within three (3) months of their financial year-end or 15 months from the promulgation of the 2015 FP Regulations. Various extensions of this transitional period have subsequently been published, with the latest extension date being 19 September 2023.</p> <p><b><i>Kangra will comply with the relevant FP Regulations when required to do so.</i></b></p> <p><b><i>The DMRE will require that FP be provided by Kangra before issuing it with an EA / WML.</i></b></p>
DFFE Web-Based Screening Tool	<p>In terms of Regulation 16(1)(b)(v), read with Regulation 21 of the 2014 EIA Regulations, it is compulsory for an EIA application to include a sensitivity report generated by the national web based environmental screening tool<sup>5</sup> (DFFE Screening Tool).</p> <p>The content of specialist reports for certain of the themes is prescribed in the Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes<sup>6</sup> (Assessment Protocols); and Appendix 4 of the EIA Regulations will not be applicable to such themes. Two Assessment Protocols have been gazetted, in March and October 2020.</p> <p><b><i>Specialist studies have been undertaken to verify the sensitivity themes as identified in the DFFE Screening Tool. Specific requirements for the content of the EIA specialist reports are included in the Assessment Protocols and these specialist reports will comply with the aforesaid for purposes of the EIA.</i></b></p>

<sup>4</sup> GN 1147 of 20 November 2015: Regulations pertaining to the Financial Provision for Prospecting, Exploration, Mining or Production Operations (GG 39425)

<sup>5</sup> GN R960 of GG 42561, dated 5 July 2019

<sup>6</sup> In terms of in terms of sections 24(5)(a) and (h) and 44 of NEMA and GN R320 of GG 43110 on 20 March 2020 and GN R1150 of GG 43855 on 30 October 2020

LEGISLATION/GUIDELINE	OBJECTIVE & RELEVANCE
National Environmental Management: Waste Act (Act 59 of 2008) (NEMWA), as amended	<p>The NEMWA's purpose is to: assist in regulating waste management; ensure the protection of human health; and prevent pollution and environmental degradation through sound waste management principles and guidelines. The NEMWA defines waste broadly.<sup>7</sup></p> <p>It furthermore provides for:</p> <ul style="list-style-type: none"> <li>• national norms and standards for regulating waste management by all spheres of government;</li> <li>• licensing and control of waste management activities;</li> <li>• remediation of contaminated land;</li> <li>• a national waste information system; and</li> <li>• provision for compliance and enforcement.</li> </ul> <p>The NEMWA imposes a general duty upon waste holders to take reasonable measures to avoid waste generation and, where this is impossible, to: minimise the toxicity and quantities of waste generated; reuse, reduce, recycle and recover waste; and ensure that it is treated and disposed of in an environmentally sound way. Failure to do so is a criminal offence, with a maximum fine of R10 million or imprisonment of up to 10 years, or both.</p>
Regulations published under NEMWA in GN 921 of Government Gazette 37083 on 29 November 2013 (2013 WML Regulations)	<p>It is necessary to hold a WML for defined waste management activities. The 2013 WML Regulations, provide that a WML is required for undertaking certain waste management activities ("Waste Listed Activities"). The Waste Listed Activities are separated into three (3) categories, namely Category A, B and C. Category A and B Waste Listed Activities require a WML, for which either a basic assessment or an EIA process needs to be undertaken that complies with the 2014 EIA Regulations. Category C activities do not require a WML but must comply with <i>inter alia</i> the Norms and Standards for Storage of Waste, 2013.<sup>8</sup></p> <p><b><i>On commencement of the NEMA Amendment Act, RS will be excluded from NEMWA and will therefore no longer be regarded as waste for which a WML is required. Instead, RS will be under NEMA.</i></b></p> <p><b><i>As the NEMA Amendment Act has still not commenced, Kangra has submitted an application for a WML for the proposed RS (i.e., the CDF), which is a Category B Waste Listed Activities in the 2013 WML Regulations, which is part of the S&amp;EIR process.</i></b></p>
NEMWA Regulations regarding the Planning and Management of Residue Stockpiles and Residue Deposits, published in GN	<p>The Residue Regulations provide the tools for and correspond to the statutory provision relating to managing RS in the manner prescribed in section 43A of the NEMWA.</p> <p>They regulate the planning, management and reporting of RS, including:</p> <ul style="list-style-type: none"> <li>• The assessment of impacts and analyses of risks relating to the management of RS;</li> <li>• Characterisation and classification of RS;</li> </ul>

<sup>7</sup> (a) any substance, material or object, that is unwanted, rejected, abandoned, discarded or disposed of, or that is intended or required to be discarded or disposed of, by the holder of that substance, material or object, whether or not such substance, material or object can be re-used, recycled or recovered and includes all wastes as defined in Schedule 3 to this Act; or

(b) any other substance, material or object that is not included in Schedule 3 that may be defined as a waste by the Minister by notice in the Gazette but any waste or portion of waste, referred to in paragraphs (a) and (b), ceases to be a waste—

(i) once an application for its re-use, recycling or recovery has been approved or, after such approval, once it is, or has been re-used, recycled or recovered;

(ii) where approval is not required, once a waste is, or has been re-used, recycled or recovered;

(iii) where the Minister has, in terms of section 74, exempted any waste or a portion of waste generated by a particular process from the definition of waste; or

(iv) where the Minister has, in the prescribed manner, excluded any waste stream or a portion of a waste stream from the definition of waste.

<sup>8</sup> Published in GN 926 of GG 37088 on 29 November 2013



LEGISLATION/GUIDELINE	OBJECTIVE & RELEVANCE
632 of GG 39020 on 24 July 2015 (Residue Regulations)	<ul style="list-style-type: none"> <li>• Conducting feasibility studies for the investigation and the selection of a site for RS, including geotechnical and hydrological investigations, by competent persons and a registered professional civil / mining engineer;</li> <li>• Design of the RS;<sup>9</sup></li> <li>• Impact management;</li> <li>• Duties of the holder of the right or permit;</li> <li>• Monitoring and reporting systems;</li> <li>• Dust management and control; and</li> <li>• Decommissioning, closure and post closure management requirements.</li> </ul> <p>When the NEMA Amendment Act commences, the Residue Regulations <sup>10</sup> will remain operational and shall be deemed to have been made under NEMA. <sup>11</sup></p>
NEMWA Waste Classification and Management Regulations (Waste Classification Regulations) and other Regulations.	<p>Classification of certain waste streams is required in terms of the Waste Classification and Management Regulations, <sup>12</sup> to ensure that the correct waste management standards and disposal methods are implemented.</p> <p>The National Norms and Standards for the Assessment of Waste for Landfill Disposal and the National Norms and Standards for the Disposal of Waste to Landfill<sup>13</sup> provide the norms and standards for disposal of waste to landfill.</p> <p><b><i>A Waste Classification was undertaken, based on the current prescribed criteria. It was concluded that the waste streams classify as a Type 3 (low risk) waste, which requires a Class C liner (pollution barrier).</i></b></p> <p><b><i>When the NEMA Amendment Act commences none of these Regulations will be applicable to RS.</i></b></p>
National Waste Information Regulations <sup>14</sup>	<p>These Regulations regulate the collection of data and information to fulfil the objectives of the national waste information system, as set out in section 61 of the NEMWA, and include reporting obligations. A registered person must keep a record of the information submitted to the SAWIS or the DFFE.</p> <p><b><i>Kangra will comply with these regulations.</i></b></p>
National Environmental Management: Air Quality Act, 2004 (Act 39 of 2004) (NEM: AQA)	<p>NEMAQA was promulgated to ensure the protection and regulation of air quality and provide measures that will prevent pollution and sustainability. Under NEMAQA, the Minister of Environmental Affairs, Forestry and Fisheries must identify substances in ambient air which present a threat to health, wellbeing or the environment and establish national standards for ambient air quality, including the permissible quantity or concentration of each substance in ambient air.</p>

<sup>9</sup> Including the general layout; type of deposition method used; rate of rise; design of the pollution control barrier system; stormwater control; freeboard; pooling; required factor of safety; control of decanting of excess water; retention of polluted water; design of the penstock; outfall pipe, under-drainage system and return water dams; height of the phreatic surface; slope angles and method of construction of the outer walls and their effects on shear stability; slope erosion by wind and water, and its control by vegetation, berms or catchment paddocks; and the potential for pollution.

<sup>10</sup> Published in Government Notice R632 in Government Gazette 39020 on 24 July 2015.

<sup>11</sup> Proposed by section 86 of the NEMLA IV Bill.

<sup>12</sup> Published in GN634 of GG 36784 on 23 August 2013

<sup>13</sup> Published under GN R635 and GN R636 respectively in GG 36784 of 23 August 2013

<sup>14</sup> Published in GN 625 of GG 35583 on 13 August 2012

LEGISLATION/GUIDELINE	OBJECTIVE & RELEVANCE
	<p>The “Listed Activities and Associated Minimum Emission Standards”<sup>15</sup>, list activities that could result in atmospheric emissions requiring an atmospheric emissions licence (AEL) before being undertaken.</p> <p>The “National Dust Control Regulations”<sup>16</sup>, provide that an acceptable dust fallout rate for a non-residential area is considered more than 600mg/m<sup>2</sup>/day but less than 1200mg/m<sup>2</sup>/day (30-day average), with maximum allowable two exceedances per year, provided these exceedances do not take place in consecutive months. Where the dust fallout rate is exceeded, a prescribed dust fallout monitoring programme must be developed and include:</p> <ul style="list-style-type: none"> <li>the establishment of a network of dust monitoring points, using method ASTM D1739:1970 (or an equivalent standard), sufficient in number to: establish the contribution to dust fallout in residential and non-residential areas near the premises; monitor identified or likely sensitive receptor locations; and establish the baseline dust fall for the district; and</li> <li>a schedule for submitting to the air quality officer dust fallout monitoring reports annually or at more frequent intervals, if requested by the air quality officer.</li> </ul> <p>Greenhouse gases have been declared priority pollutants under the “Declaration of Greenhouse Gases as Priority Air Pollutants”<sup>17</sup>.</p> <p><b><i>An AEL will not be required for the proposed projects; however, a duty of care should be employed during construction and operation to minimise air pollution as far as possible. MQE must take all reasonable measures to minimise the generation of dust and ensure compliance with the Dust Control Regulations.</i></b></p>
<p>National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004) (NEM: BA)</p>	<p>In line with the Convention on Biological Diversity, NEMBA aims to legally provide for biodiversity conservation, sustainable use and equitable access and benefit sharing. NEMBA creates a basic legal framework for the formation of a national biodiversity strategy and action plan and identification of biodiversity hotspots and bioregions, which may then be given legal recognition. It imposes obligations on landowners (state or private) regarding alien invasive species (AIS). NEMBA requires that provision be made by a site developer to remove any aliens which have been introduced to the site or are present on the site.</p> <p>The NEMBA also provides for listing of threatened or protected ecosystems in one of four (4) categories: critically endangered, endangered, vulnerable or protected. Threatened ecosystems are listed to reduce the rate of ecosystem and species extinction, by preventing further degradation and loss of structure, function and composition of threatened ecosystems. The purpose of listing protected ecosystems is primarily to conserve sites of exceptionally high conservation value.</p> <p>Section 53 of NEM:BA provides that:</p> <p><i>“(1) The Minister may, by notice in the Gazette, identify any process or activity in a listed ecosystem as a threatening process.</i></p> <p><i>(2) A threatening process identified in terms of subsection (1) must be regarded as a specified activity contemplated in section 24(2)(b) of the NEMA and a listed ecosystem must be regarded as an area identified for the purpose of that section.”</i></p> <p>No notices have been published yet under this section.</p> <p>Picking parts of, or cutting, chopping off, uprooting, damaging or destroying, any specimen of a listed threatened or protected species is a restricted activity under NEMBA. A permit is required for a restricted activity involving a listed threatened or protected (TOPS) species without a permit. Chapter 7 of the NEMBA regulates the process for the application of a permit under NEMBA.</p>

<sup>15</sup> Published in GN 893 of GG 37054 on 22 November 2013

<sup>16</sup> Published in GN 827 of GG 36974 on 1 November 2013

<sup>17</sup> Published in GN 710 of GG 40996 on 21 July 2017

LEGISLATION/GUIDELINE	OBJECTIVE & RELEVANCE
	<p>The following notices have been published in terms of section 56(1) of NEMBA:</p> <ul style="list-style-type: none"> <li>• National List of Ecosystems that are Threatened and in need of protection (TOPS List),<sup>18</sup> which contains the National List of Ecosystems that are threatened and in need of protection. This includes preventing further degradation and loss of structure, function and composition of threatened ecosystems and preserving witness sites of exceptionally high conservation value. The purpose of listing threatened ecosystems is primarily to reduce the rate of ecosystem and species extinction.</li> <li>• Lists of Critically Endangered, Endangered, Vulnerable and Protected Species;<sup>19</sup> and</li> <li>• Threatened and Protected Species Regulations.<sup>20</sup></li> </ul> <p>Chapter 5 of NEMBA pertains to AIS and provides that a person may not carry out a restricted activity involving a specimen of an AIS without a permit issued in terms of Chapter 7 of NEMBA. Such permit can only be issued after a prescribed assessment of risks and potential impacts on biodiversity is carried out. Applicable, and exempted AIS are contained within the Alien and Invasive Species List 2020.<sup>21</sup> The NEMBA Alien and Invasive Species Regulations<sup>22</sup> categorises the different types of alien and invasive plant and animal species and how they should be managed. The Revised National Biodiversity Framework 2019 - 2024 was recently published.<sup>23</sup></p> <p><b><i>It is not anticipated that the proposed projects will disturb more than 10ha of indigenous vegetation, with the Project Area mainly being in already disturbed areas or low biodiversity sensitive areas, within the MQE MR surface infrastructure area.</i></b></p> <p><b><i>MQE must control and eradicate AIS in line with the NEMBA Alien and Invasive Species Regulations.</i></b></p>
Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983) (CARA)	<p>In terms of CARA, landowners are legally responsible for the control of weeds and alien vegetation. CARA makes provision for three (3) categories of AIP:</p> <ul style="list-style-type: none"> <li>• Category 1a: must immediately be removed and destroyed;</li> <li>• Category 1b: need to be immediately removed and contained;</li> <li>• Category 2: requires a permit to retain the species on site and it must be ensured that they do not spread. All category 2 plants in riparian zones need to be removed; and</li> <li>• Category 3: require a permit to retain these species. All category 3 plants in the riparian zone need to be removed.</li> </ul> <p>CARA also regulates the conservation of soil and states that degradation of the agricultural potential is illegal. It furthermore requires the protection of land against soil erosion and the prevention of water logging and associated salinization.</p> <p>Permissions/permits are required under CARA for the 'cultivation' of 'virgin soil'; cultivation and/or draining vlei(s), marshes or water sponges; and cultivation of an area within a watercourse's flood area.</p> <p><b><i>MQE will comply with CARA in relation to AIP control and soil conservation.</i></b></p> <p><b><i>No permits under CARA are envisaged to be required for the proposed projects.</i></b></p>

<sup>18</sup> Published under GN1002 in GG34809 of 9 December 2012

<sup>19</sup> Published under GNR151 in GG 29567 of 23 February 2007

<sup>20</sup> Published under GNR152 in GG 29657 of 23 February 2007

<sup>21</sup> Published under GNR 1003 in GG 43726 of 18 September 2020

<sup>22</sup> Published under GNR1020 dated 25 September 2020

<sup>23</sup> In terms of GN 2423 of 26 August 2022,

LEGISLATION/GUIDELINE	OBJECTIVE & RELEVANCE
National Veld and Forest Fire Act, 1998 (Act 101 of 1998) (NVFFA)	<p>The NVFA's purpose is to prevent and combat veld, forest and mountain fires throughout South Africa. It applies to the open countryside beyond the urban limit and puts in place a range of requirements. The NVFA sets out the responsibilities of landowners or persons in control of the land which includes:</p> <ul style="list-style-type: none"> <li>• Prepare and maintain firebreaks on their side of the boundary if there is a reasonable risk of veld fire. The NVFA sets out the procedure in this regard and the role of neighbouring landowners and the fire protection association;</li> <li>• Have such equipment, protective clothing and trained personnel for extinguishing fires as are prescribed (in the regulations);</li> <li>• If there are no regulations, reasonably required in the circumstances, take all reasonable steps to notify the FPO of the local FPA (if there is one) when a fire breaks out; and</li> <li>• Do everything in their power to stop the spread of the fire.</li> </ul> <p>Landowners must ensure that: (i) firebreaks are wide and long enough to have a reasonable chance of preventing a veldfire from spreading to or from neighbouring property, (ii) that it does not cause soil erosion; and (iii) it is reasonably free of inflammable material capable of carrying a veldfire across it.</p> <p><b><i>The projects are in the countryside beyond the urban limit, and thus the provisions of the Act are applicable. Measures to mitigate the risk of veld fires will be included in the EMP.</i></b></p>
National Forests Act, 1998 (Act 84 of 1998) (NFA)	<p>In terms of section 15(3) of the NFA, the Minister published a list of protected tree species.<sup>24</sup> The effect thereof is that no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree or any product derived from a protected tree, except under a licence or exemption granted by the Minister to an applicant and subject to such period and conditions as may be stipulated.</p> <p><b><i>Should MQE required any licence to disturb a protected tree, it will be duly applied for.</i></b></p>
National Heritage Resources Act, 1999 (Act 25 of 1999) (NHRA)	<p>The protection and management of South Africa's heritage resources are controlled by the NHRA. The national enforcing authority for the NHRA is the South African Heritage Resources Agency (SAHRA). In terms of the NHRA, historically important features, such as graves, archaeology and fossil beds, are protected. Similarly, culturally significant symbols, spaces and landscapes are also afforded protection. In terms of section 38 of the NHRA, a permit is required for certain categories of development as follows:</p> <p><b><i>“(1) (a): The construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;</i></b></p> <p><b><i>(c): Any development or other activity which will change the character of a site -</i></b></p> <ol style="list-style-type: none"> <li><b><i>exceeding 5 000 m<sup>2</sup> in extent;</i></b></li> <li><b><i>involving three or more existing erven or subdivisions thereof;</i></b></li> <li><b><i>involving three or more erven or divisions thereof which have been consolidated within the past 5 years; or</i></b></li> <li><b><i>the costs of which will exceed a sum in terms of regulations by SAHRA or a provincial heritage resource authority.”</i></b></li> </ol> <p>In terms of Section 38(8) of the NHRA, section 38(1) approval from SAHRA is not required where an environmental impact assessment is undertaken under NEMA, including a HIA, and SAHRA's requirements are considered by the CA when granting the EA.</p>

<sup>24</sup> GN 536 of GG 41887 on of 7 September 2018

LEGISLATION/GUIDELINE	OBJECTIVE & RELEVANCE
	<p>Section 38(8) of the NHRA provides that:</p> <p><i>"The provisions of this section do not apply to a development as described in subsection (1) if an evaluation of the impact of such development on heritage resources is required in terms of the ECA, or the integrated environmental management guidelines issued by the Department of Environment Affairs and Tourism, or the Minerals Act, 1991 (Act No. 50 of 1991), or any other legislation: Provided that the consenting authority must ensure that the evaluation fulfils the requirements of the relevant heritage resources authority in terms of subsection (3), and any comments and recommendations of the relevant heritage resources authority with regard to such development have been taken into account prior to the granting of the consent."</i></p> <p>Accordingly, provision is made for the assessment of heritage impacts as part of an environmental assessment process and, if such an assessment complies with the NHRA and SAHRA's requirements and the CA considers heritage impacts when granting the EA, a separate application for consent under the NHRA is not required.</p> <p><b><i>MQE should if any heritage finds or artefacts be discovered inform the South African Police or the Heritage Authority, as per the approved EMP for the proposed project.</i></b></p>
<p>Hazardous Substance Act, 1973 (Act No. 15 of 1973) (HSA)</p>	<p>The HSA aims to control the production, import, use, handling and disposal of hazardous substances. Under the HSA, hazardous substances are defined as substances that are toxic, corrosive, irritant, strongly sensitising, flammable and pressure generating under certain circumstances and may injure, cause ill-health or even death in humans. Where hazardous substances from any of the 4 groups below are to be used, (see below) care must be taken that they are sourced, transported, handled and disposed of in compliance with HSA.</p> <ul style="list-style-type: none"> <li>• Group I: industrial chemicals (IA) and pesticides (IB);</li> <li>• Group II: 9 classes of wastes excluding Class 1: explosives and class 7: radioactive substances;</li> <li>• Group III: electronic products and group; and</li> <li>• Group IV: radioactive substances.</li> </ul> <p>The HSA provides for the:</p> <ul style="list-style-type: none"> <li>• Control of certain electronic products;</li> <li>• Division of such substances or products into the groups above in relation to the degree of danger, with licensing requirements for certain activities undertaken in respect of Groups I and III;</li> <li>• Prohibition and control of the importation, manufacture, sale, use, operation, application, modification, disposal or dumping of such substances and products; and</li> <li>• Matters connected therewith.</li> </ul> <p><b><i>Hazardous substances may be stored, handled or transported as part of the proposed projects and include diesel and other liquid fuel, oil and hydraulic fluid, cement, etc. MQE will comply with the HSA, as required.</i></b></p>
<p>National Water Act, 1998 (Act 36 of 1998) (NWA)</p>	<p>The NWA is the primary legislation controlling and managing the use of water resources and pollution thereof. It provides for fundamental reformation of legislation relating to water resource use. The NWA's preamble recognises that the ultimate aim of water resource management is to achieve sustainable use of water for the benefit of all users and that water resources quality protection is necessary to ensure sustainability of the nation's water resources in the interests of all water users. The NWA's purpose is stated in section 2 and enforced by the DWS.</p> <p>The NWA presents strategies to facilitate sound management of water resources; provides for the protection of water resources; and regulates use of water by means of Catchment Management Agencies (CMA), Water User Associations, Advisory Committees, and</p>

LEGISLATION/GUIDELINE	OBJECTIVE & RELEVANCE
	<p>International Water Management. As the NWA is founded on the principle of trusteeship, the government has overall responsibility for and authority over water resource management, including the equitable allocation and beneficial use of water in the public interest. Industry (including mines) can therefore only be entitled to use water if the use is permissible under the NWA.</p> <p>Section 19 of the NWA provides for pollution prevention and requires that a person who owns, controls, occupies, or uses the land in question, is responsible for taking reasonable measures to prevent pollution of water resources. A CMA may take action to prevent or remedy the pollution and recover all reasonable costs from the responsible party.</p> <p>Under Section 21 of the NWA, certain consumptive and non-consumptive water uses are identified and can only commence once authorised. Water use is broadly defined in the NWA and includes taking and storing water; activities which reduce stream flow; waste discharges and disposals; controlled activities; altering a watercourse; removing water found underground for certain purposes; and recreation. Consumptive water uses include taking water from a water resource (section 21(a) of NWA) and storing water (section 21(b)). Non-consumptive water uses include impeding or diverting a watercourse's flow (section 21(c)); altering a watercourse's bed, banks, course or characteristic or impeding the flow of a watercourse (sections 21 (c) and (i)); and disposal of waste in a matter that may detrimentally impact on a watercourse (section 21(g)).</p> <p>Where a water use constitutes a Scheduled 1 Use (permissible use without an authorisation requirement); permissible water uses in terms of section 22 of the NWA; or is authorised in terms of a General Authorisation (GA), a WUL is not required.<sup>25</sup></p> <p><b><i>The proposed projects will include sections 21 (c), (i) and (g) water uses. A Water Use Licence Application (WULA) will be submitted to the DWS to authorise these water uses.</i></b></p>
Government Notice 704 (GN 704), published in Government Gazette 20119, dated 4 June 1999.	<p>GN 704, promulgated under section 26(1) of the NWA is specifically aimed at the protection of water resources associated with mining related activities. It provides minimum requirements which need to be adhered to for water resource protection on a mine. GN 704 regulates the use of water; management of dirty and clean water infrastructure; and related activities at mines. This includes minimum requirements for infrastructure that hold dirty water. A mine can apply for exemptions from these requirements and could be granted approval, should sufficient management measures be put in place to ensure environmental protection. Regulation 4 of GN 704 places some restrictions in terms of the locality of certain infrastructure which could have an impact on water resources.</p> <p><b><i>MQE will comply with GN 704. Certain exemptions from GN 704 may however be necessary, including for construction of certain infrastructure in proximity to watercourses. This will be included in the WULA process.</i></b></p>
Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002) (MPRDA), as amended	<p>The MPRDA governs mineral resources in South Africa, regulates mining and mining authorisations and has as one of its principal objectives the equitable access and the sustainable development of the South Africa's mineral resources.</p> <p>Section 5A of the MPRDA indicates that: "No person may prospect for or remove, mine, conduct technical co-operation operations, reconnaissance operations, explore for and produce any mineral or petroleum or commence with any work incidental thereto on any area without - (a) an environmental authorisation (EA)".</p> <p>Section 37 of the MPRDA requires all mining and prospecting operations and related activities to be carried out in terms of the environmental management principles set out in Section 2 of NEMA.</p>

<sup>25</sup> Various GAs have been published under the NWA, including for Sections 21(c),(i),(g), and (a) water uses. In respect of sections 21(c) and (i) water uses, activities can be conducted within 100m of a watercourse and 500m of a wetland without a WUL if the impacts to the watercourse / wetland are low. Water uses that will be conducted under a GA need to be registered with the DWS.

LEGISLATION/GUIDELINE	OBJECTIVE & RELEVANCE
	<p>Social and environmental sustainability is enhanced through the requirement to submit a Social and Labour Plan (SLP), which records a mining company's obligations to improve social development. This includes a commitment to training and social investment, with the goal of transferring skills that can be used after mine closure.</p> <p><b><i>Kangra holds the MQE MR over the Project Area.</i></b></p> <p><b><i>It complies with the MPRDA and will continue to do so in respect of the proposed projects. A current Social Labour Plan (SLP) has been approved by the DMRE for MQE. There will be no increases in production or extensions to the MQE MR area and Kangra would therefore not be required to update the SLP for purposes of the proposed projects.</i></b></p>
<p>Mine Health and Safety Act, 1996 (Act 29 of 1996) (MHSA)</p>	<p>The MHSA aims to provide for protection of the health and safety (HS) of all employees and other personnel at RSA mines. Its main objectives are:</p> <ul style="list-style-type: none"> <li>• Protection of the HS of all persons at mines;</li> <li>• Requiring employers and employees to identify hazards and eliminate, control and minimise the risks relating to health and safety at mines;</li> <li>• Giving effect to the public international law obligations of South Africa that concern HS at all mines.</li> <li>• To promote: <ul style="list-style-type: none"> <li>○ a culture of HS in the mining industry;</li> <li>○ training in HS in the mining industry; and</li> <li>○ cooperation and consultation on HS between the State, employers, employees and their representatives.</li> </ul> </li> <li>• Providing for: <ul style="list-style-type: none"> <li>○ employee participation in matters of HS through HS representatives and the HS committees at mines;</li> <li>○ effective monitoring of HS conditions at mines;</li> <li>○ enforcement of HS measures at mines; and</li> <li>○ investigations and inquiries to improve HS at mines.</li> </ul> </li> </ul> <p><b><i>MQE already complies with the MHSA and will continue to do so in respect of the proposed projects.</i></b></p> <p><b><i>It will conduct the required hazard assessment under the MHSA regarding potential HS impacts prior to commencing with construction of the proposed projects.</i></b></p>
<p>MHSA: DMRE's Guideline for the Compilation of Mandatory Code of Practice ("COP") on Mine Residue Deposits, published in accordance with the MHSA ("RS COP Guideline")</p>	<p>The RS COP Guideline is published pursuant to the MHSA and contains requirements as to what a mine needs to include in its COP for RS. This includes that an employer must identify hazards; assess the HS risks to which employees, and as far as reasonably practicable to persons who are not employees, may be exposed while they are at work; and record the significant hazards identified and risks assessed ("Risk Assessment"), prior to commencing operations. The Risk Assessment must: be based on a site selection process (including input from I&amp;APs); and a site-specific investigation (including that the site is geologically and geomorphologically stable); detail pre-existing natural contaminant levels and incremental levels arising from the RS; consider all MRDs on a site in an integrated system; consider the lifestyles /living conditions of persons potentially affected; and assess future events which can give rise to increased risks.</p> <p>The RS COP Guideline set outs the technical information required during the site investigation process and various technical reports that must be compiled as a basis the RS design, which mirror the RS Regulations in various respects. This includes a detailed investigation by</p>



LEGISLATION/GUIDELINE	OBJECTIVE & RELEVANCE
	<p>a competent person of the RS's characteristics that may directly or indirectly affect the HS of mining and non-mining personnel in the vicinity of the site, and design requirements.</p> <p>It also requires a safety classification of the RS in accordance South African National Standards (SANS): Code of Practice, Mine Residue, SABS 10286: 1998 ("SABS 10286"), being the principal management guidance document for RS. SANS 10286 contains fundamental objectives, the principles, and minimum requirements for best practice, all aimed at ensuring that no unavoidable risks, problems and/or legacies are left to future generations. It does not, however, address the Safety, Health and Environmental (SHE) concerns of tailings storage, but places more focus on the need for management throughout the project's lifecycle. SANS 10286 also requires RS to be classified as either High, Medium or Low Hazard based on generic "catch-all" guidelines for determining a Zone of Influence, which is used.</p> <p><b><i>Kangra will compile a Risk Assessment on HS risks prior to commencing with operation of the proposed projects, for submission to the DMRE Mine Health Inspectorate.</i></b></p> <p><b><i>The risks, potential impacts and mitigation measures regarding HS that are identified in the detailed design and EIA will be included in the baseline process for the Risk Assessment.</i></b></p>
Occupational Health and Safety Act, 1993 (Act No. 85 of 1993) (OHSA)	The MHSA provides that OHSA is not applicable to any matter in respect of which any provision of the MHSA is applicable.
Compensation for Occupational Injuries and Diseases Act, 1993 (Act No. 130 of 1993) (COIDA)	<p>Under COIDA, employers are not held liable for compensation for injuries sustained by employees or compensation to dependants due to the death of an employee which occurred during the course and scope of their employment. Compensation is paid out of a statutory fund, administered by the Compensation Commissioner ("CC") (appointed under COIDA), which is set in accordance with a tariff prescribed in COIDA. The fund is a trust fund that is controlled by the CC, which the employer contributes to. The CC is appointed to administer the fund and approve claims lodged by employees or their dependants. The CC compensates the employee or their dependants directly.</p> <p><b><i>MQE will take cognisance of the requirements of the COIDA as part of daily operations should incidents occur.</i></b></p>
Restitution of Land Rights Act, 1994 (Act 22 of 1994) (RLRA)	<p>The RLRA governs land restoration claims. Initially, the RLRA only allowed land claims to be lodged until December 1998 (Initial Period). This Initial Period was amended with the promulgation of the Restitution of Land Rights Amendment Act of 2014 and the process for the lodgement of claims was extended to 2019. However, a few months thereafter, the Constitutional Court delivered a judgment, <i>Land Access Movement of South Africa and Others v Chairperson of the National Council of Provinces and Others</i> 2016 (5) SA 635 (CC) (LAMOSA).<sup>26</sup> In terms of the LAMOSA judgments, the Department of Rural Development and Land Reform (DRDLR) is interdicted from processing those claims lodged after December 1998 until those lodged prior to December 1998 have been finalised.</p> <p>Under section 11(7), no person may sell, exchange, donate, lease, subdivide, rezone, or develop a land in respect of which a land claim has been published in a government gazette without giving the Regional Land Claims Commissioner (LCC) one month's written notice of the intention to do so.</p> <p><b><i>MQE shall duly notify the LCC prior to developing on the Project Area.</i></b></p>
Other National Legislation and Policy	Other policies, legislation and associated regulations (where applicable) considered as part of the application process include:

<sup>26</sup> which was followed by *Speaker of the National Assembly and Another v Land Access Movement of South Africa and Others* (2019) ZACC 10.

LEGISLATION/GUIDELINE	OBJECTIVE & RELEVANCE
	<ul style="list-style-type: none"> <li>Disaster Management Act, 2002 (Act No. 57 of 2002).</li> <li>Integrated Resource Plan 2019.</li> <li>Local Government: Municipal Systems Act, 2000 (Act 32 of 2000).</li> <li>National Development Plan 2030.</li> <li>Protection of Personal Information Act, 2013 (Act 4 of 2013).</li> <li>Regulations of Gatherings Act, No. 205 of 1993</li> <li>Traditional and Khoi-San Leadership Act, 2019 (Act 3 of 2019).</li> <li>Water Services Act, 1997 (Act 108 of 1997).</li> <li>Promotion of Access to Information Act, 2000 (Act 2 of 2000)</li> <li>Promotion of Access to Justice Act, 2000 (Act 3 of 2000).</li> <li>Basic Conditions of Employment Act, 1997 (Act 75 of 1997)</li> <li>Labour Relations Act, 1995 (Act 66 of 1995).</li> </ul>
Provincial / Municipal Legislation and Policy	<p>Provincial / Municipal policies, legislation, and associated regulations (where applicable) considered as part of the application process include:</p> <ul style="list-style-type: none"> <li>Mpumalanga Nature Conservation Act, 1998 (Act 10 of 1998).</li> <li>Spatial Development Framework (SDF) 2019: Mpumalanga Province, as amended.</li> <li>Gert Sibande District Municipality (GSDM) Spatial Development Framework 2009.</li> <li>GSDM Noise Control By-Law, 2014.</li> <li>GSDM Waste By-Laws, 2017.</li> <li>Mkhondo Spatial Planning &amp; Land Use Management By-Law, 2016.</li> </ul>
Municipal Development Planning	<p>The following municipal development planning documentation is relevant to the application process:</p> <ul style="list-style-type: none"> <li>Gert Sibande District Municipality Integrated Development Plan (IDP) 2022/27 and supporting documents.</li> <li>Mkhondo IDP 2022/2027</li> </ul>
OTHER STANDARDS AND GUIDELINES	
Standards and Guidelines	<p>In addition to the abovementioned Acts and their associated Regulations, the following guidelines and reports have been taken cognisance of during the application process:</p> <ul style="list-style-type: none"> <li>Guidelines for consultation with communities and interested and affected parties issued by the DMRE.</li> <li>NEMA Implementation Guidelines: Sector Guidelines for EIA Regulation<sup>27</sup></li> <li>Department of Environmental Affairs (DEA) (2011): A user friendly guide to the National Environmental Management: Waste Act, 2008. South Africa, Pretoria.</li> </ul>

<sup>27</sup> Published under GN 654 in GG 3333 of 29 June 2010

LEGISLATION/GUIDELINE	OBJECTIVE & RELEVANCE
	<ul style="list-style-type: none"> <li>• Department of Environmental Affairs and Tourism (2004): Criteria for determining Alternatives in EIA, Integrated Environmental Management, Information Series 11.</li> <li>• DFFE Integrated Environmental Management Guideline on Need and Desirability, 2017.</li> <li>• Guideline for Implementation: Public Participation in the EIA Process.<sup>28</sup></li> <li>• Publication of Public Participation Guideline (GN 807 of 10 October 2012 GG No. 35769).</li> <li>• Mining and Biodiversity Guideline: mainstreaming biodiversity into the mining sector.</li> <li>• Department of Water and Forestry ("DWAF"), 2006. Groundwater Assessment II.</li> <li>• DWS, 2011 The Groundwater Dictionary - A comprehensive reference of groundwater related terminology, 2nd ed.</li> <li>• DWS, 2016 New Water management Areas, South Africa: Government Gazette No 40279.</li> <li>• South African Water Quality Guidelines (DWAF): <ul style="list-style-type: none"> <li>○ South African Water Quality Guidelines (2nd Edition). Volume 4: Agricultural Use: Irrigation (1996a);</li> <li>○ Water Quality Guidelines - Volume 1: Domestic Use (1996b);</li> <li>○ South African Water Quality Guidelines (2nd Edition). Volume 5: Livestock Watering (1996c);</li> <li>○ Water Quality Guidelines Volume 7: Aquatic Ecosystems (1996d);</li> <li>○ Water Quality Guidelines Volume 2: Recreational Use (1996e); and</li> <li>○ Water Quality Guidelines Volume 3: Industrial Use (1996f).</li> </ul> </li> <li>• Best Practice Guidelines (DWAF): <ul style="list-style-type: none"> <li>○ G3: Water Monitoring Systems (2007);</li> <li>○ A5: Water Management for Surface Mines (2008b); and</li> <li>○ G4: Impact Prediction (2008)</li> </ul> </li> <li>• SANS 10103 of 2008: The measurement and rating of environmental noise with respect to annoyance and to speech communication<sup>29</sup></li> <li>• SANS 10210 of 2004: Calculating and predicting road traffic noise.</li> <li>• SANS 10357: 2004: The calculation of sound propagation by the Concave method.</li> </ul>

<sup>28</sup> Published in under GN 807 in GG 35769 of 10 October 2012

<sup>29</sup> Published under GN 718 in Government Gazette No. 18022

### 3.2 NEMA EIA Regulations 2014 (as amended)

The NEMA is South Africa's overarching framework for environmental legislation. Regulations promulgated under NEMA include the EIA Regulations (2014) published under Government Notice Regulation (GNR) 982, as amended (EIA Regulations), and the associated Listing Notices Listing Notice 1, 2 and 3. Section 24(5) of NEMA stipulates that certain "listed activities" require environmental authorisation by way of either a Basic Assessment (BA) or a full Scoping and Environmental Impact Assessment (S&EIR), as defined in the Listing Notices. Activities listed under Listing Notice 1 and 3 require a BA process to be undertaken, while those listed under Listing Notice 2 require a full Scoping and S&EIR process. Table 3-4 and Table 3-5 provides an assessment of the applicable listed activities in terms of NEMA and NEMWA respectively.

### 3.2.1 Applicable Listed Activities

The proposed MQE projects will require an IEA through a S&EIR process, due to the following listed activities being triggered:

**Table 3-2: Listed activities in terms of the 2014 NEMA EIA regulations, as amended.**

Notice	Activity	Description of related activity	Applicability
1	9	The development of infrastructure exceeding 1 000m in length for the bulk transportation of water or stormwater— <u>(i) with an internal diameter of 0,36m or more; or</u> <u>(ii) with a peak throughput of 120l/s or more;</u> excluding where— (a) such infrastructure is for bulk transportation of water or stormwater or stormwater drainage inside a road reserve or railway line reserve; or (b) where such development will occur within an urban area.	The construction and operation of pipelines with a Ø of more than 0.36m and throughput of more than 120l/s, for water/stormwater reticulation for the co-disposal facility.
1	10	The development and related operation of infrastructure exceeding 1 000m in length for the bulk transportation of sewage, effluent, process water, wastewater, return water, industrial discharge or slimes - <u>(i) with an internal diameter of 0,36m or more; or</u> <u>(ii) with a peak throughput of 120l/s or more;</u> excluding where— (a) such infrastructure is for the bulk transportation of sewage, effluent, process water, wastewater, return water, industrial discharge or slimes inside a road reserve or railway line reserve; or (b) where such development will occur within an urban area.	The construction and operation of pipelines with a Ø of more than 0.36m and throughput of more than 120l/s, for process/waste/return water or effluent reticulation for the co-disposal facility, the decant management system, the WWTP and the Brine Treatment Plant.
1	12	The development of (i) dams or weirs, where the dam or weir, including infrastructure and water surface area, exceeds 100m <sup>2</sup> ; or <u>(ii) infrastructure or structures with a physical footprint of 100m<sup>2</sup> or more;</u> where such development occurs— <u>(a) within a watercourse;</u> (b) in front of a development setback; or <u>(c) if no development setback exists, within 32m of a watercourse, measured from the edge of a watercourse;</u> <u>excluding—</u> (aa) the development of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour; (bb) where such development activities are related to the development of a port or harbour, in	The proposed projects are proposed within or in proximity to various watercourses; and their development footprints exceed 100m <sup>2</sup> . However, an exclusion is relevant, as Activity 14 of LN 3 is applicable.  <b><i>This activity is therefore <u>not applicable</u> and will not be further addressed in this assessment.</i></b>

Notice	Activity	Description of related activity	Applicability
		<p>which case activity 26 in LN 2 of 2014 applies;  (cc) activities listed in activity 14 in LN 2 of 2014 or activity 14 in LN 3 of 2014, in which case that activity applies;  (dd) where such development occurs within an urban area;  (ee) where such development occurs within existing roads, road reserves or railway line reserves;  or  (ff) the development of temporary infrastructure or structures where such infrastructure or structures will be removed within 6 weeks of the commencement of the development and where indigenous vegetation will not be cleared.</p>	
1	19	<p>The <u>infilling or depositing of any material of more than 10m<sup>3</sup> into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10m<sup>3</sup> from a watercourse</u>, but excluding where such infilling, depositing, dredging, excavation, removal or moving—  (a) will occur behind a development setback;  (b) is for maintenance purposes undertaken in accordance with a maintenance management plan;  (c) falls within the ambit of activity 21 in this Notice, in which case that activity applies;  (d) occurs within existing ports or harbours that will not increase the development footprint of the port or harbour; or  (e) where such development is related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies</p>	The proposed projects are proposed within or in proximity to various watercourses; and their construction will result in the disturbance of more than 10m <sup>3</sup> of material within affected watercourses.
1	24	<p>The <u>development of a road-</u>  (i) for which an environmental authorisation was obtained for the route determination in terms of activity 5 in GNR 387 of 2006 or activity 18 in GNR 545 of 2010; or  (ii) <u>with a reserve wider than 13.5m, or where no reserve exists where the road is wider than 8m;</u>  but excluding a road-  (a) which is identified and included in activity 27 in LN 2 of 2014;  (b) where the entire road falls within an urban area; or  (c) which is 1 kilometre or shorter.</p>	Various new 16m wide haul roads is required for the proposed new CDF, and the total length of these roads will exceed 1km in length.
1	25	<p>The <u>development and related operation of facilities or infrastructure for the treatment of effluent, wastewater or sewage with a daily throughput capacity of more than 2 000m<sup>3</sup> but less than 15 000m<sup>3</sup>.</u></p>	<p>The construction of a wastewater treatment plant to treat contaminated water, with a maximum throughput capacity of 4 500m<sup>3</sup>/day.</p> <p>The construction of a Brine Treatment Plant with a</p>



Notice	Activity	Description of related activity	Applicability
			throughout capacity of 285m <sup>3</sup> /day.
1	27	<u>The clearance of an area of 1ha or more, but less than 20ha of indigenous vegetation, except where such clearance of indigenous vegetation is required for—</u> (i) the undertaking of a linear activity; or (ii) maintenance purposes undertaken in accordance with a maintenance management plan.	The total combined project footprint area is approximately 70ha in extent. Indigenous vegetation removal is likely to exceed 20ha; as such . exclusion is relevant, as Activity 15 of LN 2 is applicable.  <b><i>This activity is therefore <u>not applicable</u> and will be addressed as part of Activity 15 of LN 2.</i></b>
2	6	<u>The development of facilities or infrastructure for any process or activity which requires a permit or licence or an amended permit or licence in terms of national or provincial legislation governing the generation or release of emissions, pollution or effluent, excluding—</u> (i) activities which are identified and included in LN 1 of 2014; (ii) activities which are included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case the National Environmental Management: Waste Act, 2008 applies; (iii) the development of facilities or infrastructure for the treatment of effluent, polluted water, wastewater or sewage where such facilities have a daily throughput capacity of 2 000m <sup>3</sup> or less; or (iv) where the development is directly related to aquaculture facilities or infrastructure where the wastewater discharge capacity will not exceed 50m <sup>3</sup> /day.	The proposed new PCDs associated with the CDF and WWTP, as well as associated infrastructure will require authorisation in terms of Section 21 (a), (c), (i) and (g) of the National Water Act (Act 36 of 1989).
2	15	<u>The clearance of an area of 20ha or more of indigenous vegetation, excluding where such clearance of indigenous vegetation is required for—</u> (i) the undertaking of a linear activity; or (ii) maintenance purposes undertaken in accordance with a maintenance management plan.	The total combined project footprint area is approximately 70ha in extent. As such, indigenous vegetation removal for the combined project area may exceed 20ha.
3	4	<u>The development of a road wider than 4m with a reserve less than 13,5m.</u> <u>f. Mpumalanga</u> <u>i. Outside urban areas:</u> (aa) A protected area identified in terms of NEMPAA, excluding disturbed areas; (bb) <u>National Protected Area Expansion Strategy (NPAES) Focus areas;</u> (cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; (dd) Sites or areas identified in terms of an international convention; (ee) <u>Critical biodiversity areas (CBA) as identified in systematic biodiversity plans adopted by the</u>	MQE falls within a CBA, a NPAES Focus area and NFEPA Sub-catchment area. Establishment of new access and internal roads for the proposed projects would trigger this activity, however, as far as possible existing roads would be utilised.

Notice	Activity	Description of related activity	Applicability
		<u>competent authority or in bioregional plans;</u> (ff) Core areas in biosphere reserves; or (gg) Areas within 10km from national parks or world heritage sites or 5km from any other protected area identified in terms of NEMPAA or from the core areas of a biosphere reserve, excluding disturbed areas, where such areas comprise indigenous vegetation; or ii. Inside urban areas: (aa) Areas zoned for use as public open space; or (bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority or zoned for a conservation purpose.	
3	12	<u>The clearance of an area of 300m<sup>2</sup> or more of indigenous vegetation</u> except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan. <u>f. Mpumalanga</u> i. Within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004; <u>ii. Within CBAs identified in bioregional plans; or</u> iii. On land, where, at the time of the coming into effect of this Notice or thereafter such land was zoned open space, conservation or had an equivalent zoning or proclamation in terms of NEMPAA.	MQE falls within a CBA and indigenous vegetation removal is highly likely to exceed 300m <sup>2</sup> .
3	14	<u>The development of—</u> (i) dams or weirs, where the dam or weir, including infrastructure and water surface area exceeds 10m <sup>2</sup> ; or <u>(ii) infrastructure or structures with a physical footprint of 10m<sup>2</sup> or more; where such development occurs—</u> <u>(a) within a watercourse;</u> (b) in front of a development setback; or <u>(c) if no development setback has been adopted, within 32m of a watercourse, measured from the edge of a watercourse;</u> excluding the development of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour. <u>f. Mpumalanga</u> <u>i. Outside urban areas:</u> (aa) A protected area identified in terms of NEMPAA, excluding conservancies; (bb) <u>NPAES Focus areas;</u>	MQE is located in a CBA and NPAES Focus area. The proposed projects are located within or in close proximity to various watercourses. The projects' zone of influence will affect these watercourses as the extent of the development footprints is in excess of 10m <sup>2</sup> .

Notice	Activity	Description of related activity	Applicability
		(cc) World Heritage Sites; (dd) Sensitive areas as identified in an environmental management framework as contemplated in Chapter 5 of the Act and as adopted by the competent authority; (ee) Sites or areas identified in terms of an international convention; (ff) <u>CBA's or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;</u> (gg) Core areas in biosphere reserves; or (hh) Areas within 10km from national parks or world heritage sites or 5km from any other protected area identified in terms of NEMPAA or from the core area of a biosphere reserve, where such areas comprise indigenous vegetation; or ii. Inside urban areas: (aa) Areas zoned for use as public open space; or (bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority, zoned for a conservation purpose	
3	18	<u>The widening of a road by more than 4m, or the lengthening of a road by more than 1km.</u> <u>f. Mpumalanga</u> i. <u>Outside urban areas:</u> (aa) A protected area identified in terms of NEMPAA, excluding conservancies; (bb) <u>NPAES Focus areas;</u> (cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; (dd) Sites or areas identified in terms of an international convention; <del>(ee) CBAs as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;</del> (ff) Core areas in biosphere reserves; or (gg) Areas within 10km from national parks or world heritage sites or 5km from any other protected area identified in terms of NEMPAA or from the core area of a biosphere reserve, where such areas comprise indigenous vegetation; or ii. Inside urban areas: (aa) Areas zoned for use as public open space; or (bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority or zoned for a conservation purpose.	MQE falls within a CBA, and a NPAES Focus area. Expansion of access and internal roads for the proposed projects, will trigger this activity.

Table 3-3: Listed activities in terms of the 2013 NEMWA Waste Listed Activities, as amended.

Category	Activity	Description of related activity	Applicability
B	7	The disposal of any quantity of hazardous waste to land.	The proposed CDF will accommodate discard produced from the beneficiation plant, slurry/filter cake and potentially brine from the WWTP. The waste streams has been classified as Type 3 and Class I & II, requiring a Class C barrier system for disposal.
B	10	The construction of a facility for a waste management activity listed in Category B of this Schedule (not in isolation to associated waste management activity).	The construction of the CDF triggers this activity.
B	11	The establishment or reclamation of a residue stockpile or residue deposit resulting from activities which require a mining right, exploration right or production right in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002).	The proposed CDF will accommodate discard produced from the MQE beneficiation plant, slurry/filter cake and potentially brine from the WWTP.  If NEMLAA V commences prior to the proposed development commencing, this activity will however no longer be required, as a WML will no longer be required for residue stockpiles.

### 3.2.2 *The S&EIR Process*

A S&EIR process has two distinct phases: The Scoping Phase and the Environmental Impact Reporting Phase. The Scoping Report identifies potential biophysical, social and health aspects and impacts of the proposed development on the receiving environment and invites comments from stakeholders in the identification of key issues and areas of concern, in order to inform the S&EIR process. The main objectives of the Scoping Phase are as follows:

- Identify the relevant policies and legislation relevant to the activity;
- Motivate the need and desirability of the proposed activity, including the need and desirability of the activity in the context of the preferred location and layout;
- Identify and confirm the preferred activity and technology alternative through an impact and risk assessment and ranking process;
- Identify and confirm the preferred site, through a detailed site selection process, which includes an identification of impacts and risks inclusive of identification of cumulative impacts and a ranking process of all the identified alternatives, focusing on the geographical, physical, biological, social, economic, and cultural aspects of the environment;
- Identify the key issues to be addressed in the EIA phase;
- Agree on the level of assessment to be undertaken; and
- Identify suitable measures to avoid, manage or mitigate identified impacts and to determine the extent of the residual risks that need to be managed and monitored.

## 4 PROJECT MOTIVATION NEED AND DESIRABILITY

Kangra Coal (Pty) Ltd is an independent, coal operating mining company in South Africa.

Kangra is located approximately 45km west of the town of Piet Retief in Mpumalanga Province and produces about 2 million tons of run of mine energy coal per annum. Kangra's wash abilities allow it to produce a range of thermal coal products for both international and domestic customers. The vast majority of Kangra's coal is exported through Richards Bay Coal Terminal for use by international power producers.

Kangra's consistent quality and secure production make it highly a sought-after supplier to key markets. Kangra's location, being close to Richards Bay, positions it well for both exports and to service the local South African markets.

Kangra was founded by Graham Beck in 1957 and became a founding member of Richards Bay Coal Terminal in 1974. Kangra acquired the mining rights for Savmore/Maquasa in 1995. Currently, mining is undertaken at the Twyfelhoek and Balgarthen Adits.

Kangra is a shareholder of Richards Bay Coal Terminal, the world's largest coal export terminal which allows it to export about 1.6 million tons of coal per annum.

Kangra's Maquasa Operation is a dynamic undertaking, and as the mining progresses, the need for supporting infrastructure changes constantly.

As indicated in earlier investigations in support of the initial application for a new discard facility, Kangra is expanding their operations in the area, resulting in increased discard capacity requirements which is anticipated to reach its capacity by 2025.

Furthermore, in line with Kangra's commitment to minimising environmental degradation through the implementation of their various environmental policies and programmes and compliance focused corporate responsibility to minimise their negative impact on the environment and promote sustainable development, MQE seeks to improve their contaminated water management practices on-site. In this regard, it is proposed to construct and operate a WWTP, including associated infrastructure to improve MQE's decant, and excess process water management practices as explained in section 2 of this report as well as constructing a water pipe to discharge into the Heyshope Dam.

Important to note, is that the proposed projects do not entail any expansion of current mining activities or production levels nor change to the mine area held under the MQE MR. The purpose of these projects is to provide supplementary infrastructure required for the enhancement of current mining activities.



The proposed projects are crucial for the continued operation of the Maquasa Operations. Should they not be approved, MQE's contaminated water management practices will not be improved, and the additional disposal capacity will not be achieved, resulting in the shortening of the expected Life of Mine (LoM) potentially reducing the positive socio-economic impacts provided by the current operations.

In accordance with the EIA Regulations, 2014(as amended), the need and desirability of the proposed projects have been considered while taking the strategic concept, broader socio-economic needs, public interest, and environmental impacts into account. The tables below (Table 4-1 and Table 4-2) provide answers to a number of guiding questions as posed in the Department of Environmental Affairs' Guideline on Need and Desirability (DEA, 2017).

The answers provided below indicate that ample consideration has been given to the need and desirability of the proposed projects.

Table 4-1: Assessment of the proposed MQE projects in terms of securing ecological sustainable development and use of natural resources.

HOW WILL THIS DEVELOPMENT (AND ITS SEPARATE ELEMENTS/ASPECTS) IMPACT ON THE ECOLOGICAL INTEGRITY OF THE AREA?		
No.	Question	Answer
1.1	<p>How were the following considerations taken into account:</p> <ul style="list-style-type: none"> <li>Threatened ecosystems;</li> <li>Sensitive, vulnerable, highly dynamic or stressed ecosystems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure;</li> <li>CBAs and ESAs;</li> <li>Conservation targets;</li> <li>Ecological drivers of the ecosystem;</li> <li>Environmental Management Framework;</li> <li>Spatial Development Framework; and</li> <li>Global and international responsibilities relating to the environment.</li> </ul>	<p>Considering that MQE is located in an environmentally sensitive CBA, the EIA process would address all ecological and environmental considerations, with specific reference to the conservation importance of the area. Due diligence would be observed while undertaking the EIA to ensure that the process was in line with MQE's environmental principles, the area's environmental frameworks and all relevant guidelines.</p>
1.2	<p>How will this development disturb or enhance ecosystems and/or result in the loss or protection of biological diversity? What measures were explored to firstly avoid these negative impacts, and where these negative impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts? What measures were explored to enhance positive impacts?</p>	<p>The projects will take place in an area largely characterised by mining activities. Some wetland habitats would be lost. In order to reduce the impact of the projects on the ecosystem, clean stormwater would be diverted around the Project Areas.</p> <p>Several options were explored for the projects, with the proposed option being the best strategy. Implementation of the EMPr would ensure that negative impacts are avoided, managed, and mitigated as far as possible.</p>
1.3	<p>How will this development pollute and/or degrade the biophysical environment? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts? What measures were explored to enhance positive impacts?</p>	<p>The CDF would be lined, as per the current requirements of DWS. Seepage from the CDF is thus expected to be minimal. The projects are proposed within the MR area in previously disturbed areas, where very little indigenous vegetation remains.</p> <p>Implementation of the EMPr would ensure that negative impacts are avoided, managed, and mitigated as far as possible.</p>

1.4	<p>What waste will be generated by this development? What measures were explored to firstly avoid waste, and where waste could not be avoided altogether, what measures were explored to minimise, reuse and/or recycle the waste? What measures have been explored to safely treat and/or dispose of unavoidable waste?</p>	<p>The CDF would be a residue/discard storage facility. The waste that will be stored is a product of the processing of minerals, hence there are no further treatments that could be applied.</p> <p>The WWTP would generate brine which will initially be pumped to the proposed new Brine PCD. A Brine Treatment Plant will be installed at a later stage to remove water from the brine, thereby converting it to a dry filter cake that can be disposed of on the proposed CDF.</p> <p>Other waste products generated would enter the existing MQE waste management stream and be finally disposed of at licensed waste disposal facilities.</p>
1.5	<p>How will this development disturb or enhance landscapes and/or sites that constitute the nation's cultural heritage? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts? What measures were explored to enhance positive impacts?</p>	<p>The project falls within an existing MR and active mining area. a Heritage and Paleontological Sensitivity Verification will be undertaken during the EIA Phase.</p> <p>Implementation of the EMPr would ensure that negative impacts are avoided, managed, and mitigated as far as possible.</p>
1.6	<p>How will this development use and/or impact on non-renewable natural resources? What measures were explored to ensure responsible and equitable use of the resources? How have the consequences of the depletion of the non-renewable natural resources been considered? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy (including offsetting) the impacts? What measures were explored to enhance positive impacts?</p>	<p>There is no foreseen additional demand on natural resources due to the proposed projects that would result in any significant depletion of natural resources. In respect of water supply, MQE would continue to recycle water at the mine in a closed system. The CDF and Brine PCD would be lined with an impermeable barrier system, and this would prevent any significant impact to the groundwater, with no impact on groundwater users being anticipated. There would be limited removal of indigenous vegetation.</p>
1.7	<p>How will this development use and/or impact on renewable natural resources and the ecosystem of which they are part? Will the use of the resources and/or impact on the ecosystem jeopardise the integrity of the resource and/or system taking into account carrying capacity restrictions, limits of acceptable change, and thresholds? What measures were explored to firstly avoid the use of resources, or if avoidance is not possible, to minimise the use of resources? What measures were taken to ensure responsible and equitable use of the resources? What measures were explored to enhance positive impacts?</p> <ul style="list-style-type: none"> <li>Does the proposed development exacerbate the increased dependency on increased use of resources to maintain economic growth or does it reduce resource dependency (i.e. de-</li> </ul>	<p>Appropriate mitigation measures would be included in the EMPr to minimise impacts to non-renewable natural resources. The extent of biodiversity impacts would be assessed and the necessity to offset this.</p>

	<p>materialised growth)? (note: sustainability requires that settlements reduce their ecological footprint by using less material and energy demands and reducing the amount of waste they generate, without compromising their quest to improve their quality of life);</p> <ul style="list-style-type: none"> <li>Does the proposed use of natural resources constitute the best use thereof? Is the use justifiable when considering intra- and intergenerational equity, and are there more important priorities for which the resources should be used (i.e. what are the opportunity costs of using these resources this the proposed development alternative?);</li> <li>Do the proposed location, type and scale of development promote a reduced dependency on resources?</li> </ul>	
1.8	<p>How were a risk-averse and cautious approach applied in terms of ecological impacts?</p> <ul style="list-style-type: none"> <li>What are the limits of current knowledge?</li> <li>What is the level of risk associated with the limits of current knowledge?</li> <li>Based on the limits of knowledge and the level of risk, how and to what extent was a risk-averse and cautious approach applied to the development?</li> </ul>	<p>The impacts on ecology would be thoroughly investigated in the identified investigations. At this stage, it is unlikely that these gaps would result in a large increase in the risk. The precautionary principle was adopted during the preliminary design process whilst investigating the engineering solutions and seismicity in the area. Alternatives would be explored for the projects during the EIA process and would similarly be applied by the specialists in the EIA phase.</p>
1.9	<p>How will the ecological impacts resulting from this development impact on people's environmental right in terms following:</p> <ul style="list-style-type: none"> <li>Negative impacts: e.g. access to resources, opportunity costs, loss of amenity, air and water quality impacts, nuisance (noise, odour, etc.), health impacts, visual impacts, etc. What measures were taken to firstly avoid negative impacts, but if avoidance is not possible, to minimise, manage and remedy negative impacts?</li> <li>Positive impacts: e.g. improved access to resources, improved amenity, improved air or water quality, etc. What measures were taken to enhance positive impacts?</li> </ul>	<p>A comprehensive suite of specialist studies to investigate the impacts of the proposed projects on the environmental rights of the community are being compiled.</p> <p>The proposed projects are likely to have minimal additional impacts in terms of amenity (as it is within the MQE MR Area and owned by Kangra), air and water quality, noise, health and visual. The implementation of the EMPr would assist in minimising or managing any impacts as far as possible.</p>
1.10	<p>Describe the linkages and dependencies between human wellbeing, livelihoods and ecosystem services applicable to the area in question and how the development's ecological impacts will result in socio-economic</p>	<p>Human wellbeing in the area is linked to livelihood, air quality and water quality. Should the development negatively impact any of these factors, this may result in linked socio-economic impacts. The impacts</p>

	impacts (e.g. on livelihoods, loss of heritage site, opportunity costs, etc.)?	would be assessed, and further investigations would be undertaken as necessary in this regard.
1.11	Based on all of the above, how will this development positively or negatively impact on ecological integrity objectives/targets/considerations of the area?	It is likely that there would be little additional impacts on ecological integrity as the proposed projects would be located within the existing MQE MR Area, with existing mining activities and within an area where the MQE surface infrastructure is already situated.
1.12	Considering the need to secure ecological integrity and a healthy biophysical environment, describe how the alternatives identified (in terms of all the different elements of the development and all the different impacts being proposed), resulted in the selection of the “best practicable environmental option” in terms of ecological considerations?	<p>In considering project alternatives, it must be highlighted that the proposed projects are all located within an area classified as a “Brownfields Site” and there are various limiting factors pertaining to availability of suitable land and restrictions experienced due to biodiversity sensitivity in the area.</p> <p>Nevertheless, detailed scrutiny was undertaken of potential development options. Due to the nature and location of the current activities at MQE, the proposed projects are proposed to be positioned in the locations and on the properties on which they are needed and best located in accordance with current operational requirements and identified restrictions explained earlier.</p>
1.13	Describe the positive and negative cumulative ecological/biophysical impacts bearing in mind the size, scale, scope and nature of the project in relation to its location and existing and other planned developments in the area?	<p>Positive:</p> <ul style="list-style-type: none"> <li>• The proposed projects are all located within a “Brownfields Site” and as such the potential environmental impact has been lowered.</li> </ul> <p>Negative:</p> <ul style="list-style-type: none"> <li>• Loss of topsoil and vegetation (habitat).</li> <li>• Potential pollution of soil and water resource through improper waste and hydrocarbon management.</li> <li>• Minor air quality impacts from dust and particulate matter.</li> <li>• Minor noise impacts.</li> <li>• Potential erosion and sedimentation of water resources, impacting water quality.</li> <li>• Potential groundwater pollution through seepage (this is unlikely due to the pollution barrier system (the liner) and other mitigation measures which would be put in place).</li> <li>• Permanent visibility of the projects in landscape, changing the topography.</li> <li>• Possible impact on the water quality</li> </ul>

**Table 4-2:** Assessment of the proposed MQE projects in terms of promoting justifiable economic and social development.

No.	Question	Answer
2.1	<p>What is the socio-economic context of the area, based on, amongst other considerations, the following considerations:</p> <ul style="list-style-type: none"> <li>The IDP (and its sector plans' vision, objectives, strategies, indicators and targets) and any other strategic plans, frameworks of policies applicable to the area,</li> <li>Spatial priorities and desired spatial patterns (e.g. need for integration of segregated communities, need to upgrade informal settlements, need for densification, etc.),</li> <li>Spatial characteristics (e.g. existing land uses, planned land uses, cultural landscapes, etc.), and</li> <li>Municipal Economic Development Strategy ("LED Strategy").</li> </ul>	<p>The area is characterised by high unemployment rates, with employment being driven largely by mining activities. The development is an expansion of activities, which are already underway, in a landscape dominated by mining.</p> <p>The IDP speaks of how mining has contributed 17-26% of the Mpumalanga Province's budget in recent years and identifies various opportunities in the mining sector.</p> <p>Thus, the development is in line with the IDP and other spatial priorities. The expansion of the facility would result in continued employment as the lifespan of the operations would be increased.</p>
2.2	<p>Considering the socio-economic context, what will the socio-economic impacts be of the development (and its separate elements/aspects), and specifically also on the socio-economic objectives of the area?</p> <ul style="list-style-type: none"> <li>Will the development complement the local socio-economic initiatives (such as local economic development (LED) initiatives), or skills development programs?</li> </ul>	<p>The proposed projects would result in continued employment; and continued direct, downstream, and macro-economic positive impacts from the MQE Mine, as its LOM would be maintained and benefits to the local Communities arising from the MQE Social and Labour Plan (SLP) would continue. This is in line with the objectives of the GSDM and Local IDPs.</p>
2.3	<p>How will this development address the specific physical, psychological, developmental, cultural and social needs and interests of the relevant communities?</p>	<p>The expansion projects would likely result in continued employment, as well as continued economic input from the operations, as the lifespan of the Mine would be increased and continued benefits to the local Communities arising from the MQE SLP. This is in line with the objectives of the IDP.</p>
2.4	<p>Will the development result in equitable (intra- and inter-generational) impact distribution, in the short- and long-term? Will the impact be socially and economically sustainable in the short- and long-term?</p>	<p>The proposed projects would result in long-term benefits through maintaining the LOM; providing job opportunities to current and future generations, as most current employees would likely retire before expected LOM is reached; ongoing benefits from SLP Projects; and downstream socio-economic benefits.</p>
2.5	<p>In terms of location, describe how the placement of the proposed development will:</p>	<p>The Mine is situated in a mining belt and is neighboured by several mines. It therefore complements these land uses in the area. There is existing transport for workers commuting from the surrounds.</p>



	<ul style="list-style-type: none"> <li>• result in the creation of residential and employment opportunities in close proximity to or integrated with each other,</li> <li>• reduce the need for transport of people and goods,</li> <li>• result in access to public transport or enable non-motorised and pedestrian transport (e.g. will the development result in densification and the achievement of thresholds in terms of public transport),</li> <li>• compliment other uses in the area,</li> <li>• be in line with the planning for the area,</li> <li>• for urban related development, make use of underutilised land available with the urban edge,</li> <li>• optimise the use of existing resources and infrastructure,</li> <li>• opportunity costs in terms of bulk infrastructure expansions in non-priority areas (e.g. not aligned with the bulk infrastructure planning for the settlement that reflects the spatial reconstruction priorities of the settlement),</li> <li>• discourage "urban sprawl" and contribute to compaction/densification,</li> <li>• contribute to the correction of the historically distorted spatial patterns of settlements and the optimum use of existing infrastructure in excess of current needs,</li> <li>• encourage environmentally sustainable land development practices and processes,</li> <li>• take into account special locational factors that might favour the specific location (e.g. the location of a strategic mineral resource, access to the port, access to rail, etc.),</li> <li>• the investment in the settlement or area in question will generate the highest socio-economic returns (i.e. an area with high economic potential),</li> <li>• impact on the sense of history, sense of place and heritage of the area and the socio-cultural and cultural-historic characteristics and sensitivities of the area, and</li> <li>• in terms of the nature, scale and location of the development promote or act as a catalyst to create a more integrated settlement?</li> </ul>	<p>The proposed projects would be an environmentally sustainable land development and have a specific locational factor, being within the MQE MR and surface infrastructure area, largely on disturbed or non-sensitive areas. There would accordingly be optimal use of existing infrastructure.</p> <p>By continuing investments and development of MQE, continued socio-economic benefits can be generated.</p>
--	--	--

2.6	<p>How were a risk-averse and cautious approach applied in terms of socio-economic impacts?</p> <ul style="list-style-type: none"> <li>• What are the limits of current knowledge (note: the gaps, uncertainties and assumptions must be clearly stated)?</li> <li>• What is the level of risk (note: related to inequality, social fabric, livelihoods, vulnerable communities, critical resources, economic vulnerability and sustainability) associated with the limits of current knowledge?</li> <li>• Based on the limits of knowledge and the level of risk, how and to what extent was a risk-averse and cautious approach applied to the development?</li> </ul>	<p>Kangra has recently undertaken several socio-economic assessments and community engagements for previous EIAs, which lessens the risks of limits of current knowledge gaps.</p> <p>PPP with the surrounding Communities is being undertaken as part of the EIA process. The specialist would apply the precautionary principle and gaps noted would be discussed in the EIA. Mitigation measures for any socio-economic would be discussed under in the EIA and noted in detail in the EMPr.</p>
2.7	<p>How will the socio-economic impacts resulting from this development impact people's environmental rights in terms following:</p> <ul style="list-style-type: none"> <li>• Negative impacts: e.g. health (e.g. HIV-Aids), safety, social ills, etc. What measures were taken to firstly avoid negative impacts, but if avoidance is not possible, to minimise, manage and remedy negative impacts?</li> <li>• Positive impacts. What measures were taken to enhance positive impacts?</li> </ul>	<p>Measures to enhance socio-economic positive impacts include prioritisation of recruitment from the local community, providing up-skilling opportunities to the local community employed for the Projects, use of local and small-business goods and services and development of a communication strategy for the local community.</p> <p>Positive impacts would be enhanced through extensive public participation and involvement of the communities impacted by the development, thereby allowing suggestions and recommendations to guide the EIA process. Issues would be addressed via the Comments and Response Register.</p> <p>The socio-economic specialist would recommend the appropriate measures to address negative impacts.</p>
2.8	<p>Considering the linkages and dependencies between human well-being, livelihoods and ecosystem services, describe the linkages and dependencies applicable to the area in question and how the development's socio-economic impacts will result in ecological impacts (e.g. over utilisation of natural resources, etc.)?</p>	<p>There are no additional long-term ecological impacts foreseen due to the socio-economic impacts. Current employees would continue to utilise natural resources at the same rate as they currently do.</p>
2.9	<p>What measures were taken to pursue the selection of the "best practicable environmental option" in terms of socio-economic considerations?</p>	<p>Socio-economic aspects were considered in the assessment of alternatives and the Best Practicable Environmental Option (BPEO). The proposed development would result in the continuation of the MQE and the socio-economic impacts.</p>
2.10	<p>What measures were taken to pursue environmental justice so that adverse environmental impacts shall not be distributed in such a manner as to unfairly discriminate against any person,</p>	<p>It is not anticipated that adverse environmental impacts would be distributed in a manner as to unfairly discriminate against any person. An extensive PPP is planned</p>

	<p>particularly vulnerable and disadvantaged persons (who are the beneficiaries and is the development located appropriately)?</p> <p>Considering the need for social equity and justice, do the alternatives identified, allow the “best practicable environmental option” to be selected, or is there a need for other alternatives to be considered?</p>	to guide the development of the EIR and EMPr. Comments and suggestions by neighbouring communities would assist in ensuring that this does not occur.
2.11	What measures were taken to pursue equitable access to environmental resources, benefits and services to meet basic human needs and ensure human wellbeing, and what special measures were taken to ensure access thereto by categories of persons disadvantaged by unfair discrimination?	
2.12	What measures were taken to ensure that the responsibility for the environmental health and safety consequences of the development has been addressed throughout the development’s life cycle?	The EIA process and EMPr would take all stages of the Project’s life cycle into account and impacts specific to each phase would accordingly be addressed.
2.13	<p>What measures were taken to:</p> <ul style="list-style-type: none"> <li>• ensure the participation of all interested and affected parties,</li> <li>• provide all people with an opportunity to develop the understanding, skills and capacity necessary for achieving equitable and effective participation,</li> <li>• ensure participation by vulnerable and disadvantaged persons,</li> <li>• promote community well-being and empowerment through environmental education, the raising of environmental awareness, the sharing of knowledge and experience and other appropriate means,</li> <li>• ensure openness transparency, and access to information in terms of the process,</li> <li>• ensure that the interests, needs and values of all interested and affected parties were taken into account and that adequate recognition was given to all forms of knowledge, including traditional and ordinary knowledge, and</li> <li>• ensure that the vital role of women and youth in environmental management and development was</li> </ul>	<p>An extensive PPP would be undertaken as part of the EIA process. All impacted communities are invited to provide comments and suggestions. Notices of the application and projects are being relayed in several different formats.</p> <p>Summary documentation describing the application process and the Projects, in English and the most prevalent additional language, is provided during the PPP process to ensure adequate understanding and efficient participation.</p> <p>The relevant documents in the EIA process would be made available online and in public places near the neighbouring communities.</p>

	recognised and their full participation therein was promoted?	
2.14	Considering the interests, needs and values of all the interested and affected parties, describe how the development will allow for opportunities for all the segments of the community (e.g. a mixture of low-, middle-, and high-income housing opportunities) that is consistent with the priority needs of the local area (or that is proportional to the needs of an area)?	As previously stated, the Projects are purely an expansion of existing activities. Therefore, it is unlikely that any additional opportunities would arise because of the Projects, but it would ensure the continuation of socio-economic benefit. Current employees would benefit from extended job security and support for their dependents, who are from various segments of the community.
2.15	What measures have been taken to ensure that current and/or future workers will be informed of work that potentially might be harmful to human health or the environment or of dangers associated with the work, and what measures have been taken to ensure that the right of workers to refuse such work will be respected and protected?	Kangra MQE would undertake all activities under the guidance of the country's labour, employment and health/safety laws and its policies and procedures. The EMPr would further provide guidance for HS measures that must be implemented to ensure that employees are not subjected to adverse health conditions or dangers without the correct training, equipment, and supervision.
2.16	Describe how the development will impact on job creation in terms of, amongst other aspects: <ul style="list-style-type: none"> <li>the number of temporary versus permanent jobs that will be created,</li> <li>whether the labour available in the area will be able to take up the job opportunities (i.e. do the required skills match the skills available in the area),</li> <li>the distance from where labourers will have to travel,</li> <li>the location of job opportunities versus the location of impacts (i.e. equitable distribution of costs and benefits), and</li> <li>the opportunity costs in terms of job creation (e.g. a mine might create 100 jobs, but impact 1000 agricultural jobs, etc.).</li> </ul>	Temporary jobs would be created during the construction phase, ranging from 100 opportunities and local skilled labour would be encouraged. During the operational phase, minimal job opportunities would exist as the infrastructure would fit into the current operations and staff component.
2.17	What measures were taken to ensure: <ul style="list-style-type: none"> <li>that there was intergovernmental coordination and harmonisation of policies, legislation and actions relating to the environment, and</li> <li>that actual or potential conflicts of interest between organs of state were resolved through conflict resolution procedures?</li> </ul>	The PPP invites comment and input from all levels of government relevant to the Proposed Project- including the local municipality and various other relevant government departments. For those government arms that have specific issues related to the development, consultation meetings would be arranged to resolve those. Comments from these government departments would be before the decision maker at the DMRE.

2.18	What measures were taken to ensure that the environment will be held in public trust for the people, that the beneficial use of environmental resources will serve the public interest, and that the environment will be protected as the people's common heritage?	An intensive EIA process would be undertaken, including investigation into socio-economic factors, to ensure that the environment is protected as far as possible. This section on the need and desirability of the Projects illustrates that it would be in the public interest and there would be beneficial use of environmental resources.
2.19	Are the mitigation measures proposed realistic and what long-term environmental legacy and managed burden will be left?	The EMPr would include implementable and realistic mitigation measures, which would allow for impacts to be mitigated and managed as far as possible. The proposed project would remain in place for the foreseeable future; however, rehabilitation measures would ensure that the legacy is minimised as far as possible.
2.20	What measures were taken to ensure that the costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling, or minimising further pollution, environmental damage or adverse health effects will be paid for by those responsible for harming the environment?	Kangra MQE would increase the financial provision as it understands potential liability under the polluter pays principle and its responsibilities under duty of care under NEMA and is committed to undertaking concurrent rehabilitation and adhering to its environmental management system requirements and EMPr conditions.
2.21	Considering the need to secure ecological integrity and a healthy bio-physical environment, describe how the alternatives identified (in terms of all the different elements of the development and all the different impacts being proposed), resulted in the selection of the best practicable environmental option in terms of socio-economic considerations?	Please refer to Chapter 5 of this report wherein alternatives are discussed in detail.
2.22	Describe the positive and negative cumulative socio-economic impacts bearing in mind the size, scale, scope, and nature of the project in relation to its location and other planned developments in the area?	<p>Cumulative impacts of the Proposed Projects include:</p> <ul style="list-style-type: none"> <li>• Additional temporary jobs and income during construction, in addition to other activities providing jobs in the landscape (positive).</li> <li>• Improved local employment and income, reduced poverty, and contribution to the local economy, in addition to other projects and activities in the landscape (positive).</li> <li>• Project-induced in-migration in addition to in-migration from other mining activities and projects, (negative).</li> <li>• Increased nuisance factors- as the projects and other industrial activities act as sources of traffic, dust, and noise pollution (negative).</li> <li>• Increased resource use (water and electricity) of the Projects, in conjunction with all other resource-users in the landscape (negative).</li> <li>• Impact on external costs to local communities caused by cumulative impact of projects (negative).</li> </ul>

		<ul style="list-style-type: none"><li>• Community safety related to existing industrial activities, other mining activities in the area act as additional sources of traffic, dust and noise pollution (negative).</li></ul> <p>Residual impacts include:</p> <ul style="list-style-type: none"><li>• Temporary jobs and income during construction- up-skilled labour force (positive).</li><li>• Project-induced in-migration- additional pressure on the provision of housing and related infrastructure and health, emergency, and safety services (negative).</li><li>• Local employment and income- up-skilled labour force (positive).</li><li>• Sense of place- the visual impact of the projects and the residual impact on the sense of place and environmental risks possibly impacting on the sense of place (negative).</li><li>• Increased nuisance factors (dust and noise) and resultant potential health risks (negative).</li><li>• Environmental pollution risks (negative).</li></ul>
--	--	---



## 5 PROJECT ALTERNATIVES

In accordance with the principles stipulated in NEMA, it is required that various alternatives be investigated when considering a development which may impact significantly on the environment, to implement the Proposed developments. This means that the options will be assessed in such a manner that the alternative which has the most benefit or causes the least environmental damage to the natural environment is chosen. This option also needs to be of such a nature that the capital and social costs incurred will be acceptable to society.

Biophysical and socio-economic aspects are considered when investigating alternatives.

NEMA defines development alternatives in relation to a proposed activity as different means of meeting the general purposes and requirements of the activity, which may include alternatives to the-

- property on which, or location where it is proposed to undertake the activity.
- type of activity to be undertaken.
- design or layout of the activity.
- technology to be used in the activity.
- operational aspects of the activity; and
- option of not implementing the activity.

For this Project, rigorous Feasibility Studies and a scoping level assessment were undertaken by the Professional Team, and following on from the above, the alternatives identified as applicable to assess in this S&EIR process are as follows:

1. Property/Location Alternatives
2. Design/Layout Alternatives
3. “No-Go” Alternative (this is a mandatory option)

In considering project alternatives, must be highlighted that the proposed projects are located within an area classified as a “Brownfields Site” and there are various limiting factors pertaining to the availability of suitable land and restrictions experienced due to biodiversity sensitivity in the Area.

Based on the contextual information, and described in detail below, there is no evidence to suggest that other alternatives should be investigated for the proposed projects.

## 5.1 Property/Location Alternatives

Due to the nature and location of the current activities the proposed project is to be positioned in the locations and on the properties on which current surface mine activities are undertaken; and in accordance with current operational requirements and restrictions, including topography and surface hydrology and wetland systems.

### 5.1.1 WWTP

The purpose of the WWTP is to *treat contaminated water* resulting from MQE operations generally. All contaminated water, albeit from the processes on the site, activities from other interrelated sites, or the identified decant point (refer to **Figure 2-3**), ends up in the existing PCD complex as indicated in **Figure 5-1**.



**Figure 5-1: Existing PCD Complex at MQE**

The main consideration for the location of the WWTP was current surface structures and infrastructure, the layout thereof and available land; the proximity to the contaminated water to be treated whilst avoiding environmentally sensitive areas as far as practically possible. The most feasible and practical location is therefore right next to the PCD complex on previously disturbed land, indicated above by the yellow circle.

Similarly, the most feasible locations for the associated infrastructure were determined, using as far as possible existing routes and disturbed areas for access to the WWTP; the proposed brine treatment plant, and pipelines.

No additional feeder pipelines to transport contaminated water to the PCD complex are required, existing pipelines are sufficient. The WWTP (indicated in turquoise blue) will however require new intake and outlet pipelines (indicated in blue); a treated effluent discharge pipeline (indicated in magenta) to the discharge point at the Heyshope Dam; and a brine pipeline (indicated in yellow) to the Brine PCD (indicated in orange); as depicted in in **Figure 5-2**.

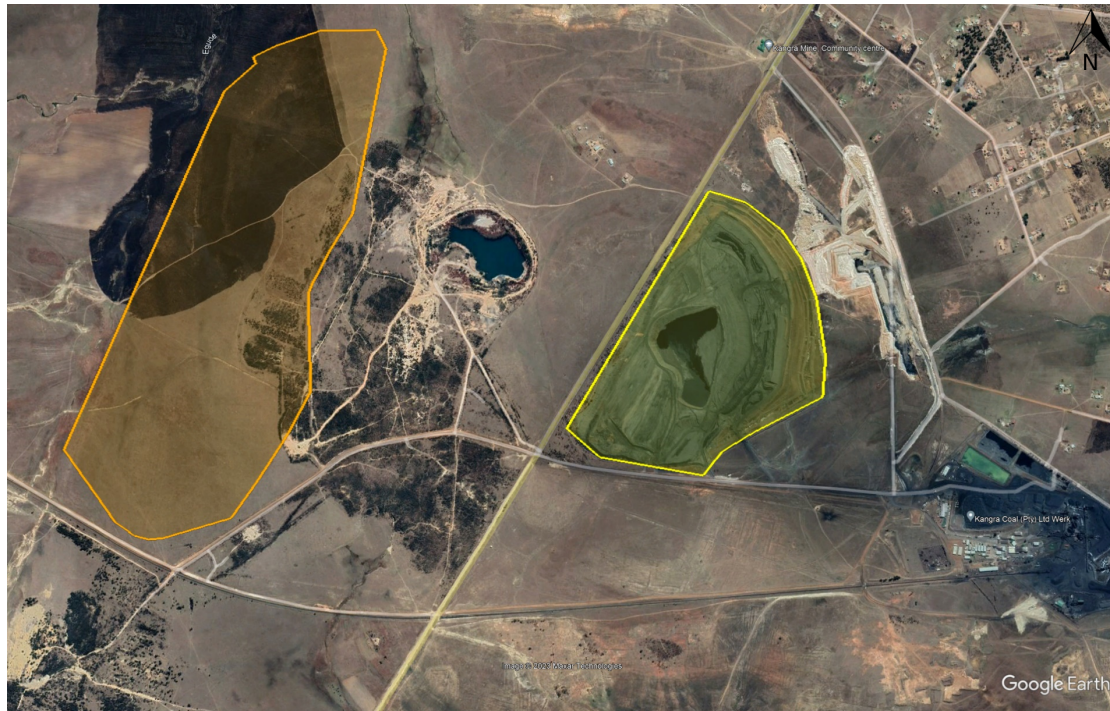


**Figure 5-2: WWTP Pipelines**

#### 5.1.2 CDF

The existing MQE Discard Dump (DD) is located to the north-west of the coal washing plant (indicated in yellow) with the proposed new MQE CDF located further west of the existing MQE DD (indicated in orange) as can be seen in **Figure 5-3**.





**Figure 5-3: Existing Discard Dump and Proposed CDF at MQE**

As indicated earlier, the new MQE CDF is proposed to be located within the exact footprint of the previously approved MQE New DD. As such, no further location alternatives were identified nor investigated in this assessment process, however, a summary of the assessment undertaken by Hatch in their 2011 Concept Study to determine the preferred location alternative is provided below.

The following six (6) alternatives were proposed for the MQE New DD and were assessed by Hatch in their 2011 Concept Study (refer to **Figure 5-4**):

- Site A: situated to the east of the coal washing plant;
- Site B: situated to the north of the coal washing plant;
- Site C: situated to the northwest of the coal washing plant and includes the existing MQE DD site;
- Site D: situated to the west of the current wash plant position and is located on the coal reserves in the area known as Maquasa West;
- Site E: is an open cast excavation situated approximately 2.4km to the west of the current wash plant position in the Maquasa West Open Cast section; and
- Site F: The site is situated approximately 3.2km to the west of the current wash plant position.



**Figure 5-4: Discard Dump Site Alternatives**

Disposal at Site E would involve disposal into an open cast excavation. The difficulty in controlling the acid mine drainage (AMD) generated in the open cast excavation was considered a fatal flaw and was therefore eliminated as an option. The assessment of the remaining sites is summarised in Table 5-1.

**Table 5-1: MQE DD Location Alternatives assessed by Hatch in 2011.**

SITE ID	ADVANTAGES	DISADVANTAGES	COMMENTS
Site A	<ul style="list-style-type: none"> <li>The relatively flat topography.</li> <li>The proximity (<math>\pm 0.2\text{km}</math>) to the proposed plant position.</li> <li>The dump cannot sterilise any coal reserves.</li> </ul>	<ul style="list-style-type: none"> <li>The proximity (<math>\pm 0.6\text{km}</math>) to the Heyshope Dam.</li> <li>The collected seepage must be handled by a pumping system that must operate after mine closure.</li> <li>The visible impact of the dump.</li> <li>The polluted surface water and stormwater runoff must be handled by a pumping system during operation.</li> </ul>	No comment
Site B	<ul style="list-style-type: none"> <li>The proximity (<math>\pm 0.5\text{km}</math>) to the proposed plant.</li> <li>The dump can blend in with the natural topography to reduce the visible impact.</li> <li>The polluted surface water and stormwater run-off can be handled by a gravity system (passive).</li> <li>The seepage can be handled by a gravity system (passive).</li> </ul>	<ul style="list-style-type: none"> <li>The major seep zone that will require significant engineering design to overcome and will have a low confidence level of success.</li> <li>The Site is located partially above the old mined-out area and the correct as mined out survey should be sourced to establish how many pillars have been left after mining activities stopped.</li> <li>The depth to underground workings is approximately 30 m.</li> </ul>	Steep zone

SITE ID	ADVANTAGES	DISADVANTAGES	COMMENTS
Site C	<ul style="list-style-type: none"> <li>The dump can blend in with the natural topography to reduce the visible impact.</li> <li>The polluted surface water and stormwater run-off be handled by a gravity system (passive).</li> <li>The seepage can be handled by a gravity system (passive).</li> </ul>	<ul style="list-style-type: none"> <li>That it is (<math>\pm 1.2</math>km) from the existing washing area.</li> <li>The Site is located directly above the old mined out area and the correct as mined out survey should be sourced to establish how many pillars have been left after mining activities stopped.</li> </ul>	Above old mine out area including existing Discard Dump
Site D	<ul style="list-style-type: none"> <li>The dump can blend in with the natural topography to reduce the visible impact.</li> <li>The polluted surface water and stormwater runoff can be handled by a gravity system (passive).</li> <li>The seepage can be handled by a gravity system (passive).</li> </ul>	<ul style="list-style-type: none"> <li>The difficulty in containing seepage.</li> <li>The distance (<math>\pm 1.9</math>km) from the proposed plant position.</li> <li>The Site is located partially above the old mined out area and the correct as mined out survey should be sourced to establish how many pillars have been left after mining activities stopped.</li> </ul>	AMD (Acid Mine Drainage) could exclude this site.
Site F	<ul style="list-style-type: none"> <li>The dump is on a slope that faces away from the Heyshope Dam and Driefontein and therefore the visual impact is reduced.</li> <li>The two naturally occurring clay layers within the soil profile and the elevation of the groundwater is below the second layer.</li> <li>The dump cannot sterilise any coal reserves.</li> </ul>	<ul style="list-style-type: none"> <li>The distance from the current washing plant position.</li> <li>The introduction of a pumping system to return the seepage to the plant during its operational life.</li> </ul>	No comment

## 5.2 Design/Layout Alternatives

A summary of the aspects considered for the potential design and/or layout alternatives for the proposed projects is outlined below.

### 5.2.1 WWTP

The potential management/remedial measures for contaminated water present at MQE were first identified in 2018 by GCS as part of the Numerical Groundwater and Transport Model Update for the Maquasa Operations and then further investigated by GFK Consulting Engineers as part of their investigations to determine the most appropriate way forward in this regard.

Potential decant management/remedial actions were identified in 2018 by GCS as part of the Numerical Groundwater and Transport Model Update for the Maquasa Operations. Various management/remedial actions were investigated and are summarised below:

- Evaporation of decant over the PCDs;
- Passive treatment via an artificially constructed wetland system; and
- Active treatment via a wastewater treatment plant.

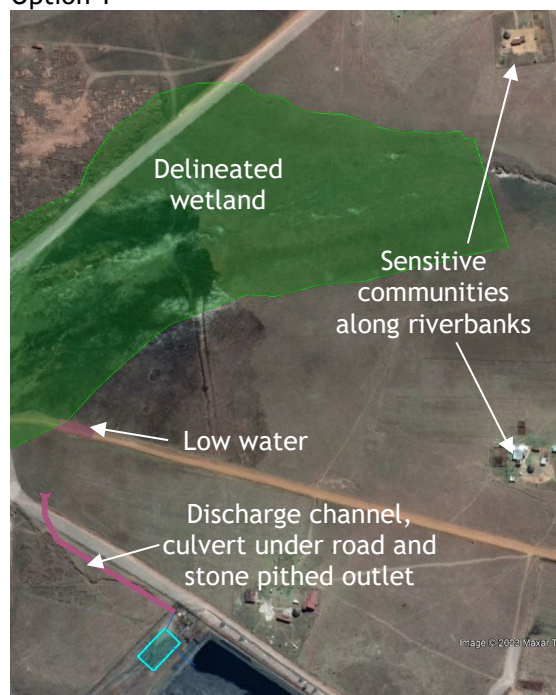


It was found that active treatment is the most feasible solution due to the decant point location, high contaminated water flow rates, and required discharge water quality. Additionally, with evaporation, the weather would determine the efficiency of the water management system, and the operation has time (can operate a maximum of 12 hours per day) and spatial (can only be undertaken over the existing PCDs due to salt load) constraints.

Active treatment will be able to accommodate high contaminated water flow rates (4500m<sup>3</sup>/day) to be treated and the required discharge quality. Passive treatment systems are typically limited to 50l/s inflow rates, making such a system unfeasible and nearly impossible to implement.

Active treatment is further favoured over mechanically forced evaporation of the surplus water, as the efficiency of such an evaporation system is dependent on the weather, the limited pumping hours (maximum 12 hours per day), as well as special constraints (must be pumped/evaporated over the PCD's due to salt load).

Option 1



*The WWTP outlet will discharge into a channel which will route the water through a culvert at the first road opening into a stone-pitched outlet to the open field. Provision has been made for a low water bridge at the next road with final discharge into the wetland.*

Option 2



*The WWTP outlet will discharge into an underground pipeline following the fence line and existing roadways, towards a protected discharge point into the Heyshope Dam.*

From the above, it is clear that Option 2 is the preferred alternative with the least potential impact associated with it. Due to the high erosion potential, risk to the communities, and disturbance to the ecological and water resources associated with Option 1, it was deemed to be unfeasible, and thus Option 2 was identified as the preferred alternative for further investigation.

### 5.2.2 CDF

Similarly, to the discussion around property/location alternatives for the MQE CDF, the design alternatives have previously been investigated and are still applicable. The determining factor for the preferred alternative is however again associated with the nature and location of the current activities; the location, extent, and design of the previously approved MQE DD; the current operational requirements and restrictions, whereby specifically a co-disposal facility is required. The preferred alternative is Integrated Discard “Dry”. The alternatives assessment provided in the 2016 EIR is provided below.

#### Integrated Discard “Dry” (Preferred Alternative)

Integrated discard “dry” process involves dumping coarse discard material the conventional way in layers and mixing the low moisture “filter cake” fine discard material in layers with the coarse discard.

The integrated discard “dry” technique will reduce the permeability of the coarse discard and therefore have a reduction in AMD. Although the expected AMD is significantly less than that for co-disposal AMD is expected to continue after closure.

#### Co-disposal “Wet and Dry”

Co-disposal involves the impoundment of slurry within the body of the coarse discard, which will lead to AMD during the operating life and a considerable period after closure.

#### Integrated Discard “Wet”

Integrated discard involves the mixing of slurry and the coarse discard which will be deposited like conventional tailings. The tailings will beach, with the coarse product being deposited first followed by the fine product which will accumulate at the pool center.

The integrated discard technique will reduce the permeability of the coarse discard and therefore a reduction in AMD is expected. Although the expected AMD is significantly less than that for co-disposal, AMD is expected to continue after closure. However, this disposal technique is a relatively new and unproven technology.

### Separate Disposal “Wet - Site 1 and Dry Site 2”

Separate disposal involves the deposition of the slurry into the underground workings or a separate above-ground fines slurry pond, and the impoundment of the coarse discard above the ground surface. This reduces the AMD potential of the coarse discard, and the control and containment of AMD from the slurry if it is placed below ground.

In the case of Maquasa, the fines could be transported and deposited in the form of a slurry back into the underground workings. These areas of disposal would be prepared using the appropriate preplanning and mining methods.

The slurry would then be deposited at an elevation below the expected working level and remain flooded thereby excluding or limiting the supply of oxygen. However, a decision has been made to stop this operation and to dry the slurry, and dispose of the “filter cake” on the coarse discard dump.

Coarse Discard disposal involves impounding the coarse discard on a selected site above natural ground. The coarse discard is then compacted to minimise the risk of spontaneous combustion by limiting the ingress of air and water into the waste dump. The AMD that could be generated from the coarse discard during operations would then be captured and contained within the mine property and once the dump has been encapsulated, the amount of seepage is likely to cease after a short period of time.

### **5.3 No-Go Alternative**

The EIA Regulations, 2014 (as amended) requires that all development alternatives be included in the investigation process. The no-go option would be comparatively assessed against the above-mentioned alternatives during the EIA phase and will act as a baseline against which all the other development alternatives are measured.

The “no-go” option would result in the MQE projects not being implemented, i.e. not constructing the WWTP to treat contaminated water at the site, and not constructing the CDF to accommodate the required discard and slurry produced at the site.

Should the new CDF not be realised, disposal capacity for the wastes produced at MQE will run out and operations at MQE may need to cease. The no-go option would thus result in a significant economic loss for Kangra (Maquasa Operations); the surrounding community; the municipality; and at local, provincial, and national macro-economic levels. The loss of employment would be immense, as workers often support entire families in an area with high unemployment rates. Furthermore, the benefits that flow from the MQE in terms of local economic development projects and skills development training to employees would be lost.

Additionally, the potential for inappropriate disposal of wastes produced at MQE without having established the new CDF increases the environmental risk to the surrounding sensitive landscapes exponentially. The risk for resource water pollution of the Heyshope Dam as a result of the continued decant of untreated contaminated water will also increase with no establishment of the new WWTP.

Consequently, the “no-go” alternative is not the preferred alternative.

#### **5.4 Concluding Statement of Preferred Alternatives**

Based on the preliminary results of scientific studies done and socio-economic consideration, the following concluding remarks are made regarding the preferred alternatives:

- **MQE WWTP & Associated Infrastructure:** A few wetlands of low sensitivity are in the area. Towards the south medium sensitivity wetlands are found. The preferred alternative as described in Section 2.1 is deemed to be the only viable option for further investigation.
- **MQE CDF & Associated Infrastructure:** A few wetlands with low sensitivity are in the CDF footprint’s location. This is due to previously mined areas. This alternative is however still deemed to be the preferred alternative as explained in earlier sections.

## 6 ENVIRONMENTAL BASELINE

The baseline environment is described in this chapter. The baseline environment provides a status against which to assess the proposed project activities and potential impacts.

### 6.1 Geology

#### 6.1.1 Regional Geology

The geology of the region comprises Vryheid Arenites, a sedimentary rock composed of sand-sized fragments irrespective of composition, thick beds of yellowish to white cross-bedded sandstone and grit, which alternate with beds of soft, dark-grey, sandy shale, and a few seams of coal. It would appear as if the underlying geological patterns do not have a significant effect on the vegetation development.

#### 6.1.2 Local Geology

The geology of the study area is shown in Figure 6-1. The Quaternary Period deposits, representing the youngest period in geological history, consist of alluvial sands that occur along the major rivers as well as surface ferricrete. The area is generally underlain by sedimentary rocks of the Ecca Group, a subgroup of the Karoo Supergroup. These sediments form part of a segment of the northeastern margin of the depositional Karoo Basin. The sedimentary rocks have been deposited discordantly on the basement.

In this area of the Karoo Basin, the Ecca Group consists of the Pietermaritzburg Shale Formation at the base, followed by the Vryheid Formation, which is composed predominantly of sandstone, and the Volksrust Shale Formation at the top. The Vryheid Formation comprises a lower fluvial-dominated deltaic interval, a middle fluvial interval, and an upper fluvial-dominated deltaic interval.

The fluvial deltaic intervals are the fluvial sequences of sediments deposition as a delta. This process explains the lithological units of Vryheid which are lower sandstones, coal zone, and upper sandstones. The Volksrust Formation consists of silty shale, mudstone, and siltstone or sandstone lenses towards its upper and lower boundaries (Johnson, M.R *et al.*, 2006).

Sedimentary rocks of the Vryheid Formation of the Ecca Group underlie the study area. The Formation is characterized by thick beds of yellowish to white, cross-bedded sandstone and grit, which alternate with beds of soft, dark-grey, sandy shale and a few seams of coal in the middle of the formation. All the coal seams occur within the Vryheid Formation of the Ecca Group (Karoo Supergroup). The basal rocks comprise of lava, tuff, schists, and chert of the Undifferentiated Onverwacht Group, which forms part of the Barberton Sequence. Figure 6-1 shows the lithostratigraphy of the area.

**Table 6-1: Lithostratigraphic Sequence**

SUPERGROUP	AGE	GROUP	FORMATION	DESCRIPTION
	(Ma)			
	65		Surface deposits	Alluvium, scree & ferricrete
Karoo	570	Ecca	Volsrust	Shale
			Vryheid	Grit, sandstone, shale, coal
			Pietermaritzburg	Micaceous shale
Barberton	2061	Undifferentiated Onverwacht		Schist, volcanic rock, tuff, chert, agglomerate

The Maquasa West and East Coal Field deposit is part of a very large basin extending far to the West and North and cutting off against a basement headland towards the East in the Amsterdam and Piet Retief directions.

The most important coal seams in the Maquasa West and East Coal Field are as follows:

- GUS SEAM (Top) Moderately to well-developed 1.0 - 2.0m thick; and
- DUNDAS SEAM (Bottom) Varies in thickness and remains well developed.

The coal seam lithology is mixed with subordinate dull to dull lustrous bands within an essentially mixed, mainly bright laminated coal sequence. A coarsely pyrite/siderite spotted horizon occurs throughout the upper half of the seam. The roof consists of a thick 15 - 20m competent, coarse-grained sandstone unit up to 100 m. However, in certain areas, the roof is associated with a combination of mudstone, siltstone, and shale.

The floor of the coal seams is generally competent and consists of siltstone/sandstone rock types. During the deposits of sediments in the still sagging Karoo basin, tension in the crust due to continuing sagging leads to failure and subsequently intrusion of Post-Karoo dolerite sills and dykes along weak zones such as fractures, fissures, and faults. Consequently, dykes and sills varying between a few centimetres to a couple of metres in thickness intruded the study area.

The highest topographic features comprise resistant remnants of the B4 and B6 dolerite sills. The B4 sill lies concordant to sedimentation at the base of the Volsrust Formation. Contrasting to the B4 sill, the B6 sill is highly transgressively active and creates complex ring dyke structures that transgress the coal, causing vertical displacement and areas of burnt or devolatilised coal.



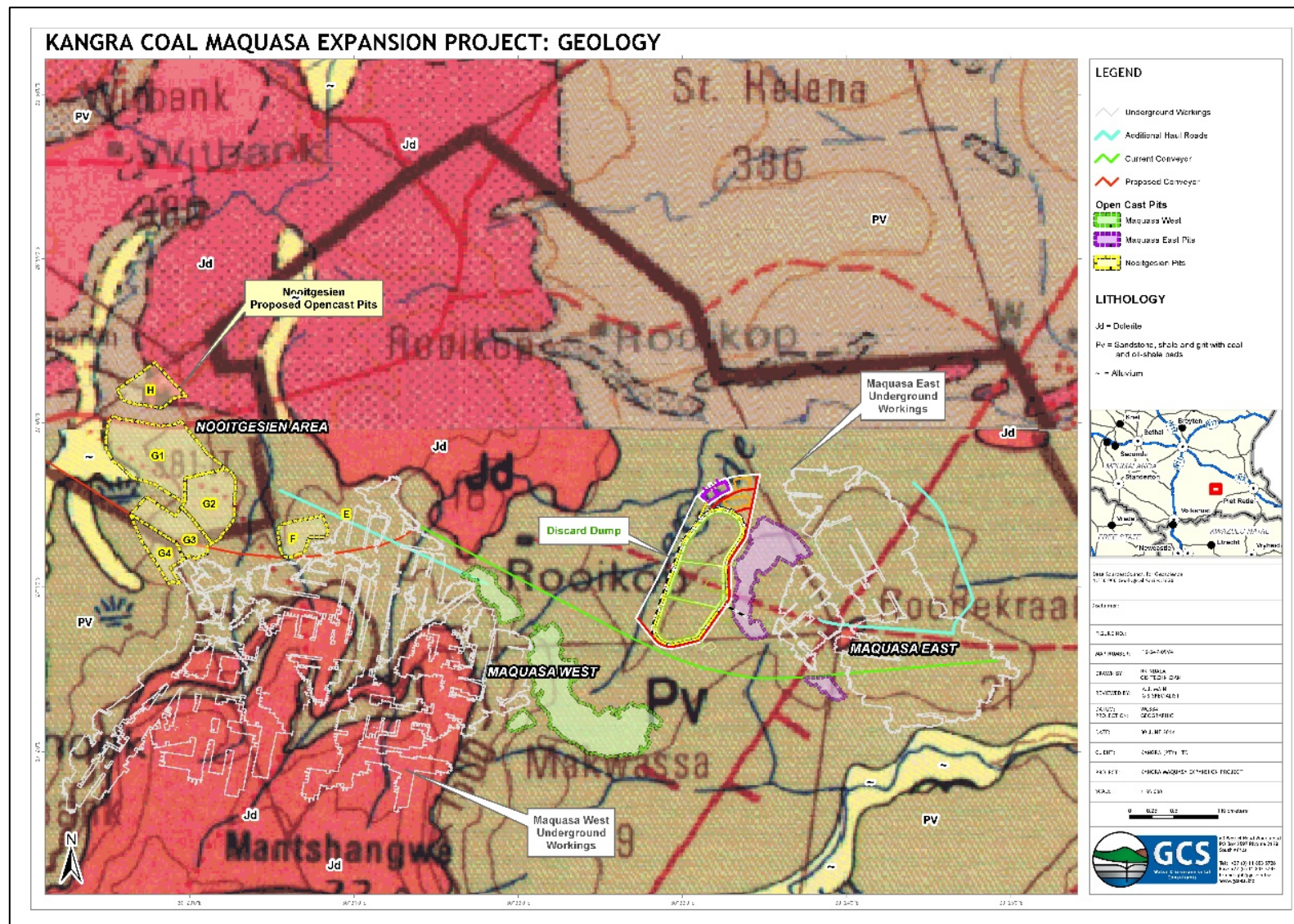


Figure 6-1: Geology of the project area

## 6.2 Topography

The regional topography can be described as undulating with elevations ranging from 1750 (metres above mean sea level) mamsl in the highest regions to the south-east of the mining operations in the south-eastern corner of the remainder portion of the farm Kransbank, to 1300 mamsl at the lowest point of the Heyshope dam to the south-east of the Maquasa East operations.

The regional topography is characterised primarily by the two (2) catchments of the Mpundu (south-southeast of the mining operations) and Hlelo (west / north-west of the mining operations) rivers. The ridge separating the Maquasa and Nooitgesien operations acts as the boundary between these two (2) catchments. Several smaller non-perennial rivers form part of these river systems including small marsh and swamp areas as a result of inundation during the wet season.

The Maquasa East and West mining operations are located on the eastern facing slopes of the Heyshope Dam valley with elevations ranging from 1545 to 1305 mamsl with an average gradient of 1:19 in an easterly direction. The topography of the project area is presented in Figure 6-2.





### 6.3 Climate

The study area is in Water Management Area 12: Usutu to Mhlatuze and falls over 2 quaternary catchment areas namely W51B and W52A.

#### 6.3.1 Temperature

The average yearly temperature (refer to Figure 6-3) for the project area ranges from 25 to 33°C (high) and -4 to -2°C (Low). The study area is situated in a subtropical highland climate or temperate oceanic climate with dry winters (Cwb) area, as per the Köppen Climate Classification (Kottek, et al., 2006). The project area receives summer rainfall.

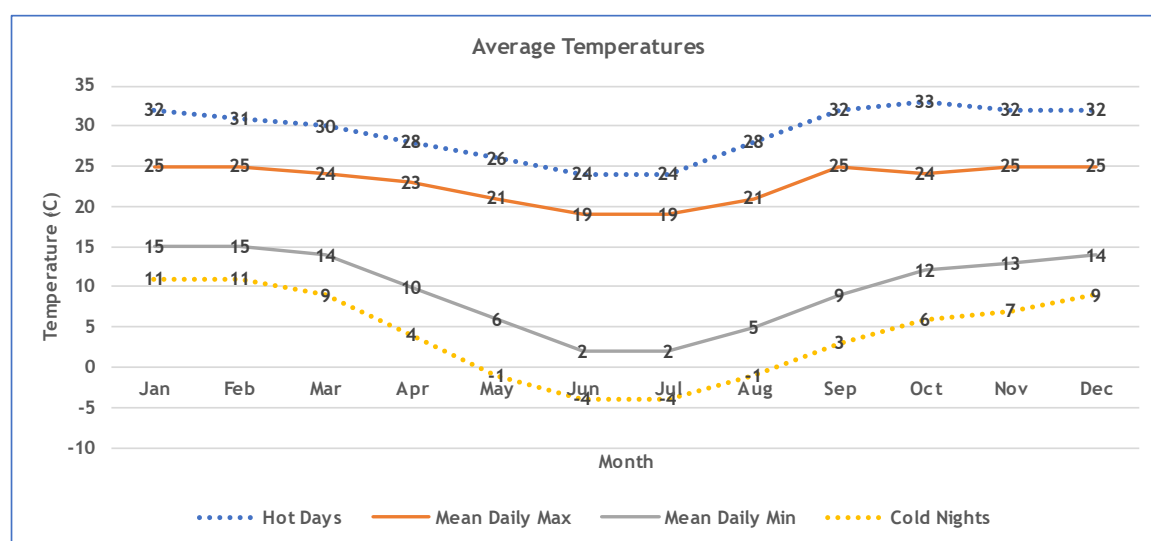


Figure 6-3: Average yearly temperatures (Meteoblue, 2022)

#### 6.3.2 Rainfall and Evaporation

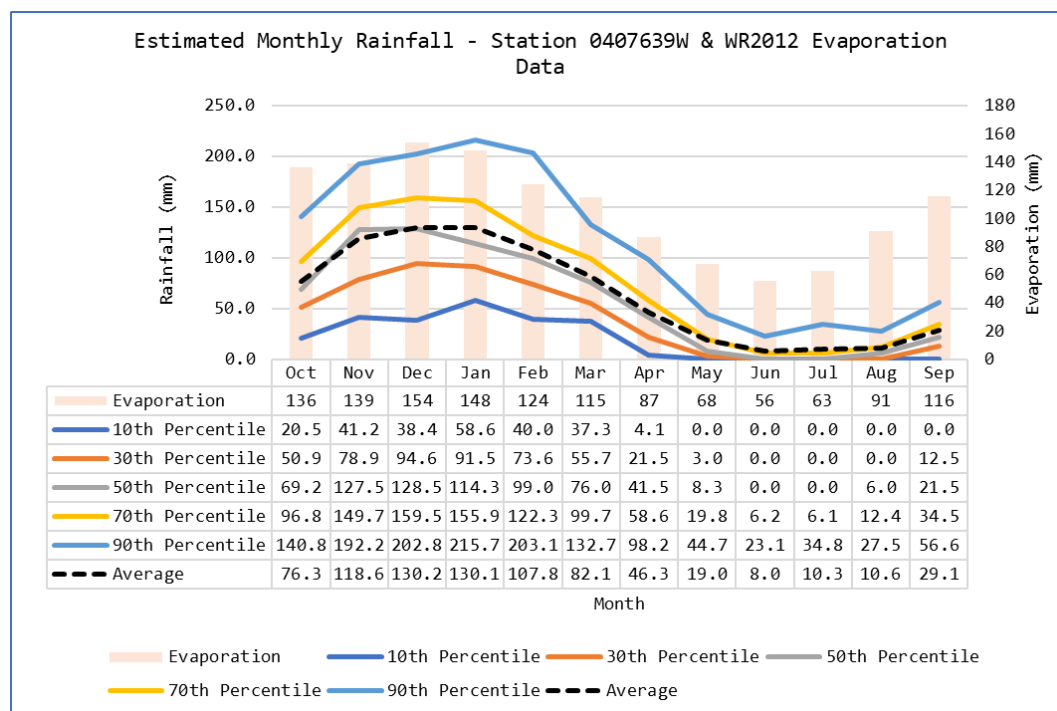
The project area is situated in rainfall zone W5A. The mean annual precipitation (MAP) measured at several rainfall stations that fall close to the site is summarised in Table 6-2, below.

Table 6-2: MAP of nearest rainfall stations

STATION NAME	ID	MAP (mm/yr)
GROOT RIETVLEI	0407639_W	770
DIRKIESDORP (POL)	0407730_W	681
SPITSKOP	0407397_W	800
BRERETON PARK	0443807_W	900
Average		787.75

The monthly rainfall data used to calculate MAP was obtained from rainfall station 0407639W (Grootvlei). The rainfall record is for the period 1929 to 2003 (74 years). Monthly rainfall for the site is likely to be distributed as shown in Figure 6-4, below.

Available rainfall data suggest a MAP ranging from 482 (30<sup>th</sup> percentile) to 1372 (90<sup>th</sup> percentile) mm/yr. The average rainfall is in the order of 768 mm/yr. The project area falls within evaporation zone 13A, of which Mean Annual Evaporation (MAE) ranges from 1 200 to 1 300 mm/yr. The MAE far exceeds the MAP for the site, which implies greater evaporative losses when compared to incident rainfall. Monthly evapotranspiration for the site is likely to be distributed as shown in Figure 6-4, below.



**Figure 6-4: Average rainfall for Station 0407639W & WR2012 evaporation**

### 6.3.3 Wind

Figure 6-5 shows the wind rose for the project area (Vryheid used as reference) and presents the number of hours per year the wind blows from the indicated direction. The wind blows from WW, ENE, and E more often, at velocities ranging from 1 km/hr to 28 km/hr; and from other directions but less frequently and at lower velocities (< 19 km/hr).

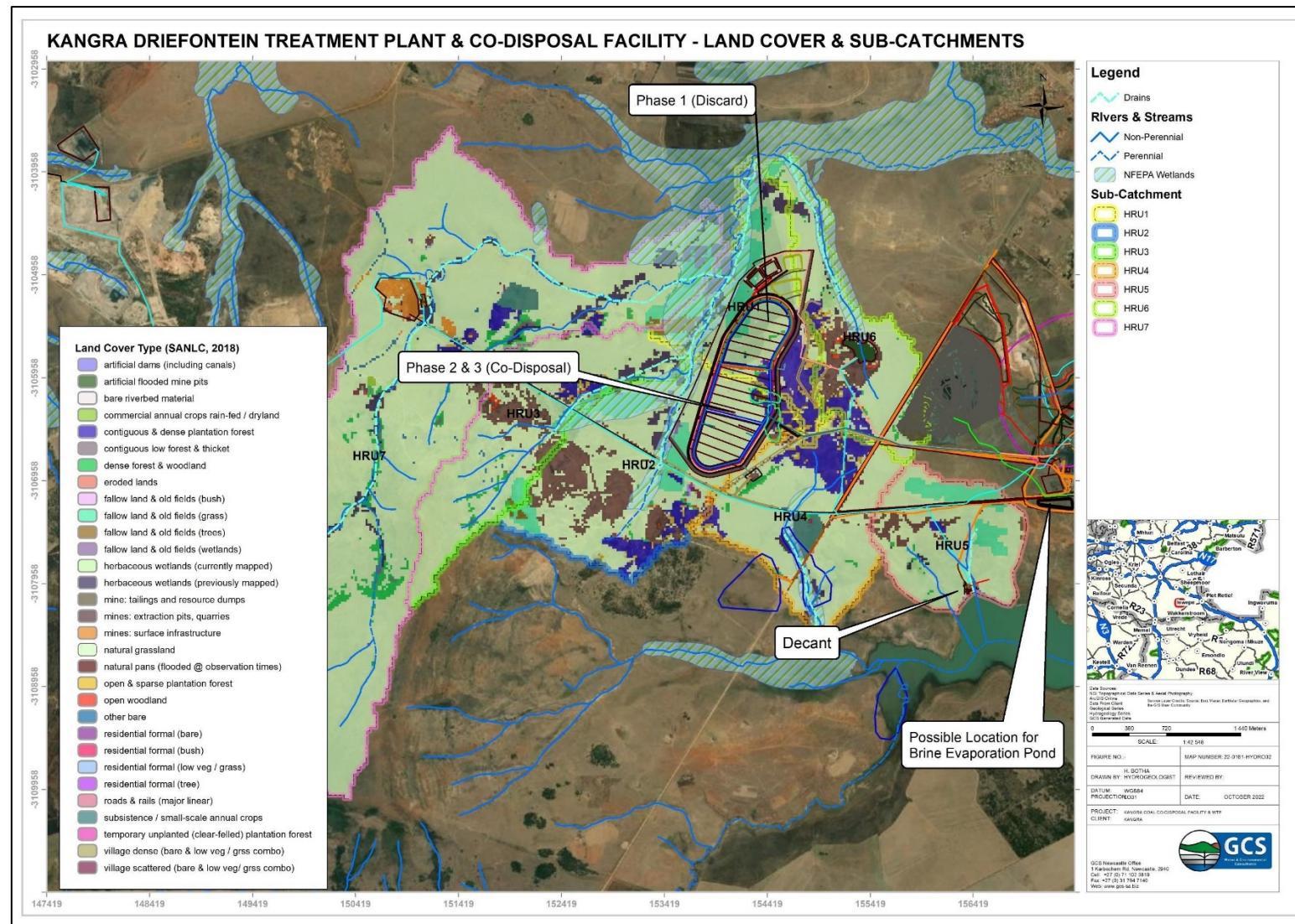


Figure 6-5: Wind rose (Meteoblue, 2022)

#### 6.4 Land Cover

The dominant land types associated with the sub-catchment are shown in Figure 6-6, and is observed to be natural grasslands. The slope % rise for the general area is shown in Figure 6-7. Slope rise % was used to characterise the sub-catchment slope, hydrogeology flow fields, and general drainage.







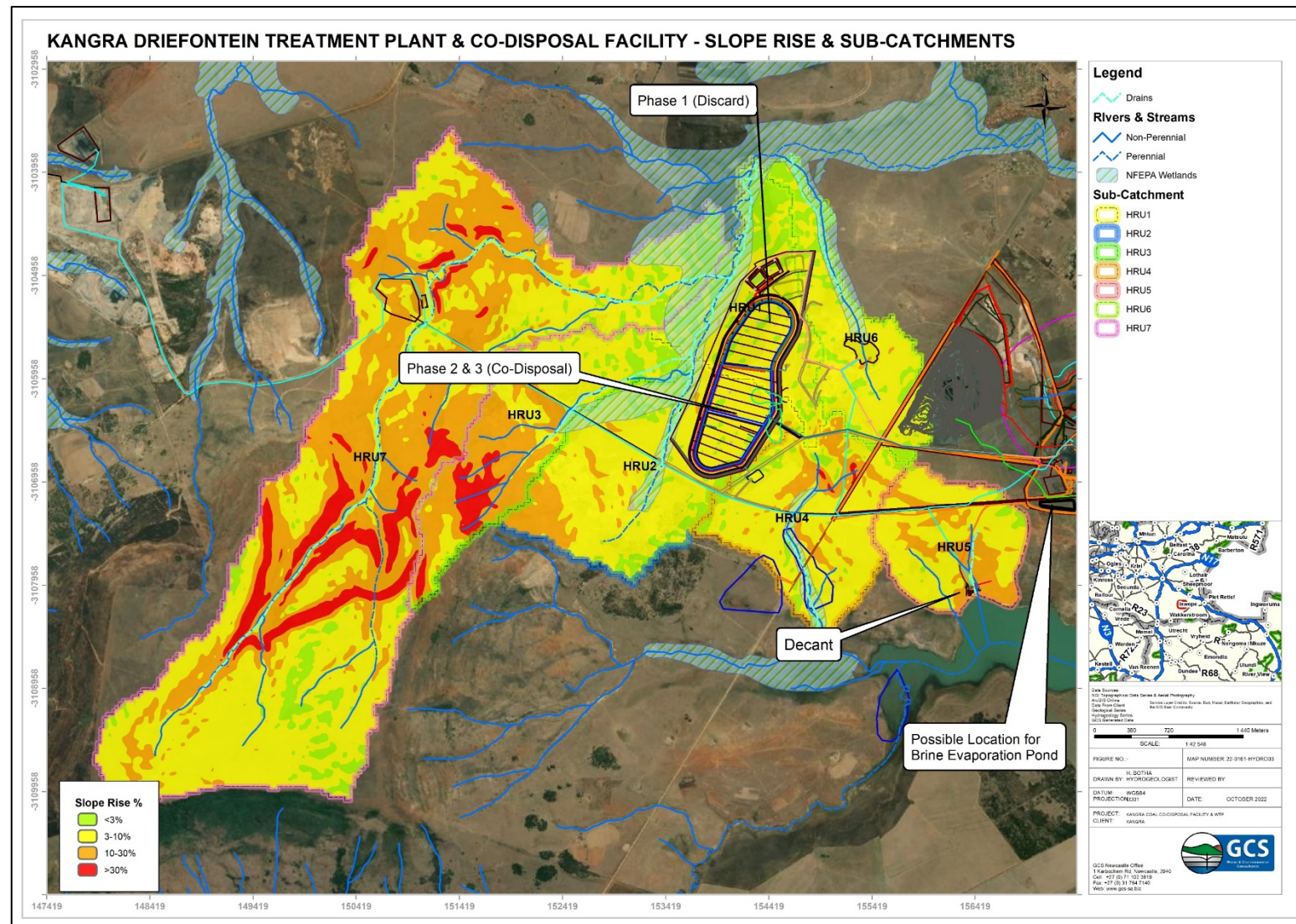


Figure 6-7: Sub-catchments and surface slope rise %

## 6.5 Land Morphology and Soils

### 6.5.1 Soil Types

Different soil types are encountered within shoulder, mid-slope, and valley positions of the project area (referred to as soil hillslope) and are mainly due to sub-surface geology, products of weathering, degree of saturation, soil texture, and slope position (refer to Figure 6-8). The terrain in the project area is slightly sloping to flat (due to undulating hills), with soil depths ranging from 600 mm to 1200 mm generally with clay content ranging from 15 to 60%.

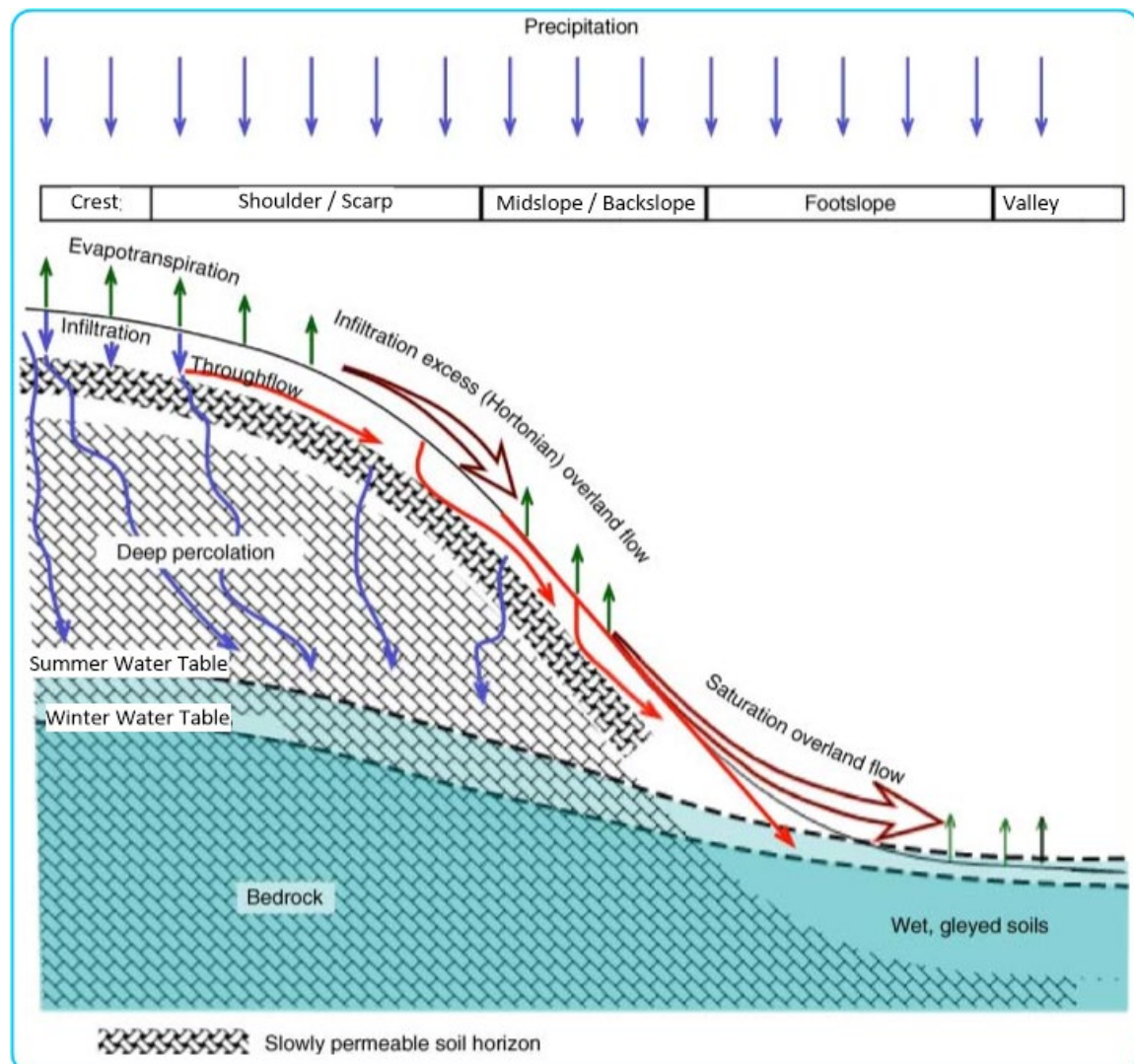
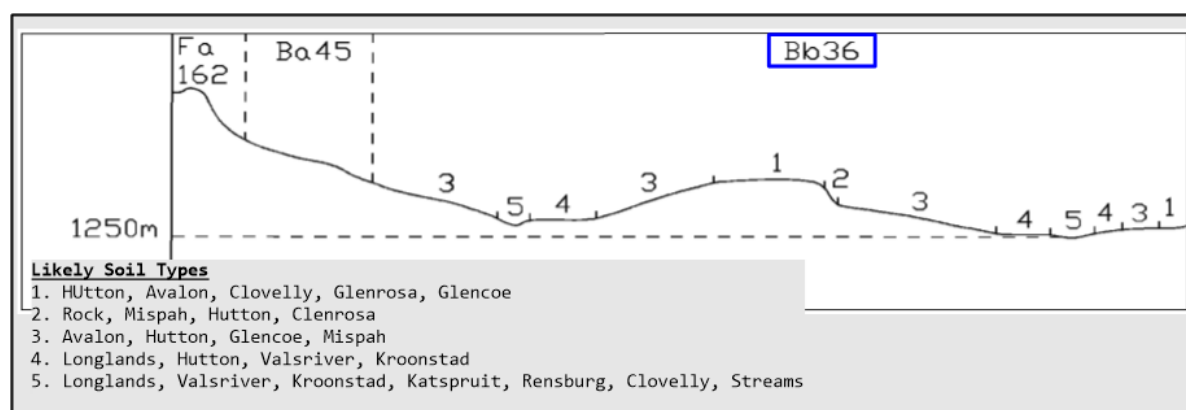


Figure 6-8: Land morphology concept (Almond, 2016)

According to the Land Types of South Africa databases (Land Type Survey Staff, 1972 - 2006c), the soils in the area typically conform to land types of the Bb62 group, which entail duplex soils typically red and yellow, dystrophic/mesotrophic, apedal soils with plinthic subsoils (plinthic soils comprise > 10% of land type, red soils comprise < 33% of land type). According to WR2012 soil data for the area, the erodibility of the soils for the area can be considered medium (WRC, 2015). Typical soil types on hillslopes associated with this landform are shown in Figure 6-9 and Figure 6-10 shows the soil land types associated with the greater project area.



**Figure 6-9: Bb62**

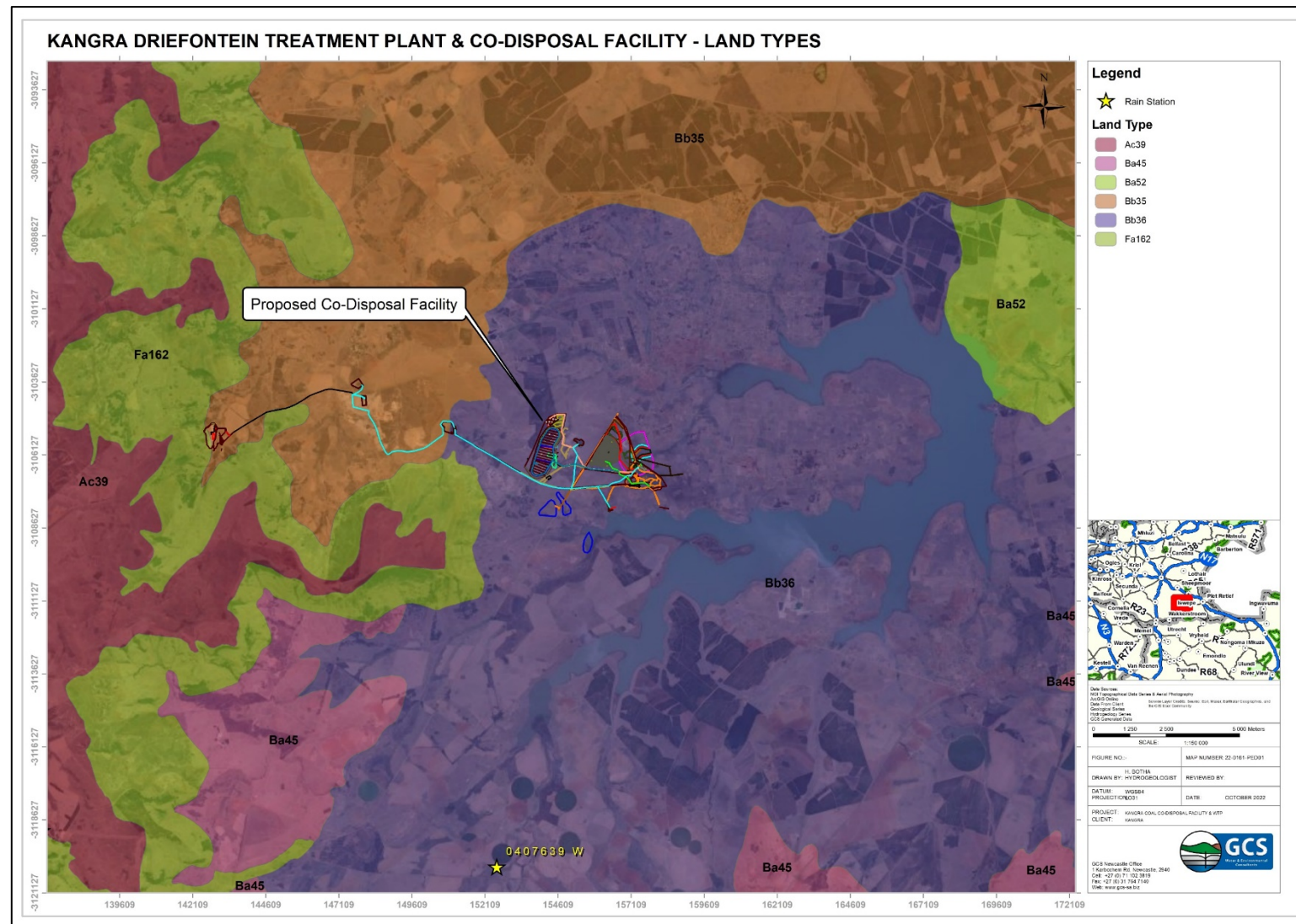
Duplex soils are characterised by a distinct difference in saturated and unsaturated hydraulic conductivity between the coarser overlying and higher clay content structured underlying horizons. In this regard, the coarser materials can accommodate more distinct lateral flows of water with its associated redox morphology in the form of bleaching and removal of sesquioxides. The structured subsoil horizon may exhibit a certain degree of redox morphology expression (redox depletions and redox accumulations) that can, in its maximal expression, lead to the classification of a G horizon in the lower parts of the landscape. Wetlands are often identified in areas with E horizons and shallow lateral seepage due to the perching of the water on the structured subsoil.

Distinct water accumulation and lateral flows may also occur beneath the structured horizons in unconsolidated materials or fractured and weathering rock. In these cases, the redox morphology is consistent with the criteria used for wetland identification except for the depth criteria that preclude it from formal wetland identification.



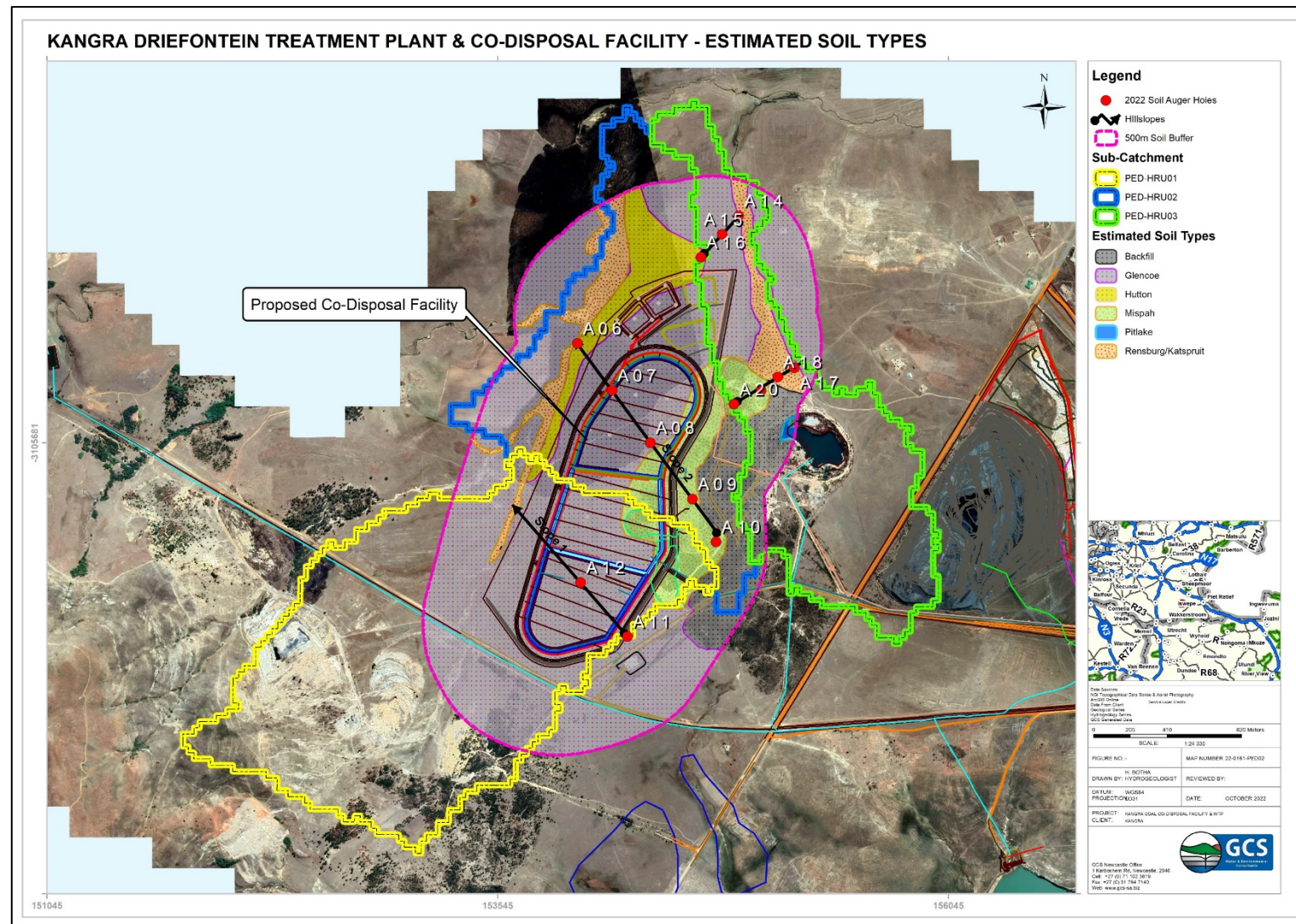
GCS undertook a soil survey to evaluate the soil types, and to derive the hydropedological soil types (refer to soil auger positions and estimated soil types in Figure 6-11). Four (4) dominant hillslopes define the site and soil hydrological processes (from the position of the proposed co-disposal facility). From the soil survey undertaken, the following is noted:

- The majority of the co-disposal facility footprint area is characterised by shallow soils classified as the Glencoe soil type. The soil type was observed to have relatively shallow orthic A (topsoil) horizons, followed by a yellow-brown apedal B horizon with evidence of Fe and Mn concretions, clay matter (more than in the A horizon) that gradually transitions into very hard plinthic rock (horizon). The presence of clay matter and weathered plinth will likely cause temporary perched water tables, during prolonged rainfall events/storm events. Stagnant flow along the hard plinthic / soil interface is expected in a lateral direction. The Glencoe soil form was observed in 42% of the test auger holes.
- Towards the southeast side of the site (crest/hilltop) very shallow soils were encountered off the Mispah soil type. Augering in these areas hit refusal at depths <0.1m. The Mispah soil form was encountered in 28% of the test auger holes. It was noted that the area southeast of the proposed co-disposal facility gradually extends into backfilled material used to rehabilitate the old opencast pit associated with the area. The Mispah soil form occurred in areas that appear to be associated with the high wall of the old pit.
- Towards the northeastern side of the site, soils of the Hutton soil type were observed. These soils are signified by deeply weathered soils, having a distinct A horizon, followed by thick yellow-brown apedal B horizons. Deeper in the profile, weathered zone material was observed, with signs of wetness. The soils lacked pedological features which would classify this layer as soft plinthic B. The Hutton soil form was encountered in 14% of the auger test holes.
- Towards the northeast and northwest of the site, near the drainage line areas in depression areas or areas where stagnant water was observed, soils of the Katspruit and Rensburg soil forms were encountered. The presence of a saturated G horizon, with mottling and gleying, suggests long-term saturated conditions. These soil types were inferred to the greater project area, based on their position of the hillslopes. The Katspruit and Rensburg soil forms were encountered in 16% of the auger test holes.



**Figure 6-10: Land types associated with the project area**





**Figure 6-11: Estimated soil distribution for sub-catchments associated with the project**

### 6.5.2 Soil Permeability

Several soil samples were taken from both A and B horizons and subjected to particle size distribution (PSD) tests. The laboratory test results are available in Appendix B of the Hydropedology Report (refer to Appendix E-5 of this report). Based on available soil data for the project area, it is anticipated that the area is characterized by sandy loam to sandy clay loam soil types. As such, the anticipated permeability of the soils is estimated at 1.3 cm/hr to  $4.1 \times 10^{-3}$  cm/hr (refer to Table 6-3)

**Table 6-3: Soil permeability classes for agriculture and conservation (Food and Agriculture Organization (FAO, 1980))**


Soil Texture	Permeability (cm/hour)
Sand	5
Sandy Loam	2.5
Loam	1.3
Clay Loam	0.8
Silty Clay	0.25
Clay	0.05

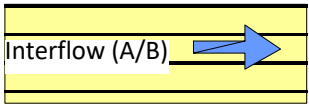


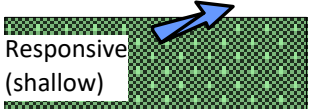

### 6.5.3 Hydrological Soil Types (HST)

Soil genesis is influenced by physical and chemical water-related processes and soils are, therefore, the first-order control of hydrological processes. The water transfer function of soils varies on several factors including soil properties, topography, and climate.

Characteristic soil properties make it possible to conceptualise hillslope hydrological responses within catchments. In the determination of Hydrological Soil Types (HST), soils were divided into classes based on their expected hydrological responses (Von Tol, et al., 2013). Hydrological processes were perceived from traceable signatures in the soil matrix resulting from the soil's ability to transmit, store, and react with water (Le Roux et al., 2011). The HST descriptions and representative symbols are presented in Table 6-4.

**Table 6-4: Hydrological soil types**

HYDROLOGICAL SOIL TYPE	DESCRIPTION	SYMBOL
Recharge	The soils do not have any morphological indication of saturation. Vertical flow through and out of the profile into the underlying bedrock is the dominant flow path. These soils are deep and freely drained and are experiencing the leaching of nutrients to underlying soil horizons.	

HYDROLOGICAL SOIL TYPE	DESCRIPTION	SYMBOL
Interflow (A/B)	The soils have a textural discontinuity which facilitates the build-up of water in the topsoil, the water that sits on the upper layer then flows laterally into the stream on the A/B horizon interface. The flow path is predominantly downslope in a lateral direction.	
Interflow (Soil/Bedrock) Or Interflow (A/ Bedrock)	Soils overlying relatively impermeable bedrock. Hydromorphic properties signify the temporal build of water on the soil/bedrock interface and slow discharge in a predominantly lateral direction.	
Stagnating	Stagnating soils tend to act like interflow (soil/bedrock) soil types, however, due to the presence of abundant clays lateral discharge is slow. A build-up of water content in the soil, profile leads to temporary perched groundwater after high rainfall events.	
Responsive (Shallow)	The soils are shallow, and they are over a relatively less permeable weathered rock or bedrock. They have limited storage capacity which results in the generation of overland flow after rainfall events.	
Responsive (Saturated)	Soils with morphological evidence of long periods of saturation. These soils are close to saturation during rainy seasons and promote the generation of overland flow due to saturation.	

\*Adapted from (Van Tol, et al., 2013)

Hillslopes and preferential soil flow can be seen in Figure 3-5. The hillslopes generally feed into responsive soil types or streams/rivers.

The hydrological processes associated with the land types and soil types in the project area are discussed concerning the numbered arrows in Figure 6-12 to Figure 6-15, and the hillslope positions are indicated in Figure 6-17. The following provides a summary of the likely soil flow paths and the HSTs.

#### 6.5.3.1 Hillslope 1

##### Crest to midslope/backslope:

On the crest to midslope position of the hillslope, stagnating soils of the Glencoe soil types were encountered.

2. a. Stagnating soils tend to act like interflow (soil/bedrock) soil types, however, due to the presence of abundant clays lateral discharge is slow. Slow discharge in a predominantly lateral direction is expected for water that can make it to the plinthic interface. A build-up of water content in the soil, profile leads to temporary perched groundwater after high rainfall events.

2. b. Deep percolation into the sub-soils/hard rock and subsequent aquifers towards the lower topography areas is expected.

#### Footslope:

On the footslope position of the hillslope, deep/shallow recharge soils of the Hutton soil types were encountered.

1.a. Shallow and deep vertical recharge to sub-soils are expected, as well as some lateral movement where sub-soils turn to hard rock/plinthic material (as per greater site context).

1. b. Deep percolation into the sub-soils/hard rock and subsequent aquifers towards the lower topography areas is expected. This deep percolation water contributes to surface water streams as groundwater baseflow.

#### Valley bottom:

On the valley positions of the hillslope, responsive (saturated) soils occur.

4.a. b. In responsive soils, the build-up of water is expected in the B and upper A horizons after rain, and overland discharge and minor lateral seepage are expected (due to saturation excess). Secondary vertical seepage to deeper soil zones from the saturated B horizon is expected. At the transition from one soil type to the other (upstream to downstream) overland flow may take place during wet seasons.

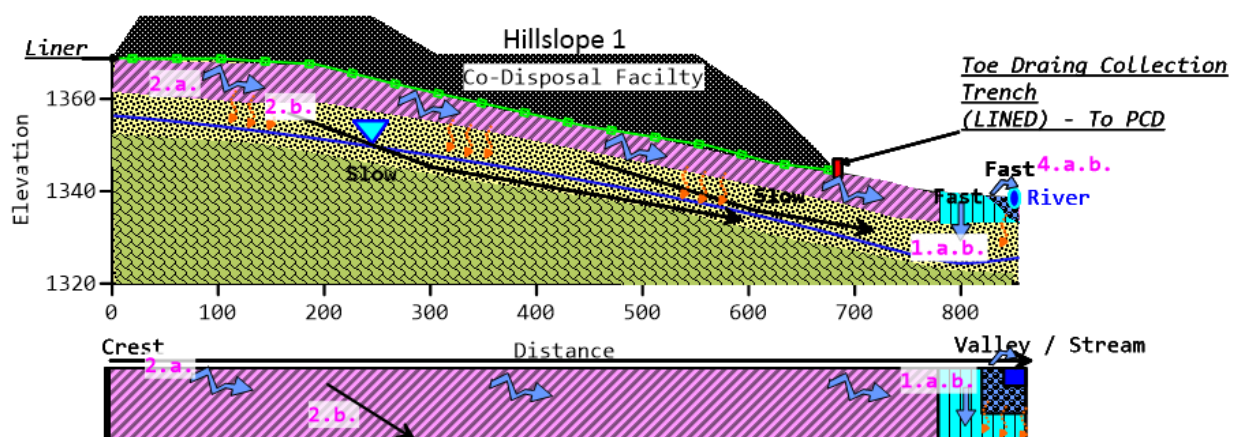


Figure 6-12: Hillslope 1 - conceptual hydrogeology flow regimes

#### 6.5.3.2 Hillslope 2

##### Crest:

On the crest position of the hillslope, the rehabilitated opencast associated with the area will act as anthropogenic recharge soils.



1.a. Shallow and deep vertical recharge to sub-soils are expected, as well as some lateral movement where sub-soils turn to hard rock/plinthic material (as per greater site context).

1. b. Deep percolation into the sub-soils/hard rock and subsequent aquifers towards the lower topography areas is expected. This deep percolation water contributes to surface water streams as groundwater baseflow.

**Shoulder to midslope:**

On the shoulder to midslope position of the hillslope, interflow (soil/bedrock) soils of the Mispah type were encountered.

3.a. Shallow hard rock or soft plinthic B horizons will signify a temporal build of water on the soil/bedrock interface and slow discharge in a predominantly lateral direction will occur.

3. b. In areas where bedrock has been subjected to fracturing secondary flow paths towards the groundwater table could exist. Water in the fractured zone will likely seep vertically down into the groundwater table.

**Footslope:**

On the footslope position of the hillslope, deep/shallow recharge soils of the Hutton soil types were encountered.

1.a. Shallow and deep vertical recharge to sub-soils are expected, as well as some lateral movement where sub-soils turn to hard rock/plinthic material (as per greater site context).

1. b. Deep percolation into the sub-soils/hard rock and subsequent aquifers towards the lower topography areas is expected. This deep percolation water contributes to surface water streams as groundwater baseflow.

**Valley bottom:**

On the valley positions of the hillslope, responsive (saturated) soils occur.

4.a. b. In responsive soils, the build-up of water is expected in the B and upper A horizons after rain, and overland discharge and minor lateral seepage are expected (due to saturation excess). Secondary vertical seepage to deeper soil zones from the saturated B horizon is expected. At the transition from one soil type to the other (upstream to downstream) overland flow may take place during wet seasons.

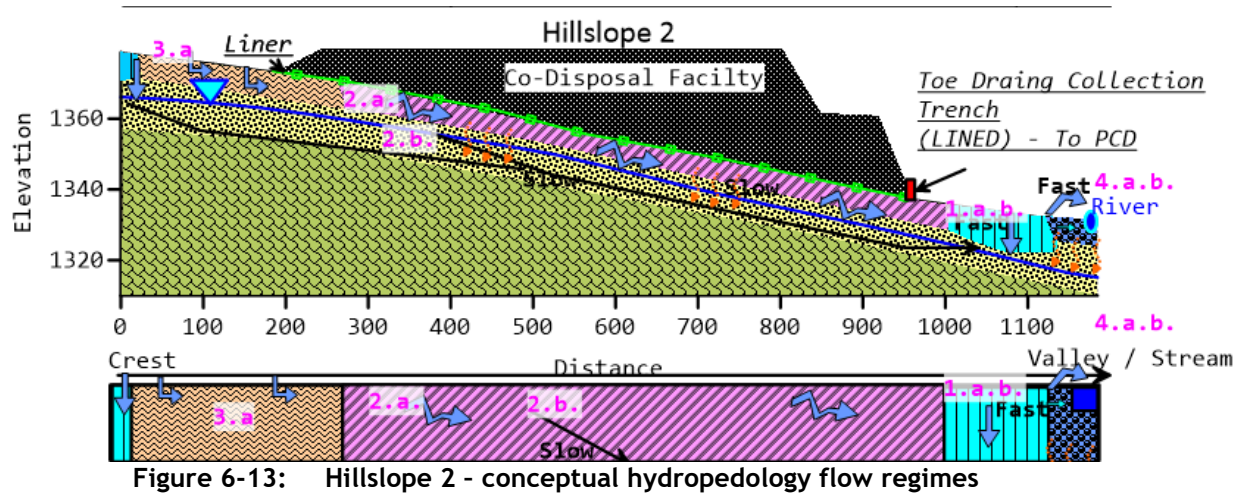


Figure 6-13: Hillslope 2 - conceptual hydrogeology flow regimes

### 6.5.3.3 Hillslope 3

#### Crest to midslope

On the crest to midslope position of the hillslope, interflow (soil/bedrock) soils of the Mispah type were encountered.

3.a. Shallow hard rock or soft plinthic B horizons will signify a temporal build of water on the soil/bedrock interface and slow discharge in a predominantly lateral direction will occur.

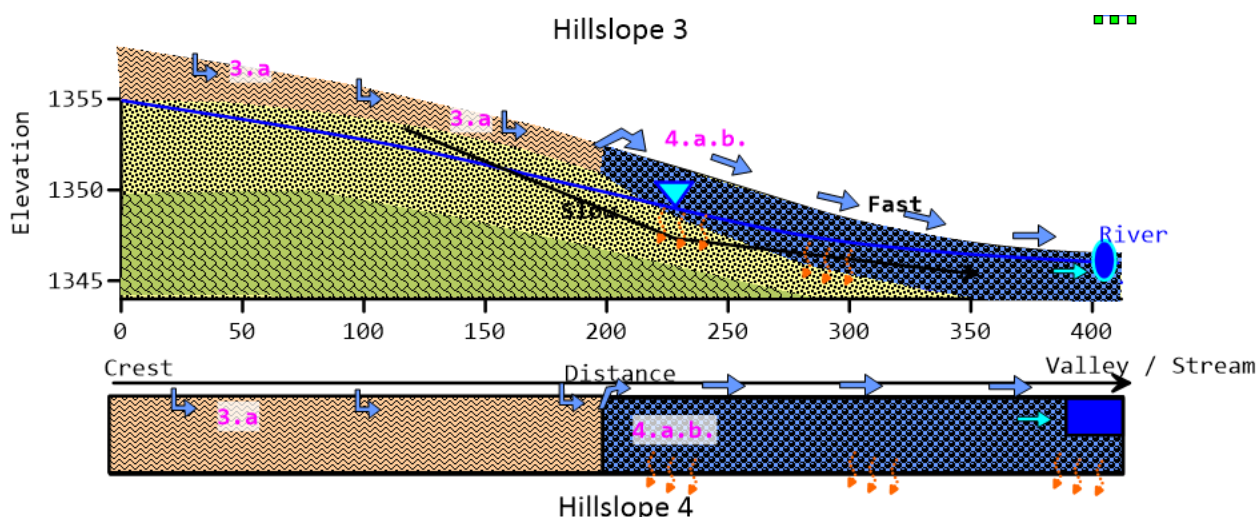
3. b. In areas where bedrock has been subjected to fracturing secondary flow paths towards the groundwater table could exist. Water in the fractured zone will likely seep vertically down into the groundwater table.

#### Footslope to the valley bottom

On the valley positions of the hillslope, responsive (saturated) soils occur.

4.a. b. In responsive soils, the build-up of water is expected in the B and upper A horizons after rain, and overland discharge and minor lateral seepage are expected (due to saturation excess). Secondary vertical seepage to deeper soil zones from the saturated B horizon is expected. At the transition from one soil type to the other (upstream to downstream) overland flow may take place during wet seasons.





**Figure 6-14: Hillslope 3 - conceptual hydrogeology flow regimes**

#### 6.5.3.4 Hillslope 4

##### Crest

On the crest position of the hillslope, deep/shallow recharge soils of the Hutton soil types were encountered.

1.a. Shallow and deep vertical recharge to sub-soils are expected, as well as some lateral movement where sub-soils turn to hard rock/plinthic material (as per greater site context).

1. b. Deep percolation into the sub-soils/hard rock and subsequent aquifers towards the lower topography areas is expected. This deep percolation water contributes to surface water streams as groundwater baseflow.

##### Scarp to footslope

On the scarp to footslope position of the hillslope, stagnating soils of the Glencoe soil types were encountered.

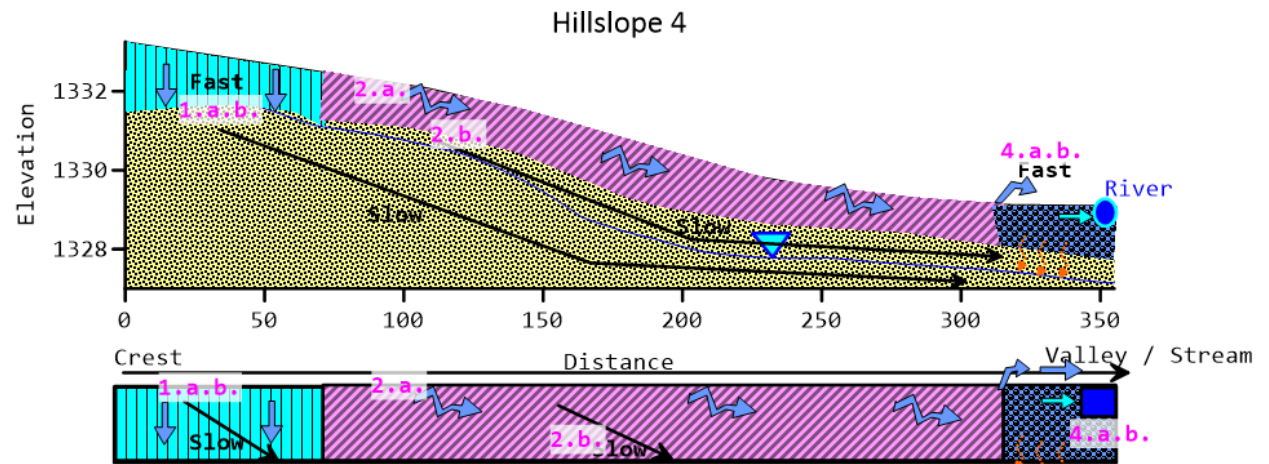
2. a. Stagnating soils tend to act like interflow (soil/bedrock) soil types, however, due to the presence of abundant clays lateral discharge is slow. Slow discharge in a predominantly lateral direction is expected for water that can make it to the plinthic interface. A build-up of water content in the soil, profile leads to temporary perched groundwater after high rainfall events.

2. b. Deep percolation into the sub-soils/hard rock and subsequent aquifers towards the lower topography areas is expected.

##### Valley bottom

On the valley positions of the hillslope, responsive (saturated) soils occur.

4.a. b. In responsive soils, the build-up of water is expected in the B and upper A horizons after rain, and overland discharge and minor lateral seepage are expected (due to saturation excess). Secondary vertical seepage to deeper soil zones from the saturated B horizon is expected. At the transition from one soil type to the other (upstream to downstream) overland flow may take place during wet seasons.



**Figure 6-15: Hillslope 4 - conceptual hydrogeology flow regimes**

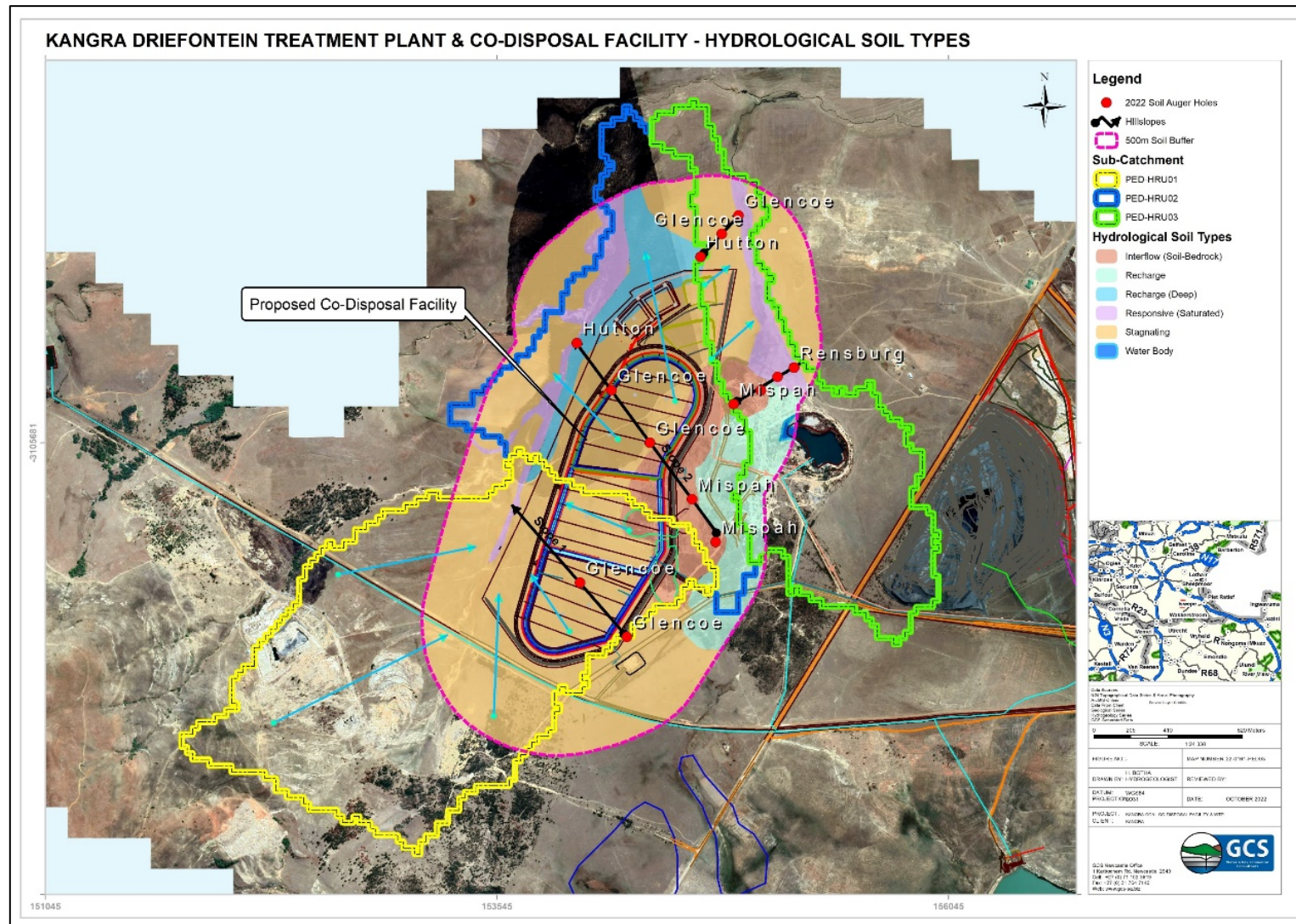


Figure 6-16: Hydrological soil types in the study area and soil flow paths



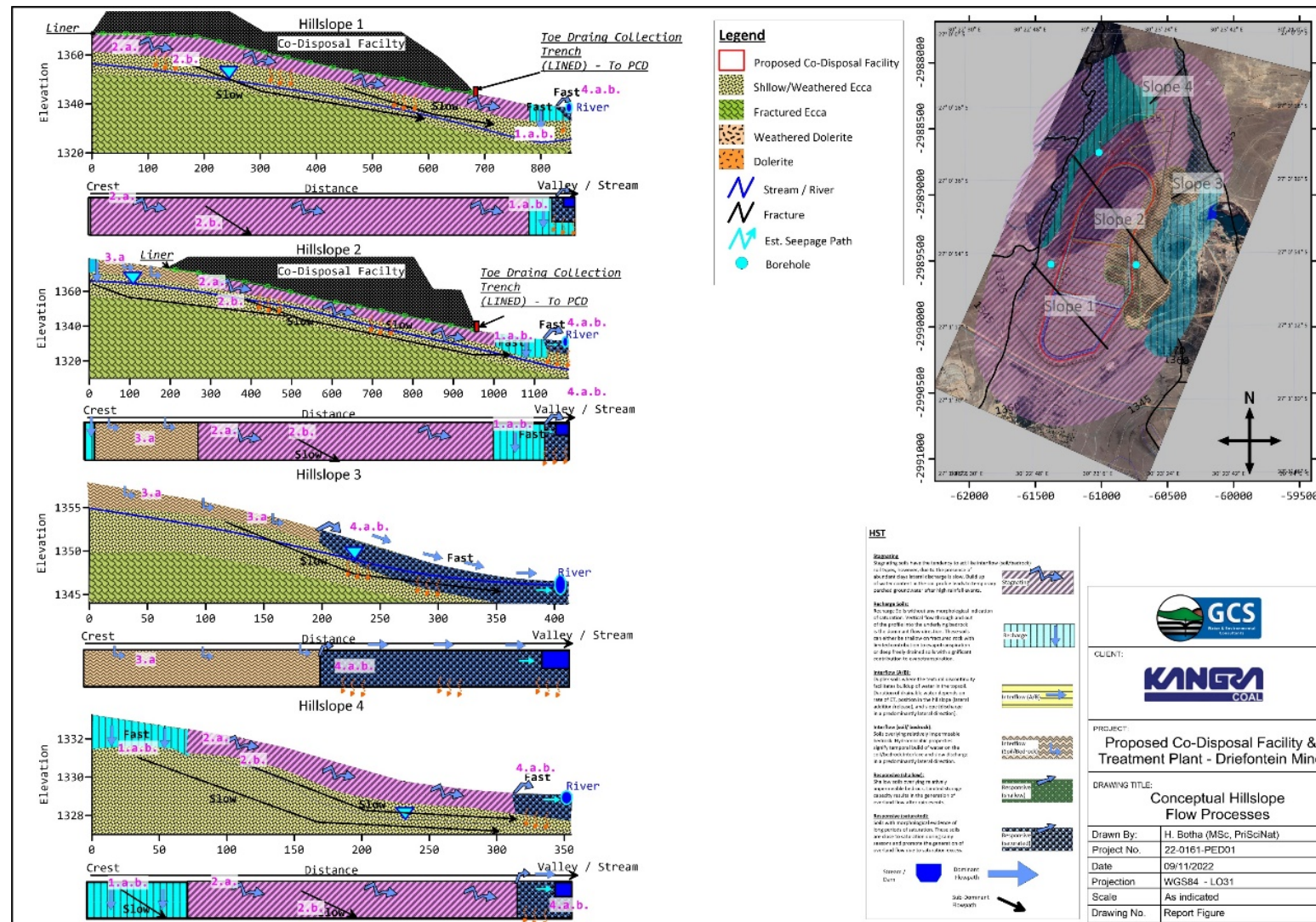


Figure 6-17: Conceptualisation of hydrological soil flow paths

#### 6.5.4 Flow Drivers

The general hydrogeological flow drivers, and coupled geohydrological processes, for a natural setting are presented in Figure 6-18. It can be seen that the main hydrological processes in a non-mining setting are:

- Atmospheric zone:
  - Precipitation;
  - Runoff; and
  - Evaporation.
- Unsaturated zone:
  - Infiltration;
  - Interflow (soil capillary rise, percolation, vertical soil water flow); and
  - Groundwater baseflow (lateral soil water possibly saturated lateral groundwater flow - in areas where shallow groundwater levels occur).
- Saturated zone:
  - Deep lateral seepage; and
  - Groundwater flow (baseflow and aquifer flow).

For the proposed development (built-up areas, that make the land surface impervious) the hydrological process will be altered and is presented in Figure 6-19. The following components will highly likely be impacted and will depend on the geomorphology and HSTs of a specific sub-catchment and associated hillslopes, namely:

- Natural runoff towards the valley areas will be disturbed. All runoff from the co-disposal facility will be collected in the toe drain systems and report to the PCDs.
- Infiltration over the surface area that is disturbed will be suppressed/removed completely, and no longer be available to add to soil interflow and deep percolation soil functions.
- Interflow (vertical or lateral or both) will be intercepted by the upstream cut-off trench, acting as a clean water diversion system.
- Runoff from the upper reaches of the sub-catchment will be intercepted and removed (if not diverted).

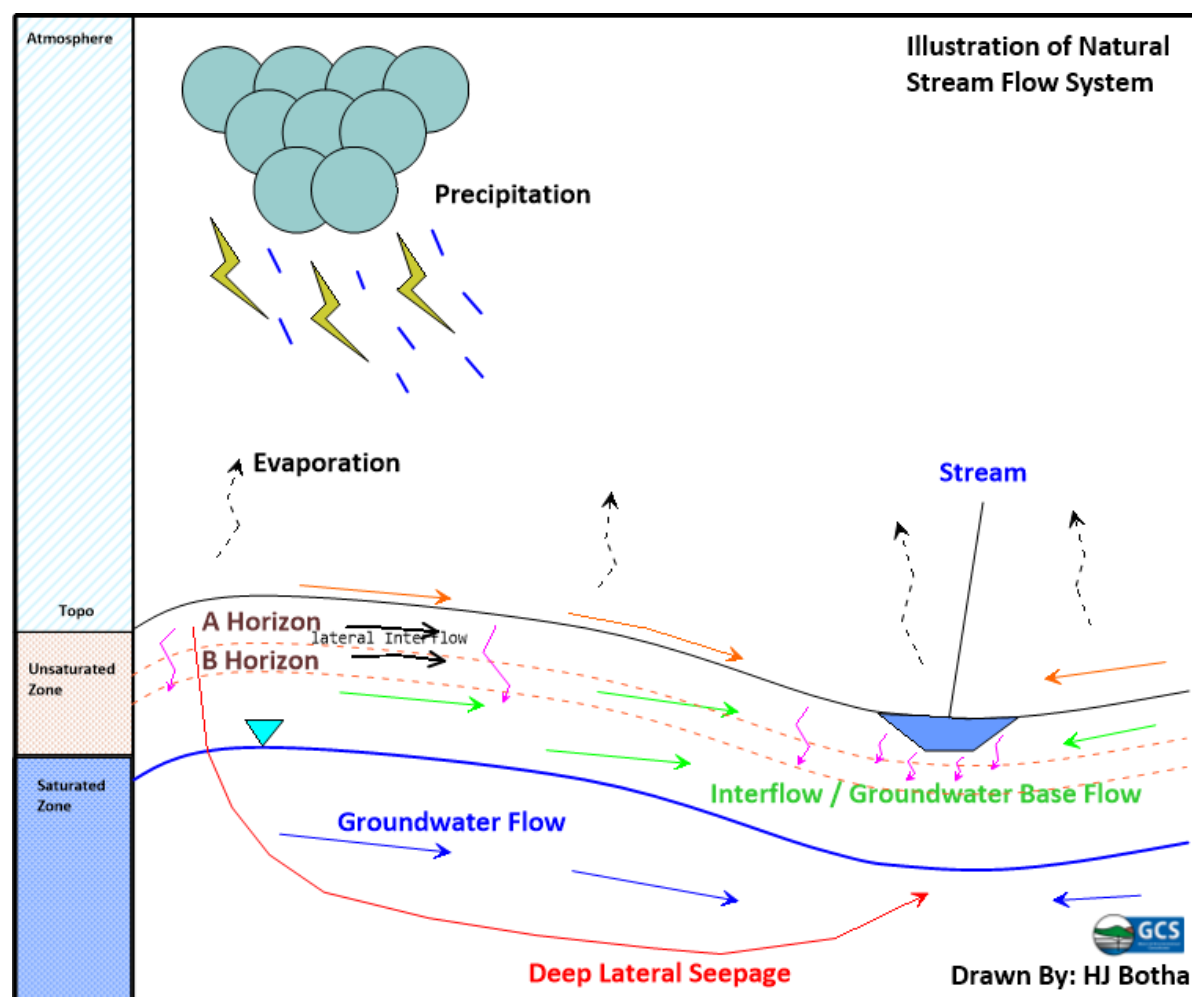


Figure 6-18: Natural flow drivers



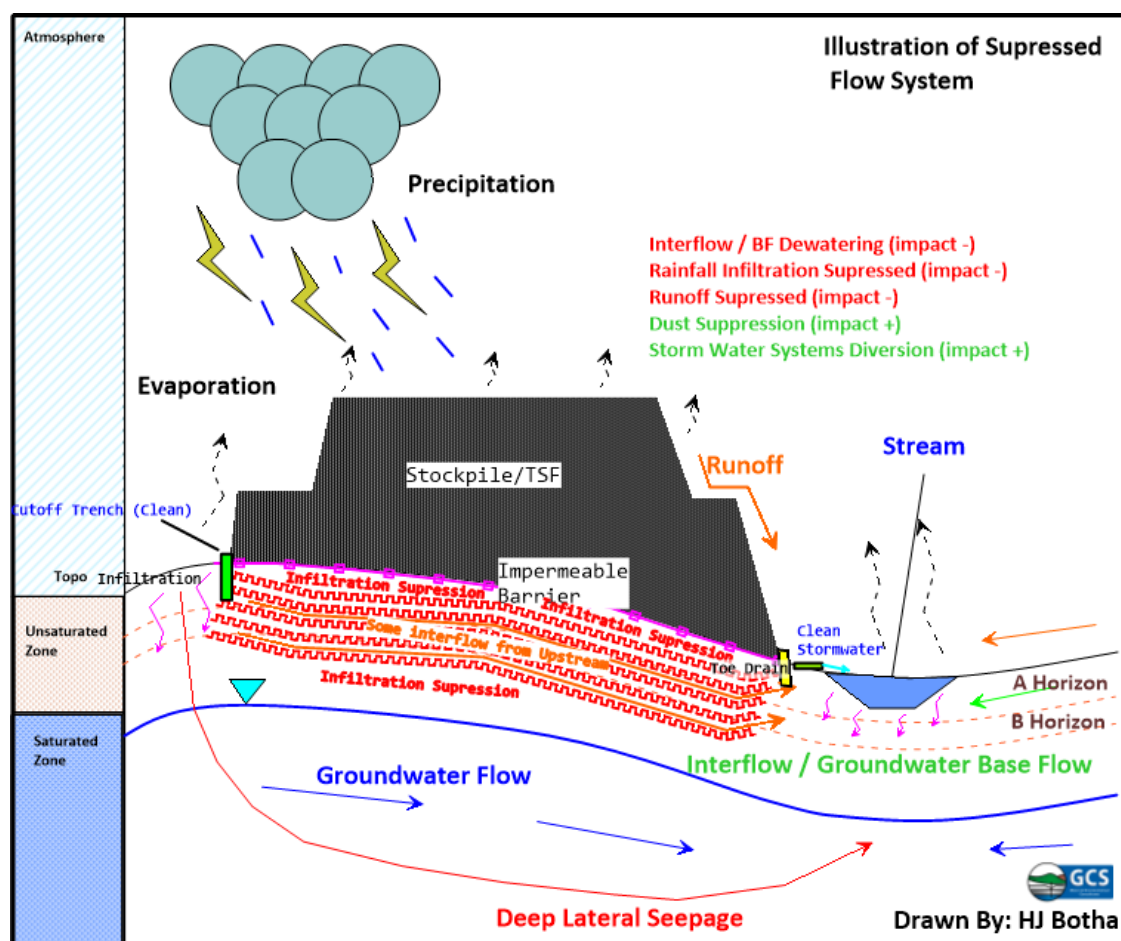


Figure 6-19: Altered flow drivers - built-up area for a lines TSF/Landfill

## 6.6 Land Capability

Land Capability generally refers to the ability of given soil and contextual conditions to sustain productive agricultural cultivation. The Land Use Capability Assessment undertaken for the previous Discard Dump Project (GCS, 2014) established the following land capability categories within the CDF study area:

- Intensive Agriculture (84.22ha): Most of the study area is covered by Clovelly and Pinedene soil forms, classified as Class II - arable land (refer to Table 6-5). These soils can be used for intensive agriculture. These soils are major agricultural soil forms in South Africa, owing to their deep, well-drained nature.

- **Moderate Agriculture (17.06ha):** The study area also comprises soils of the Glencoe form, which are poorly drained owing to their moderately slow permeability in the upper parts of the soil (Horizon A). This influences their high-water holding capacity (James, 1986). These soils are suitable for moderate agriculture owing to their high management requirements, as they exhibit a seasonal water table or ponding. These were thus classified as Class III. These soils tend to compact and form clods when worked while they are still wet (James, 1986).
- **Undefined Use (4.62ha):** The study area also comprises an area under rehabilitation, comprising Anthrosols. These soils do not have a defined capability owing to the mixed and unknown composition of these soil types. In this case, this area will initially be grassed once rehabilitation is completed.

**Table 6-5: Land Capability Classes- Description and Suitability**

CLASS	DEFINITION	CONSERVATION NEEDS	USE SUITABILITY
I	<ul style="list-style-type: none"> <li>• No or few limitations.</li> <li>• Very high arable potential.</li> <li>• Very low erosion hazard.</li> </ul>	Good agronomic practice.	Annual cropping.
II	<ul style="list-style-type: none"> <li>• Slight limitations.</li> <li>• High arable potential.</li> <li>• Low erosion hazard.</li> </ul>	Adequate run-off control	Annual cropping with special tillage or ley (25 %).
III	<ul style="list-style-type: none"> <li>• Moderate limitations.</li> <li>• Some erosion hazards.</li> </ul>	Special conservation practice and tillage methods.	Rotation of crops and ley (50 %).
IV	<ul style="list-style-type: none"> <li>• Severe limitations.</li> <li>• Low arable potential.</li> <li>• High erosion hazard.</li> </ul>	Intensive conservation practice.	Long-term leys (75 %).
V	<ul style="list-style-type: none"> <li>• Watercourse and land with wetness limitations.</li> </ul>	Protection and control of water table	Improved pastures or Wildlife
VI	<ul style="list-style-type: none"> <li>• Limitations preclude cultivation.</li> <li>• Suitable for perennial vegetation.</li> </ul>	Protection measures for establishment e.g. Sod-seeding	Veld and/or afforestation
VII	<ul style="list-style-type: none"> <li>• Very severe limitations.</li> <li>• Suitable only for natural vegetation.</li> </ul>	Adequate management of natural vegetation.	Natural veld grazing and afforestation.
VIII	<ul style="list-style-type: none"> <li>• Extremely severe limitations.</li> <li>• Not suitable for grazing or afforestation.</li> </ul>	Total protection from agriculture.	Wildlife.

## 6.7 Terrestrial Biodiversity

The baseline information related to the terrestrial biodiversity of the site is extracted from the Ecological Assessment Report attached under Appendix E-1.

### 6.7.1 Flora

#### 6.7.1.1 Vegetation Unit

The study area corresponds to the Grassland Biome as defined by Mucina & Rutherford (VegMap, 2006). This unit is found in the eastern, precipitation-rich regions of the Highveld. Grasslands of these parts are regarded as 'sour grasslands'. The proposed development is located within the Eastern Highveld Grassland (GM12) vegetation unit (refer to Figure 6-20), which is distributed along slightly, to moderately undulating plains, including some low hills and pan depressions, in Mpumalanga and Gauteng Provinces. The vegetation is short dense grassland dominated by the usual Highveld grass composition (*Aristida*, *Digitaria*, *Erigeron*, *Themeda*, *Tristachya*, etc.) with small, scattered rocky outcrops with wiry, sour grasses and some woody species (*Senegalia caffra*, *Celtis Africana*, *Diospyros lycioides* subsp. *lycioides*, *Parinari capensis*, *Protea caffra*, *P. welwitschii*, and *Rhus magalismontanum*).

The diversity of plants within the study area represents 56 plant families, typically dominated by Poaceae (graminoids, 28 species, 15.3%) and Asteraceae (Daisy family, 28 species, 14.7%). The important taxa associated with this vegetation unit are:

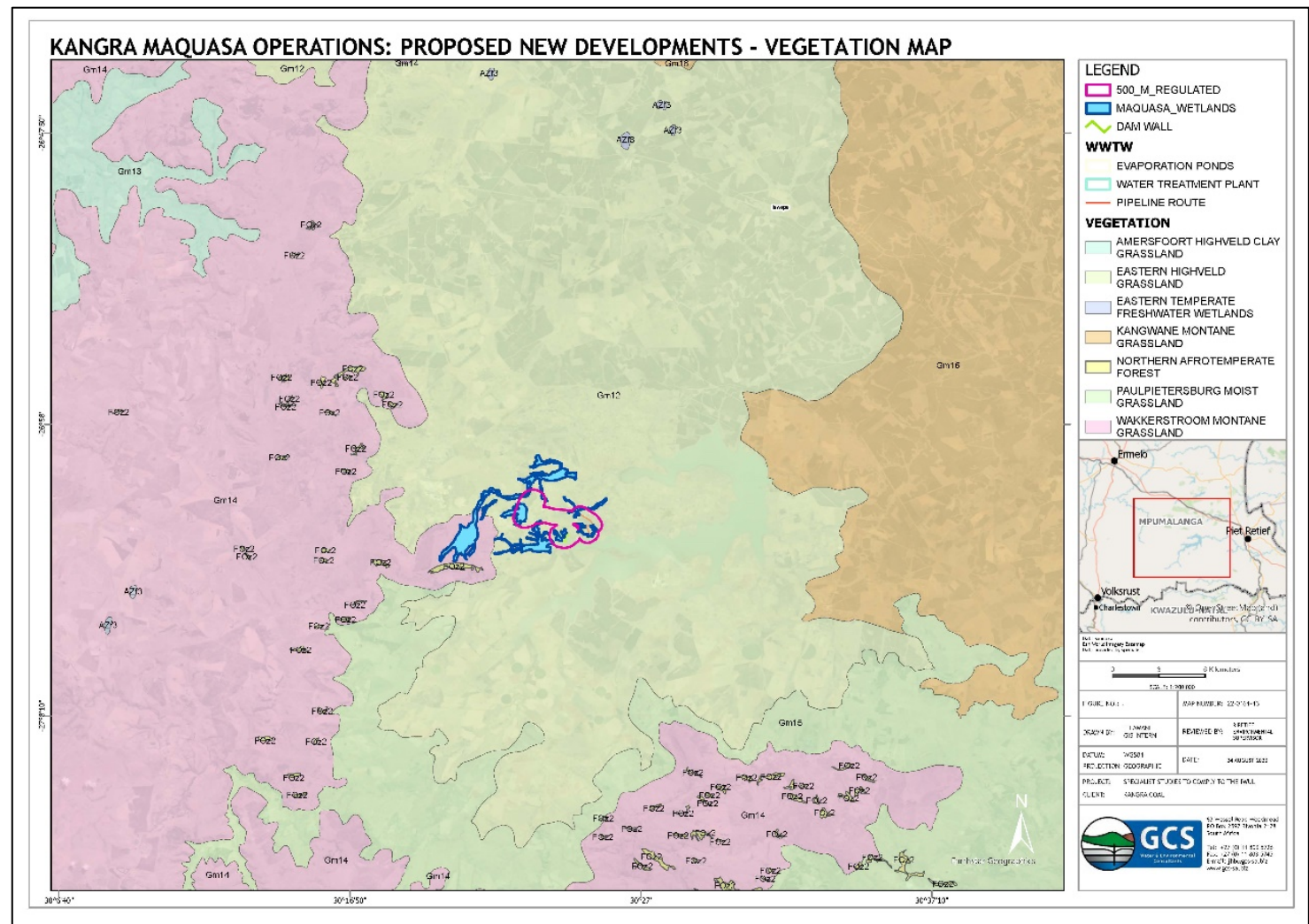
**Graminoids:** *Aristida aequiglumis* (d), *A. congesta* (d), *A. junciformis* subsp. *galpinii* (d), *D. tricholaenoides* (d), *Elionurus muticus* (d), *Eragrostis chloromelas* (d), *E. curvula* (d), *E. plana* (d), *E. racemosa* (d), *E. sclerantha* (d), *Heteropogon contortus* (d), *Loudetia simplex* (d), *Setaria sphacelata* (d), *Sporobolus africanus* (d), *S. pectinatus* (d), *Themeda triandra* (d), *Trachypogon spicatus* (d), *Tristachya leucothrix* (d), *T. rehmannii* (d), *Alloteropsis semialata* subsp. *eckloniana*, *Andropogon appendiculatus*, *A. schirensis*, *Bewsia biflora*, *Ctenium concinnum*, *Diheteropogon amplexans*, *Eragrostis capensis*, *E. gummiflua*, *E. patentissima*, *Harpachloa falx*, *Panicum natalense*, *renalia altera*, *Schizachyrium sanguineum*, *Setaria nigrirostris*, *Urelytrum agropyroides*.

**Herbs:** *Berkheya setifera* (d), *Haplocarpha scaposa* (d), *Justicia anagalloides* (d), *Pelargonium luridum* (d), *Acalypha angustata*, *Chamaecrista mimosoides*, *Dicoma anomala*, *Euryops gilfillanii*, *E. transvaalensis* subsp. *setilobus*, *Helichrysum aureonitens*, *H. caespitum*, *H. callicomum*, *H. oreophilum*, *H. rugulosum*, *Ipomoea crassipes*, *Pentanisia prunelloides* subsp. *latifolia*, *Selago densiflora*, *Sencio coronatus*, *Vernonia oligocephala*, and *Wahlenbergia undulate*.

**Geophytic Herbs:** *Gladiolus crassifolius*, *Haemanthus humilis* subsp. *hirsutus*, *Hypoxis rigidula* var. *pilosissima*, *Ledebouria ovatifolia*.

**Succulent Herb:** *Aloe ecklonis*.

**Low Shrubs:** *Anthospermum rigidum* subsp. *pumilum*, *Stoebe plumose*.



**Figure 6-20: Vegetation Units of the Study Area**

#### 6.7.1.2 Conservation Status and Sensitivity

The conservation status of the Eastern Highveld Grassland vegetation is listed as Endangered. This vegetation type has a conservation target of 24%. Currently, only a small fraction is conserved in statutory reserves (Nooitgedacht Dam and Jericho Dam Nature Reserves) and private reserves (Holkransse, Kransbank, Morgenstroom). Some 44% is transformed primarily by cultivation, plantations, mines, urbanization, and by building dams. Cultivation may have had a more extensive impact than indicated by land cover data. The vegetation sensitivity map for the study area is shown in Figure 6.21.

#### 6.7.1.3 Protected Areas

The mining area has three protected areas within its vicinity, namely Paardeplaats Nature Reserve (approximately 6 km to the southeast); Pongola Bush Nature Reserve (approximately 8 km to the south); and Wakkerstroom Wetland Nature Reserve (approximately 13 km to the southwest).

Moist Escarpment Grasslands (adjacent to the mining area running from northwest through to southeast) comprise a National Protected Areas Expansion Strategy (NPAES) Focus Area.

#### 6.7.1.4 Critical Biodiversity Areas (CBA)

From an ecological perspective, the development is situated within an area that has been disturbed. The Terrestrial CBA of the site is mixed between transformed areas and ecological support areas (ESA). The CBA map of the study area is provided in Figure 6-22.

#### 6.7.1.5 Plant and Tree Species of Conservation Concern

The Real Yellowwood (Opregte-geelhout) [*Potocarpus latifolius*] was found in the QDS. This tree is a listed protected tree in terms of the NFA.

No individuals of the endemic or biogeographically important plants were observed during the survey, although they may have previously been found in the larger area due to the season of assessment. Six (6) red data species potentially occur in the QDS of the study area according to the SIBIS database. Potential habitat for species does exist, however, the verification for these species and habitat conditions must be reassessed during the summer period. None of these threatened species were identified during the site inspection in May 2023. The list of Red Listed Plant species within QDS 2730AB is presented in Table 6-6.

**Table 6-6: List of Red Listed Plant Species under QDS 2730AB**

FAMILY	TAXON	RED LIST CATEGORY
Asphodelaceae	<i>Aloe kniphofioides</i>	Vulnerable
Araceae	<i>Zantedeschia pentlandii</i>	Vulnerable
Fabaceae	<i>Indigofera hybrida</i>	Vulnerable
Proteaceae	<i>Protea parvula</i>	Near Threatened
Hyacinthaceae	<i>Merwillia plumbea</i>	Near Threatened



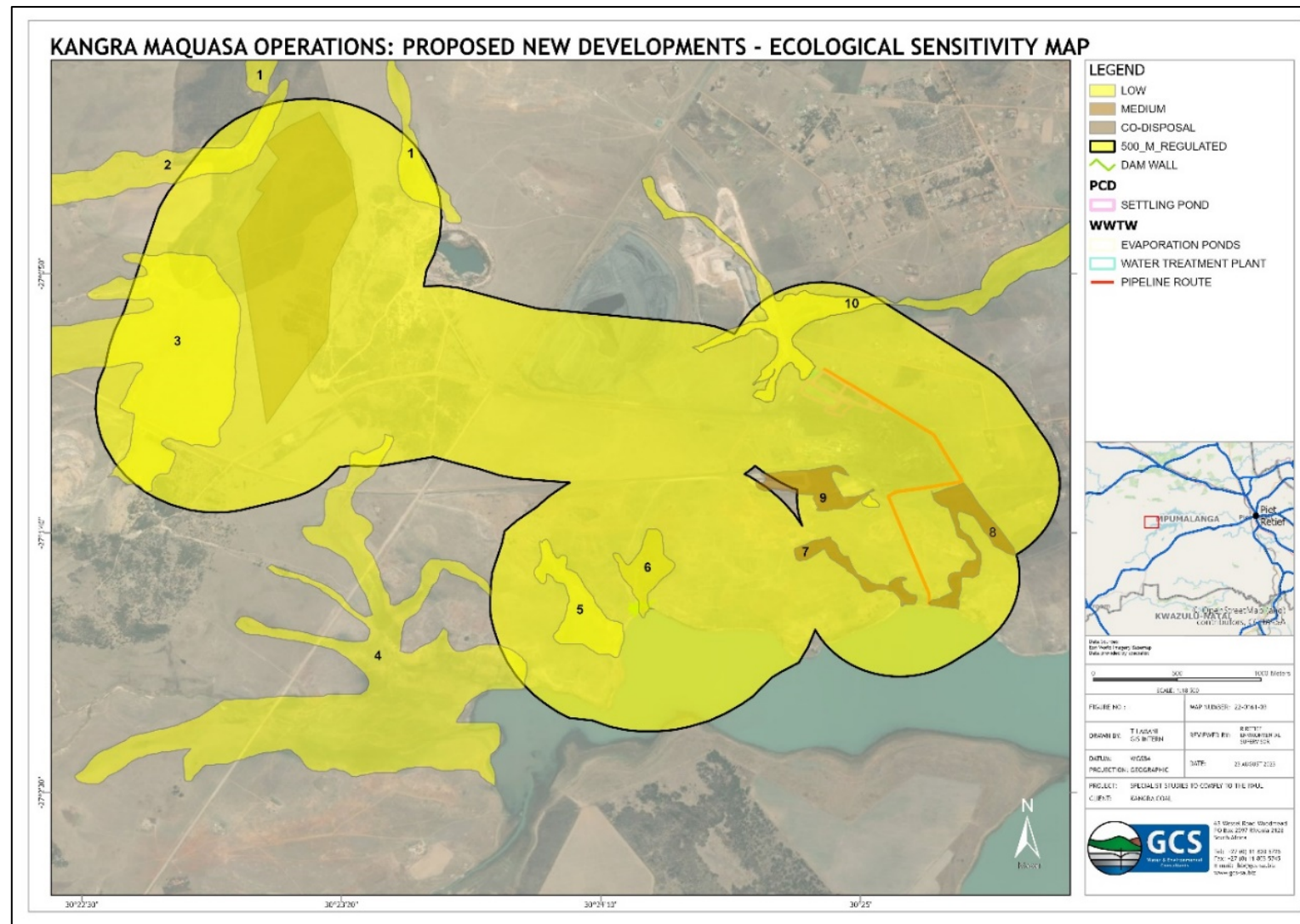


Figure 6.21 Sensitivity of the study area



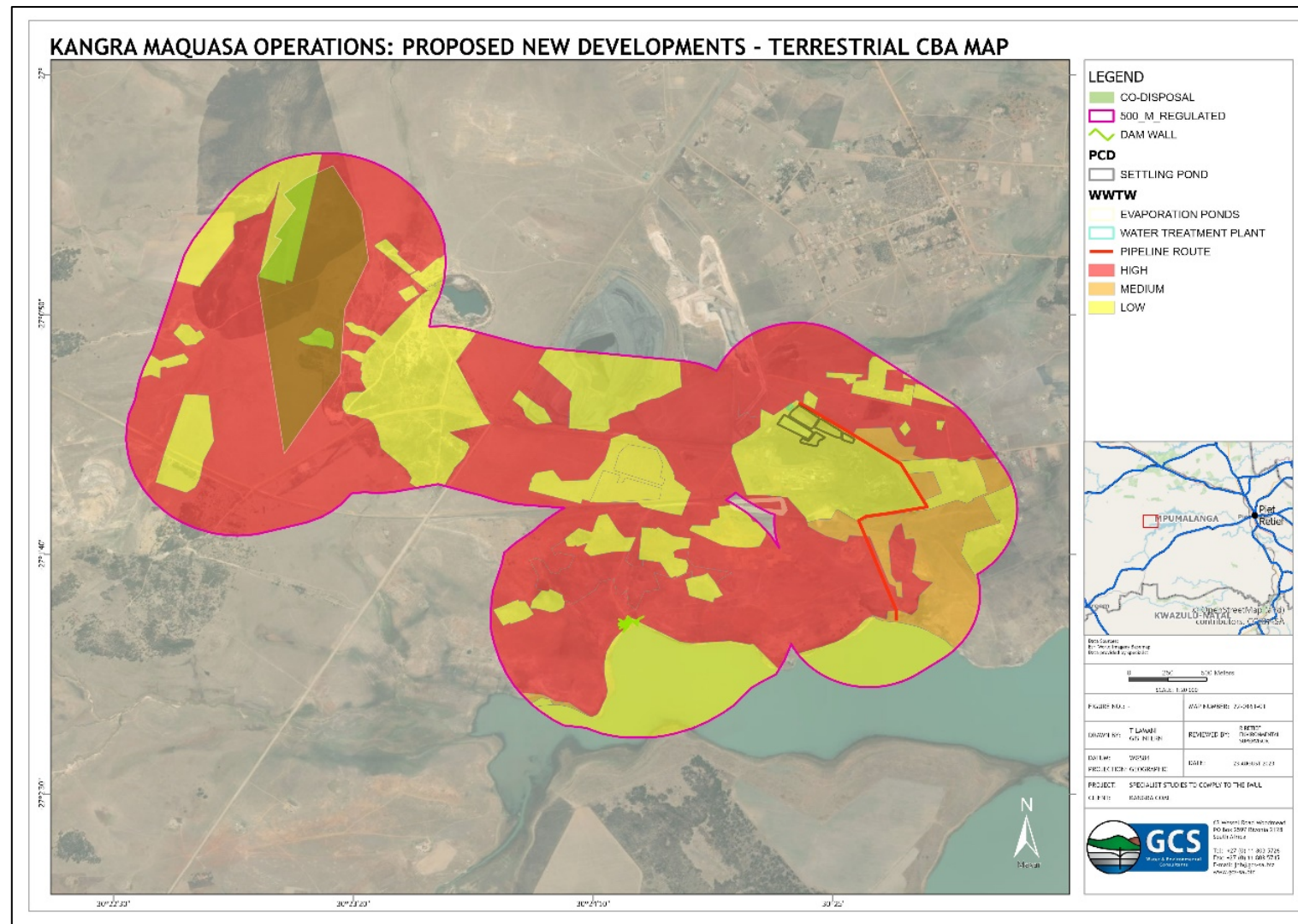


Figure 6-22: Terrestrial CBA and ESA surrounding the proposed development.

### 6.7.2 Fauna

The area investigated (proposed areas of mine expansion) is situated within the proposed Grassland Biosphere Reserve which is undoubtedly one of the most important biodiversity areas in Africa and despite “proposed Biosphere Reserve” status, this area is severely threatened, and it faces some monumental conservation problems. It might be reasoned that the study area comprises only a small fraction of the entire proposed Grassland Biosphere Reserve, but cumulative anthropogenic impacts relevant to the faunal communities of the region need to be taken in consideration. Most of the study area is characterised by untransformed wetland and grassland faunal habitat.

The proposed project is located within one of South Africa’s registered Important Bird and Biodiversity Areas (IBAs). Even though IBAs do not have formal protection status it is important to indicate in EIA reports when a development falls within an IBA.

#### 6.7.2.1 Mammals

The site has two (2) listed threatened species identified to occur within the site QDS (Refer to Table 6-7). The results show there are eight (8) identified mammal species occurring within the QDS. These species have all been listed as South African endemics (Virtual Museum). Of the identified species there are 5 listed species, these being 3 **Near Threatened** and 2 **Endangered** species. The Endangered species identified are:

- **Oribi:** this species is listed as Least Concern globally, however within South Africa this species is listed as **Endangered**. This species is mainly threatened by habitat destruction (Loss and Fragmentation) due to commercial forestry, commercial farming, grassland degradation, and mining. Illegal hunting is the biggest threat to the survival of this species.
- **Swinny’s Horseshoe Bat:** this species is listed as Least Concern globally, however within South Africa this species is listed as **Endangered**. This species is threatened by deforestation and general habitat conversion.

None of these species were observed during the site visit, however, habitat for the Swamp Must Shrew, the Swinny Horseshoe Bat, and the black-footed cat exist around the site.

Table 6-7: Mammal species identified to occur in QDS 2730AB

FAMILY	SCIENTIFIC NAME	COMMON NAME	RED LIST CATEGORY
Bovidae	<i>Ourebia ourebi</i>	Oribi	Endangered
Felidae	<i>Felis nigripes</i>	Black-footed Cat	Vulnerable (2016)
Felidae	<i>Leptailurus serval</i>	Serval	Near Threatened (2016)
Leporidae	<i>Lepus saxatilis</i>	Scrub Hare	Least Concern
Muridae	<i>Aethomys ineptus</i>	Tete Veld Aethomys	Least Concern (2016)
Muridae	<i>Gerbilliscus leucogaster</i>	Bushveld Gerbil	Least Concern (2016)
Rhinolophidae	<i>Rhinolophus clivosus</i>	Geoffroy's Horseshoe Bat	Least Concern (2016)
Rhinolophidae	<i>Rhinolophus swinnyi</i>	Swinny's Horseshoe Bat	Vulnerable (2016)
Soricidae	<i>Crocidura cyanea</i>	Reddish-gray Musk Shrew	Least Concern (2016)
Soricidae	<i>Crocidura mariquensis</i>	Swamp Musk Shrew	Near Threatened (2016)
Vespertilionidae	<i>Miniopterus natalensis</i>	Natal Long-fingered Bat	Least Concern (2016)
Vespertilionidae	<i>Myotis tricolor</i>	Temminck's Myotis	Least Concern (2016)

#### 6.7.2.2 Avifauna

In terms of the migrating and nesting birds in the quarter-degree square, a total of 107 different species occur in the area. Of these five (5) species of birds were recorded on the Red List for birds in the quarter-degree square. Blue Cranes were physically observed within the wetland area of HGM 9. Nesting sites and vulnerable areas should be minimally disturbed.

Table 6-8: Avifauna species identified to occur in QDS 2730AB

REF	COMMON SPECIES	COMMON GROUP	GENUS	SPECIES	RD (REGIONAL, GLOBAL)
72	Hamerkop		<i>Scopus</i>	<i>umbretta</i>	
637	Neddicky		<i>Cisticola</i>	<i>fulvicapilla</i>	
844	Quailfinch		<i>Ortygospiza</i>	<i>atricollis</i>	
105	Secretarybird		<i>Sagittarius</i>	<i>serpentarius</i>	VU, EN
431	Black-collared	Barbet	<i>Lybius</i>	<i>torquatus</i>	
439	Crested	Barbet	<i>Trachyphonus</i>	<i>vaillantii</i>	
808	Southern Red	Bishop	<i>Euplectes</i>	<i>orix</i>	
810	Yellow	Bishop	<i>Euplectes</i>	<i>capensis</i>	
709	Southern	Boubou	<i>Laniarius</i>	<i>ferrugineus</i>	
545	Dark-capped	Bulbul	<i>Pycnonotus</i>	<i>tricolor</i>	
874	Golden-breasted	Bunting	<i>Emberiza</i>	<i>flaviventris</i>	
219	Denham's	Bustard	<i>Neotis</i>	<i>denhami</i>	NT, NT
222	White-bellied	Bustard	<i>Eupodotis</i>	<i>senegalensis</i>	
154	Common	Buzzard	<i>Buteo</i>	<i>buteo</i>	
155	Forest	Buzzard	<i>Buteo</i>	<i>trizonatus</i>	

REF	COMMON SPECIES	COMMON GROUP	GENUS	SPECIES	RD (REGIONAL, GLOBAL)
152	Jackal	Buzzard	<i>Buteo</i>	<i>rufofuscus</i>	
860	Black-throated	Canary	<i>Crithagra</i>	<i>atroregularis</i>	
857	Cape	Canary	<i>Serinus</i>	<i>canicollis</i>	
859	Yellow-fronted	Canary	<i>Crithagra</i>	<i>mozambica</i>	
575	Ant-eating	Chat	<i>Myrmecocichla</i>	<i>formicivora</i>	
631	Cloud	Cisticola	<i>Cisticola</i>	<i>textrix</i>	
646	Levaillant's	Cisticola	<i>Cisticola</i>	<i>tinniens</i>	
634	Wing-snapping	Cisticola	<i>Cisticola</i>	<i>ayresii</i>	
629	Zitting	Cisticola	<i>Cisticola</i>	<i>juncidis</i>	
50	Reed	Cormorant	<i>Microcarbo</i>	<i>africanus</i>	
216	Blue	Crane	<i>Grus</i>	<i>paradisea</i>	NT, VU
214	Grey Crowned	Crane	<i>Balearica</i>	<i>regulorum</i>	EN, EN
523	Cape	Crow	<i>Corvus</i>	<i>capensis</i>	
352	Diederik	Cuckoo	<i>Chrysococcyx</i>	<i>caprius</i>	
316	Cape Turtle	Dove	<i>Streptopelia</i>	<i>capicola</i>	
317	Laughing	Dove	<i>Spilopelia</i>	<i>senegalensis</i>	
318	Namaqua	Dove	<i>Oena</i>	<i>capensis</i>	
314	Red-eyed	Dove	<i>Streptopelia</i>	<i>semitorquata</i>	
96	Yellow-billed	Duck	<i>Anas</i>	<i>undulata</i>	
60	Intermediate	Egret	<i>Ardea</i>	<i>intermedia</i>	
61	Western Cattle	Egret	<i>Bubulcus</i>	<i>ibis</i>	
119	Amur	Falcon	<i>Falco</i>	<i>amurensis</i>	
707	Southern	Fiscal	<i>Lanius</i>	<i>collaris</i>	
655	African Dusky	Flycatcher	<i>Muscicapa</i>	<i>adusta</i>	
682	African Paradise	Flycatcher	<i>Terpsiphone</i>	<i>viridis</i>	
173	Coqui	Francolin	<i>Peliperdix</i>	<i>coqui</i>	
89	Egyptian	Goose	<i>Alopochen</i>	<i>aegyptiaca</i>	
88	Spur-winged	Goose	<i>Plectropterus</i>	<i>gambensis</i>	
618	Cape	Grassbird	<i>Sphenoeacus</i>	<i>afer</i>	
171	African	Harrier-Hawk	<i>Polyboroides</i>	<i>typus</i>	
55	Black-headed	Heron	<i>Ardea</i>	<i>melanocephala</i>	
54	Grey	Heron	<i>Ardea</i>	<i>cinerea</i>	
81	African Sacred	Ibis	<i>Threskiornis</i>	<i>aethiopicus</i>	
83	Glossy	Ibis	<i>Plegadis</i>	<i>falcinellus</i>	
84	Hadada	Ibis	<i>Bostrychia</i>	<i>hagedash</i>	
82	Southern Bald	Ibis	<i>Geronticus</i>	<i>calvus</i>	VU, VU
397	Malachite	Kingfisher	<i>Corythornis</i>	<i>cristatus</i>	
130	Black-winged	Kite	<i>Elanus</i>	<i>caeruleus</i>	
129	Yellow-billed	Kite	<i>Milvus</i>	<i>aegyptius</i>	
247	African Wattled	Lapwing	<i>Vanellus</i>	<i>senegallus</i>	
243	Black-winged	Lapwing	<i>Vanellus</i>	<i>melanopterus</i>	
245	Blacksmith	Lapwing	<i>Vanellus</i>	<i>armatus</i>	

REF	COMMON SPECIES	COMMON GROUP	GENUS	SPECIES	RD (REGIONAL, GLOBAL)
242	Crowned	Lapwing	<i>Vanellus</i>	<i>coronatus</i>	
458	Rufous-naped	Lark	<i>Mirafra</i>	<i>africana</i>	
474	Spike-heeled	Lark	<i>Chersomanes</i>	<i>albofasciata</i>	
703	Cape	Longclaw	<i>Macronyx</i>	<i>capensis</i>	
510	Banded	Martin	<i>Riparia</i>	<i>cincta</i>	
509	Brown-throated	Martin	<i>Riparia</i>	<i>paludicola</i>	
390	Speckled	Mousebird	<i>Colius</i>	<i>striatus</i>	
521	Black-headed	Oriole	<i>Oriolus</i>	<i>larvatus</i>	
311	Speckled	Pigeon	<i>Columba</i>	<i>guinea</i>	
692	African	Pipit	<i>Anthus</i>	<i>cinnamomeus</i>	
238	Three-banded	Plover	<i>Charadrius</i>	<i>tricoloris</i>	
649	Tawny-flanked	Prinia	<i>Prinia</i>	<i>subflava</i>	
189	Common	Quail	<i>Coturnix</i>	<i>coturnix</i>	
581	Cape	Robin-Chat	<i>Cossypha</i>	<i>caffa</i>	
511	Black (Southern Africa)	Saw-wing	<i>Psilidoprocne</i>	<i>pristoptera holomelas</i>	
250	African	Snipe	<i>Gallinago</i>	<i>nigripennis</i>	
786	Cape	Sparrow	<i>Passer</i>	<i>melanurus</i>	
784	House	Sparrow	<i>Passer</i>	<i>domesticus</i>	
4142	Southern Grey-headed	Sparrow	<i>Passer</i>	<i>diffusus</i>	
85	African	Spoonbill	<i>Platalea</i>	<i>alba</i>	
185	Swainson's	Spurfowl	<i>Pternistis</i>	<i>swainsonii</i>	
746	Pied	Starling	<i>Lamprotornis</i>	<i>bicolor</i>	
745	Red-winged	Starling	<i>Onychognathus</i>	<i>morio</i>	
736	Violet-backed	Starling	<i>Cinnyricinclus</i>	<i>leucogaster</i>	
576	African	Stonechat	<i>Saxicola</i>	<i>torquatus</i>	
751	Malachite	Sunbird	<i>Nectarinia</i>	<i>famosa</i>	
493	Barn	Swallow	<i>Hirundo</i>	<i>rustica</i>	
502	Greater Striped	Swallow	<i>Cecropis</i>	<i>cucullata</i>	
503	Lesser Striped	Swallow	<i>Cecropis</i>	<i>abyssinica</i>	
504	South African Cliff	Swallow	<i>Petrochelidon</i>	<i>spilodera</i>	
495	White-throated	Swallow	<i>Hirundo</i>	<i>albigularis</i>	
385	Little	Swift	<i>Apus</i>	<i>affinis</i>	
383	White-rumped	Swift	<i>Apus</i>	<i>caffer</i>	
305	Whiskered	Tern	<i>Chlidonias</i>	<i>hybrida</i>	
275	Spotted	Thick-knee	<i>Burhinus</i>	<i>capensis</i>	
1105	Olive	Thrush	<i>Turdus</i>	<i>olivaceus</i>	
686	Cape	Wagtail	<i>Motacilla</i>	<i>capensis</i>	
666	African Yellow	Warbler	<i>Iduna</i>	<i>natalensis</i>	
843	Common	Waxbill	<i>Estrilda</i>	<i>astrild</i>	
838	Orange-breasted	Waxbill	<i>Amandava</i>	<i>subflava</i>	
799	Cape	Weaver	<i>Ploceus</i>	<i>capensis</i>	
803	Southern Masked	Weaver	<i>Ploceus</i>	<i>velatus</i>	

REF	COMMON SPECIES	COMMON GROUP	GENUS	SPECIES	RD (REGIONAL, GLOBAL)
564	Mountain	Wheatear	<i>Myrmecocichla</i>	<i>monticola</i>	
1172	Cape	White-eye	<i>Zosterops</i>	<i>virens</i>	
846	Pin-tailed	Whydah	<i>Vidua</i>	<i>macroura</i>	
816	Fan-tailed	Widowbird	<i>Euplectes</i>	<i>axillaris</i>	
818	Long tailed	Widowbird	<i>Euplectes</i>	<i>progne</i>	
814	White-winged	Widowbird	<i>Euplectes</i>	<i>albonotatus</i>	
445	Ground	Woodpecker	<i>Geocolaptes</i>	<i>olivaceus</i>	
452	Olive	Woodpecker	<i>Dendropicos</i>	<i>griseocephalus</i>	

### 6.7.2.3 Reptiles

In terms of the reptile species of concern in the area, a total of 20 species of reptiles were recorded. None of these were, however, on the IUCN red list. Suitable habitat for the least concerned reptile species is located around the mining operations for the species to occur. The list of reptiles expected to occur in the QDS is presented in Table 6-9.

**Table 6-9: Reptile species identified to occur in QDS 2730AB**

#	FAMILY	SCIENTIFIC NAME	COMMON NAME	RED CATEGORY	LIST
1	Agamidae	<i>Agama aculeata distanti</i>	Distant's Ground Agama	Least Concern (SARCA 2014)	
2	Chamaeleonidae	<i>Chamaeleo dilepis</i>	Common Flap-neck Chameleon	Least Concern (SARCA 2014)	
3	Colubridae	<i>Crotaphopeltis hotamboeia</i>	Red-lipped Snake	Least Concern (SARCA 2014)	
4	Cordylidae	<i>Chamaesaura anguina anguina</i>	Cape Grass Lizard	Least Concern (SARCA 2014)	
5	Cordylidae	<i>Cordylus vittifer</i>	Common Girdled Lizard	Least Concern (SARCA 2014)	
6	Cordylidae	<i>Pseudocordylus melanotus melanotus</i>	Common Crag Lizard	Least Concern (SARCA 2014)	
7	Elapidae	<i>Hemachatus haemachatus</i>	Rinkhals	Least Concern (SARCA 2014)	
8	Gekkonidae	<i>Lygodactylus ocellatus</i>	Spotted Dwarf Gecko	Least Concern (SARCA 2014)	
9	Gekkonidae	<i>Pachydactylus vansonii</i>	Van Son's Gecko	Least Concern (SARCA 2014)	
10	Gerrhosauridae	<i>Gerrhosaurus flavigularis</i>	Yellow-throated Plated Lizard	Least Concern (SARCA 2014)	
11	Lacertidae	<i>Pedioplanis burchelli</i>	Burchell's Sand Lizard	Least Concern (SARCA 2014)	
12	Lamprophiidae	<i>Duberria lutrix lutrix</i>	South African Slug-eater	Least Concern (IUCN 2021, sp. level)	
13	Lamprophiidae	<i>Lamprophis guttatus</i>	Spotted House Snake	Least Concern (SARCA 2014)	
14	Lamprophiidae	<i>Lycophidion capense capense</i>	Cape Wolf Snake	Least Concern (SARCA 2014)	
15	Lamprophiidae	<i>Psammophis brevirostris</i>	Short-snouted Grass Snake	Least Concern (SARCA 2014)	
16	Lamprophiidae	<i>Psammophylax rhombeatus</i>	Spotted Grass Snake	Least Concern (SARCA 2014)	
17	Scincidae	<i>Acontias wakkerstroomensis</i>	Wakkerstroom Legless Skink		



#	FAMILY	SCIENTIFIC NAME	COMMON NAME	RED CATEGORY	LIST
18	Scincidae	<i>Trachylepis capensis</i>	Cape Skink	Least Concern (SARCA 2014)	
19	Scincidae	<i>Trachylepis punctatissima</i>	Speckled Rock Skink	Least Concern (SARCA 2014)	
20	Scincidae	<i>Trachylepis varia sensu lato</i>	Common Variable Skink Complex	Least Concern (SARCA 2014)	

#### 6.7.2.4 Amphibians

In terms of frog species of concern in the area, a total of 12 species of amphibians occur in the area (Refer to Table 6-10), and none are on the IUCN red list.

**Table 6-10: Amphibian species identified to occur in QDS 2730AB**

#	SPECIES CODE	FAMILY	SCIENTIFIC NAME	COMMON NAME	RED CATEGORY	LIST
1	370	Bufonidae	<i>Sclerophrys capensis</i>	Raucous Toad	Least Concern	
2	330	Bufonidae	<i>Sclerophrys gutturalis</i>	Guttural Toad	Least Concern (IUCN, 2016)	
3	590	Hyperoliidae	<i>Hyperolius marmoratus</i>	Painted Reed Frog	Least Concern (IUCN ver 3.1, 2013)	
4	660	Hyperoliidae	<i>Kassina senegalensis</i>	Bubbling Kassina	Least Concern	
5	1050	Pipidae	<i>Xenopus laevis</i>	Common Platanna	Least Concern (IUCN 2020)	
6	820	Ptychadenidae	<i>Ptychadena porosissima</i>	Striped Grass Frog	Least Concern	
7	880	Pyxicephalidae	<i>Amietia delalandii</i>	Delalande's River Frog	Least Concern (2017)	
8	890	Pyxicephalidae	<i>Amietia fuscigula</i>	Cape River Frog	Least Concern (2017)	
9	400	Pyxicephalidae	<i>Cacosternum boettgeri</i>	Common Caco	Least Concern (2013)	
10	940	Pyxicephalidae	<i>Strongylopus fasciatus</i>	Striped Stream Frog	Least Concern	
11	950	Pyxicephalidae	<i>Strongylopus grayii</i>	Clicking Stream Frog	Least Concern	
12	1030	Pyxicephalidae	<i>Tomopterna natalensis</i>	Natal Sand Frog	Least Concern	

#### 6.7.2.5 Invertebrate Species of Conservation Concern

In terms of butterfly species of concern in the area, a total of 22 species of butterfly occur in the area (Refer to Table 6-11), and one, the Wakkerstroom Widow is listed on the IUCN red list as Near Threatened. Suitable vegetation and habitat for the species were observed and the possibility of the species occurring onsite, cannot be excluded.

#### Beetles, Scorpions, and Spiders

- No beetles of conservation priority were recorded within the quarter degree square 2730AB. The likelihood of these species occurring within the quarter-degree square cannot be excluded;

- None of the baboon spiders were recorded within the QSD 2730AB, however suitable habitat for spiders exists in the wetland and grassland areas.
- None of the red-listed scorpions were recorded within the QSD 2730AB. The chance-finding scorpions in the rocky and grassland areas cannot be excluded.

**Table 6-11: Butterfly species identified to occur in QDS 2730AB**

#	FAMILY	SCIENTIFIC NAME	COMMON NAME	RED LIST CATEGORY
1	HESPERIIDAE	<i>Afrogegenes sp.</i>		
2	LYCAENIDAE	<i>Actizera lucida</i>	Rayed blue	Least Concern (SABCA 2013)
3	LYCAENIDAE	<i>Aloeides henningi</i>	Hillside russet	Least Concern (SABCA 2013)
4	LYCAENIDAE	<i>Aloeides merces</i>	Wakkerstroom russet	Least Concern (SABCA 2013)
5	LYCAENIDAE	<i>Aloeides oreas</i>	Small mountain russet	Least Concern (SABCA 2013)
6	LYCAENIDAE	<i>Aloeides titei</i>	Mountain russet	Least Concern (SABCA 2013)
7	LYCAENIDAE	<i>Capys alpheus extentus</i>	Orange banded protea	Least Concern (SABCA 2013)
8	LYCAENIDAE	<i>Chrysoritis aethon</i>	Lydenburg opal	Least Concern (SABCA 2013)
9	LYCAENIDAE	<i>Durbania amakosa ayresi</i>	Amakoza rocksitter	Least Concern (SABCA 2013)
10	LYCAENIDAE	<i>Orachrysops lacrimosa</i>	Restless cupid	Least Concern (SABCA 2013)
11	NYMPHALIDAE	<i>Acraea violarum</i>	Speckled red acraea	Least Concern (SABCA 2013)
12	NYMPHALIDAE	<i>Aerpetes tulbaghia</i>	Table Mountain beauty	Least Concern (SABCA 2013)
13	NYMPHALIDAE	<i>Danaus chrysippus orientis</i>	African plain tiger	Least Concern (SABCA 2013)
14	NYMPHALIDAE	<i>Dingana alaedeus</i>	Wakkerstroom widow	Near Threatened (SABCA 2013)
15	NYMPHALIDAE	<i>Junonia hierta cebrene</i>	Yellow pansy	Least Concern (SABCA 2013)
16	NYMPHALIDAE	<i>Pseudonympha magoides</i>	False silver-bottom brown	Least Concern (SABCA 2013)
17	NYMPHALIDAE	<i>Pseudonympha paludis</i>	Marsh brown	Least Concern (SABCA 2013)
18	NYMPHALIDAE	<i>Pseudonympha varii</i>	Mountain marsh brown	Least Concern (SABCA 2013)
19	NYMPHALIDAE	<i>Stygionympha curlei</i>	Marsh hillside brown	Least Concern (SABCA 2013)
20	NYMPHALIDAE	<i>Stygionympha wichgrafi williami</i>	Wichgraf's hillside brown	Least Concern (SABCA 2013)
21	PIERIDAE	<i>Eurema brigitta brigitta</i>	Broad-bordered grass yellow	Least Concern (SABCA 2013)
22	PIERIDAE	<i>Teracolus agoye bowkeri</i>	Speckled sulphur tip	Least Concern (SABCA 2013)

## 6.8 Surface Water

### 6.8.1 Water Management Area

The project area is located in the W51B and W52A quaternary catchments, which form part of the Inkomati-Usuthu Water Management Area (Figure 6-23).

The project boundary area covers 42.40km<sup>2</sup>. The majority of the project area is situated within quaternary catchment W51B which drains towards the Heyshope Dam. Only a small portion of the project area (Nooitgesien opencast area on the western side of the mining right area) is situated in W52A which drains towards the Hlelo River.

### 6.8.2 Surface Water Hydrology

Seven (7) hydrological response units (HRUs) describe the natural drainage for the study area (using a 1:1 000 stream count and 30 m DTM fill) (refer to Figure 6-24). The sub-catchment relates well to desktop-delineated drainage lines for the project area, as well as verified streams associated with the project area.

Primary drainage from the position of the proposed co-disposal site, and much of the MQE area is towards the northeast, to the perennial Egude River, which makes up the bottom inflow of the Heyshope Dam. Drainage from the southern portions of the MQE area, and Maquasa West (MQW) is towards the south, via several perennial and non-perennial drainage lines, towards the southern inflow of the Heyshope Dam. The Heyshope Dam is therefore the end received of any surface water-related pollution that may take place at the MQE operations. The sub-catchments that are associated with the proposed CDF are HRU1 to 3, and HRU6. The sub-catchment associated with the proposed treatment area is HRU5.

**Table 6-12: Summary of sub-catchment characteristics**

Sub-Catchment		HRU1	HRU2	HRU3	HRU4	HRU5	HRU6	HRU7
Area (km <sup>2</sup> )		1.549	2.609	1.890	1.84	1.24	1.36	9.92
Longest Drainage Line (km)		1.99	1.08	1.148	1.18	0.57	1.33	7.26
Average Slope (%)		0.56%	1.23%	3.08%	2.01%	9.14%	1.70%	4.30%
Slope (%)	<3	35.66%	15.25%	8.46%	12.24%	4.19%	26.40%	20.00%
	3-10	63.80%	73.48%	42.12%	72.04%	66.11%	73.10%	10.00%
	10-30	0.53%	11.27%	39.28%	14.94%	29.70%	0.50%	20.00%
	>30	0.00%	0.00%	10.14%	0.78%	0.00%	0.00%	50.00%
Land Cover	Thick bush & plantation	18%	11%	8%	17%	2%	12%	5.91%
	Light bush & farmlands	29%	11%	4%	4%	16%	2%	2.60%
	Grasslands	51.5%	61.3%	77.4%	75.6%	75.0%	63.1%	89.4%
	No Vegetation	1%	17%	10%	3%	7%	23%	2.08%

The site area was divided into five (5) natural sub-catchment areas based on natural topography and contour data. The sub-catchments were delineated, and runoff was estimated. Two (2) sub-catchments drain in a northerly direction and fall within quaternary catchment W52A (the western side of the project area) while the remaining three (3) sub-catchments (eastern side of the project area) fall within quaternary catchment area W51B.

Sub-catchments 3 and 4 drain in a north-eastern direction whilst sub-catchment 5 drains to the southeast. Sub-catchment 5 comprises several smaller catchments that all drain into the Heyshope dam but were lumped together to represent 1 cumulative sub-catchment for this study. The largely rural catchments are dominated by grasslands, but mining activities and small peri-urban settlements to the east will influence runoff patterns.

Surrounding areas are dominated by plantations and natural forests. The catchment is hilly, with steep slopes and (normally) well-defined, narrow streams (channels).

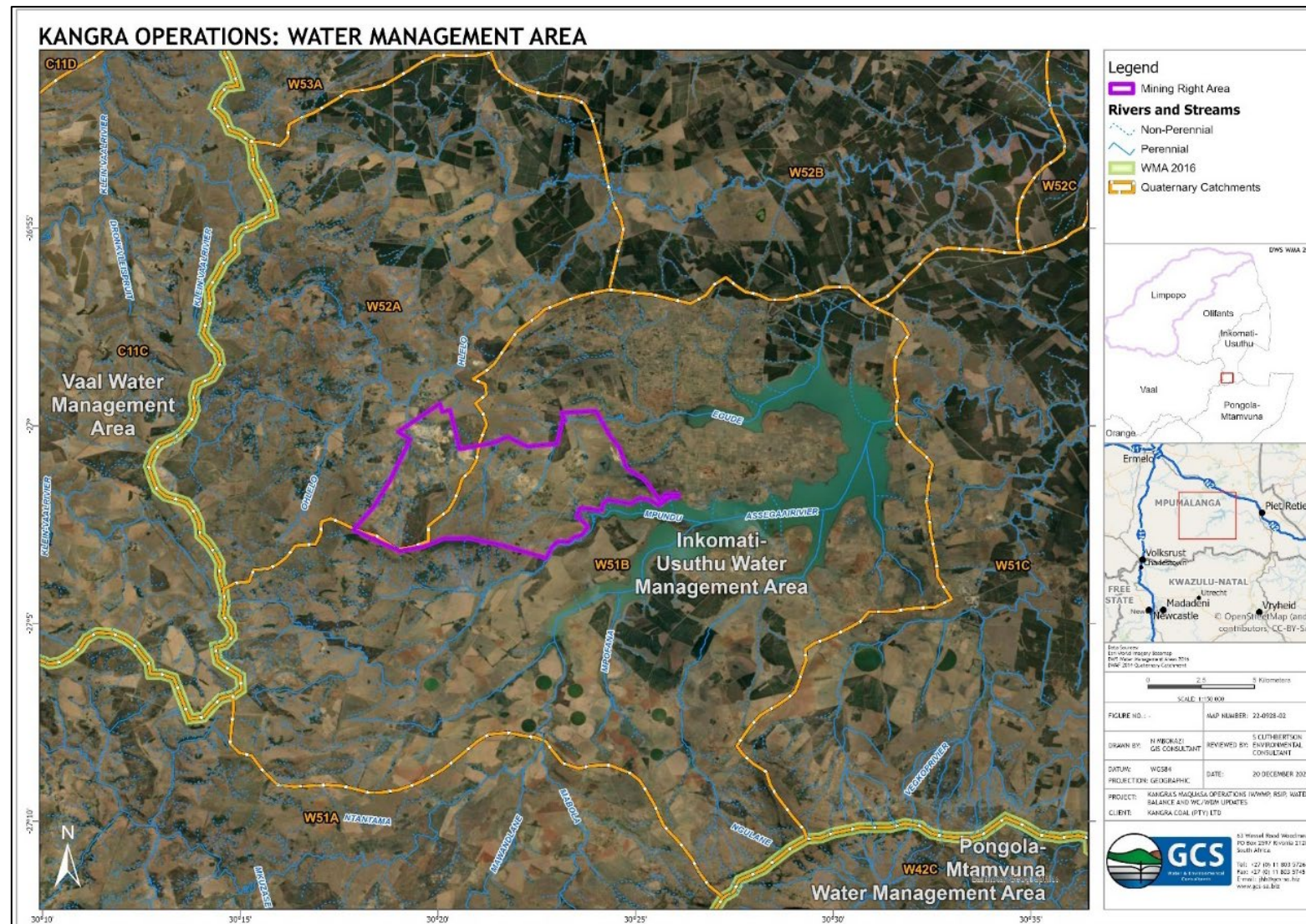


Figure 6-23: Water Management Area and Quaternary Catchments for Kangra Maquasa Operations



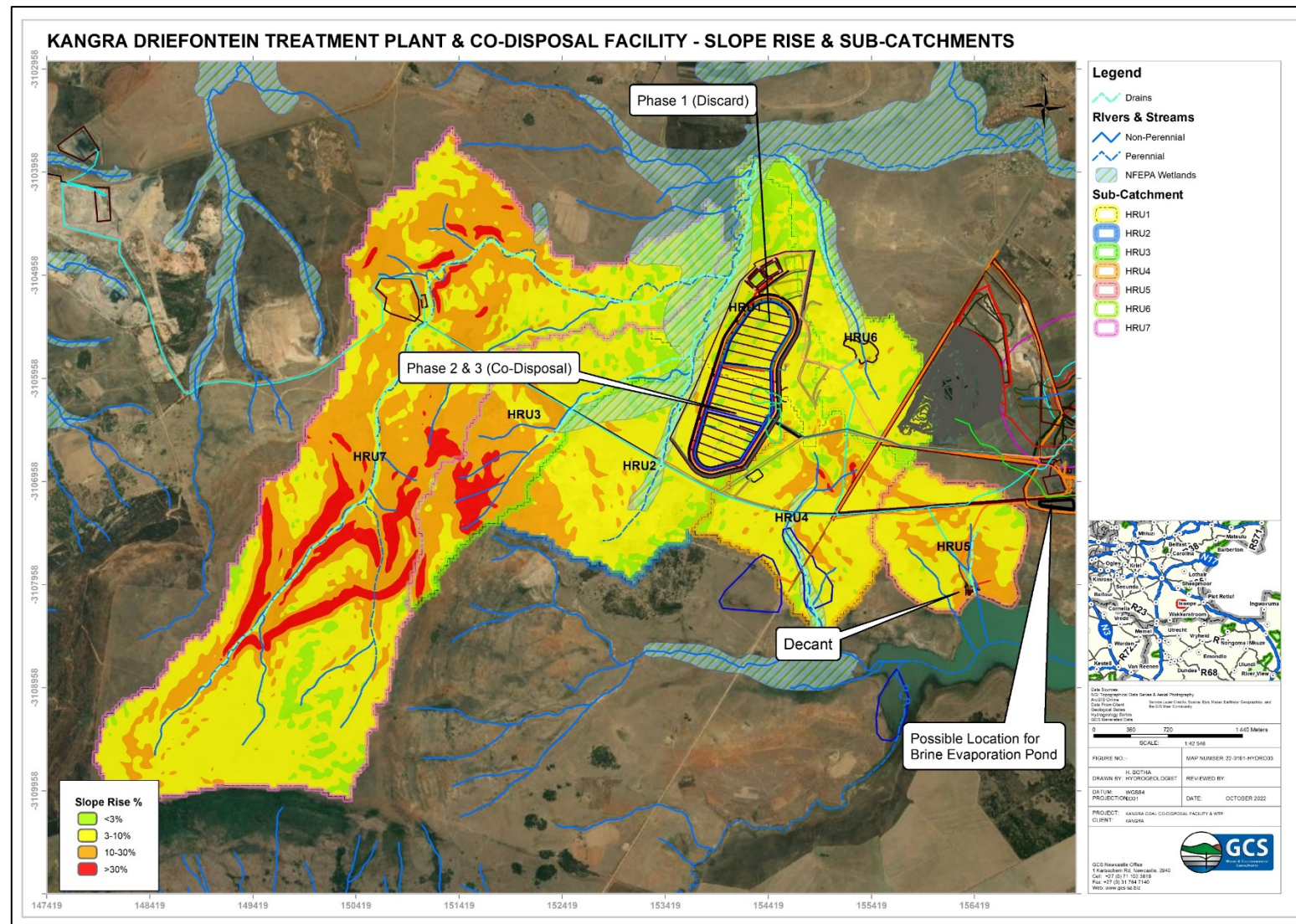


Figure 6-24: Maquasa Hydrology Sub Catchments



### 6.8.3 Surface Water Quality

The MQE area consists of mine infrastructure, open cast areas, an overburden dump, a discard dump, pollution control dams, settling ponds and underground mine workings. A total of (19) nineteen groundwater sites and twenty-three (23) surface water sites exist in the MQE area and are monitored quarterly or monthly (depending on the sampling site type).

The surface water sampling points at MQE are summarised in Table 6-13 and shown in Figure 6-25 and the water quality is discussed thereafter.

**Table 6-13: MQE surface water sampling sites**

SITE ID	LATITUDE	LONGITUDE
	(WGS84)	(WGS84)
Below Highwall Seepage	-27.0300	30.39053
Canal Along Main Road	-27.00575	30.4068
Discard Dump Dam 1	-27.01555	30.40247
Discard Dump Seepage 1	-27.01161	30.4032
Discard Plant	-27.02391	30.41937
Discharge into Heyshope Dam	-27.02665	30.40522
DS of Natural Seepage	-27.03175	30.42167
East Heyshope	-27.03188	30.40492
Enprotec Filter Discharge	-27.02567	30.41827
Export Plant	-27.02275	30.41793
Heyshope Dam Water / Abstraction	-27.0317	30.42058
Highwall Seepage	-27.02541	30.38938
Improtect Clarified	-27.02516	30.4177
Inland Plant	-27.02232	30.41798
Pit D East	-27.01373	30.39485
Plant Set Pond / Dam 2	-27.01917	30.41457
Plant Water Dam 3	-27.02003	30.41356
Water Treatment Maquasa Plant East	-27.02252	30.41292
West Heyshope	-27.03175	30.4054
924	-27.02259	30.43474
932	-27.00536	30.43202
933	-27.01793	30.41272
CSW04	-27.016445	30.412429
Monitoring Localities		
Internal Process Water		

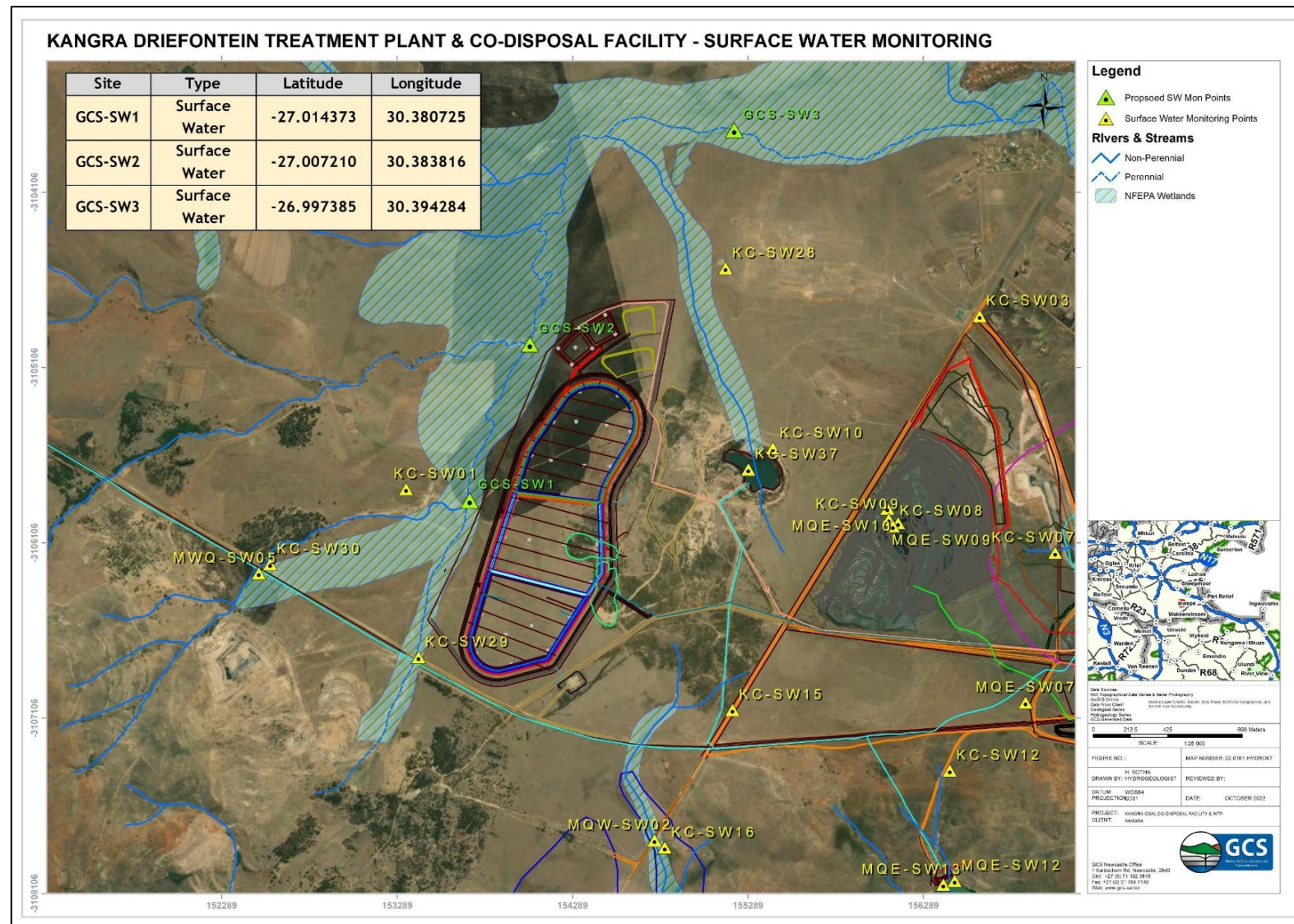
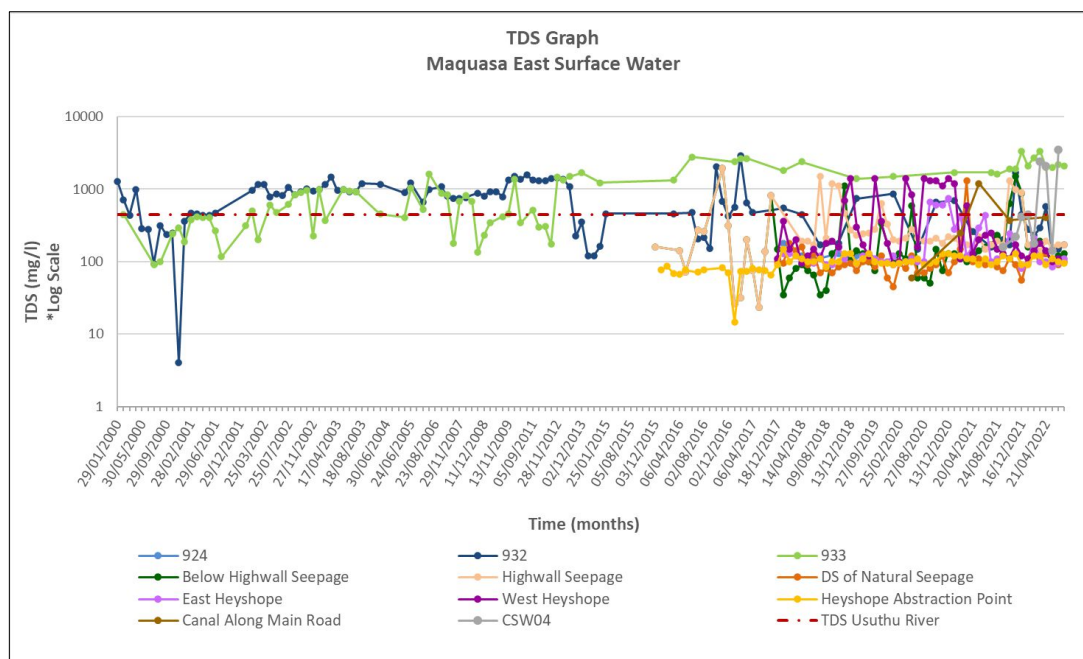


Figure 6-25: Surface Water Monitoring Points in the vicinity of CDF and WWTP

One new surface water point (CSW04) was added to the surface water monitoring network in July 2021. Canal Along Main Road was dry throughout the second quarter whilst CSW04 was dry during the July 2022 sampling event.

The following observations were made during the 2022 second quarter:

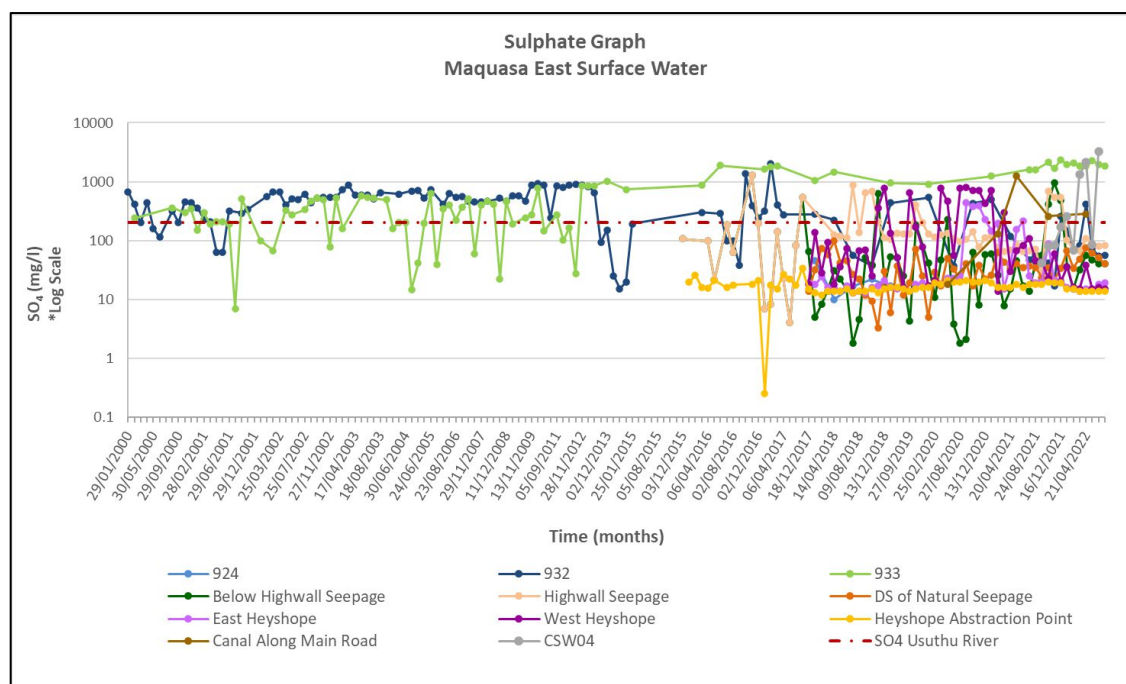
- All surface water monitoring points exhibited neutral to slightly alkaline pH conditions throughout the second quarter, ranging between 6.8 and 8.3.
- Surface water points Below Highwall Seepage, Highwall Seepage, D/S of Natural Seepage, East Heyshope, Heyshope Dam Abstraction, West Heyshope and SW 932 displayed low to no significant impact from the site.
  - In terms of metal concentrations, manganese (< 0.65 mg/l) was elevated at Below Highwall Seepage, Highwall Seepage and SW 932 during the second quarter of 2022. Iron (< 0.15 mg/l) was elevated at East Heyshope, Heyshope Dam Abstraction and West Heyshope during the second quarter of 2022.
  - Aluminium concentrations were elevated at Heyshope Dam Abstraction and West Heyshope during the second quarter of 2022. The source is most likely the upstream discard dump. Aluminium is commonly associated with burnt clinker material generated by discard dumps.
  - Ammonia concentrations were elevated at Below Highwall Seepage, Highwall Seepage, D/S of Natural Seepage, East Heyshope, Heyshope Dam Abstraction, West Heyshope and SW 932 during the June 2022 sampling event, ranging between 7.3 and 7.9 mg/l.
- CSW04 and SW 933 indicated an impact from the site during the 2022 second quarter period. CSW04 was compliant with the Usuthu River Catchment TWQG during the May 2022 sampling event and could not be sampled during the July 2022 sampling event due to low water levels.
  - EC, TDS, calcium and sodium concentrations exceeded the Usuthu River Catchment TWQGs at SW 933 throughout the second quarter. TDS ranged between 2 00 mg/l and 3 300 mg/l as shown in Figure 6-26.
  - During the June 2022 sampling event, CSW04 indicated elevated EC, TDS, calcium and sodium concentrations exceeding the Usuthu River Catchment TWQGs. Elevated salt concentrations at CSW04 are likely due to evaporation at this locality causing the water to become more concentrated.



**Figure 6-26: Maquasa East logarithmic surface water TDS graph**

- Sulphate concentrations predominantly exceeded the Usuthu River Catchment TWQG at CSW04 and SW 933 as shown in Figure 6-27.
  - Sulphate at SW 933, located downstream of the underground workings, has historically fluctuated however, a relatively stable trend has been observed since 2013. Sulphate ranged between 1 840 and 2 260 mg/l in the second quarter.
  - Sulphate at most localities indicated slight decreases in concentrations during the second quarter.
  - Sulphate exceeded the Usuthu River Catchment TWQG at CSW04 (3 230 mg/l) during the June 2022 sampling event.
- Additionally, ammonia (8 mg/l) and nitrate (30 mg/l) were elevated at CSW04 during the June 2022 sampling event. SW 933 indicated elevated ammonia (7.8 mg/l) concentrations during the June 2022 sampling event.
- In terms of metal concentrations, manganese was in exceedance at SW 933 and CSW04, ranging between 3 and 10.0 mg/l.





**Figure 6-27: Maquasa East logarithmic surface water sulphate graph**

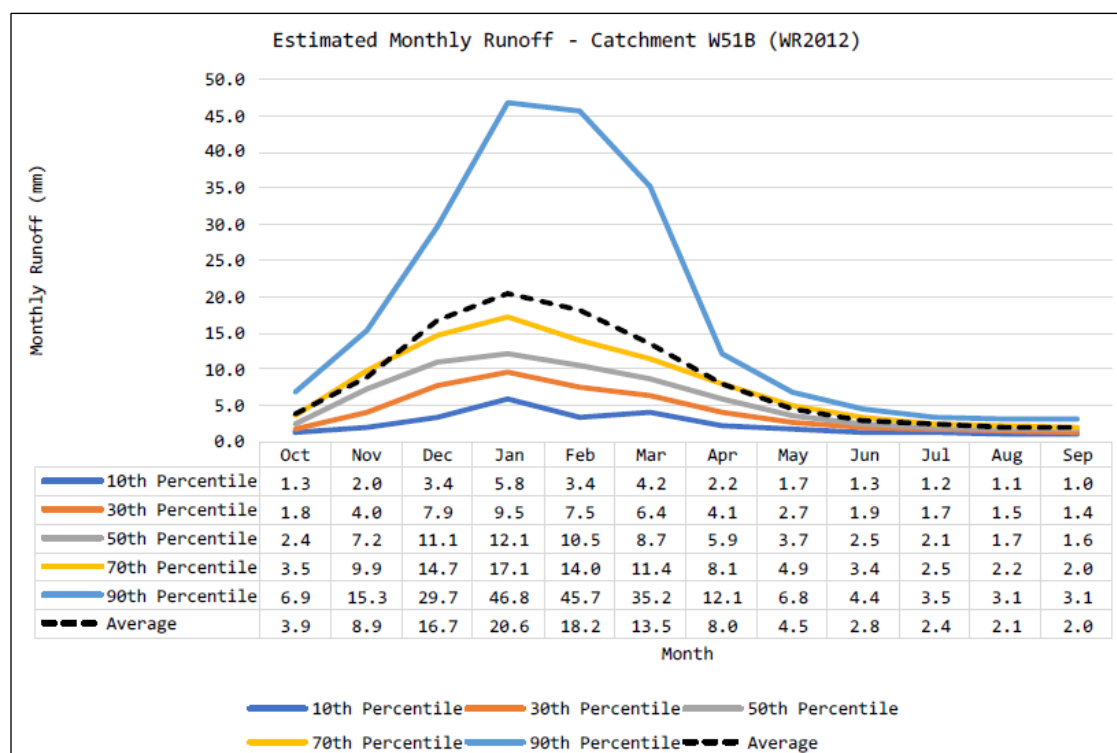
The groundwater quality results for boreholes Well Yende, KGA1, KGA2, BCBH02, GCS16 and GCS17 indicate an impact from the site. KGA1 and GCS16 indicate the most significant impact, which is most likely a result of combined seepage from the discard facility and underground workings. These boreholes have displayed consistently non-compliant water quality, representative of high sulphate mine drainage as a result of decanting mine water from the underground workings.

Surface water points Canal Along Main Road, CSW04, SW 932 and SW 933 indicated an impact from the site; the remaining points displayed low to no significant impact.

The predominant trend at this site indicates intermittently impacted surface water quality. This may suggest periodic decant or dilution following rainfall events, at certain sample positions.

#### 6.8.4 Mean Annual Runoff

Runoff from natural (unmodified) catchments for quaternary catchment W51B is simulated in WR2012 (WRC, 2015) as being equivalent to 103.5 mm/yr (or 13% of the MAP). This is approximately 51.369 Mm<sup>3</sup>/yr NMAR for the surface area of W51B. The simulated natural (unmodified) runoff for W51B is presented in Figure 6-28.



**Figure 6-28: Simulated natural (unmodified) runoff for W51B**

#### 6.8.5 Floodlines

Flood peak flow for the perennial stream portion associated with the sub-catchment was estimated with the Rational Method (3), Standard Design Flood (SDF) and Midgley & Pitman (MIPI) Method (refer to Appendix A of the Hydrological Assessment Report). The full methodology for the calculation of floodlines is provided under section 5 of the Hydrological Assessment Report (Appendix E-3). The floodlines are presented in Figure 6-29.



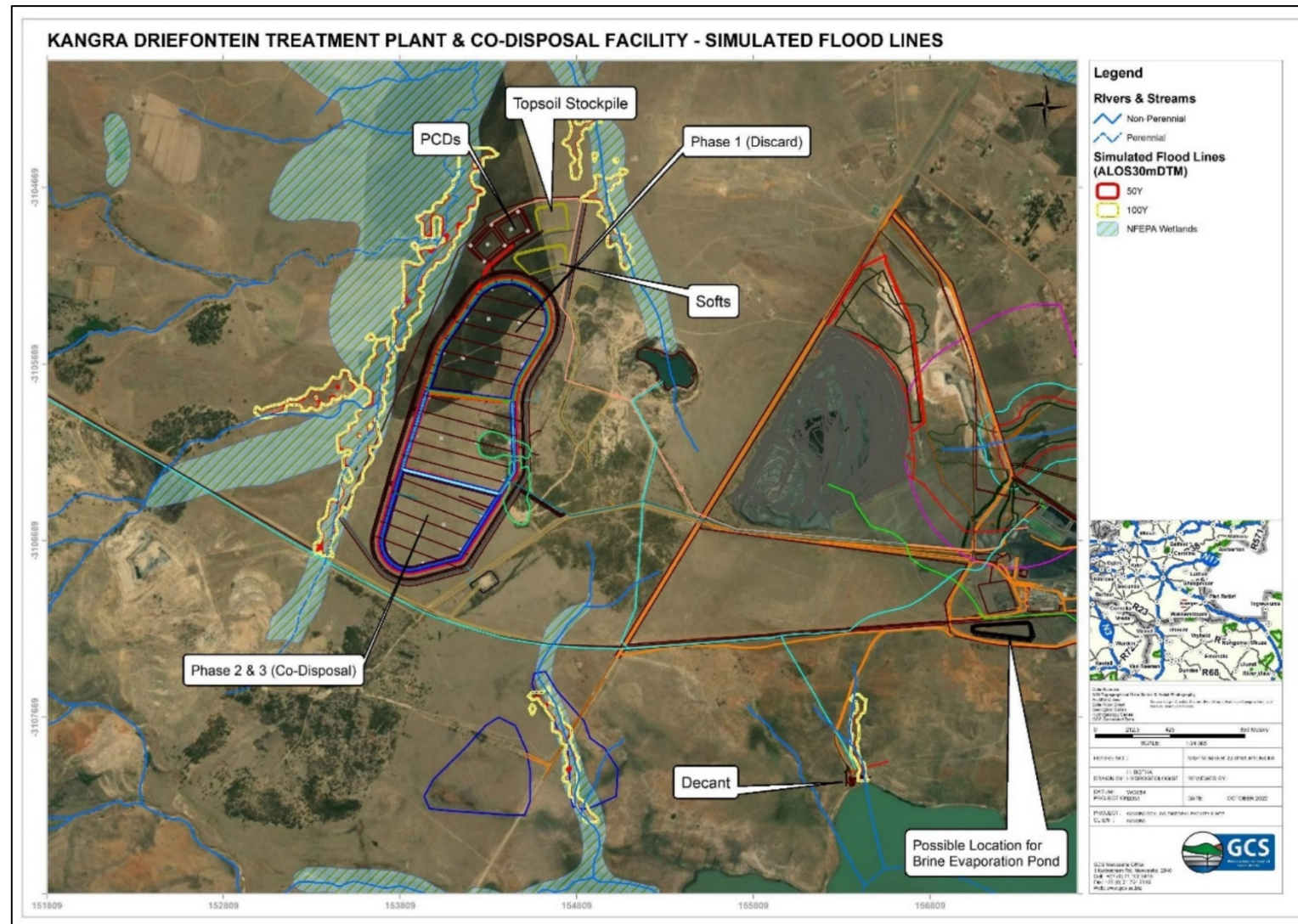


Figure 6-29: Floodline Map of the Project Area

### 6.8.6 Resource Class and River Health

In South Africa, a river health classification scheme is used to standardise the output of different river systems. The document titled “Resource Directed Measures for Protection of Water Resources: River Ecosystems Version 1.0.24”, dated September 1999, compiled by the DWS, provides the indexes of Attainable Ecological Management Classes (AEMC) as shown in Table 6-14. Each index is calibrated so that its results can be expressed in terms of ecological and management perspectives.

**Table 6-14: Resource Classes at set out by the DWS**

River Health Class	Ecological perspective	Management perspective
<b>Natural / Excellent (Class A)</b>	No or negligible modification of in-stream and riparian habitats and biota.	Protected rivers; relatively untouched by human hands; no discharge or impoundments allowed.
<b>Good (Class B)</b>	Ecosystems essentially in a good state; biodiversity is largely intact.	Some human-related disturbance but mostly of low impact potential.
<b>Fair (Class C)</b>	A few sensitive species may be lost; a lower abundance of biological populations is likely to occur, or sometimes, higher abundances of tolerant or opportunistic species occur.	Multiple disturbances associated with need for socio-economic development, e.g., impoundment habitat modification and water quality degradation.
<b>Poor Class D)</b>	Habitat diversity and availability have declined; mostly only tolerant species present; species present are often diseased; population dynamics have been disrupted (e.g., biota can no longer reproduce, or alien species have invaded the ecosystem)	Often characterised by high human densities or extensive resource exploitation. Management intervention is needed to improve river health - e.g., to restore flow patterns, river habitats or water quality.

#### 6.8.6.1 Determining Current Management Class for the Water Resource

With reference to ‘A guideline for water use authorisation in the mining sector, Edition 1 (2005),’ DWS has identified the Drainage Region as being: W51B and W52A. Drainage region W5 is classified as:

- **High** in its Ecological Importance and Sensitivity (EIS);
- **Moderately Modified**, Class C (W51B) in its Present Ecological State (PES); and
- **Largely Natural**, Class B (W52A) in its PES.

### 6.8.6.2 Determining Sensitivity of the Water Resource in the vicinity of the Mine

In the short term, with the future Management classes not defined, the precautionary principle will apply, and the vision for the catchment will be based on ecological criteria, as tabulated in Table 6-15. Management measures in the short term for W51B have been evaluated as improving the PES of the River to a Class B/C. Management measures in the short term for W52A have been evaluated as improving the PES of the River to a Class A/B (Table 6-16).

**Table 6-15: Short Term PES and EIS for W51B**

			Ecological Importance and Sensitivity (EIS)			
			VH	H	M	L
Present Ecological State (PES)	A	Pristine	A Maintain	A Maintain	A Maintain	A Maintain
	B	Natural	A Improve	A/B Improve	B Maintain	B Maintain
	C	Good	B Improve	B/C Improve	C Maintain	C Maintain
	D	Fair	C Improve	C/D Improve	D Maintain	D Maintain
	E/F	Poor	D Improve	D/E/F Improve	E/F Maintain	E/F Maintain

**Table 6-16: Short Term PES and EIS for W52A**

			Ecological Importance and Sensitivity (EIS)			
			VH	H	M	L
Present Ecological State (PES)	A	Pristine	A Maintain	A Maintain	A Maintain	A Maintain
	B	Natural	A Improve	A/B Improve	B Maintain	B Maintain
	C	Good	B Improve	B/C Improve	C Maintain	C Maintain
	D	Fair	C Improve	C/D Improve	D Maintain	D Maintain
	E/F	Poor	D Improve	D/E/F Improve	E/F Maintain	E/F Maintain

In the long term, the catchment vision will be based on the current assessment and the future Management Class, as tabulated in Table 6-17 and Table 6-18.

Management measures in the long term have been evaluated as maintained with a vision of a future Management Class III for drainage regions W51B and W52A.

**Table 6-17: Long Term PES and EIS for W51B**

Present Ecological State (PES)			Ecological Importance and Sensitivity (EIS)			
			I Special Protected	II Protected	III Good Quality	IV Acceptable Quality
	A	Pristine	Maintain	Maintain	N/A	N/A
	B	Natural	Maintain	Maintain	Maintain	Sustainable use
	C	Good	Improve	Improve	Maintain	Sustainable use
	D	Fair	Improve	Improve	Improve	Maintain
	E/F	Poor	Improve	Improve	Improve	Improve

**Table 6-18: Long Term PES and EIS for W51A**

Present Ecological State (PES)			Ecological Importance and Sensitivity (EIS)			
			I Special Protected	II Protected	III Good Quality	IV Acceptable Quality
	A	Pristine	Maintain	Maintain	N/A	N/A
	B	Natural	Maintain	Maintain	Maintain	Sustainable use
	C	Good	Improve	Improve	Maintain	Sustainable use
	D	Fair	Improve	Improve	Improve	Maintain
	E/F	Poor	Improve	Improve	Improve	Improve

The sensitivity of the water resource is based on the management measures that will be employed to affect the catchment vision. This has been tabulated in Table 6-19.

**Table 6-19: Sensitivity of the Water Resource**

STRATEGY NO.	STRATEGY FOR THE WATER RESOURCE	SENSITIVITY OF THE WATER RESOURCE
1	Employ management measures with a view to improving the resource class.	High
2	Employ management measures with a view to maintain the resource class as is.	Medium
3	Employ management measures with a view to allow controlled degradation of the water resource	Low

#### **6.8.7 Receiving Water Quality Objectives**

There are currently no receiving water quality objectives published for the project's catchment area by the DWS. The last known resource quality objectives relating to Kangra Operations (i.e., Lower Vaal Catchment) to be published was done so in April 2016 (GN 470). It should, however, be noted that no water is discharged to any receiving water resources by the Maquasa mining area. The mine is operating on a closed water circuit.

#### **6.8.8 Surface Water User Survey**

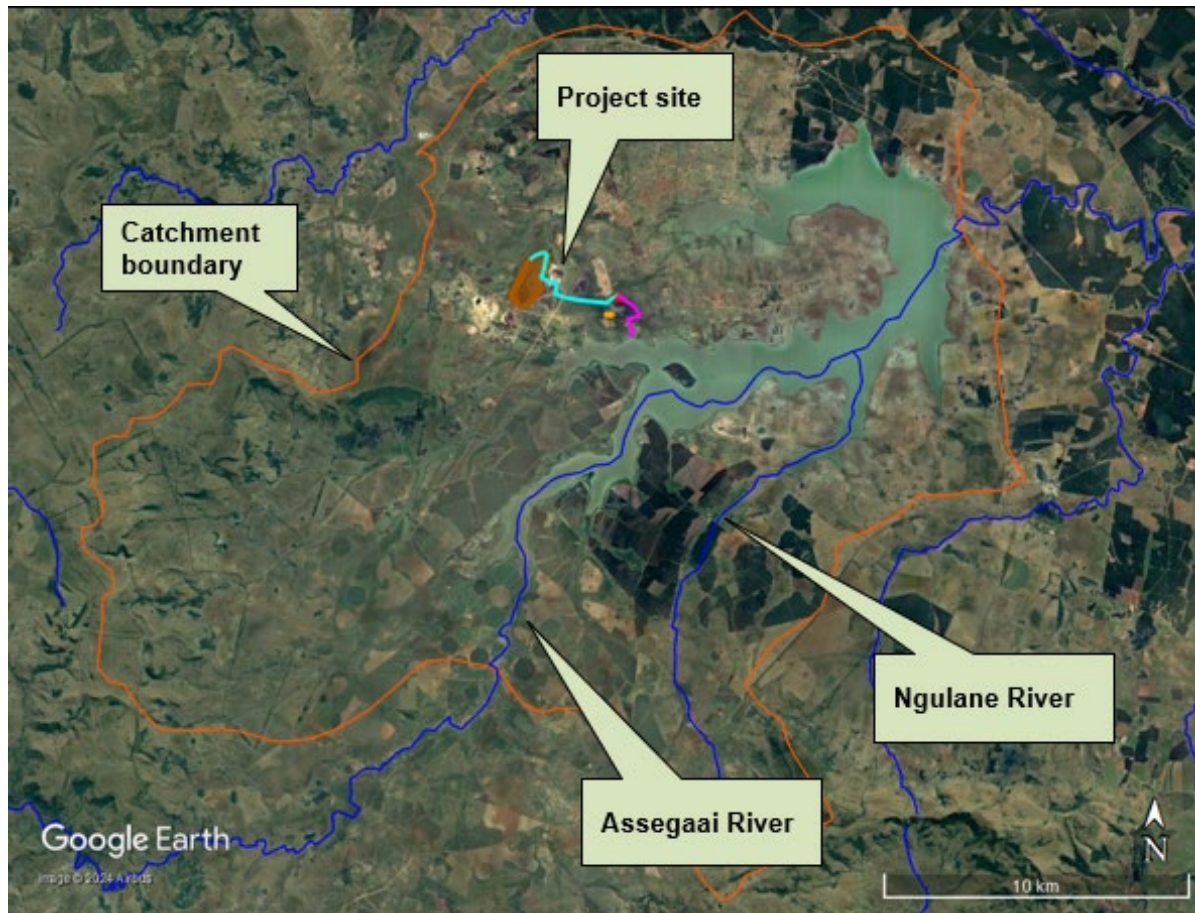
The mining area is situated north of the western portion of the Heyshope Dam. This dam was established in 1986 and it is used to supply water to surrounding municipalities and industries. Water from the dam is also used to supply Eskom with water for electricity generation.

#### **6.8.9 National Freshwater Ecosystem Priority Area (FEPA)**

The Atlas of Freshwater Ecosystem Priority Areas (FEPA) in South Africa (Nel *et al*, 2011a) (The Atlas) provides a series of maps detailing strategic spatial priorities for conserving South Africa's freshwater ecosystems and supporting sustainable use of water resources. Freshwater Ecosystem Priority Areas (FEPA's) were identified through a systematic biodiversity planning approach that incorporated a range of biodiversity aspects such as ecoregion, current condition of habitat, presence of threatened vegetation, fish, frogs and birds, and importance in terms of maintaining downstream habitat. The Atlas incorporates the National Wetland Inventory (SANBI, 2011) to provide information on the distribution and extent of wetland areas.

River FEPA's achieve biodiversity targets for river ecosystems and threatened/near threatened fish species and were identified in rivers that are currently in a good condition (A or B ecological category). The FEPA status indicates that they should remain in a good condition in order to contribute to national biodiversity goals and support sustainable use of water resources. Kangra CDF is located in the W51B Quaternary Catchment. The dominant rivers in this Quaternary Catchment are the Assegai and Ngulane Rivers that drain the catchment in an easterly direction (see Figure 6-30). Both these rivers are classified as NFEPA Rivers and has been classified as Class C features which means that they are Moderately Modified.

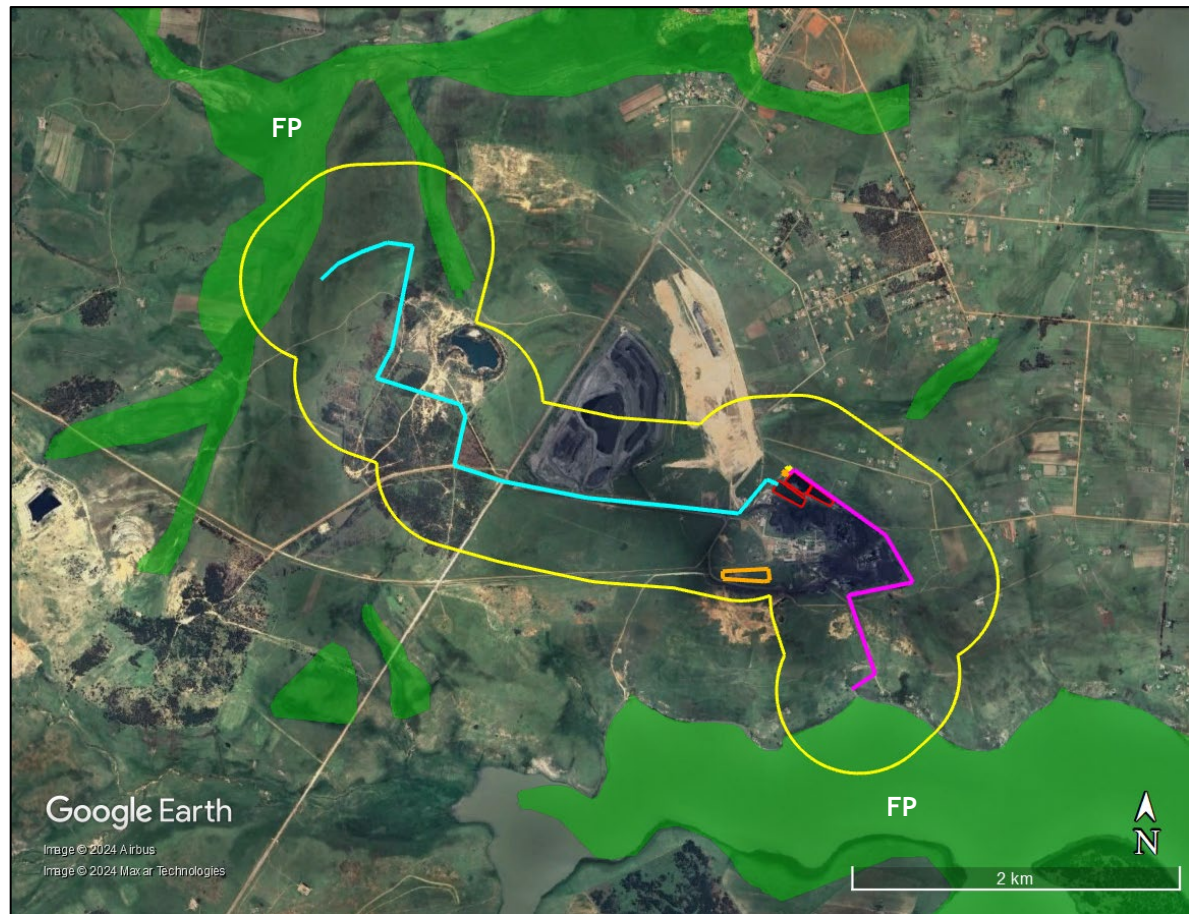




**Figure 6-30: Location of the NFEPA Rivers identified in the NFEPA Database for Quaternary Catchment W51B**

The database has also identified two wetland features within a 500m radius of the project site. The location of these wetland features is project site is provided in Figure 6-31. The database identifies both the wetland features as Floodplain wetlands. The Floodplain wetland located to the south of the study site is artificial in nature and consists of the Heyshope Dam.





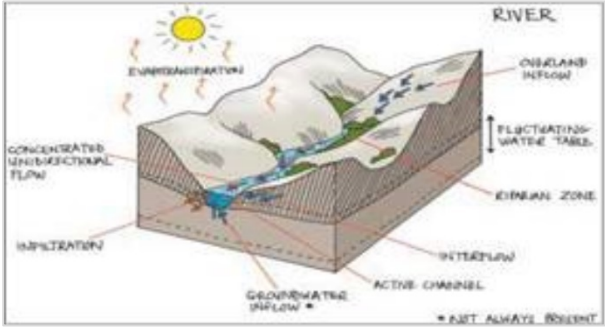
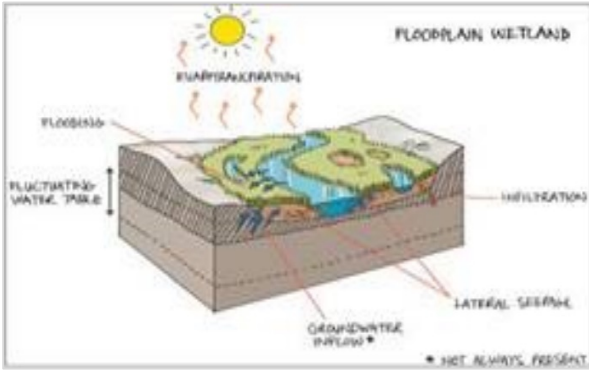
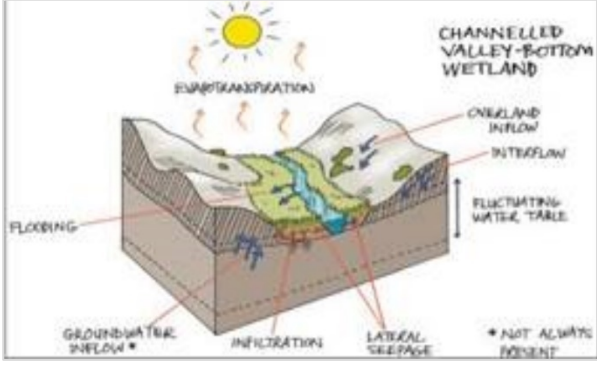
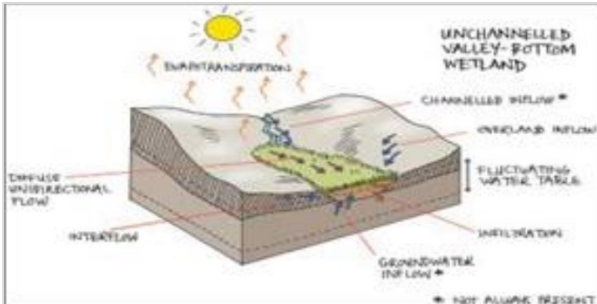
FP = Floodplain

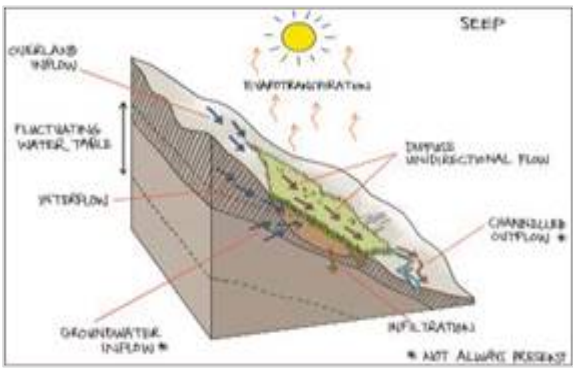
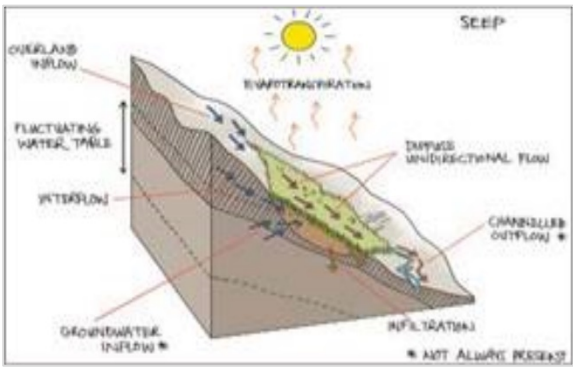
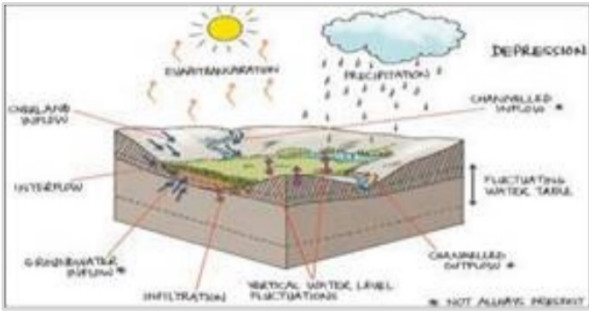
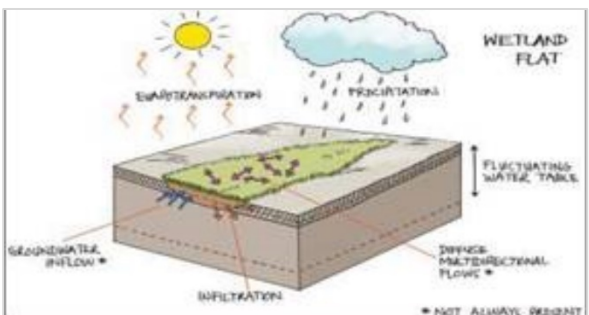
**Figure 6-31: Location of the wetland features identified in the NFEPA Dataset (shown in green) in relation to a 500m radius (shown in yellow) of the project site**

#### **6.8.10 Sensitive Areas (Wetlands)**

Following the identification of the aquatic features on the study site, these are then classified into specific hydrogeomorphic (HGM) units according to the Classification System for Wetlands and other Aquatic Ecosystems in South Africa (inland systems) (Ollis et al., 2013). The summary of these HGM types is presented in Table 6-20.

**Table 6-20: Wetland hydrogeomorphic (HGM) types typically supporting inland wetlands in South Africa (Ollis et al., 2013)**

HYDROGEOMORPHIC TYPES	DESCRIPTION
<p><b>River</b></p>	 <p>Rivers are linear landforms with clearly discernible banks and a channel, which permanently or periodically, carries a contained and defined flow of water. A river is taken to include both the active channel and the riparian zone.</p>
<p><b>Floodplain</b></p>	 <p>Valley bottom areas with a well-defined stream channel, gently sloped and characterised by floodplain features such as oxbow depressions and natural levees and the alluvial (by water) transport and deposition of sediment, usually leading to a net accumulation of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.</p>
<p><b>Valley bottom with channel</b></p>	 <p>Valley bottom areas with a well-defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterised by the net accumulation of alluvial deposits or may have steeper slopes and be characterised by the net loss of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.</p>
<p><b>Valley bottom without a channel</b></p>	 <p>Valley bottom areas with no clearly defined stream channel, usually gently sloped and characterised by alluvial sediment deposition generally leading to a net accumulation of sediment. Water inputs mainly from channel entering the wetland and also from adjacent slopes.</p>

HYDROGEOMORPHIC TYPES	DESCRIPTION
Hillslope seepage linked to a stream channel	 <p>Slopes on hillsides, which are characterised by the colluvial (transported by gravity) movement of materials. Water inputs are mainly sub-surface flow and outflow is usually via a well-defined stream channel connecting the area directly to a stream channel.</p>
Isolated Hillslope seepage	 <p>Similar to other hillslope seeps but with no direct surface water connection to a stream channel. Slopes on hillsides, which are characterised by the colluvial (transported by gravity) movement of materials. Water inputs mainly from sub-surface flow and outflow primarily by diffuse sub-surface and/or limited surface flow.</p>
Depression (includes Pans)	 <p>A basin shaped area with a closed elevation contour that allows for the accumulation of surface water (i.e. it is inward draining). It may also receive sub-surface water. An outlet is usually absent, and therefore this type is usually isolated from the stream channel network.</p>
Wetland Flat	 <p>A flat wetland with no apparent inlet or outlet points. Water is obtained from surface or near surface flows and is lost either by downward percolation or evapotranspiration. May be only seasonal in terms of its wetness and hydromorphic soils may be only weakly developed or else be absent. Vegetation may be the strongest indicator.</p>

#### 6.8.10.1 Wetland Delineation and Description

The site assessment confirmed the absence of any natural wetland features within the boundaries of the project site. Furthermore, it identified three wetland features, one a Floodplain wetland (FP) associated with the Kwaggalaagte River, one a Channelled Valley Bottom wetland (CVB) associated with the Heilvleispruit and a Seep wetland (SP) within a 500m radius of the project site. The location of these features is indicated in Figure 6-32 and the identification of the wetland features is provided in Table 6-21.

**Table 6-21: Wetland classification as per SANBI guideline (Ollis *et al.* 2013)**

Wetland System	Level 1	Level 2			Level 3	Level 4
	System	NFEPA Wet Veg Group/s			Landscape Unit	4A (HGM)
HGM 1	Inland	Mesic	Highveld	Grassland	Slope	Channelled Valley Bottom wetland
HGM 2	Inland	Mesic	Highveld	Grassland	Slope	Channelled Valley Bottom wetland
HGM 3	Inland	Mesic	Highveld	Grassland	Slope	Channelled Valley Bottom wetland
HGM 4	Inland	Mesic	Highveld	Grassland	Gentle slope	Seep wetland
HGM 5	Inland	Mesic	Highveld	Grassland	Valley floor	Unchannelled valley bottom wetland
HGM 6	Inland	Mesic	Highveld	Grassland	Valley floor	Unchannelled valley bottom wetland
HGM 7	Inland	Mesic	Highveld	Grassland	Valley floor	Channelled Valley bottom



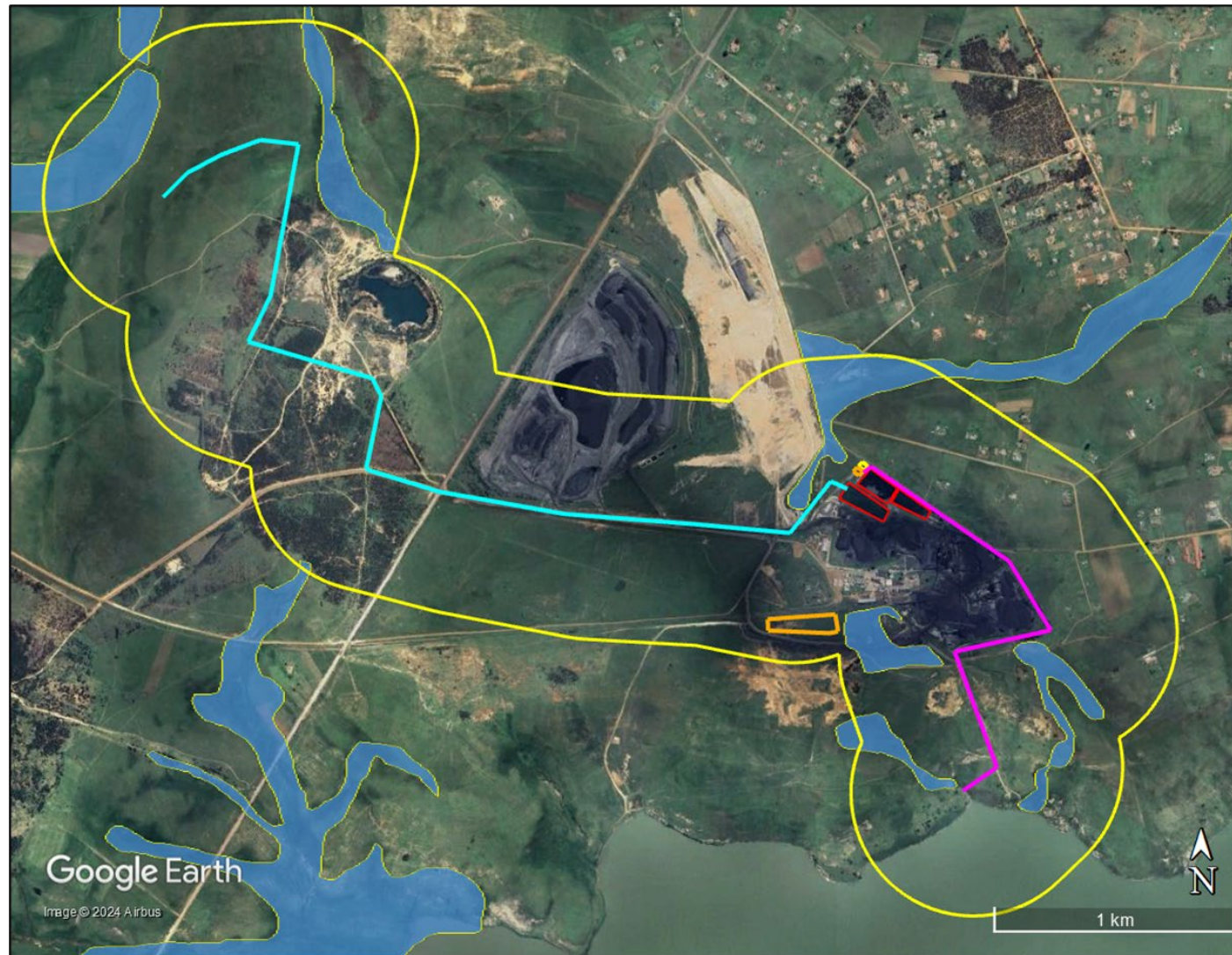


Figure 6-32: Location of the wetland features identified during the field assessment (in blue) within a 500m radius (in yellow) of the project site

#### 6.8.10.2 Aquatic Features Functional Assessment

The functional assessment of the wetland features all relates to the HGM Unit classification of the wetlands.

**Seep wetlands** (Figure 6-33) are typically located on gentle slopes and contain no water inflow channels. Water will typically collect in these Seep areas and due to the dense vegetation within the footprint will have a relatively high roughness coefficient that slows the movement of water to a point that infiltration into the soils is a prominent feature of these wetlands. The key water inputs into these Seeps are the interflow from the near surface groundwater that moves down the slopes as well as overland surface flow down the slopes. Evaporation and channelled outflow are key water releases from the features.

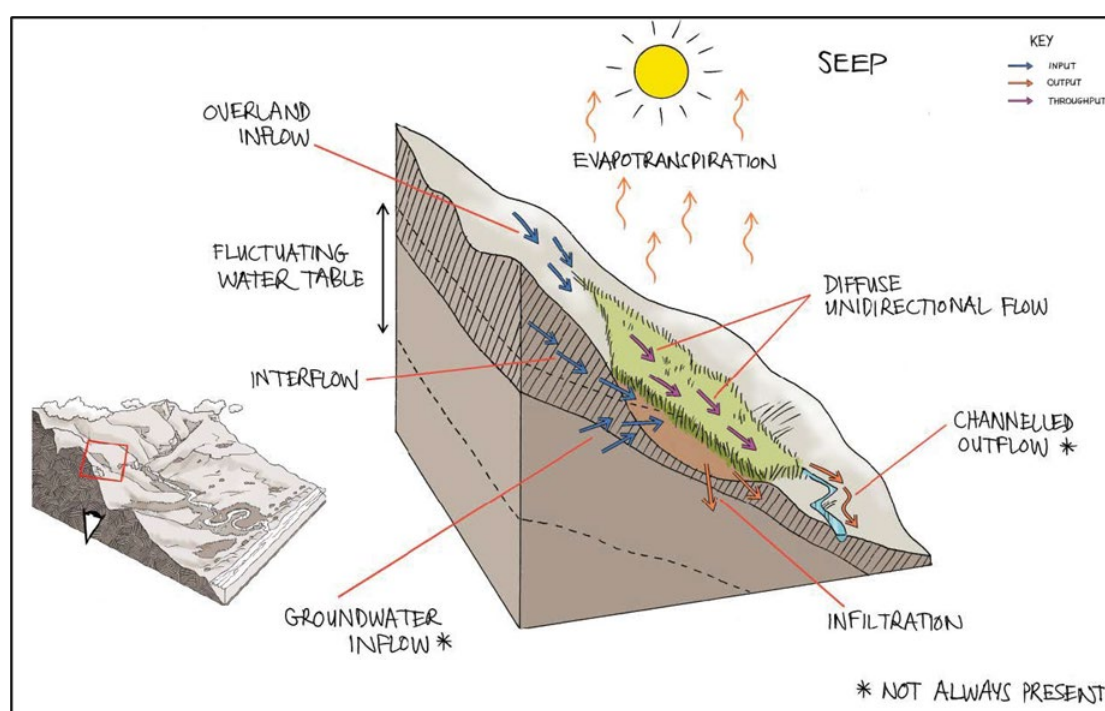


Figure 6-33: Conceptual illustration of a Seep wetland, showing the typical landscape setting and the dominant inputs, throughputs and outputs of water (Ollis et al. 2013)

**Unchannelled Valley Bottom wetlands** (Figure 6-34) are characterised by their location on valley floors, an absence of a distinct channel and the presence of the diffuse flow of water through the feature. Water inputs are typically from an upstream channel that becomes dominated by diffuse (surface and subsurface) flow as it enters the wetland and seepage from adjacent slopes. There may also be groundwater input into the wetland. Water characteristically moves through the wetland in the form of diffuse surface or subsurface flow, but the outflow may be in the form of either diffuse or concentrated surface flow. As such, these wetland types provide services associated with the erosion control, storage of toxicants, phosphates and nitrates and certain level of flood retention.



Infiltration and evapotranspiration from unchanneled valley-bottom wetlands can be significant, but horizontal, unidirectional, diffuse surface flow tends to dominate these wetland systems.

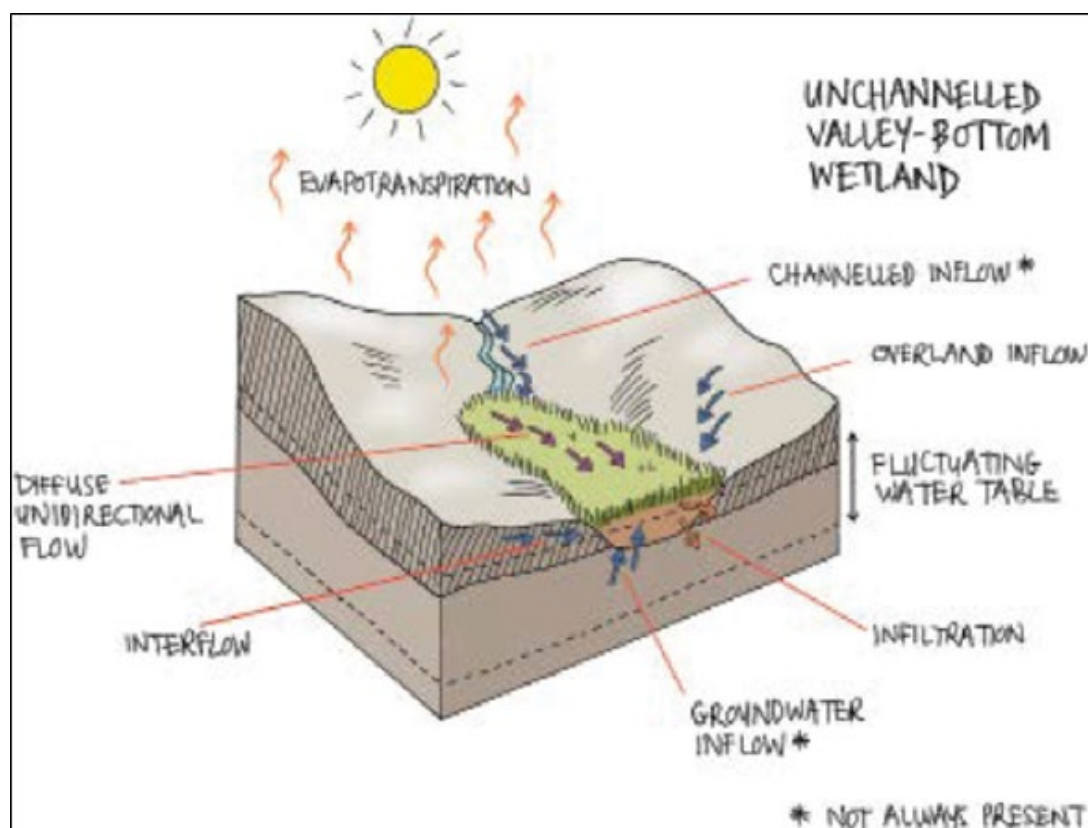
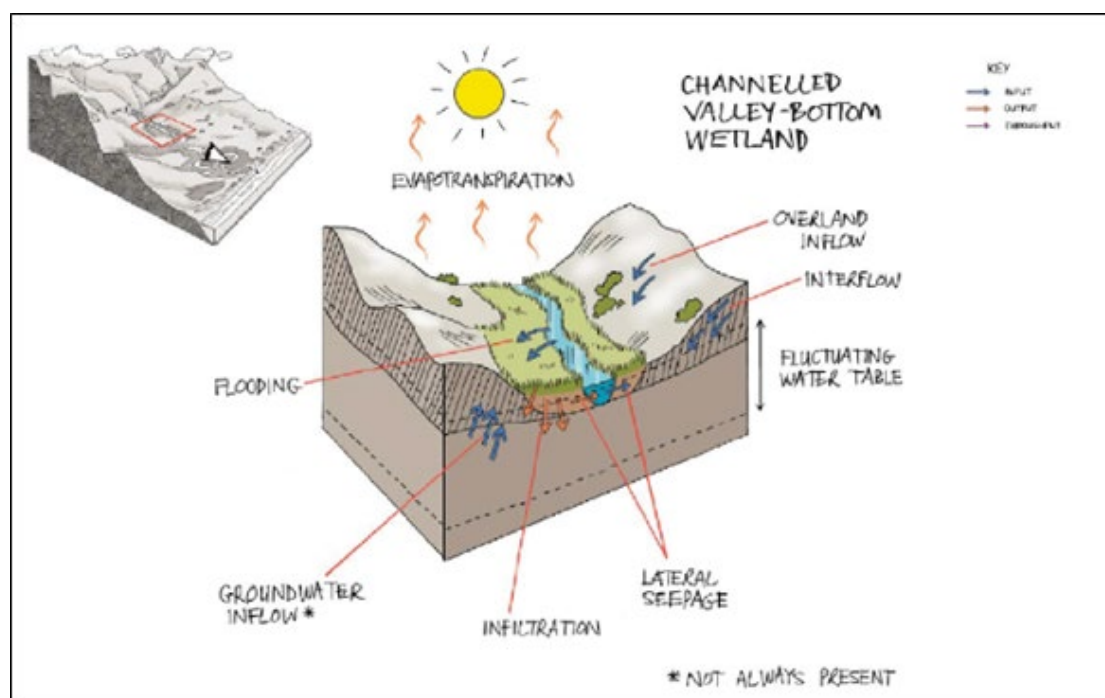


Figure 6-34: Conceptual illustration of a Unchannelled Valley Bottom wetland showing the typical landscape setting and the dominant inputs, throughputs and outputs of water (Ollis et al. 2013)

**Channelled Valley Bottom wetlands** must be considered as wetland ecosystems that are distinct from, but sometimes associated with, the adjacent river channel itself, which must be classified as a 'river'. These wetlands are characterised by their location on valley floors, the absence of characteristic floodplain features and the presence of a river channel flowing through the wetland.

Figure 6-35 is a conceptual diagram of a Channelled Valley Bottom wetland, showing the dominant inputs and outputs of water. Dominant water inputs to these wetlands are from the river channel flowing through the wetland, either as surface flow resulting from flooding or as sub-surface flow, and/or from adjacent valley-side slopes (as overland flow or interflow). Water generally moves through the wetland as diffuse surface flow, although occasional, short-lived concentrated flows are possible during flooding events



**Figure 6-35: Conceptual illustration of a Channelled Valley Bottom wetland showing the typical landscape setting and the dominant inputs, throughputs and outputs of water (Ollis et al. 2013)**

Water generally exits a Channelled Valley Bottom wetland in the form of diffuse surface or subsurface flow into the adjacent river, with infiltration into the ground and evapotranspiration of water from these wetlands also being potentially significant. Based on the hydrological characteristics of these wetlands they provide sediment, toxicant and nutrient storage functions as well as water supply particularly during the dry seasons.

#### 6.8.10.3 Wetland Ecological Function

The ecosystem services provided by the wetlands identified on site were assessed and rated using the WET-EcoServices method (Kotze et al. 2008). The summarised results for HGM 1 to HGM 7 are provided in Table 6-22. The average ecosystem services score has been determined to be “Moderately high”.

**Table 6-22: Ecosystem service provision by the Channelled Valley Bottom Wetlands associated with the project site**

Wetland Unit				HGM							
				1	2	3	4	5	6	7	
Ecosystem Services	Indirect Benefits	Regulating and supporting	Flood attenuation		2.1	2.0	2.0	2.2	2.3	2.3	2.3
			Streamflow regulation		2.0	2.0	2.3	2.2	2.3	2.3	2.3
			Water Quality	Sediment trapping	2.8	2.8	2.8	2.9	2.8	2.8	2.8

				Phosphate assimilation	2.4	2.2	1.9	2.2	2.4	2.2	1.9
				Nitrate assimilation	1.9	1.9	1.5	2.4	2.2	2.2	2.2
				Toxicant assimilation	2.4	2.4	1.9	2.6	2.4	2.4	2.4
				Erosion control	2.3	2.0	1.7	1.8	1.8	1.8	1.7
			Carbon storage		1.7	1.7	1.3	1.3	2.0	2.0	1.7
			<b>Biodiversity maintenance</b>		1.4	1.4	1.8	1.6	1.8	1.6	1.6
			<b>Provisioning benefits</b>	Provisioning of water for human use	2.2	1.7	1.7	1.7	1.7	1.7	1.7
				Provisioning of harvestable resources	2.8	2.2	2.2	2.2	2.2	2.2	2.2
				Provisioning of cultivated foods	1.8	1.8	1.8	1.8	1.8	1.8	1.8
			<b>Cultural benefits</b>	Cultural heritage	1.3	1.3	1.3	1.3	1.3	1.3	1.3
				Tourism and recreation	1.7	1.7	1.7	1.7	1.9	1.7	1.7
				Education and research	1.0	1.0	1.0	0.8	1.8	0.8	1.0
			<b>Average Eco Services Score</b>		2.0	3.0	2.0	2.0	2.0	2.0	2.0

The key ecosystem services provided by the wetland features relate directly their ability to assimilate various substances that move through the catchment. These include nitrates, phosphates and toxicants while the wetlands trap sediment from the catchment which allows for the establishment of dense wetland vegetation that in turn limits the erosion in the features.

#### 6.8.10.4 Present Ecological State (PES) of the Delineated Wetlands

The Present Ecological State (PES) of an aquatic feature is a function of the impacts that are present within the footprint of the feature as well as the catchments associated with each of these features and how these impacts affect the drivers of the wetland and watercourse.

The impacts identified in the table above were used in the Level 1 WET-Health assessment to determine the PES of the wetland system. The results of the Level 1 assessment are provided in Table 6-23 below.

**Table 6-23: Present Ecological Status of the System**

HGM Unit	DRIVER			COMBINED SCORE
	HYDROLOGY	GEOMORPHOLOGY	VEGETATION	
1	4.1	6.2	4.6	4.8 = Class D Largely modified
2	4.5	6.8	4.8	5.2 = Class D Largely modified
3	4.7	7.3	5.3	5.6 = Class D Largely modified

4	2.3	1.2	2.6	2.0 = Class C Moderately modified
5	2.2	1.1	1.7	1.7 = Class B Small modification
6	2.6	1.4	2.6	2.3 = Class C Moderately modified
7	4.4	4.6	5.2	4.7 = Class D Largely modified

The wetland classification provided above makes provision for the following:

- The Class B wetland is considered to be largely natural with limited impacts on the wetland drivers resulting in very little impact on the wetland biodiversity and function.
- The Class C wetlands are considered to have moderate modifications of its wetland drivers resulting in limited impact to the wetland biodiversity and function.
- The Class D wetlands are considered to have undergone large modifications due to severe impacts resulting in large changes to the wetland drivers which consequently results in significant impacts on the wetland biodiversity and function.

#### 6.8.10.5 Ecological Importance and Sensitivity (EIS) of the Delineated Wetlands

The Ecological Importance of any aquatic feature is an expression of its importance to the maintenance of the ecological diversity and functioning within itself, as well as hydrologically downstream. The Ecological Sensitivity is a function of the system's ability to resist disturbances on its drivers and its capability to recover from these disturbances once they have occurred.

The wetland EIS assessment was applied to the HGM units described in the previous section to assess the levels of sensitivity and ecological importance of the wetlands. The result of the assessment is shown in Table 6-24.

**Table 6-24: Ecological importance and sensitivity of the aquatic system**

HGM UNIT	CRITERIA	IMPORTANCE	EIS CLASS	OVERALL IMPORTANCE AND SENSITIVITY
1	Ecological importance and sensitivity	2.7	M	Medium
	Hydrological/functional importance	2.8	M	
	Direct human benefits	1.3	L	
2	Ecological importance and sensitivity	2.7	M	Medium
	Hydrological/functional importance	2.8	M	
	Direct human benefit	1.3	L	
3	Ecological importance and sensitivity	2.4	M	Medium

HGM UNIT	CRITERIA	IMPORTANCE	EIS CLASS	OVERALL IMPORTANCE AND SENSITIVITY
	Hydrological/functional importance	2.7	M	
	Direct human benefits	1.9	L	
4	Ecological importance and sensitivity	3.7	H	Medium
	Hydrological/functional importance	2.8	M	
	Direct human benefits	1.0	L	
5	Ecological importance and sensitivity	3.3	H	High
	Hydrological/functional importance	3.0	H	
	Direct human benefits	1.7	L	
6	Ecological importance and sensitivity	2.2	M	Medium
	Hydrological/functional importance	2.2	M	
	Direct human benefits	1.7	L	
7	Ecological importance and sensitivity	2.2	M	Medium
	Hydrological/functional importance	2.2	M	
	Direct human benefits	1.7	L	

#### 6.8.10.6 Buffer Determination

The modelled wetland characteristics was used to determine the appropriate buffer for these wetlands by using the wetland buffer determination model developed by the Water Research Commission.

Based on the findings of the assessment, the location and extent of the aquatic features, the PES of the aquatic features, the ecosystem services provided by the system and the EIS of the aquatic features, the following buffers have been determined:

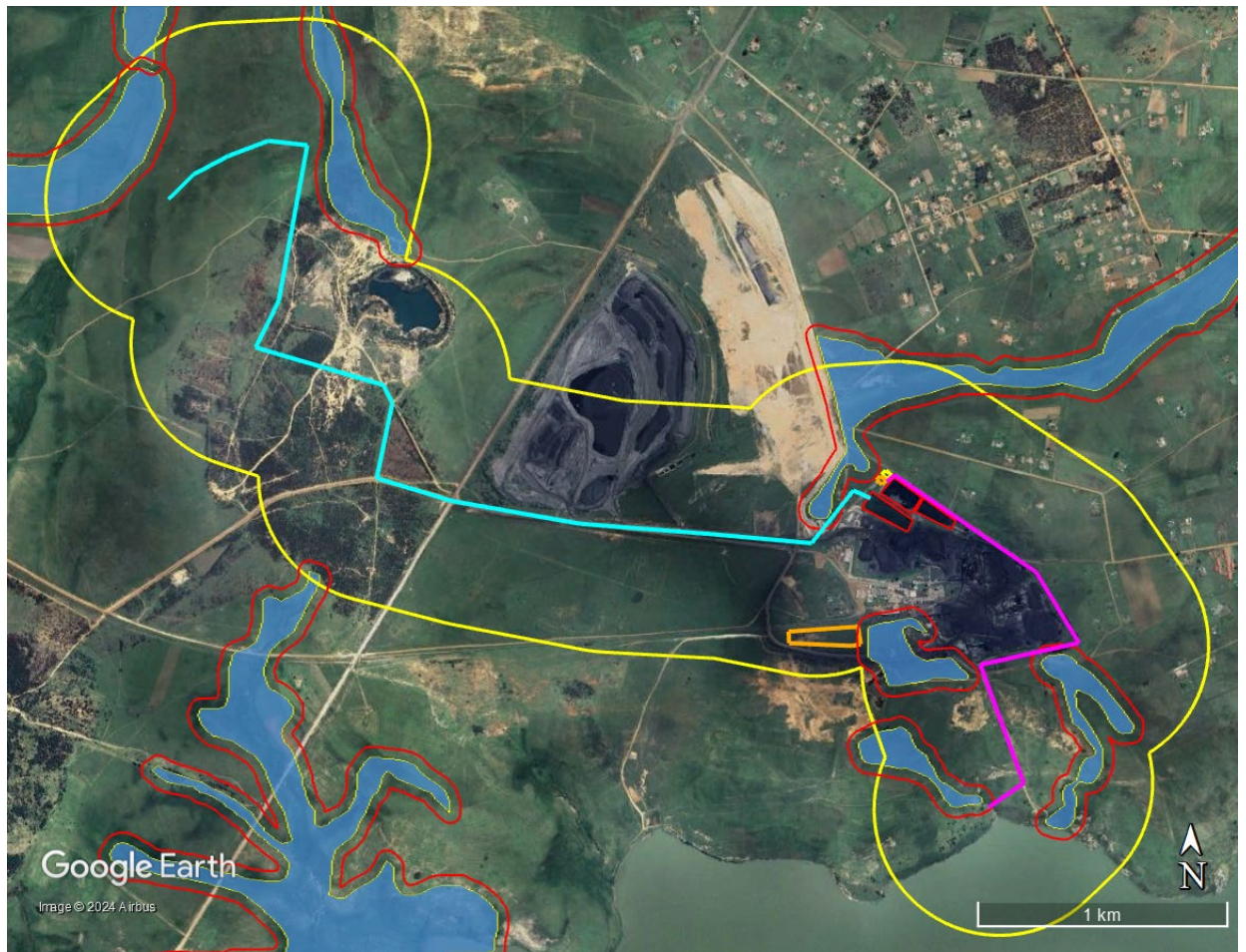
#### **Construction Phase** (Figure 6-36):

- No plant and equipment must be allowed to be parked within a 40m distance of the delineated edge of any delineated wetland;
- No portable ablution facilities must be allowed to be placed within a 40m distance of the delineated edge of any wetland; and
- No petrochemical storage facilities must be allowed to be placed within a 40m distance of the delineated edge of any wetland.

#### **Operational Phase** (Figure 6-37):

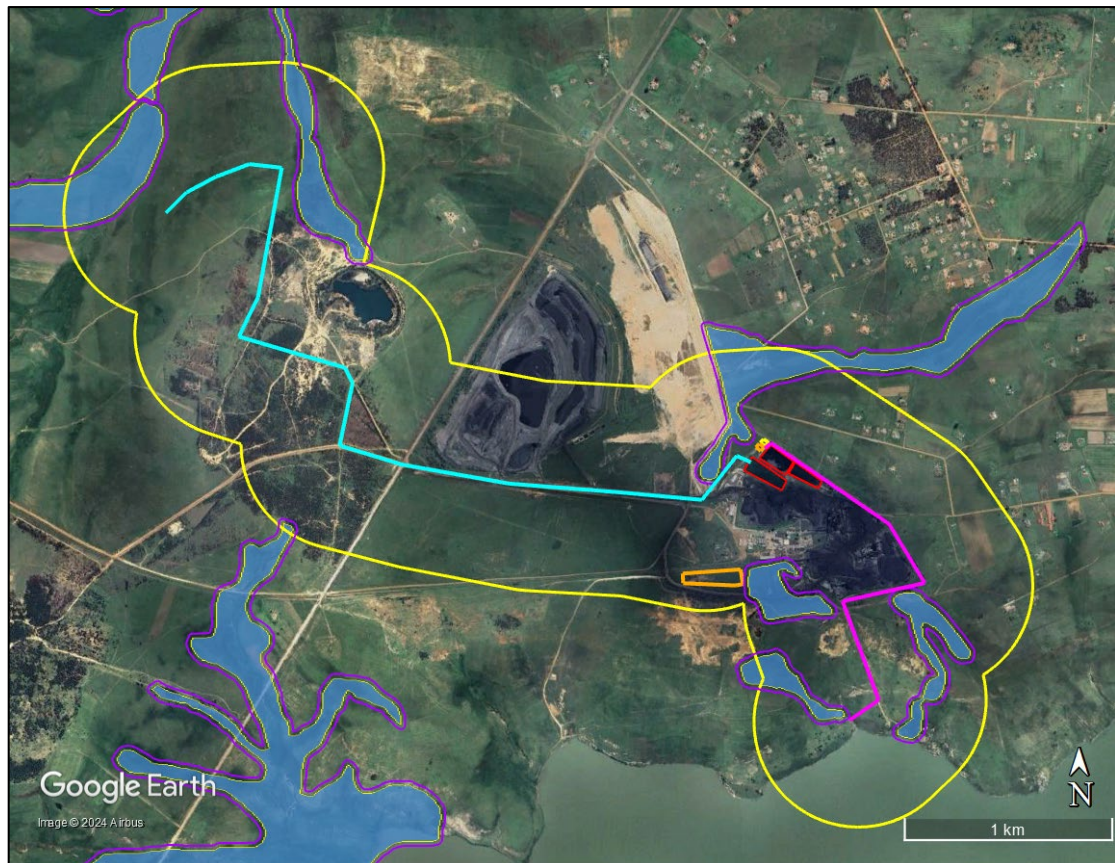
- No part of the infrastructure associated with the project must be allowed to be within a 20m distance from the delineated edge of any wetland.





**Figure 6-36** Location and extent of the applicable 40m construction buffer (in red) around the wetland within the study site





**Figure 6-37** Location and extent of the applicable 20m operational buffer (in purple) around the wetland features within the study site

## 6.9 Groundwater

### 6.9.1 Aquifer Characterization

The following section supplies a brief overview of the aquifer characteristics encountered at the Maquasa (East and West) and Nooitgesien operations, with a specific focus on the aquifer type, aquifer zones, preferential flow paths and groundwater occurrence.

#### 6.9.1.1 Aquifer Type and Aquifer Zones

Based on available data, the aquifer occurring in the area can be divided into three (3) distinct zones:

##### 1. Alluvium zone:

- Alluvial horizons occur along streams and rivers that traverse the area. These water-bearing horizons are generally connected to the streams and rivers and can be connected to deeper lying weathered and fractured water-bearing horizons depending on the nature of the alluvial sediments (ERM, 2013).

## 2. Weathered to semi-confined aquifer zone:

- The sedimentary rocks of the Eccca Group form the main water-bearing strata. In the Eccca group, multi-layered aquifers are common, especially within the coalfields. It is, however, conceptualised as a single unit with interconnectivity between layers, as a worst-case scenario; and
- On average the saturated thickness of the weathered to semi-confined aquifer zone, determined by boreholes drilled at the site, varies from 5 to 27m. However, on a catchment scale, the average weathered thickness is estimated to be in the order of 16 to 23m (King *et al.*, 1998a; King *et al.*, 1998b; ERM, 2013; GCS, 2013).

## 3. Confined fractured aquifer zone:

- The Dwyka Formation, which underlies the Eccca Group, normally has a very low permeability due to its secondary aquifer characteristics. The aquifer can be referred to as being primarily fractured and acts as an aquitard.
- The fractured aquifer thickness for the general area is estimated to extend from a depth of 23 to 124 mbgl; and is estimated to be in the order of 100 - 130m thick (King *et al.*, 1998; and Lourens, 2013).

From the above mentioned, the aquifer in the area can be referred to as being predominantly intergranular and fractured. These aquifer types generally have very low to medium primary hydraulic conductivity/porosity due to the secondary nature of the aquifer (King *et al.*, 1998). A conceptual drawing of the typical aquifer zones in the study area is presented in Figure 6-38.

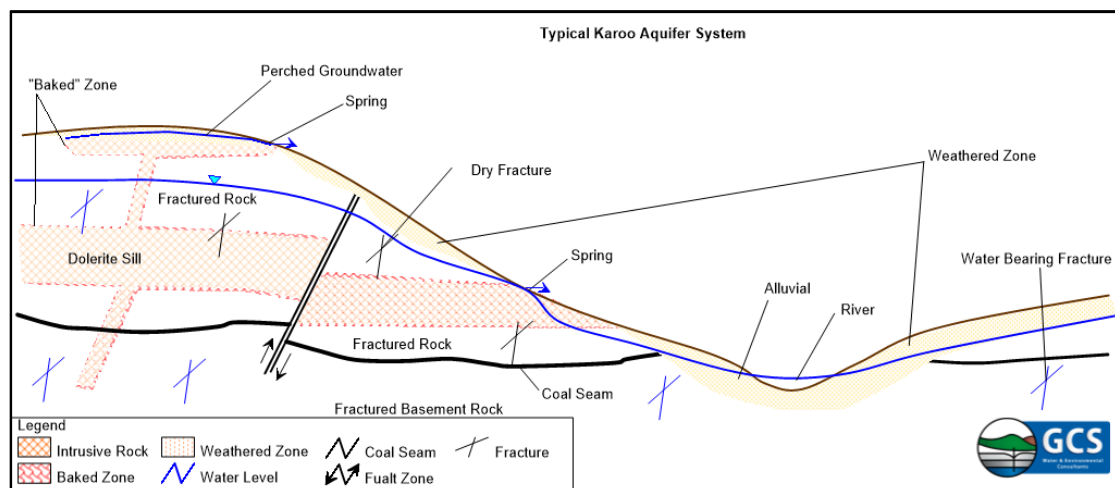


Figure 6-38: Conceptualisation of the study area aquifer zone

#### 6.9.1.2 Preferential Flow Paths

Dolerite intrusions in the form of dykes and sills are common in the Karoo Supergroup and are often encountered in the study area. These intrusions can serve as both aquifers and aquifuges<sup>30</sup>.

Thick un-weathered dykes will inhibit the flow of water, while the baked and cracked contact zones can be highly conductive. These conductive zones effectively interconnect the strata of the Eccra sediments both vertically and horizontally into a single, but highly heterogeneous and anisotropic zone on the scale of typical mining activity.

Various dolerite dykes and contact zones have been mapped during the course of the underground mining activities in the area. The strike of the dykes in this area are both parallel and perpendicular to the direction of groundwater flow and therefore act as no flow and preferential flow boundaries. It is therefore currently assumed that the different groundwater bearing horizons are interconnected on a regional scale. On a more local scale, the sills can present horizontal barriers to groundwater flow which results in the local development of wetlands and springs.

Furthermore, significant vertical displacement of the coal seams has been observed adjacent to some geological structures in the Project Area, which suggests that faulting has occurred. Significant differences in water levels were observed across some of these faults, which suggest that in places faults act as barriers to groundwater flow, creating separate groundwater compartments (ERM, 2013).

#### 6.9.1.3 Primary Groundwater Occurrence

According to literature for the region (King *et al.*, 1998), groundwater is typically encountered in/along:

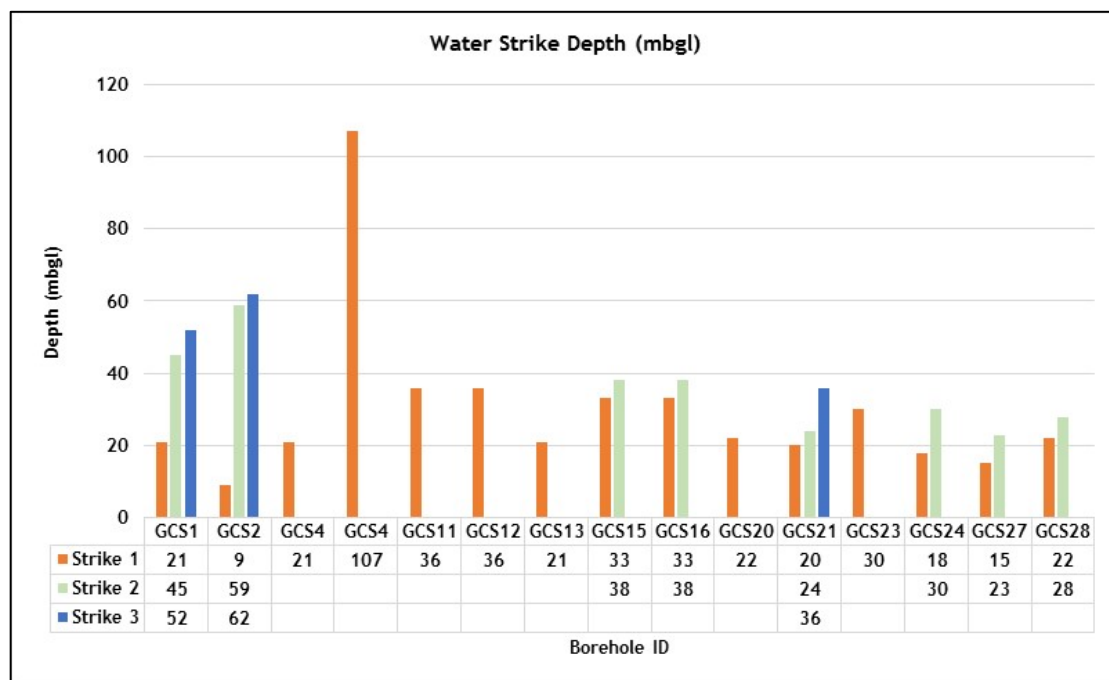
- Dolerite dyke and sill contacts with host rock;
- Contact zones between lithologies or unconformities; and
- Faults and associated fracture zones.

Based on borehole logs drilled in 2013 by GCS (GCS, 2013), it is clear that groundwater in the local area is typically encountered within contact zones between lithologies or unconformities.

---

<sup>30</sup> **Aquifuge:** An impermeable body of rock which contains no interconnected openings or interstices and therefore neither absorbs nor transmits water.

Figure 6-39 plots available water strike data for boreholes previously drilled by GCS with hydrogeological data recorded. The first water strike generally occurs at a depth in the order of 29mbgl, with the exception of borehole GCS4. The 2<sup>nd</sup> water strike generally occurs at a depth in the order of 35mbgl and the third water strike at depths > 50mbgl. Irrespective of the borehole depth, water strikes generally occurred along sandstone/siltstone (shale) contacts as well as dolerite contacts with the host rocks.



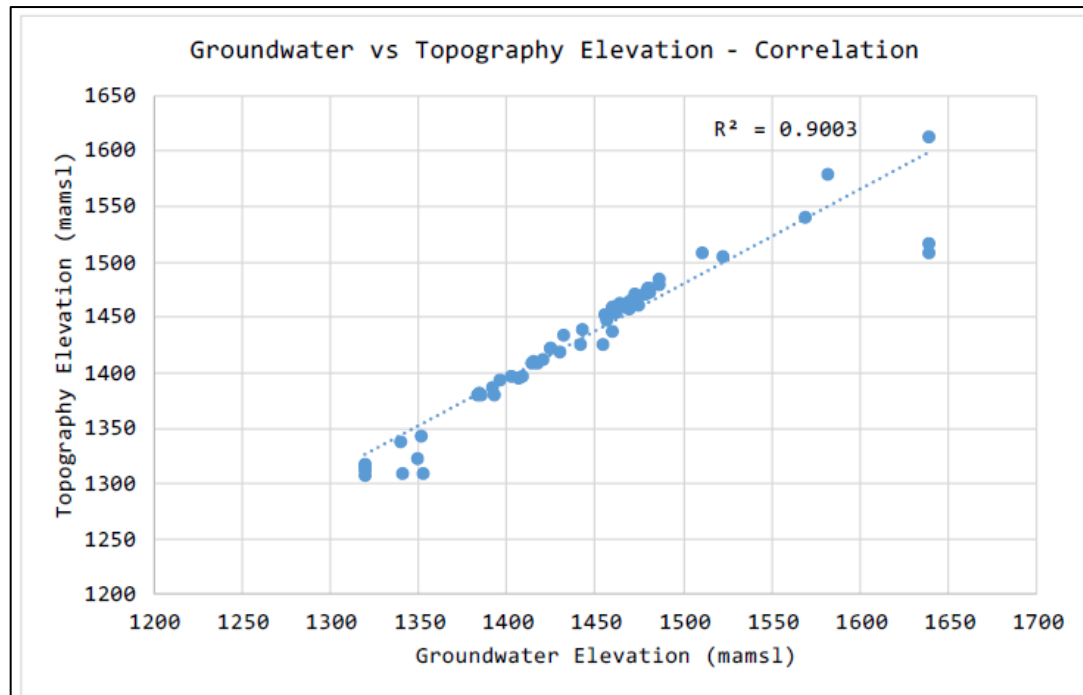
**Figure 6-39: Borehole water strike depths**

#### 6.9.2 Groundwater Levels and Direction

As groundwater flow behaviour is aligned to surface water flow conditions, it was assumed that the aquifer extent for the work conducted by GCS coincides with the surface water catchment boundaries.

There are several monitoring boreholes situated at the Maquasa and Nooitgesien Operation Areas. Furthermore, several groundwater levels have previously been recorded at hydrocensus boreholes identified in the area.

Based on the available groundwater data (1998 - 2022) the groundwater levels range from 1.8 to > 50 mbgl. In some areas, piezometric pressure heads cause artesian conditions, where groundwater emerges to the surface via boreholes drilled into these confined aquifers. Figure 6-40 plots the groundwater elevation vs topographic elevation for groundwater boreholes in the project area. There is a good linear relationship between topographic and groundwater elevations. The data suggest that the groundwater table mimics the topography and that groundwater levels have not fluctuated significantly between the hydrocensus periods.



**Figure 6-40: Groundwater elevation vs topographic elevation**

### 6.9.3 Groundwater Recharge

The effective groundwater recharge from rainfall is the portion of rainfall that reaches the groundwater rest level and excludes surface water run-off, evapotranspiration and soil moisture. The effective rainfall recharge is dependent on catchment geology, soils and surface run-off and stream morphology.

Recharge in the order of 5 to 7% (King et al., 1998; DWAF, 2006) of the MAP was calculated and will vary depending on the annual rainfall. Groundwater recharge, calculated using the chloride (Cl) method, gives rainfall recharge figures varying between as high as 25% and as low as 10% (ERM, 2013).

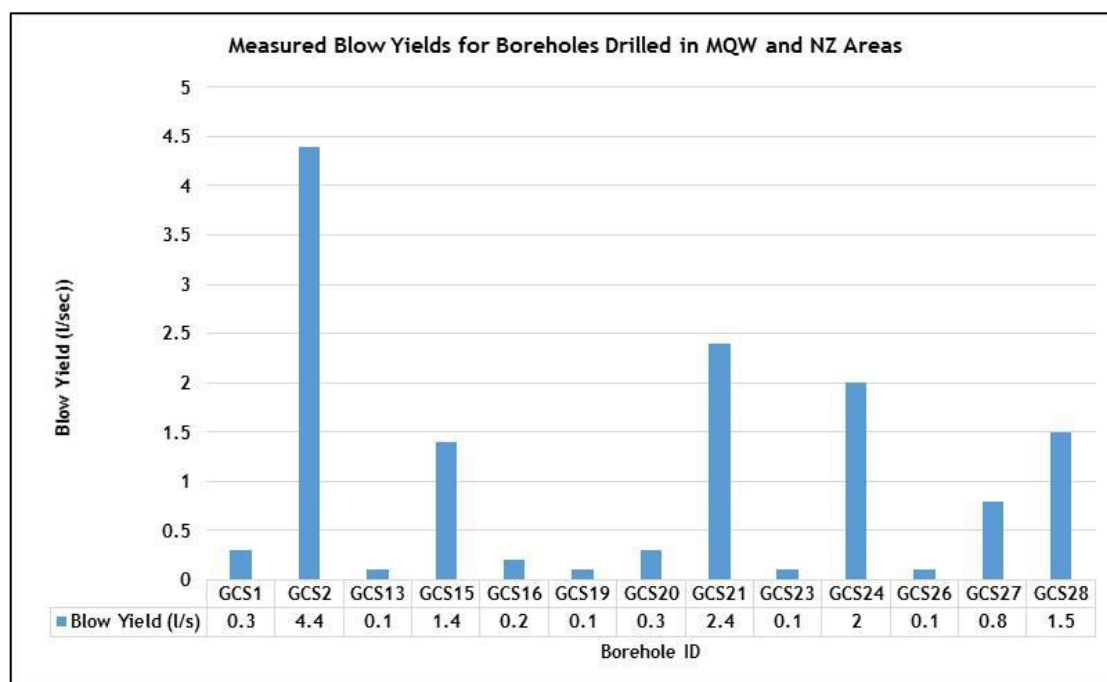
Observed discharges from the weathered aquifer in other areas of Mpumalanga suggest isolated occurrences of recharge as high as 15% of the annual rainfall. The average natural recharge to the deeper fractured aquifer is estimated to be in the order of 3 - 5% of the annual rainfall (GCS, 2008).

It is highly likely that recharged of mined-out and backfilled opencast areas can be as high as 15%. Moreover, conveying any surface water (i.e. stormwater or seepage wastewater) underground will greatly increase artificial recharge to the groundwater aquifer.

#### 6.9.4 Aquifer Yield

The aquifer can be considered a low to moderate-yielding aquifer and has a reported average yield in the order of 0.5 l/s to 2 l/s (King et al., 1998a and King et al., 1998b).

Boreholes drilled in the Maquasa and Nooitgesien areas have low yields in the range of 0.01 to 4.5 l/s (refer to Figure 6-41). Higher blow yields are often encountered at boreholes drilled into contact zones associated with dolerite intrusions, or fault zones.



**Figure 6-41: Measured blow yields for boreholes drilled in the Maquasa and Kusipongo areas**

#### 6.9.5 Groundwater Quality

The groundwater quality results were obtained from the *Water Quality Monitoring Report for the Kangra Coal Maquasa East, Maquasa West & Nooitgesien Operations: Third Quarter, 2022 Monitoring Period* (Annexure A).

##### 6.9.5.1 Maquasa West and Nooitgesien

The following observations were made during the 2022 third quarter monitoring event:

- Borehole GCS20 indicated slightly acidic pH levels (5.8) whilst the remaining boreholes indicated neutral to slightly alkaline pH levels (6.5 to 8.2); refer to Figure 6-42.
  - The pH levels at borehole GC19 (8.2) and GCS20 (5.8) were non-compliant with the WUL limits; the remaining boreholes were compliant.
- Boreholes GCS18, GCS19, GCS20 and GCS21 showed low to no significant impact from the site, based on typical mine indicator parameters.



- Elevated EC, TDS, total alkalinity, sodium and fluoride concentrations exceeded the WUL limits at GCS21.
  - Nitrate concentrations (<0.8 mg/l) slightly exceeded the WUL limit at GCS18, GCS 19 and GCS20.
- The water quality at boreholes GCS22, GCS23 and GCS24 located down-gradient of the NS mine workings, was non-compliant when compared to the WUL limits.
  - EC, TDS, total hardness, calcium, magnesium and potassium concentrations were elevated above the WUL limits at all three (3) boreholes. Additionally, sodium was in exceedance at GCS22 and GCS24. TDS ranged between 840 mg/l (GCS23) and 2 000 mg/l (GCS24); refer to Figure 6-43.
  - All three (3) boreholes are characterized by fluctuating sulphate concentrations, which exceed the WUL limit, ranging between 548 mg/l (GCS23) and 1 960 mg/l (GCS24) in October 2022 (Figure 6-44). The water quality at GCS22 and GCS24 has deteriorated since 2020. Borehole GCS23 indicated an initial improvement in water quality between 2019 and 2021, however subsequent data indicates deteriorating water quality.
  - Additionally, nitrate concentrations exceeded the WUL limit at all three (3) boreholes ranging between 0.6 mg/l (GCS24) and 1.9 mg/l (GCS22), in October 2022.
  - In terms of metal concentrations, manganese was elevated at all three (3) boreholes, ranging between 1.0 mg/l (GCS23) and 15.0 mg/l (GCS24) in October 2022.
- Borehole GCS24 is located adjacent to the NS opencast workings. Water level data for this borehole shows rebounding water levels following a period of drawdown at the opencast workings. As such, the groundwater flow path is now moving away from the opencast workings and the data shows that the Zone of Impact (ZOI) has been intersected by GCS22, GCS23 and GCS24.

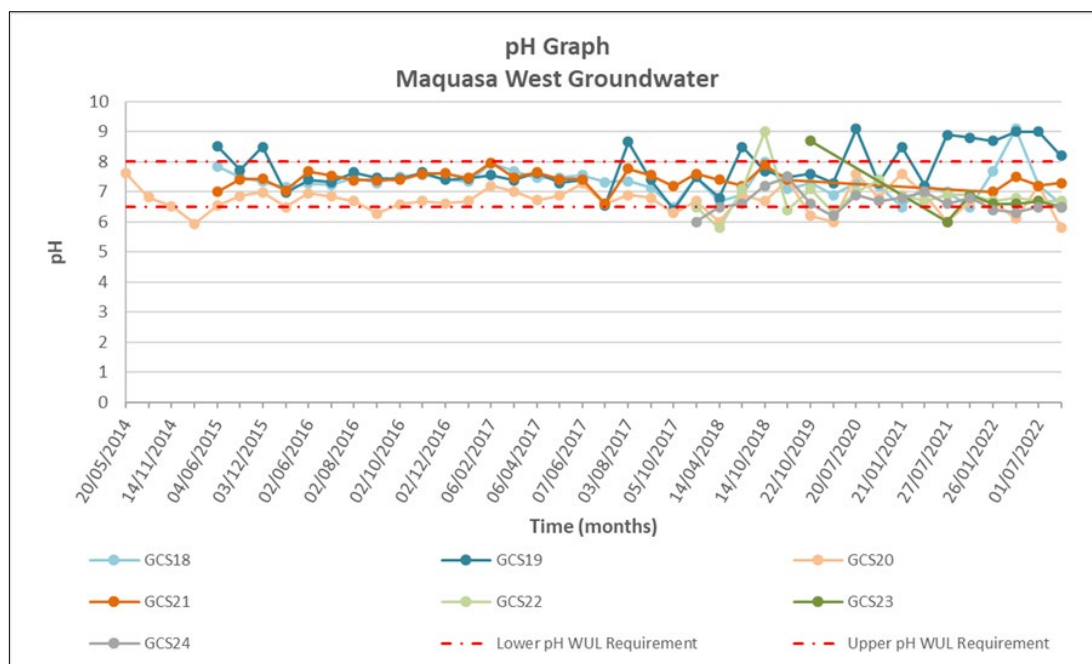


Figure 6-42: Maquasa West groundwater pH graph

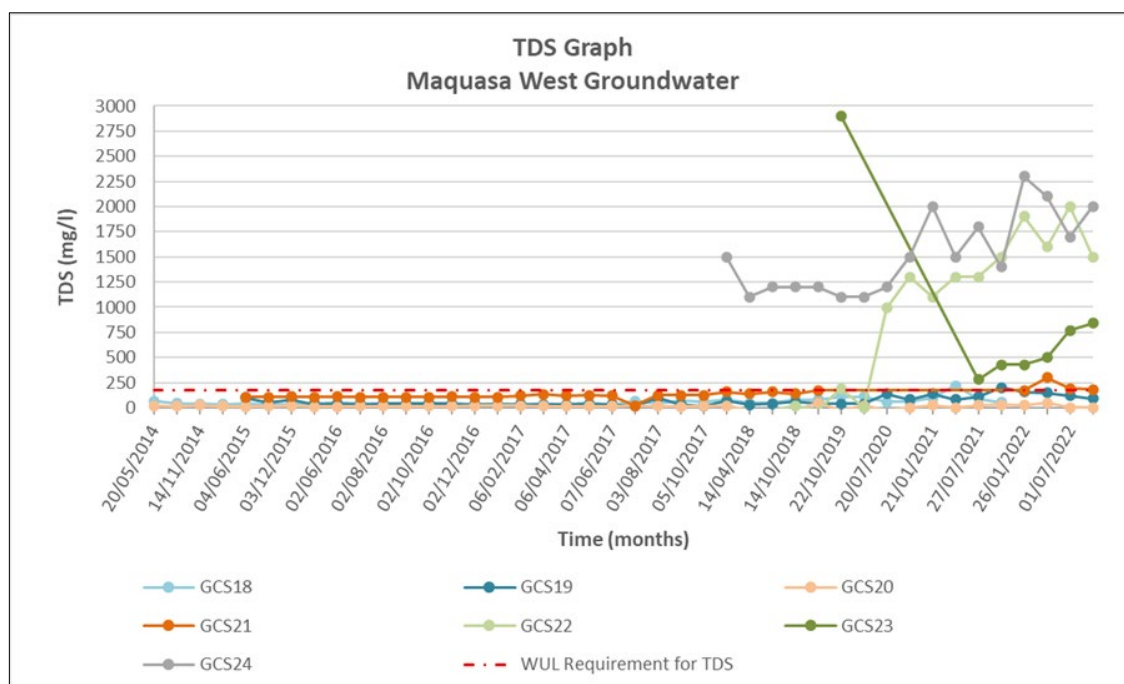
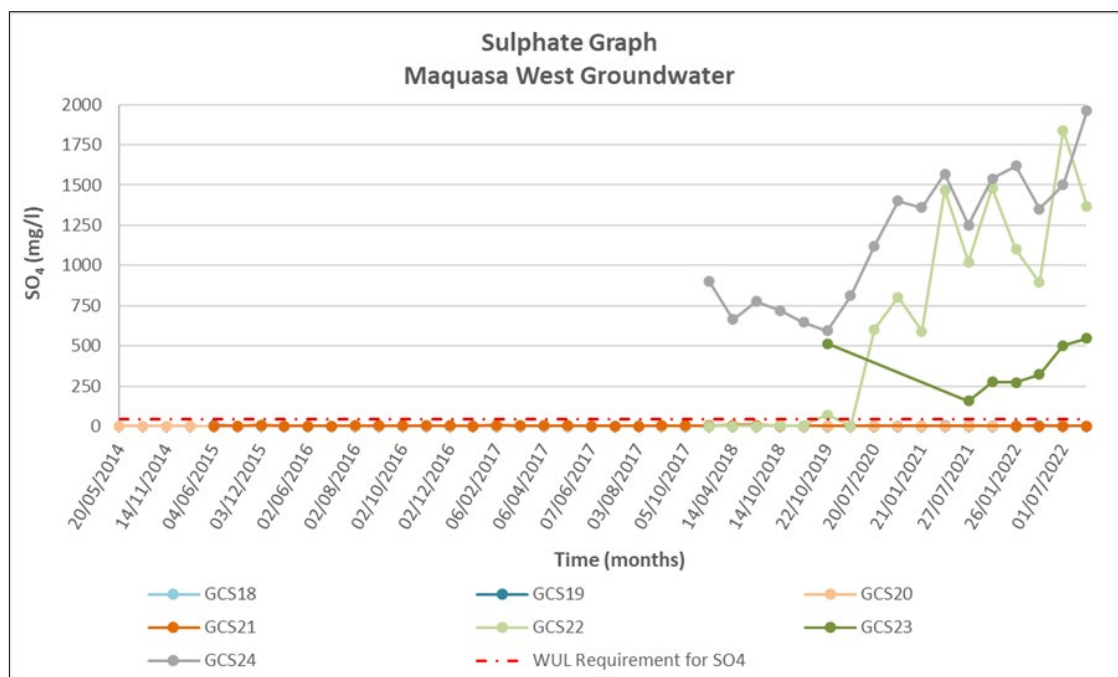


Figure 6-43: Maquasa West groundwater TDS graph



**Figure 6-44: Maquasa West groundwater sulphate graph**

#### 6.9.5.2 Maquasa East

Borehole BCBH02 is buried. Four (4) new boreholes (GCS28, MON BH03, MON BH04 and MON BH05) were added and one borehole (Well Yende Family) was removed from the groundwater monitoring network in September 2022.

The following observations were made during the 2022 third quarter monitoring event:

- All groundwater monitoring points exhibited neutral pH conditions, ranging between 6.5 and 7.9; refer to Figure 6-45.
- Boreholes Well Yende, BH 923, BCBH01, GCS11, GCS12, GCS13, GCS14, GCS15, MON BH04 and MON BH05 showed low to no significant impact from the site in the third quarter of 2022.
  - Slight exceedances of the WUL Limits were observed, including chloride at Well Yende, fluoride at BCBH01, potassium, chloride and fluoride at MON BH04 and sodium at MON BH05.
  - Additionally, nitrate was elevated at most points, ranging between 0.3 and 6.9 mg/l.
- The water quality at KGA1, KGA2, GCS16, GCS17, GCS28 and MON BH03 was non-compliant when compared to the WUL limits.
  - Several parameter concentrations exceeded the WUL Limits in October 2022:

- EC, TDS, calcium, magnesium, sodium, potassium, total alkalinity, chloride and total hardness were elevated at GCS16. GCS16 indicated the most impacted water quality, with TDS recorded as 1 400 mg/l.
- EC, TDS, magnesium, sodium, potassium and chloride were elevated at KGA1.
- Potassium and nitrate were elevated at KGA2.
- EC, TDS, sodium, total alkalinity, chloride and fluoride were elevated at GCS17.
- EC, TDS, calcium, magnesium, potassium and total hardness were elevated at GCS28.
- EC, TDS, calcium, magnesium, sodium, potassium, total alkalinity, fluoride and total hardness were elevated at MON BH03.
- Sulphate concentrations varied at the site; refer to Figure 6-46.
  - Sulphate at GCS16 has displayed a stable trend over time, consistently exceeding the WUL limit, recorded as 764 mg/l in October 2022. GCS16 is decanting directly from the underground workings at MQE into a PCD, situated in close proximity to the Heyshope Dam.
  - Sulphate at KGA1 and KGA2 have displayed an increasing trend over time, currently exceeding the WUL limit, recorded as 300 and 73 mg/l respectively in October 2022. KGA1 is situated downgradient of the Discard Plant and KGA2 is situated downgradient of both the discard dump and the underground workings at MQE.
  - Sulphate was also elevated at GCS28 (240 mg/l) and MON BH03 (93 mg/l) in October 2022. Future monitoring will confirm the trends.

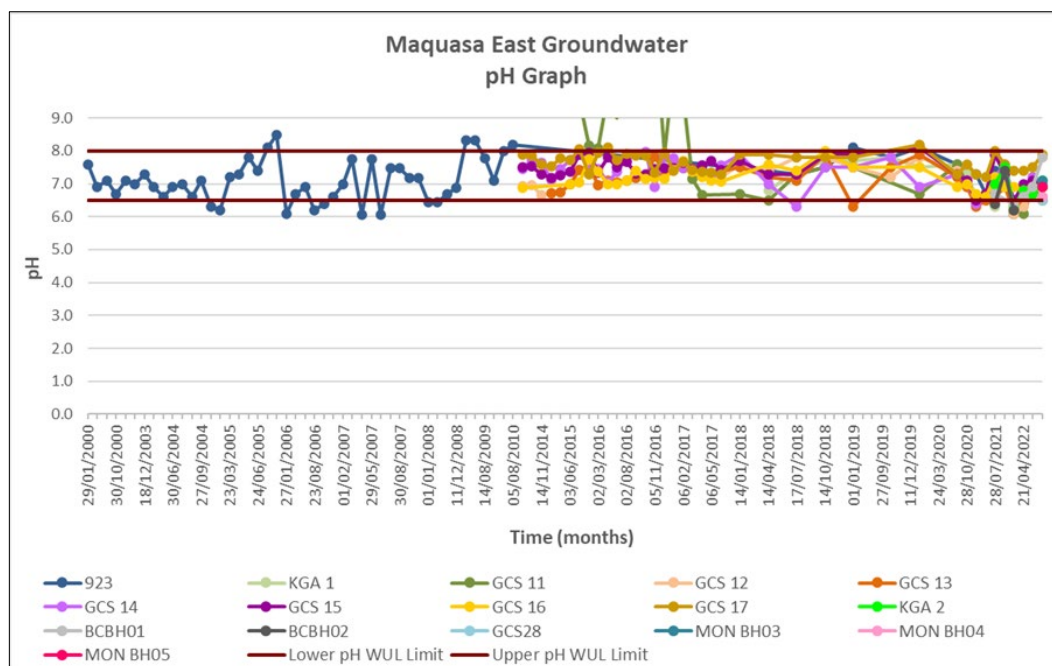


Figure 6-45: Maquasa East groundwater pH graph

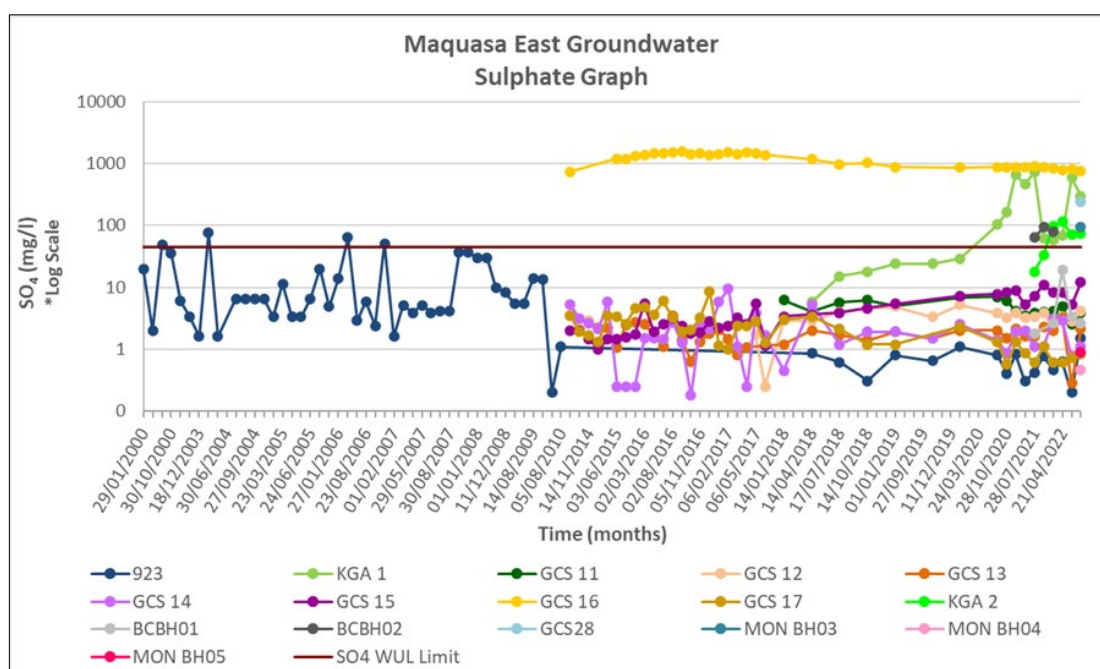


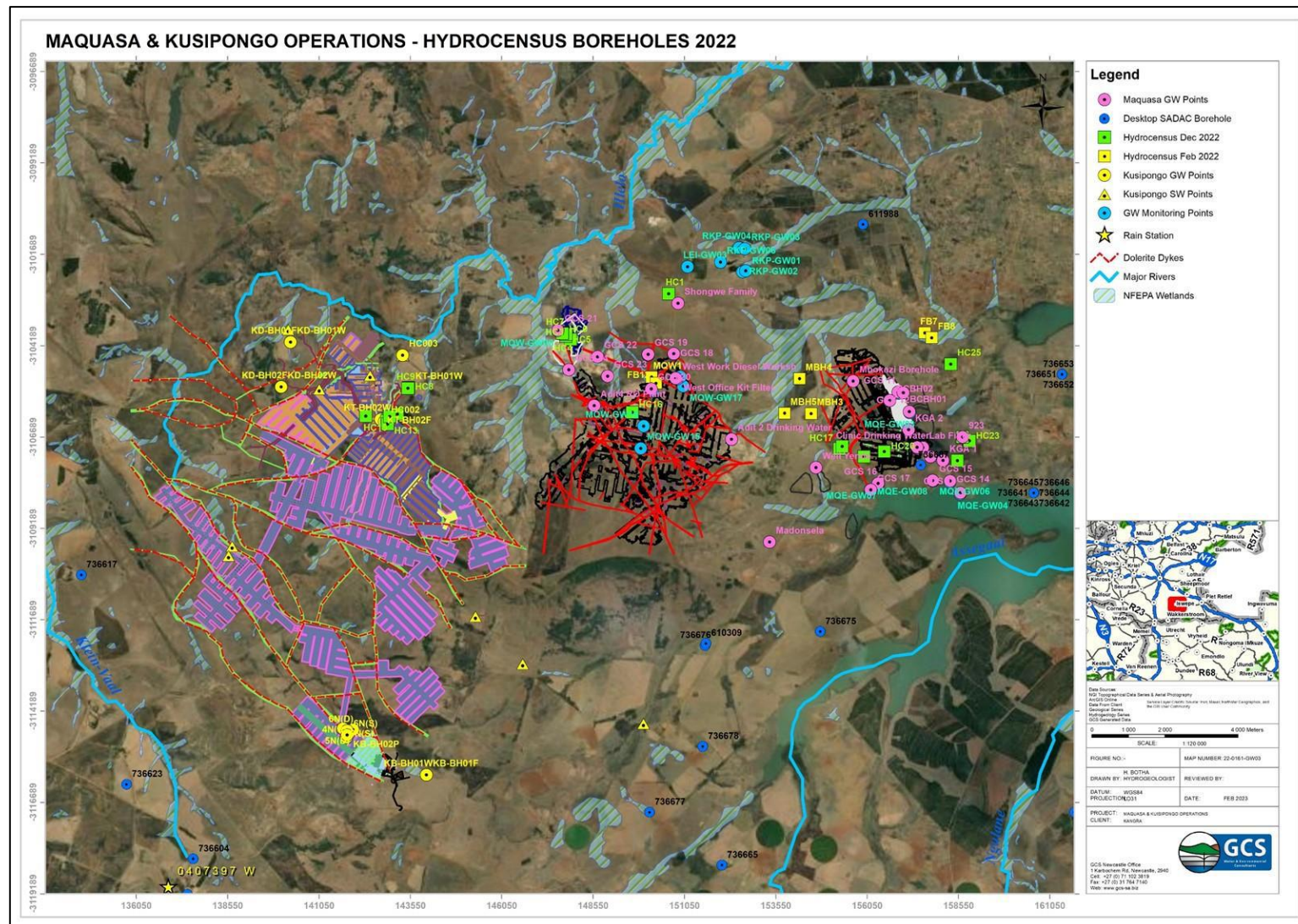
Figure 6-46: Maquasa East logarithmic groundwater sulphate graph

#### 6.9.6 *Hydrocensus*

Given that groundwater flow direction generally follows the surface topography of the area; the hydrocensus survey focused more on eight (8) opencast pits. To identify the groundwater users, a census of all groundwater abstraction points was conducted within and surrounding the mining area.

The survey of boreholes and springs was undertaken during site investigation before the rainy season. The survey was aimed at identifying existing users, depth to water levels, depth of boreholes, and the ambient groundwater quality. This included all the springs and boreholes in a search area of 1 500ha. No boreholes which are used for water supply were found during the survey. Only one spring, which was used by the local community, was identified (Spring 4). Water levels were also measured in the newly drilled hydro-exploration boreholes (GCS 11 - GCS 30), open uncased exploration boreholes (A - AAZ, BHM 1&3), and existing monitoring boreholes (GCS 1 & 2). The hydrocensus results are presented in the map under Figure 6-47.





### 6.9.7 Conceptual Groundwater Model

#### 6.9.7.1 Pollution Sources

The following sources have been identified:

- Underground workings at MQE and decant therefrom into the Heyshope dam- an existing source of pollution.
- Mined out MQW workings - partially flooded.
- Several historic open-cast sections around NZ, MQE and MQW (rehabilitated).
- Processing plant, PCDs (lined), ROM stockpiles and product stockpiles.
- A co-disposal facility (coal discard and coal slurry) was constructed on top of the old MQE workings.
- Overburden dumps around the access ports of MQW and Nooitgesien.
- Offices, ablution, stores, hard park, existing dams, channels, berms, culverts, silt traps, oil traps, fuel depot, workshop, wash bay, substation, parking and sewage management.

Material present in the underground working cavities consists of the roof and floor sandstones, shales and dolerite (likely some carbonaceous rock in contact with the coal seam) and coal pillars, which are required to be barred down from above the mined horizon making the working environment safe and will not be waste generated from the mined seam.

ROM is generally kept on-site long enough to ensure haulage for processing. ROM will be a combination of floor and roof sandstone (traces), shale (traces) and coal. The footprint of the ROM pads is maintained as small as possible.

Based on the available mine plan, coal (ROM), soft material, hard rock material, topsoil, coal discard and slurry wastes will be kept on site. Acid drainage (AD) is associated with the discard dump and slurry wastes as well as the hanging wall, footwall, and mine pillars within the mining void during and after mining. Neutral mine drainage (ND) may be associated with the softs and hard dumps which may contain sulphide-rich minerals, and SD can be expected for flooded mine workings which do daylight (i.e. diffuse decant to surface as is currently observed at MQE).

GCS has previously (2013 and 2022) conducted various Acid-Base Accounting (ABA), Net-Acid Generation (NAG), X-Ray Diffraction (XRD), X-Ray Fluorescence (XRF) and static leach tests on coal and overburden (shale, sandstone, and siltstone) material samples retrieved from the Maquasa mining areas. These studies established that the coal discard and coal slurry samples from the MQE discard dump are potentially long-term acid generating (PAG).

Coal and coal wastes have a significant potential to generate acid-mine drainage (AMD), while overburden samples showed a low AMD potential. The overburden/roof samples are also likely to generate low to medium salt loads.

SO<sub>4</sub> is the dominant anion that leached out in the peroxide extraction. Al, As, Fe, Mn, Ni and Sb are present at elevated concentrations in the peroxide extraction from either the coal or the overburden samples. None of these metals and trace elements leached at high concentrations in the peroxide extraction of the floor sample as the solution is near neutral.

#### 6.9.7.2 Pathway

Based on the aquifer characteristics (e.g. weathering depth, groundwater strike and static water levels), the hydrogeological system at the Project site can be categorised into two aquifers: shallow weathered rock/material aquifer and deeper fractured rock aquifer hosted within the Vryheid Formation sediments.

Shallow weathered rock/material aquifer - Vryheid Formation sediments comprise highly weathered material and have an average thickness of between ~5 and ~27 m. Due to the limited depth extent and average depth to groundwater (between ~2.5 and ~35 m), it is unlikely that this system will comprise a significant groundwater potential. However, in terms of seepage emanating contaminant transport, this aquifer is considered important.

Deeper fractured rock aquifer - Vryheid Formation sediments comprise a thick sequence of interlayered sediments with limited primary porosity. Secondary structures are likely to result in the development of discrete zones of high hydraulic conductivity. Although specific differences in the lithological units of this formation are observed (e.g. degree of weathering and alteration etc.), the lithology of this formation can be considered similar across the Project site.

Various dolerite dykes and contact zones have been mapped during the underground mining activities and exploration drilling in the area. The strike of the dykes in this area are both parallel and perpendicular to the direction of groundwater flow and therefore act as no flow and preferential flow boundaries. It is therefore currently assumed that the different groundwater-bearing horizons are interconnected on a regional scale. On a more local scale, the sills can present horizontal barriers to groundwater flow which results in the local development of wetlands and springs.

The groundwater table mimics the topography and groundwater flows from high-lying areas (water divides) to low-lying areas, with groundwater levels varying from the surface (seepage) to >50 mbgl. The variation in groundwater levels is due to the topography changes associated with the steep escarpments as well as the result of localised structural features (i.e. barrier) traversing the project area.

#### 6.9.7.3 Receptors

No groundwater-dependent receptors within the project area have been identified. However, the many non-perennial (ephemeral) and perennial streams in the study area are considered the end-receptors of any poor-quality seepage or loss of base flow (i.e. mine dewatering impacts). Due to the mining depth at Kusipongo and Maquasa both the weathered and fractured aquifer zones are considered receptors of potential pollution.

#### 6.9.8 Numerical Groundwater Model

The update of the numerical flow and transport model for the Maquasa Operations is presented in this section. The parameters, structure of the model is provided under Chapter 7 of the Geohydrological Report (Appendix E-4).

The purpose of the modelling exercise is to understand the operational groundwater flow system; simulate the existing Zone of Impact (ZOIp) associated with the mining operations (SO<sub>4</sub> was used to illustrate plume movement); and to simulate the zone of influence (ZOIf) for active mine workings.

The groundwater regime of the study area is highly heterogeneous due to complex faulting and intrusions, which ultimately influence the groundwater flow patterns. Constructing a groundwater flow model with all the detail is close to impossible; however, assumptions are made based on data gathered and used to simulate different scenarios to conclude with management protocol.

##### 6.9.8.1 Calibrated Flow Model

Groundwater flow models are simplified mathematical representations of complex aquifer systems. The simplification limits the accuracy with which groundwater systems can be simulated. There are numerous sources of error and uncertainty in these models, stemming from practical limitations of grid spacing, time discretisation, parameter structure, insufficient calibration data, and the effects of processes not simulated by the model. These factors, alongside unavoidable error in field observations and measurements, result in uncertainty in the model predictions.

The calibrated flow model with simulated groundwater elevations is shown in Figure 6-48. The following is noted when evaluating the flow model:

- The groundwater table mimics the topography.

- The flow model indicates groundwater flow velocities ranging from 0.01 (min) to 1.75 (max) m/day (or 638 m/yr). Groundwater movement in the weathered zone is greater than that of the deeper aquifer zones, as well as several orders greater in the alluvium zones when compared to the host rock.

#### 6.9.8.2 *Calibrated 2022 Sulphate Plumes (ZOlp)*

Calibrated sulphate plume for MQE is shown in Figure 6-49. In general, it is observed that pollution plume gradients are higher closer to known mine waste residue sites, and gradually decrease further away towards lower laying areas (prevailing groundwater flow directions).

#### 6.9.8.3 *Simulated Aquifer Drawdown*

The simulated aquifer drawdown as a result of the opencast mining operation at MQE is shown in Figure 6-50.

Due to the general stable trend of groundwater levels, as well as the observation that several boreholes situated along pit areas or actively dewatered adits down reflect dewatering patterns, the dewatering model could not be calibrated. Hence, the maximum potential aquifer drawdown ZOlf is presented for active workings. The dewatering zones were defined based on the provided mining plan up to the year December 2022.

Although the mines in the project area very seldom have groundwater ingress, dewatering activities may induce aquifer drawdown.



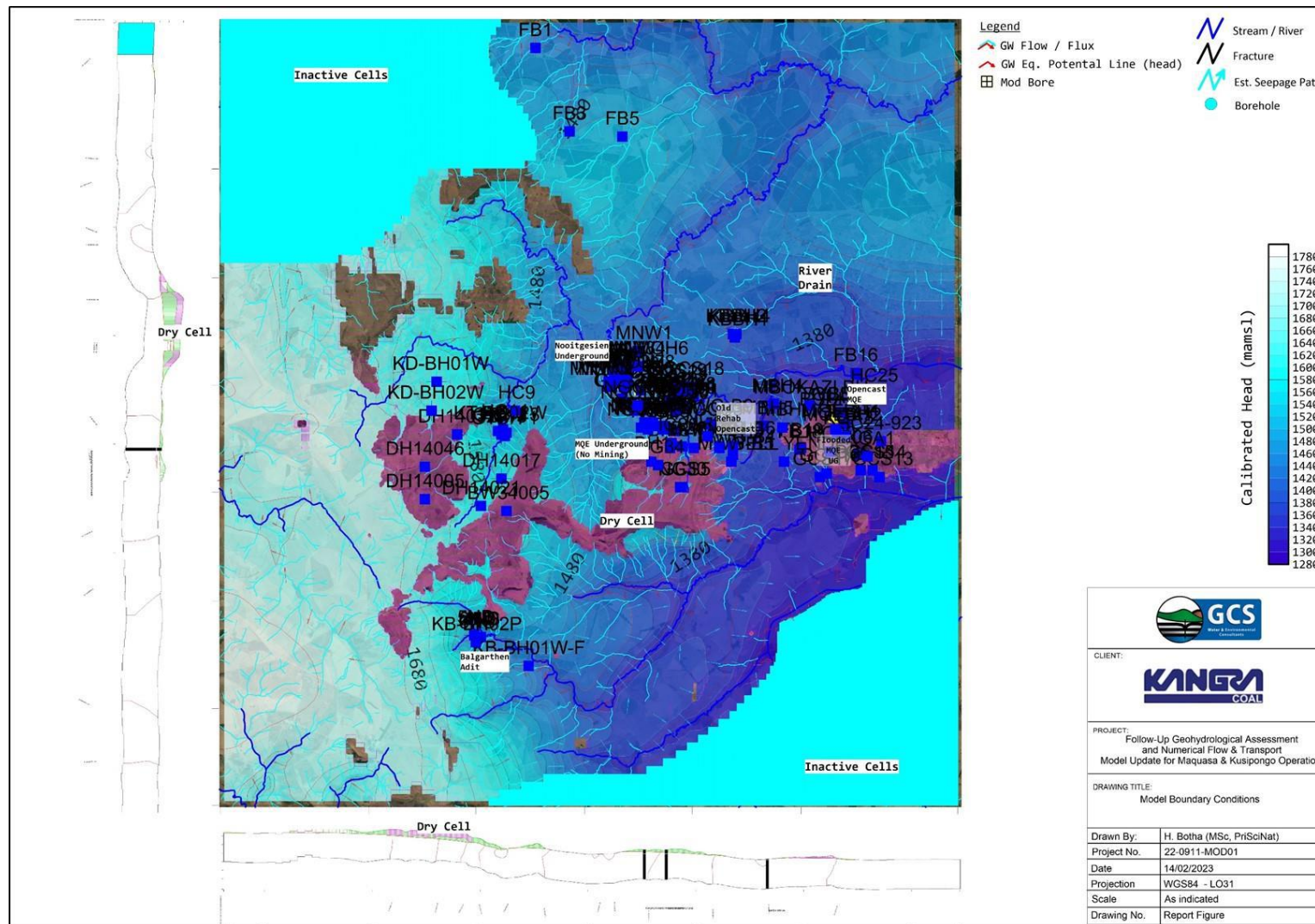


Figure 6-48: Calibrated flow model for the Kusipongo and Maquasa operations



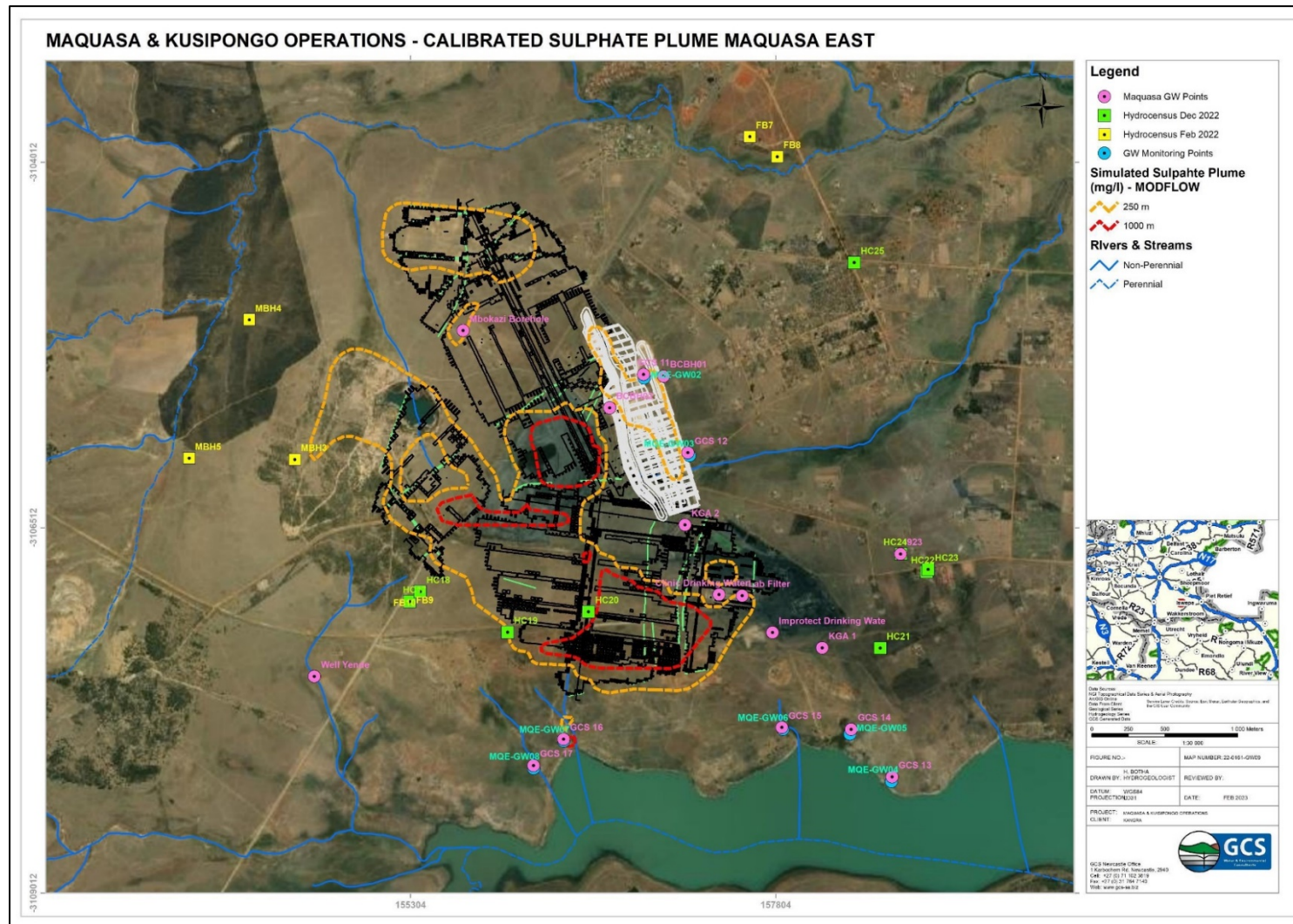


Figure 6-49: Calibrated sulphate plume for the year 2022 - MQE



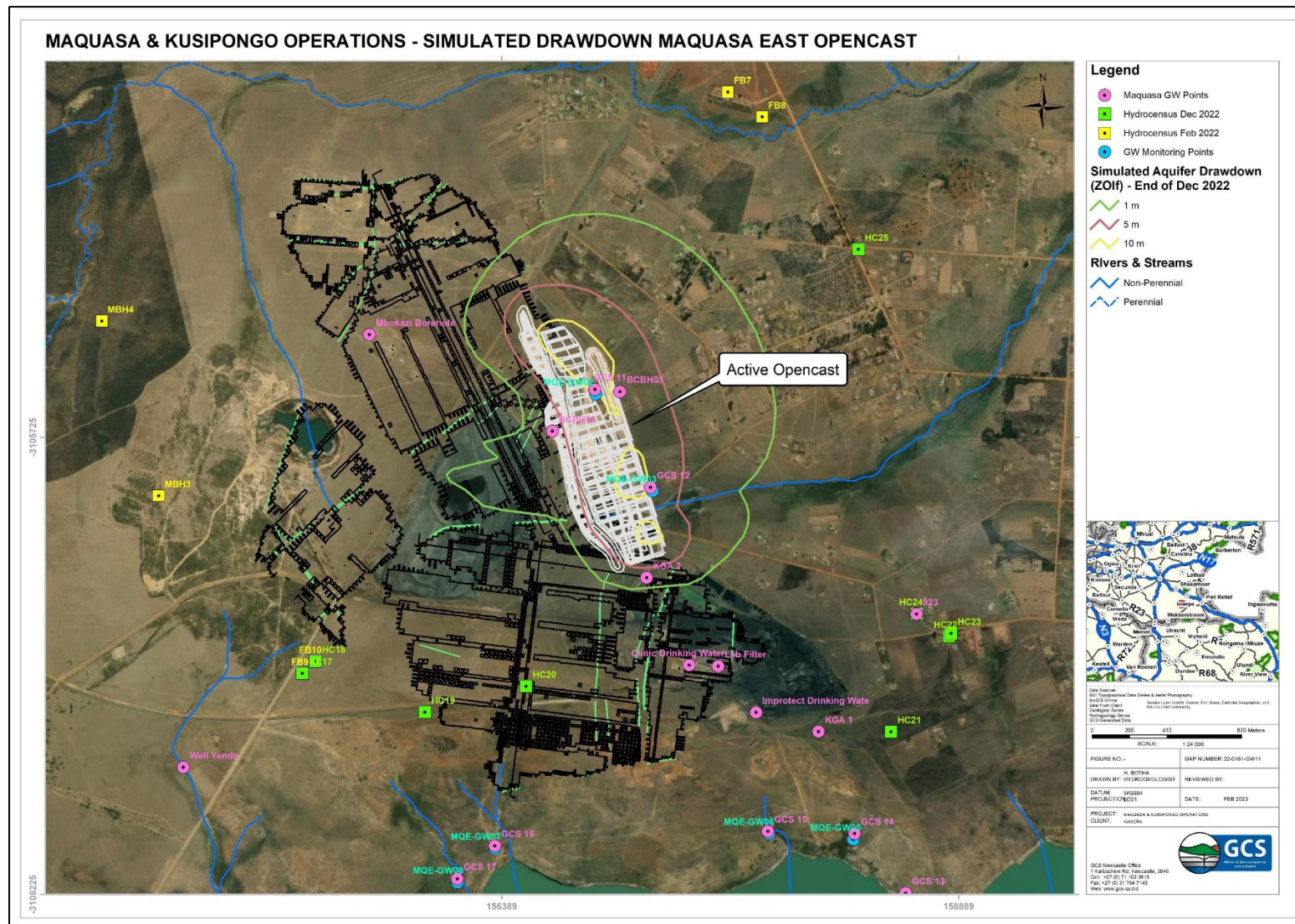


Figure 6-50: Predicted aquifer drawdown (Z0lf)- MQE opencast operations

## 6.10 Air Quality

The proposed Project is located within the northeastern portion of the Highveld Priority Area (HPA) declared in 2007 terms of the NEMAQA.

Approximately half of the total annual emissions (279 630 tons/a) of fine particulate matter (PM<sub>10</sub>) within the HPA, is attributed to particulate entrainment on mine haul roads. Primary metallurgical industry and power generation account for 17% and 12% respectively. Other substances of concern are Nitrogen Oxides (NO<sub>x</sub>) (73% from power generation) and Sulphur Dioxide (SO<sub>2</sub>) (82% from power generation).

Other sources of emissions within the HPA include the petrochemical industry, motor vehicles, clay brick manufacturing, household fuel burning, etc.

According to the HPA Air Quality Management Plan (AQMP), most of the HPA experiences relatively good air quality, but there are nine (9) extensive areas where ambient air quality standards for SO<sub>2</sub>, NO<sub>2</sub>, PM<sub>10</sub> and Ozone (O<sub>3</sub>) are exceeded. These nine(9) areas are referred to as hotspots.

The Pixley Isaka Ka Seme Local Municipality (PSLM) is highlighted as a hotspot, however, ambient air quality complies with the standards because the frequency of the exceedances recorded is within the tolerance limits. The exceedances of S- limit values occur at the Majuba monitoring site (close to the Majuba Power Station).

The “Deadly Air” Case in 2019, brought to the Pretoria High Court by the Centre for Environmental Rights (CER) on behalf of two environmental justice groups, Groundwork and the Vukani Environmental Justice Movement, sought recourse on the high air pollution levels in the HPA (Wernecke, et.al., 2022). The “Deadly Air” Case is an indication of the aims set out in the AQMP since it was published.

The proposed Project is located within a landscape comprising of natural vegetation and small patches of cultivated fields. The main sources of air pollutants include:

- Emissions from vehicles, i.e., mine trucks and vehicles traveling along nearby main roads; and
- Dust created from conveyors, RoM stockpiles, opencast pits, and the coal washing plant.

## 6.11 Noise

In 2008, a Noise Impact Assessment was undertaken by DBAccoustics (Van der Merwe, 2008) in respect of the Power Station and Ash Dump. The noise survey found that the mining and mining-related activities are the sources of noise in the general area, i.e. mine vehicles; conveyors; and ventilation fan noise from the Maquasa West Mining operations (clearly audible in the study area when there is a westerly wind) and the crushing and screening plant at Maquasa East.

The prevailing noise level recorded at the gravel road (to the south of the proposed CDF location and adjacent to a conveyor) at the time of the survey was 66.7 dBA during the daytime and 70.0 dBA during the nighttime.

The noise assessment established that the district cannot be classified as a rural district according to the definition set out in the SANS 10103 of 2008. There are existing mining activities with the result that there is more traffic (heavy-duty vehicles), which is one of the biggest contributors to the higher prevailing ambient noise levels.

The Driefontein residential area and the residents are already exposed to a certain extent of higher noise levels than expected in a residential area.

## 6.12 Heritage and Archaeology

A Phase 1 Heritage Impact Assessment was undertaken by Dr Julius C.C. Pistorius in 2012 in respect of the MQE opencast mining expansion project.

During the survey, two square dwellings dating from the recent past (less than 60 years) were identified. These dwellings are of low significance.

No sites of high significance (e.g. graveyards) were identified within the areas surveyed. No further cultural, heritage, or archaeological studies are considered necessary for the project area.

It is always a possibility that the assessments may have overlooked heritage resources in the areas surveyed. This is because heritage sites may occur in tall grass or in Blue Gum lots, while others may lie below the surface of the earth and may only be exposed once development commences.

## 6.13 Socio-Economic Environment

### 6.13.1 Regional Context

Kangra is located within the Mpumalanga Province, Gert Sibande District Municipality (DM), Mkhondo Local Municipality (LM), and Dr Pixley Isaka Ka Seme LM. Mpumalanga means "the place where the sun rises".

Mpumalanga lies in eastern South Africa, north of KwaZulu-Natal, and borders Swaziland and Mozambique. In the north, it borders on the Limpopo Province, while to the west it borders on the Gauteng Province, to the southwest it borders on the Free State Province, and to the south the KwaZulu-Natal Province. The capital of the province is Mbombela (previously known as Nelspruit).

Mpumalanga Province is divided into three (3) District Municipalities (DM), which are further subdivided into 17 Local Municipalities (LM). The DMs for the Mpumalanga Province are provided below:

- **Gert Sibande DM.**
- Nkangala DM.
- Ehlanzeni DM.

The Gert Sibande DM is divided into the following LM:

- Chief Albert Luthuli Local Municipality.
- Msukaligwa Local Municipality.
- **Mkhondo Local Municipality.**
- **Dr. Pixley Isaka Ka Seme Local Municipality.**
- Lekwa Local Municipality.
- Dipaleseng Local Municipality.
- Govan Mbeki Local Municipality.

#### **6.13.2 Local Context**

The following information has been sourced from the Gert Sibande District Municipality Amended Integrated Development Plan 2021-2022 and the Statistics South Africa 2016 Census Data.

##### *6.13.2.1 Demographic profile*

#### **Population and household profile:**

The population size (persons) for the Mkhondo LM increased by 2.1% over the 2011 to 2016 time period, whereas the Dr Pixley Ka Isaka Seme LM had a growth of 0.6% over the same period. The Gert Sibande DM only saw a slight increase (1.9%) in population size between 2011 and 2016. Households have grown over the 2011 to 2016 time period, with the Gert Sibande DM experiencing an increase of 18.07%.

### **Population group**

The Mkhondo LM population is composed of mostly Black African persons (98%) followed by 1% White persons. The Dr Pixley Ka Isaka Seme LM population has a similar composition with 92.1% Black African persons followed by 6.7% White persons. The Gert Sibande DM shows a 91.6% Black African population with a larger percentage of White persons (6.8%) (Statistics SA, 2016).

#### *6.13.2.2 Economic Profile*

This section provides a delineation of the study area and a brief economic status quo pertaining to employment and labour profile.

### **Employment and labour profile**

The employment status of the population has a variety of important implications. Economically active and employed persons can contribute to the overall welfare of a specific community by paying their taxes, looking after the youth and aged, and by stimulating the economy. However, should a community have a large number of economically inactive and/or unemployed persons, the burden on the economically active population of that community is amplified.

Gert Sibande's unemployment rate was the lowest among all the districts in Mpumalanga (28.7%). In 2019 the youth unemployment rate was at 58.0% with a very high youth unemployment rate of females (68.5%). The job loss estimates in 2020, due to the COVID-19 lockdown, were between 30 000 and 39 000 with the unemployment rate (strict definition) increasing to between 35.3% and 37.4%. In 2019, the Mkhondo LM had an unemployment rate of 32.3% (20 075 people) and the Dr. Pixley Ka Isaka Seme LM had a 37.5% unemployment rate (10 215 people).

In 2019, Trade (23.2%), Community Service (18.3%) and Finance (12.9%) were the top three (3) leading industries in terms of providing employment in the Gert Sibande DM. However, the largest industries in the Gert Sibande DM are Mining, Manufacturing, Community Services and Trade.

Mkhondo LM's top three (3) industry sectors are Agriculture (25.2%), Trade (15.8%) and Transport (14.5%). Dr Pixley Isaka Ka Seme LM's top 3 industry sectors are Utilities (12.2%), Construction (11.5%), and Agriculture (7.5%)

### **Water and sanitation**

In the Gert Sibande DM, 81.3% of people have access to safe drinking water with 87.2% of Dr Pixley Ka Isaka Seme LM and 85.4% of Mkhondo LM residents having access to safe drinking water. The top three (3) main sources of water for drinking in both Gert Sibande DM and Mkhondo LM were piped tap water (inside yard), followed by piped tap water (inside dwelling)



and finally flowing water/stream. Whereas Dr Pixley Ka Isaka Seme LM's top three (3) main sources for drinking water were piped tap water (inside yard), followed by piped tap water (inside dwelling) and finally boreholes.

The majority of residents in the Gert Sibande DM (97.38%) have access to some type of toilet facility. The main toilet facility access is via flush toilets connected to public sewage systems (67.14%), followed by pit toilets with a ventilation pipe (11.8%) and pit toilets without a ventilation pipe (11.08%). However, 2.62% do not have access to any type of toilet facility. In the Mkhondo LM, 95.69% of residents have access to toilet facilities. The main toilet facility access is via flush toilets connected to public sewage systems (42.78%), followed by pit toilets without ventilation (32.27%) and ecological toilets (9.8%). In the Dr Pixley Ka Isaka Seme LM, 95.75% of residents have access to toilet facilities. The main toilet facility access is via flush toilets connected to public sewage systems (64.8%), followed by pit toilets with a ventilation pipe (16.01%) and pit toilets without a ventilation pipe (8.64%).

#### **6.13.3 Neighbouring Community/Sensitive Receptors**

The Driefontein community, which is located to the east of the proposed CDF, borders the Maquasa East property.

This community consists of a densely populated settlement of mostly Reconstruction and Development Property (RDP) style housing, or low-cost housing. According to the Kangra Social and Labour Plan (SLP) (2022-2026) MP30/5/1/2/3/2/1/10099 MR), 194 people from the Driefontein community are employed by Kangra.

The Driefontein local area still has many dwellings without clean running water and sanitation facilities, and several roads are in poor condition and pose a risk to the safety of pedestrians and the health of the larger community by dust creation.

#### **6.14 Visual Aspects**

The visual character of an area plays a significant role in determining an area's sense of place, specifically the area's land use, topography, cultural features, landscape quality, etc.

The area surrounding the study area comprises of existing Kangra coal mine and related infrastructure, land that has been rehabilitated and grassland.

### **6.15 Traffic**

The proposed project is situated approximately 45km west of Piet Retief and just off the N2 national road on a secondary road leading to the Heyshope Dam. The N2 is a surface single carriageway road. The area in the vicinity of the mine is largely rural in nature, therefore the secondary road is used largely by vehicles accessing the mine and local communities.

## 7 SUMMARY OF SPECIALIST INVESTIGATIONS

This section provides an overview of the specialist studies undertaken for the project, including the following information regarding each study:

- The details of the specialist who prepared the report;
- An overview of the scope of each study; and
- An overview of each specialist's findings and the implications of those on the project.

The results of the Department of Forestry, Fisheries and the Environment (DFFE) Screening Tool (01 November 2022) (Appendix A) for the MQE proposed projects and the studies undertaken as required are presented in Table 7-1. A Geohydrological Impact Assessment was also undertaken.

**Table 7-1: Site Sensitivities (based on the property description) from the DFFE Screening Tool.**

THEME	VERY HIGH	HIGH	MEDIUM	LOW	Specialist Study
Agriculture	X				Hydropedological Impact Assessment
Animal Species		X			Ecological Assessment
Aquatic Biodiversity	X				Aquatic & Wetland Impact Assessment Hydrological Impact Assessment
Archaeological and Cultural Heritage				X	Heritage & Paleontological Sensitivity Investigation Verification
Civil Aviation				X	None required
Defence				X	None required
Palaeontology	X				Heritage & Paleontological Sensitivity Investigation Verification
Plant Species			X		Ecological Assessment
Terrestrial Biodiversity	X				Ecological Assessment

### 7.1 Ecological Assessment

#### 7.1.1 Specialist Details

An Ecological Assessment was undertaken by GCS (Pty) Ltd (C/O Nico-Ronaldo Greeff-Retief, June 2023) for the proposed Project in accordance with the requirements for specialist assessments as outlined within the NEMA EIA Regulations (as amended). This report is included in Appendix E-1.

#### 7.1.2 Scope of Work

The Ecological Assessment comprised of the following components:

- Fauna: Mammals (including bats), birds, reptiles, amphibians and invertebrates.

- Plants and vegetation (including alien vegetation).
- Habitat features - Caves and/or ridges.

Specifically, the Terms of Reference (ToR) included the following:

- Desktop description of the baseline receiving environment specific to the field of expertise (general surrounding area as well as site specific environment);
- Identification and description of any sensitive receptors in terms of relevant specialist disciplines (biodiversity) that occur in the study area, and the manner in which these sensitive receptors may be affected by the activity;
- Identify 'significant' ecological, botanical, and faunal features within the proposed development areas;
- Site visit to verify desktop information;
- Screening to identify any critical issues (potential fatal flaws) that may result in project delays or rejection of the application; and
- Provide a map to identify sensitive receptors in the study area, based on available maps, database information & site visit verification.

#### **7.1.3 Findings**

The following findings were made during the Ecological Assessment:

- Anthropogenic impacts identified within the study site include alien vegetation encroachment, gravel roads, natural vegetation removal, hardening of surfaces to establish the mining infrastructure, fencing, grazing of animals, and disturbances to the wetland systems around the site.
- The study site still has a functional role to play in regional ecological functioning and biological functions at the site even though it has been influenced by human-related impacts.
- The Terrestrial Critical Biodiversity Area (CBA) of the site is mixed between transformed areas and ecological support areas (ESA).
- Ecological connectivity between the grasslands and drainage located towards the Heyshope Dam cannot be excluded from the overall study area. The vegetation and drainage may still fulfil an ecological function by sustaining biodiversity and ecological maintenance of downstream users as well as maintenance of ecological biodiversity drivers.
- Applying the relevant mitigation measures to the system to ensure that the functionality of the watercourse is not lost will directly ensure that the surrounding system's functionality is retained and that impacts on the water resources are limited.

#### **7.1.4 Recommendations**

From an ecological perspective, the development is situated within an area which has been disturbed. If all mitigatory actions are implemented with due care, satisfactory standards will be achieved. Alien eradication and rehabilitation must be encouraged through the development the implementation of an alien and invasive species plan, starting during the construction phase, and must continue for the life of the proposed development. Mitigation must include limiting activities to the designated, demarcated footprint, good waste management, concurrent rehabilitation of disturbed areas, relocation of animals, and the prohibition of harm to animals.

Based on the results and conclusions presented in the Ecological Assessment Report, and the outcomes of the field survey, it is the opinion of the specialists that a follow-up study must be accompanied by this study to verify all protected trees, medicinal plants, birds, and other fauna onsite, before a decision by the CA may be undertaken.

#### **7.1.5 Conclusion**

It was concluded that the construction activities would impact on the low sensitive terrestrial biota. Mitigation measures are provided may reduce the negative risks anticipated with the mining infrastructure construction.

The specialist has recommended that a follow up specialist study be undertaken prior to the issuance of a decision by the CA. It is recommended that this follow-up survey is included as a condition in the EA and must be undertaken prior to site clearing.

### **7.2 Wetland Assessment**

#### **7.2.1 Specialist Details**

A Wetland and Aquatic Assessment was undertaken by Ecolink Consulting (C/O Magnus van Rooyen, September 2024) for the proposed Project in accordance with the requirements for specialist assessments as outlined within the NEMA EIA Regulations (as amended). This report is included in Appendix E-2.

#### **7.2.2 Scope of Work**

The Scope of Work comprised the following:

- The characterisation of the current state of the local river systems.
- The delineation and assessment of wetlands within 500m of the project area.
- A risk assessment for the proposed development; and
- The prescription of mitigation measures and recommendations for identified risks.

The SOW was undertaken in the following manner:

- Phase 1: Wetland Baseline Assessment:
  - Delineate the extent of the wetland units occurring within and in the vicinity of the mining footprint and proposed expansions.
  - Describe the soil and vegetation of the delineated wetland units based on onsite observations.
  - Determine the Present Ecological State of the delineated wetland areas using the WETHealth tool (Level 1) developed by Macfarlane *et al.* (2009).
- Phase 2: Wetland Impact Assessment:
  - Identify, describe, and assess the potential impacts to be imparted on the delineated wetland units resulting from the establishment and operation of the proposed sand mine; and
  - Provide mitigation measures to avoid, minimise, repair, and/or offset the severity/magnitude of the potential impacts on the delineated wetland units.

### 7.2.3 Findings

The wetland and aquatic assessment established the following:

- The site assessment confirmed the absence of any natural wetland features and any river FEPAs within the boundaries of the project site.
- A total of seven wetland systems were identified within the “regulated area of a watercourse” as defined by the NWA.
- The PES of these wetlands ranged from Class B (one wetland), Class C (two wetlands) and Class D (four wetlands) with the EIS of the features being classified as low to medium.
- The impacts that were identified and assessed can all be sufficiently managed and mitigated by the implementation of the measures detailed in this assessment.

### 7.2.4 Recommendations

The following recommendations have been made:

- A 40m buffer has been recommended around the wetlands for the construction phase and a 20m buffer for the operational phase. These fulfil ecological functions and serve as natural corridors for fauna species and breeding grounds.
- It is also suggested by the specialist that a rehabilitation plan must be implemented during the rehabilitation of the mine. The rehabilitation plan must focus on the following aspects:



- Rehabilitation of head-cuts where they occur within the identified wetland features.
  - Rehabilitation of overgrazed riparian and surrounding areas.
- It is recommended that an Environmental Control Officer, who meets the requirements of the NEMA: EIA Regulations (2014) as amended, be appointed to conduct monthly audits of the construction phase of the project. An audit report must be completed for each monthly audit and be submitted to the relevant authority.
- In addition, it is suggested that provision be made for a biannual biomonitoring be conducted of the identified wetland features and that monthly water quality monitoring be done on the treated effluent discharge at the point of discharge into the Heyshope Dam. This will ensure early detection of any exceedances of the discharged limits.

#### **7.2.5 Conclusion**

Based on the findings of the Wetland Assessment, it is the opinion of the specialist that there are no fatal flaws that will prevent the development from being authorised subject to the implementation of the mitigation measures provided in this report and the specialist investigation report.

### **7.3 Hydrological Assessment**

#### **7.3.1 Specialist Details**

A Hydrological Assessment was undertaken by GCS (Pty) Ltd (C/O Hendrik Botha, June 2023) for the proposed Project in accordance with the requirements for specialist assessments as outlined within the NEMA EIA Regulations (as amended). This report is included in Appendix E-3.

#### **7.3.2 Scope of Work**

The scope of work completed, was as follows:

- **Baseline Hydrology Review:**
  - Hydro-meteorological data collection and analysis.
  - Catchment delineation and drainage characteristics.
  - Determination of catchment hydraulic and geometric parameters.
- **Peak Flows & Flood Line Modelling:**
  - Peak flood volume calculation for the 1:10, 1:20, 1:50, and 1:100-year recurring events.
  - Flood line modelling using HEC-RAS hydraulic software - 1:50 and 1:100-year flood lines were presented; and
  - Analysis of the modelling results.
- **Conceptual Storm Water Management Plan and Stormwater Monitoring:**

- Identification of stormwater sub-catchments (i.e., clean and dirty areas)
- Determination of stormwater flows and volumes (1:10, 1:20, 1:50 and 1:100-year return periods) were undertaken.
- Indications and explanations of the placement of stormwater attenuation infrastructure were offered.
- A stormwater monitoring system plan was drafted, to ensure that the stormwater discharge impact on the environment is managed and controlled.
- Risk assessment:
  - A hydrological risk assessment was undertaken, to contextualise the potential surface water risk of the project.
- Surface Water Monitoring Plan:
  - A surface water monitoring plan was developed.
- Reporting:
  - This report was compiled, composing the components above.

### 7.3.3 Findings

The delineated drainage lines associated with the project area can be considered moderate flood hazard areas, based on the peak flows estimated and the flooding depth observed from the HEC-RAS model output. From the flood lines produced, it is noted that all the proposed infrastructure (CDF, PCDs, WWTP and Brine PCD) will be situated outside probable zones of inundation. Hence, there is no likely flooding risk. Limited sedimentation and erosion for the drainage lines and streams associated with the site are anticipated.

The non-perennial and perennial streams downstream of the proposed CDF, NFEPA wetland units and vadose zone soils are the main receptors of potential surface-related pollution at the site.

### 7.3.4 Recommendations

- Several additional monitoring points are proposed, to be incorporated into the existing surface water monitoring program for the mine.
- Avoidance areas: The flood lines also suggest no flooding risk associated with the proposed development. The 1:100-year flood line should be considered an avoidance area (buffer area) (CSIR, 2005).

- Care should be taken if development is to take place within the exclusion zone. If development does take place in the exclusion zone, proper flooding protocols and erosion prevention measures should be implemented. This could include gabion mattresses and cut-off walls, gutters and drains, roadside curbs, reed beds or stilling basins at discharged areas, integrated into the engineering designs for the development. Sub-surface infrastructure (i.e. sewer lines, water pipes, etc.) will be less susceptible to surface flood damage, and can highly likely be constructed in the demarked flood line areas. It should, however, be noted that soils on steeply sloped areas ( $> 1:4$ ) should be compacted to prevent slope failure which could cause mass wasting and sub-surface infrastructure damage. These systems would need to be sized by a civil engineer, considering runoff patterns and stormwater flow velocities from the final engineering designs for the development.
- If linear infrastructure is zoned to occur in the demarcated flood line areas, the structures are to be designed to such a degree by a professional engineer to prevent environmental damage if a flood does occur; prevent slope failure on the water course banks; prevent increased flooding potential; withstand the flood peak flow forces and buoyancy forces; effectively convey flood water/stormwater for safe discharge to the environment; and have erosion control measures in place at any point of discharge into the environment (stilling basins, reed beds, energy damping blocks or mats, gabion mattresses etc).

### **7.3.5 Conclusion**

Based on the risks identified, and assuming the mitigation measures proposed will be implemented, it is proposed that the construction of the CDF and the WWTP and the authorisation of these activities be considered. This is grounded on the assumption that the proposed mitigation measures, EMPr and EIA recommendations are implemented during the construction, operational and closure phases of the project.

## **7.4 Geohydrological Assessment**

### **7.4.1 Specialist Details**

A Geohydrological Assessment was undertaken by GCS (Pty) Ltd (C/O Hendrik Botha, February 2023) for the proposed Project in accordance with the requirements for specialist assessments as outlined within the NEMA EIA Regulations (as amended). This report is included in Appendix E-4.

This study provides an update of the numerical groundwater model. A Geohydrological Investigation was undertaken with respect to the previously proposed Discard Dump (GCS, 2015), located in the same position as the proposed CDF.

#### 7.4.2 Scope of Work

The scope of work completed, was as follows:

- Desktop Data Review:
  - All available reports relating to the site were assessed, including a review of all geohydrology, hydrology, hydrochemistry, and geology literature data.
  - GCS water monitoring data for the site were assessed and integrated into this investigation.
  - A desktop-level hydrocensus was conducted. The National Groundwater Archive (NGA, 2019), Groundwater Resource Information Project (GRIP, 2016) and the Southern African Development Community Groundwater Information Portal (SADAC GIP) databases were assessed to identify existing groundwater users in the area.
- Baseline Hydrology Review:
  - Hydro-meteorological data collection and analysis.
  - Catchment delineation and drainage characteristics.
  - Determination of catchment hydraulic and geometric parameters.
- Field investigation:
  - A site walk-over assessment was undertaken to map sensitive groundwater-surface water interaction zones identified on a desktop level.
  - Slug testing was conducted on suitable boreholes at the site.
  - A groundwater hydrocensus was conducted within a 5km radius of the Maquasa and Kusipongo.
- Hydrogeological, geochemical, and geological conceptual model update:
  - The existing hydrogeological and geological site conceptual model was updated with data obtained for the study area - focusing on the Maquasa and Kusipongo operations areas.
- Groundwater numerical flow and transport update:
  - The steady-state model was updated and calibrated with data available for the study area (2022 monitoring data). The steady-state model was converted to a transient-state model to enable scenario modelling. The following were evaluated:
    - Groundwater flow velocities and directions.

- The mining operation's impact on groundwater levels and cone of depression is presented as the zone of influence (ZOIf). This includes:
  - MQE- opencast mining in progress.
  - NZ -underground mining in progress.
  - Twyfelhoek (Udumo) adit; and
  - Balgarthern Adit.
- Source term impacts presented as the zone of impact (ZOIp) for the Maquasa and Kusipongo operations.
- Hydrogeological risk assessment:
  - A risk assessment was conducted based on the source-pathway-receptor principle.
  - The existing impacts associated with the Maquasa and Kusipongo operations on the groundwater and subsequent surface water environments were evaluated.
- Monitoring, Audit, and Groundwater remediation plan:
  - A groundwater and surface water monitoring plan, with mitigation measures, was developed for the site based on the baseline assessment of the site conditions.
  - A groundwater remediation plan for the Kusipongo resource Twyfelhoek (Udumo) adit and Balgarthern Adit.
- Reporting:
  - A geohydrological report encompassing all work done as well as a groundwater risk assessment and monitoring plan will be compiled.

#### **7.4.3 Findings**

Based on the aquifer characteristics (e.g. weathering depth, groundwater strike, and static water levels), the hydrogeological system at the Project site can be categorised into two aquifers: shallow weathered rock/material aquifer and deeper fractured rock aquifer hosted within the Vryheid Formation sediments.

Shallow weathered rock/material aquifer - Vryheid Formation sediments comprise highly weathered material and have an average thickness of between ~5 and ~27 m. Due to the limited depth extent and average depth to groundwater (between ~2.5 and ~35 m), it is unlikely that this system will comprise a significant groundwater potential. However, in terms of seepage emanating contaminant transport, this aquifer is considered important.

The previous assessment (GCS, 2015) found that the potential groundwater quality and quantity impact/s associated with the discard storage facility can be countered by the appropriate design of the discard facility (i.e. liner system, concurrent rehabilitation methodology).

#### 7.4.4 Recommendations

- Rock samples should be collected during mining, to maintain a clear understanding of the AMD potential of the rock being mined. It is important to use ABA and NAG as pre-emptive tools to determine if any AMD may occur. An annual geochemical screening assessment of mine residue waste sites is recommended.
- The numerical groundwater model and transport model should be updated annually to:
  - Recalibrate the flow system based on the dedicated monitoring boreholes drilled and routine water level monitoring data gathered for the site.
  - Confirm preferential flow paths and groundwater migration velocities as new geological data is attained via mining.
  - Evaluate the spatial impact (i.e., SO<sub>4</sub> plume) calibrated with the proposed monitoring borehole data.
  - Confirm long-term liabilities associated with the workings (i.e. predict likely changes in flow fields etc.); and
  - Ensure no monitoring network gaps exist (i.e. check if the monitoring network is representative of the site).
- The following can be done to improve the assumptions and understanding of the groundwater aquifer and hence improve the numerical groundwater model confidence:
  - All new exploration boreholes drilled in the area should note groundwater occurrences as well as strike depths. The data can be used to update the conceptual hydrogeological model which is incorporated into the numerical flow model.
  - Water levels of dedicated monitoring boreholes that will be drilled, as well as any new boreholes that are discovered in the area during routine hydrocensus updates, should be monitored (quarterly dedicated holes, bi-annual hydrocensus).



- Dewatering volumes (during mining) should be recorded daily and reported bi-monthly.

#### **7.4.5 Conclusion**

The 2015 Geohydrological Assessment (GCS, 2015) did not identify any fatal flaws which would preclude the authorisation of the proposed CDF.

### **7.5 Hydropedological Assessment**

#### **7.5.1 Specialist Details**

A Hydropedological Assessment was undertaken by GCS (Pty) Ltd (C/O Hendrik Botha, February 2023) for the proposed Project in accordance with the requirements for specialist assessments as outlined within the NEMA EIA Regulations (as amended). This report is included in Appendix E-5.

#### **7.5.2 Scope of Work**

The scope of work completed was as follows:

- Desktop study:
  - All available reports (which were provided by the client) relating to the site were assessed.
  - Evaluation of soil occurrences in the study area, based on available South African databases.
- Field investigation:
  - Several auger holes were drilled in the project area, in pre-determined hillslope areas.
  - The soils identified in the study area were screened per the Soil Classification guidelines for South Africa (Department of Agricultural Development, 1991) and (SCWG, 2018) To derive hydropedological flow regimes.
- Hydropedological assessment:
  - Meteorological evaluation.
  - Catchment delineation.
  - Estimation of soil permeability and soil flow processes based on field observation and desktop data.
  - HOSASH (Hydrology of South African Soils and Hillslopes) index.

- Water balance and flow modelling:
  - A simple spreadsheet-based water balance model was used to illustrate unsaturated zone fluxes/water balances.
  - The total water loss during a development phase concerning the natural water processes in a sub-catchment was estimated. This was used in conjunction with the water balance flow model to determine the natural stream loss % for a sub-catchment and associated hillslopes.
- Risk assessment:
  - The risk and impact criteria were applied to the study area, to evaluate hydrogeological risks.
  - Natural flow losses were estimated, using a spreadsheet water balance developed for the site.
- Mapping and report:
  - Several hydrological hillslope profiles, soil distribution, and hydrological soil type maps were produced; and
  - The report was compiled.

### 7.5.3 Findings

Soil data were evaluated for the project area to produce a soil distribution map. The soil map was used to categorise the hydrological soil types (HST), into six (6) categories: Recharge; Responsive (shallow); Responsive (saturated); Stagnating; Interflow (A/B); and Interflow (soil/bedrock).

Three (3) sub-catchments and four (4) prominent hillslopes were defined for the proposed development area. Generally, recharge soils were observed on the crest and footslope positions of two (2) of the hillslopes, with the remainder of the hillslopes (and the majority of the site) being dominated by stagnating hydrological soil types. It was noted that the area southeast of the proposed CDF gradually extends into backfilled material used to rehabilitate the old opencast pit associated with the area.

These soils were classified as interflow (soil/bedrock) type and occurred in areas that appear to be associated with the high wall of the old rehabilitated pit. The valley positions associated with the site, nearing perennial and non-perennial drainage lines, are dominated by responses (saturated) soil types. In responsive soils, the build-up of water is expected in the B and upper A horizons after rain, and overland discharge and minor lateral seepage are expected (due to saturation excess). Secondary vertical seepage to deeper soil zones from the saturated B horizon is expected. At the transition from one soil type to the other (upstream to downstream) overland flow may take place during wet seasons.

As the areas are mainly undeveloped, natural soil water processes are expected. The predicted impact on the wetlands and watercourses fed by the hydrogeological processes ranges from 2.95% (expected no impact) to 25.39% (expected high impact) for the hydrogeological sub-catchments.

It is assumed that wetlands that do exist in the area need to maintain the current PES and EIS post-development, as per the resource management objectives (RMO). The calculation suggests that the PES will likely change if the wetland units are only fed by the sub-catchments. However, considering the greater sub-catchment and drainage area, the severity decreases to low and moderate for HRU1 and HRU2. The severity of a flow driver suppression on a sub-catchment scale can further be improved by incorporating stormwater attenuation back into the environment.

#### **7.5.4 Recommendations**

No defined hydrogeological buffer areas are recommended; however, it is proposed that stormwater attenuation from the development area back to the natural environment be considered. Wetland buffers should be at least 15 m to 25 m, or as per the dedicated wetland assessment report for the site (refer to GCS, 2022 - wetland assessment report). Efforts should be made to maintain the current PES and EIS of the wetland units identified during the operational phase of the project, as well as during the closure phase.

#### **7.5.5 Conclusion**

This assessment cannot find any grounds or identify high hydrogeological risks that do not proceed with the development. This is grounded on the assumption that the proposed mitigation measures and EMP recommendations are implemented during the construction, operational, and closure phases of the development.

## 8 PUBLIC PARTICIPATION PROCESS

The PPP is a legislated requirement under NEMA for EA and WML applications. This section of the report documents the process, which was and will be followed with respect to the consultation of Interested and Affected Parties (I&APs)/stakeholders and government authorities.

### 8.1 Purpose of Public Participation

The most important objective of PPP is to provide sufficient and accessible information to potential I&APs in an objective manner and a platform for constructive participation in the EA Application, thereby assisting I&APs to:

- Gain an understanding of the Proposed Project, the various components, and the potential impacts (positive and negative);
- Raise issues of concern and suggestions for enhanced benefits;
- Verify that their issues have been recorded in the Comments and Responses Report (CRR) and considered in investigations; and
- Contribute relevant local information and traditional knowledge to the process.

### 8.2 Competent Authority Consultation

The CA (Mpumalanga DMRE) has been/will be consulted at the following key stages:

- The FSR was submitted to the CA on 23 November 2023. The acceptance of the report was issued on 13 August 2024.
- A possible site meeting and site visit with the CA will be held during the EIR phase.
- A consultation meeting will be held with the CA approximately two (2) weeks after the distribution of the DEIR, to discuss any additional comments from I&APs and the outcome of the specialist studies, should it be required. An indication of the CA's satisfaction with the process undertaken to that stage should also be clear after the meeting.
- The FEIR will be submitted to the CA once all outstanding issues have been resolved.
- The CA may convene a meeting post-submission of the FEIR should it be deemed necessary.

### 8.3 Public Consultation Process

This section provides a summary of the various activities of the public consultation process to be undertaken in support of the application process.

#### 8.3.1 Stakeholder database

A stakeholder database or list of I&APs was compiled and will be updated during the PPP and as more I&APs are registered. The database was compiled by:

- a) using lists of contact details of I&APs from previous environmental applications for MQE;
- b) using information provided by the applicant's community liaison officers; and
- c) including responses from I&APs.

The I&AP database will be used to convey information to stakeholders as part of the announcement of the S&EIR Application; the opportunity for I&AP consultation and the availability of the draft and final S&EIR Reports as these became available for public review. For the Proposed Project, I&APs included the following:

- Owners of the land where the Proposed Projects is to be undertaken (Project Area) other than Maquasa Mine (Kangra (Pty) Ltd);
- Owners and occupiers of land adjacent to the Project Area;
- Provincial (Mpumalanga) and local government;
- Organs of state, other than the competent authority (CA) having jurisdiction over any aspect of the proposed activities, including the DWS, Mpumalanga Department of Economic Development, Environment and Tourism (MDEDET), etc.
- Relevant residents' associations, agricultural unions, community-based organisations, water user associations, and any catchment management authority and Non-Governmental Organisation (NGOs);
- Environmental organisations, forums, groups, and associations; and
- Private sector organisations (businesses, industries) in the vicinity.

#### 8.3.2 Preapplication and Announcement of the Application Process

A pre-application consultation process was undertaken, whereby the I&APs were provided to opportunity to register for the proposed project. The integrated application process was announced to I&APs by means of the following:

- An advertisement was placed in the Excelsior News on the 27<sup>th</sup> of January 2023; and
- Site Notices were placed all around the project area.

All I&APs were given 14 days to register their interest in the project. This task was undertaken to ensure that the current participants who are interested in or affected by the proposed project are registered as I&APs.

### **8.3.3 Application Process Notifications**

The continuation of the integrated application process, the commencement of the Scoping Phase, and the availability of the Draft Scoping Report (DSR) was announced to I&APs by means of the following:

- An advertisement was placed in the Excelsior News on the 24<sup>th</sup> of November 2023;
- A Background Information Document (BID) was compiled and distributed to all I&APs on the stakeholder database and copies were available on request;
- Site Notices were placed all around the project area;
- Placement of copies of the notification documentation and the BIDs on the GCS website (<https://www.gcs-sa.biz/public-documents/>). The GCS website is used to make documents electronically available to stakeholders. The website address was published in the advertisement, BIDs, site notices, and all other communication; and
- A Registration and Comment Sheet was distributed with every BID, inviting stakeholders to register as I&APs and to provide their comments on the proposed application.
- The I&APs had 30 days to register, however, according to NEMA the process only ends after the submission of the final EIA report to the CA, therefore, registration and comment remains open.

### **8.3.4 Public Review of Draft Scoping Report**

The DSR was available for public comment from 24 November 2023 until 16 January 2024 (30 days).

- Piet Retief Library, 10B Retief Street;
- Maquasa East Security Office, Maquasa East Mine; and
- Thusong Service Centre, Driefontein Community.

The Report was also available electronically via the GCS Website (link provided above) or a CD/USB was available upon request.

The report was updated at the end of the 30 days to include all comments received during the public review period. The Final Scoping Report was then submitted to the Mpumalanga Department of Mineral Resources and Energy (DMRE).



### **8.3.5 Public Review of the DEIR and DEMPR**

The review of the Draft EIR(DEIR)/EMPr (DEMPR) will take place from 17 September to 18 October 2024, providing all stakeholders with 30 days to submit comments in respect of the reports. The main objectives of public participation during this phase are:

- to verify that stakeholder issues have been considered by the EIA Specialist Studies and in the reports that will be compiled; and
- to provide stakeholders the opportunity to comment on the findings of the EIR/EMP Report and other associated reports, including the measures that have been proposed to enhance positive impacts and reduce or avoid negative ones.

All registered stakeholders have been notified of the availability of the DEIR/DEMPR for review via email. This report is available for review at the same venues where the DSR was placed (refer to section 8.3.4).

### **8.3.6 Availability of the FEIR and EMPr**

After comments from I&APs have been incorporated into the CRR table and the DEIR revised accordingly, all stakeholders on the database will receive a letter informing them that the FEIR and EMPr have been submitted to the CA for consideration. Electronic copies of the FEIR will be available should the I&APs wish to review the documents submitted to the CA. The I&APs will be informed that should they wish to submit comments on the FEIR; these must be submitted directly to the CA and copied to the EAP.

### **8.3.7 Public Participation following the Competent Authority Decision**

Once the CA issues their decision in respect of the integrated application in writing, their decision and the details thereof will be communicated to I&APs according to the conditions stipulated. I&APs will be made aware of their rights to appeal the decision and the proposed process to follow in such regard. The legislative and required public participation activities will end once the appeal periods have lapsed.

### **8.3.8 Comments and Response Report**

All comments received during the application process thus far were captured in the Comments and Responses (CRR) chapter of the Public Participation Report (Refer to Appendix C). The CRR will be updated continuously and will be presented to the authorities and other I&APs together with the consultation and final reports as a full record of issues raised, including responses on how the issues were considered during the application process.

## 9 EIA PROCESS AND APPROACH

A S&EIR process has two distinct phases: The Scoping Phase and the Environmental Impact Reporting Phase. The Scoping Phase has been concluded with the acceptance of the Scoping Report by the on the 13 August 2024.

This DEIR illustrates the risk assessment undertaken of potential biophysical and socio-economic aspects and impacts of the proposed Project on the receiving environment. This DEIR summarises the risks and findings of various specialist studies undertaken and outlines avoidance, mitigation, and management actions that will assist in minimising the impact of the Project as far as possible.

The Environmental Impact Phase concludes with the submission of a Final EIR (FEIR) to the CA for consideration, thereafter the application will be granted or rejected.

### 9.1 Impact Assessment Methodology

Possible impacts are identified through comments from I&APs, specialist reports, and from the EAP's experience.

The assessment of potential impacts was addressed in a standard manner, to ensure that a wide range of impacts were comparable. The ranking criteria and rating scales were applied to all specialist studies for the BS Expansion Projects. To enable a scientific approach to the determination of the environmental significance (importance), a numerical value is linked to each rating scale.

Clearly defined rating and rankings scales (Table 9-1-Table 9-7) will be used to assess the impacts associated with the BS Expansion Projects. The impacts identified by each specialist study and through PPP will be combined into a single impact rating table for ease of assessment.

**Table 9-1: Severity or magnitude of impact**

Not applicable/none/negligible	0
Minor/insignificant/non-harmful (no loss of species/habitat)	2
Low/small/potentially harmful (replaceable loss with minimal effort)	4
Moderate/significant/slightly harmful (replaceable loss of species/habitat with great effort and investment)	6
High/highly Significant/harmful (impact on human health or welfare/loss of species/habitat)	8
Very High/extremely significant/extremely harmful/within a regulated sensitive area (loss of human life/irreplaceable loss of Red Data species/conservation habitat)	10

**Table 9-2: Spatial Scale of activity**

Not applicable/none/negligible	0
Site only	1
Local (within 5km)	2
Regional/neighbouring areas (5 km to 50 km)	3
National	4
International	5

**Table 9-3: Duration of activity**

Not applicable/none/negligible	0
Immediate (immediately reversible with minimal effort)	1
Short-term (0-5 years - reversible)	2
Medium-term (5 to 15 years - difficult to reverse with effort)	3
Long-term/life of the activity (very difficult to reverse with extensive effort)	4
Permanent/beyond the life of the activity (not reversible)	5

**Table 9-4: Frequency of activity (how often the activity is undertaken)**

Not applicable/none/negligible	0
Improbable /almost never/annually or less	1
Low probability/very seldom/6 monthly	2
Medium probability/infrequent/temporary/monthly	3
Highly probable/often/semi-permanent/weekly	4
Definite/always/permanent/daily	5

**Table 9-5: Frequency of incident/impact (how often activity impacts environment)**

Almost never/almost impossible/>20%	1
Very seldom/highly unlikely/>40%	2
Infrequent/unlikely/seldom/>60%	3
Often/regularly/likely/possible/>80%	4
Daily/highly likely/definitely/>100%	5

**Table 9-6: Legal Issues - governance of activity by legislation.**

No legislation	1
Fully covered by legislation	5

**Table 9-7: Detection (how quickly/easily impacts/risks of activity on environment, people, and property are detected)**

Immediately (easier to mitigate)	1
Without much effort	2
Need some effort	3
Remote and difficult to observe	4
Covered (more difficult to mitigate)	5

Each impact identified must be assessed in terms of probability (likelihood of occurring); the consequence of the impact (spatial scale, severity, and duration); and the associated risk (impact significance).

Consequence was then determined as follows:

$$\text{CONSEQUENCE} = \text{Severity} + \text{Spatial Scale} + \text{Duration}$$

The probability or likelihood of occurrence of the activity was then calculated based on frequencies of the activity and impact, whether the activity is governed by legislation, and how easily it can be detected:

$$\text{LIKELIHOOD} = \text{Frequency of Activity} + \text{Frequency of Impact} + \text{Legal issues} + \text{Detection}$$

The significance or risk of each identified impact was then based on the product of consequence and likelihood:

$$\text{Environmental Significance/Risk} = \text{Consequence} \times \text{Likelihood}$$

Impacts will be rated as either of high, medium, or low significance on the basis provided in Table 9-8. Each impact will also be assessed in terms of the level to which there is an irreplaceable loss of resources (Table 9-9) and its degree of reversibility (Table 9-10).

**Table 9-8: Impact significance ratings.**

SIGNIFICANCE	ENVIRONMENTAL RISK	COLOUR CODE
High (positive)	>240	H
Medium (positive)	120 to 240	M
Low (positive)	<120	L
Neutral	0	N
Low (negative)	>-120	L
Medium (negative)	-120 to -240	M
High (negative)	<-240 (max = 400)	H

**Sub-categories:**

Significance	Extreme	Very High	High	Moderate	Significance	Extreme	Very High	High	Moderate
High	260-400	320-359	280-319	241-279	High	260-400	320-359	280-319	241-279
Significance	High	Moderate	Medium		Significance	High	Moderate	Low	
Medium	200-240	160-199	120-159		Medium	200-240	160-199	120-159	
Significance	Moderate	Moderate	Low		Significance	High	Moderate	Negligible	
Low	80-119	40-79	1-39		Low	80-119	40-79	1-39	

**Table 9-9: Irreplaceability of resource caused by impacts**

No irreplaceable resources will be impacted (the affected resource is easy to replace/rehabilitate)	Low
Resources that will be impacted can be replaced, with effort	Medium
Project will destroy unique resources that cannot be replaced	High

**Table 9-10: Reversibility of impacts**

Low reversibility to non-reversible	Low
Moderate reversibility of impacts	Medium
High reversibility of impacts	High

The significance of an impact gives one indication of the level of mitigation measures required to minimise negative impacts and reduce environmental damage during the construction, operational and decommissioning phases. Suitable and appropriate mitigation measures, to ensure avoidance, management and mitigation of impacts, will be identified for each of the potential impacts based on specialist recommendations and GCS expertise.

## 9.2 Impact Management

Each specialist has identified means of avoiding, mitigating and/or managing the negative impacts in their particular aspect of investigation. The recommended management strategies were synthesized by GCS to formulate the EMPR for the proposed Project.

## 10 ENVIRONMENTAL IMPACT ASSESSMENT

The potential impact identified for the life of the proposed Project are discussed in this chapter. The significance rating for each impact is presented in the Impact Assessment Matrix under Appendix D. The matrix includes the proposed mitigation measures, which are expanded upon in the DEMPR, attached under Appendix F.

### 10.1 Assessment of Construction Phase Impacts

The potential construction phase impacts identified due to the following anticipated construction activities are discussed in this section:

- Clearing of vegetation.
- Stripping, handling and stockpiling of topsoil.
- Excavation of material/earthworks.
- Transportation of construction materials.
- Travel along unsurfaced roads.
- Construction of structures including development of berms and channels, pouring of concrete, installation of pipelines.
- Storage of construction materials and hydrocarbons
- Storage and handling of general, hazardous and construction waste.

#### *10.1.1 Potential Impacts on Air Quality and Climate*

Localised impacts on ambient air quality are anticipated through the generation of wind-borne dust due to construction activities. Dust has the potential to impact human health and cause ecosystem damage. Sources of dust include travelling on gravel roads, wind-borne dust from exposed areas and stockpiles, soil stripping and handling and earthworks/excavating.

Due to the temporary nature of the construction phase and the limited footprint areas associated with the proposed Project, the potential impacts were considered to have a relatively high, **Low** significance. With the implementation of the dust suppression control measures listed in the EMPR, the impacts can be reduced to **Low** significance.



Greenhouse Gases (GHGs), which contribute to global climate change, will be generated throughout the construction and decommissioning phases of the proposed Project. Direct GHG emissions include exhaust fumes from equipment, vehicles and backup generators (when required). Allowing fires for cooking or burning of waste or debris may also contribute to this impact. The anticipated impact of the project activities on GHG emissions and climate is expected to be moderate **Low** and can be reduced to **Negligible** with the implementation of the recommended mitigation measures.

#### *10.1.2 Potential Impacts on Terrestrial Ecology*

The construction phase is considered to have the largest direct impact on biodiversity. The proposed clearing and excavation of the footprint areas will result in the physical destruction and/or modification of terrestrial habitat and includes habitat loss impacts and habitat and vegetation degradation impacts.

The loss of vegetation within the development footprint has been rated as extremely **High** significance, which can be reduced to **Medium** through the implementation of the recommended mitigation measures such as demarcation of the footprint, limiting all activities to the demarcated footprint and existing roads, implementing a fire management plan and progressive/concurrent rehabilitation. The irreplaceability of the loss of resources is considered **High** and the degree to which it can be reversed is **Low** as all vegetation will be removed from the areas where the structures will be constructed.

The introduction of alien species, especially plants, will lead to the degradation and loss of surrounding natural vegetation. This is probably one of the most significant potential impacts from a terrestrial invertebrate perspective and may have very significant knock-on effects that could impact virtually every aspect of the surrounding ecosystem. Vehicles often transport many seeds, and some may be of invader species, which may become established along the road, especially where the area is disturbed. Continued movement of personnel and vehicles on and off the site, as well as occasional delivery of materials required for maintenance, will result in a risk of importation of alien species throughout the life of the project. This impact has been ranked as **Medium** and can be reduced to **Low** with the implementation of an alien plant management plan and appropriate waste management to prevent attracting pests.

The faunal community faces displacement due to habitat loss, direct mortalities and disturbance. Construction activities will likely lead to direct mortality of fauna due to earthworks, vehicle collisions, accidental hazardous chemical spills and persecution. Disturbance due to dust and noise pollution and vibration may disrupt behaviour. The impact has been ranked as **Medium** but can be reduced to **Low** with the implementation of the recommended mitigation measures such as footprint demarcation, placement of warning and speed limit signs and environmental awareness training to manage the behaviour of personnel in order to prevent harm to animals; warding off animals and removing slow moving animals prior to vegetation clearing and planning of activities to clear vegetation during the dry season.

#### ***10.1.3 Potential Impacts on Freshwater Ecology***

The construction phase impacts on the HGM units, Heyshope dam and drainage lines were ranked as **Medium** significance. The significance of these impacts can be reduced to **Low** through the implementation of the recommended mitigation measures. The following impacts were identified:

- Potential loss of riparian vegetation as a result of the vegetation clearing and earthworks associated with the construction activities.
- Uncontrolled stormwater management of the cleared construction areas could result in increased sedimentation of the wetlands.
- The presence of plant and equipment on the construction site that make use of petrochemical substances for operation pose a risk of contamination of the water quality in the wetlands.
- Spillage or leakage from ablution facilities could impact on the water quality that moves through the aquatic features, which could decrease the PES of the features.

#### ***10.1.4 Potential Impacts on Soils, Land Capability and Land Use***

The construction phase will require the stripping, handling and stockpiling of topsoil and will result in soil compaction, erosion and loss of land capability.

The loss of land capability is rated as **Medium** largely due to the location of the proposed CDF and WWTP within an existing active mining area. This impact can be reduced to **Low** through the implementation of mitigation measures aimed primarily at minimising the extent of the affected area.

There is potential to impact the *soil interflow processes*, namely:

- Alteration to natural hydrogeological flow paths by infilling or cut and fill activities.

- Suppression of rainfall infiltration as a result of the installation of an impermeable barrier and initial deposition of coal wastes onto the impermeable barrier.
- Impacts on the macro-soil structure.
- Impacts on the hydrogeological processes supporting the watercourses.

This will result in subsequent impacts on *soil structure and land capability* and could compromise soil quality. These impacts are expected from the preparation to the closure phase of the project. There is the potential for *soil contamination and suppression of natural hydrogeological flow drivers* in areas associated with the proposed CDF and PCDs. Potential contaminants from the project are expected to include construction-related consumables, fuels, hydrocarbons, residues and hazardous wastes. The final design of the facility is based on the waste classification which informs the liner requirements. In the absence of mitigation, the intensity of unmitigated impacts would be high, particularly for the suppression of the natural hydrogeological flow drivers and that relating to soil quality. In time, reduced soil water quality could be reversed, however, at this stage, the related period is not known. The related unmitigated significance is, therefore, **Medium**.

With respect to the impact on water quality and quantity of watercourses/wetlands sustained by the hydrogeological flow; as well as the contamination of soils and subsequent compromised water quality, the following is anticipated:

- Soil and surface water contamination, degradation and sedimentation from the following activities:
  - Leakages from vehicles and mine machines, and seepage from mine materials (i.e. construction material for permanent facilities, cement, paint, etc.).
  - Erosion and sedimentation of watercourses as a result of mine preparation activities, stockpiling and initial mining phase due to unforeseen circumstances (i.e. bad weather).
  - Alteration of natural drainage lines may lead to ponding or increased runoff patterns (i.e. may cause stagnant water levels or increase erosion).
- Vegetation loss will likely decrease soil infiltration and increase runoff, which will likely increase erosion.
- Soil quality could be compromised if oil and fuel spills from vehicles occur during the operational phase at the site. Prolonged pollution may migrate to the nearby watercourse and/or percolate into the groundwater table.

The following construction phase activities may contribute to these impacts:

- Site preparation, including placement of contractor laydown areas and storage (i.e. temporary stockpiles, bunded areas etc.) facilities.
- Disturbing vadose zone during soil excavations/infilling activities.
- In-situ placement of new soils, altering existing soil-flow processes (i.e. cut-and-fill areas).
- Linear developments (pipelines, electrical pylons & transmission lines and roads associated with the project) will likely not have a major impact on hydrogeology as these structures entail disturbing a very shallow or small surface area. However, soil compaction due to road and pipeline installations, and the movement of heavy vehicles and mining machinery is highly likely to occur.
- Vegetation loss will likely decrease soil infiltration and increase runoff, which will likely increase erosion.

#### *10.1.5 Potential Impact on Geohydrology*

The clearing and excavation during the construction phase will disturb the vadose zone. This could contribute to sediment runoff and surface water contamination. Clearing topsoil from footprint areas will influence the rate of infiltration of water to the shallow groundwater system and/or baseflow component to shallow streams.

Spills of sewage water, as well as spills and leaks of hydrocarbons from the hydrocarbon storage areas, plant and machinery used for clearing and excavation and parked vehicles, can infiltrate and contaminate the groundwater system.

Temporary dewatering of perched groundwater is also expected during intense storm events and shortly thereafter. This can be managed by discharging clean dewatered / rainwater collected into the nearby stream with appropriate erosion protection measures in place. If water is contaminated, discharge to the closest greywater system (depending on the extent of contamination).

The impacts on groundwater identified during the construction phase have been rated as **Medium** and can be reduced to **Low** with the implementation of the recommended mitigation measures. Water monitoring from the outset of the development is crucial to provide input into the active water management system and act as an early warning system for the application of mitigation measures.

#### *10.1.6 Potential Impact on Hydrology*

The identified risks for the construction/development phase include:

- The destruction of the localised geological units during excavations. This impact is permanent and is therefore not included in the impact table as no mitigation measures can be recommended.
- Clearing topsoil from footprint areas will influence the rate of infiltration of water to the shallow groundwater system and/or base-flow component to shallow streams. This disturbance of the vadose zone has been rated as **High** significance.
- Surface water contamination and sedimentation from various construction activities such as clearing and excavation, hydrocarbon laden runoff from unattended leaks or spills; and the alteration of natural drainage lines which may lead to ponding or increased runoff patterns (i.e. may cause stagnant water levels or increase erosion). This impact has been rated as having **Medium** significance.
- The temporary dewatering of perched groundwater (only expected during intense storm events and shortly thereafter). Has the potential to impact the surface water resource. This impact has been rated as having **Medium** significance.

The continuation of the existing monitoring plan during construction is critical. The collected information should be used as part of an active water management system and act as an early warning system for the application of mitigation measures. Except for the destruction of the geology, the other identified impacts during the construction phase are rated low after mitigation and management measures are applied. The identified impacts are therefore not likely to negatively affect the commencement of the proposed project.

#### *10.1.7 Potential Visual Impacts*

The construction phase will transform the landscape through the removal of vegetation, excavating the area and constructing infrastructure. The severity of the impact is lessened by the location of the activities within a current mining area. This impact is rated as **Medium**.

Dust creation has the potential to create poor visibility conditions. This is likely to largely be confined to the site. This impact has been rated as having **Medium** significance if unmitigated.

The significance of both of the abovementioned impacts can be reduced to **Low** with the implementation of the recommended mitigation measures.

During the construction phase, night lighting at the laydown area and for security purposes may be required. The significance of this impact is rated as **Low** but can be further reduced by carefully considering the type and positioning of this lighting in order to contain the light to the areas that need illumination and prevent glare from the activities.

#### **10.1.8 Potential Noise Impacts**

Although noise is likely to be created during the construction phase, these are not likely to be above the ambient noise levels of the nearby mining operations, therefore the impact on sensitive receptors (neighbouring community) is considered **Low**. Mitigation and management measures such as maintaining standard working hours, servicing vehicles and equipment in accordance with a service schedule, noise monitoring and recording and investigating complaints, can further reduce the significance of this impact.

#### **10.1.9 Potential Cultural Heritage and Paleontological Impacts**

Considering that no heritage or paleontological resources were recorded during the site surveys, impact significance has been determined to be **Low**. The possibility of unearthing resources of significance remains, however. A Chance Finds Procedure must be compiled and implemented should any sites of significance be unearthed/identified during construction. This would involve stopping all work in the area until a qualified specialist has visited the site. Work may only continue on the advice of the heritage specialist. Work may only continue after clearance is received from the heritage specialist.

#### **10.1.10 Potential Traffic Impacts**

The presence of construction vehicles and more personnel at the site during the construction phase is anticipated to increase the traffic volumes and potentially the number of traffic incidents. This is considered to be of **Medium** significance and can be reduced to **Low** by managing working hours, creating awareness and implementing penalties for non-compliance with the rules of the road.

#### **10.1.11 Potential Socio-Economic Impacts**

The creation of employment opportunities during the construction phase is considered a positive impact, however, due to the scale and duration of the construction, the number of jobs created will be low and these jobs will be short-term/temporary. This impact has been rated as **Low**. It is imperative that Kangra enforces the application of its employment and procurement policies by the contractors appointed to maximise the benefit to the local community and contribute to Kangra's Social and Labour commitments.

The nuisance created by dust and noise is considered to be of **Medium** significance due to the current ambient conditions created by the existing mining operation. This can be reduced to **Low** through the implementation of the recommended mitigation measures, monitoring, as well as the recording and investigating of complaints.



## 10.2 Assessment of Operational Phase Impacts

The potential construction phase impacts identified due to the following anticipated operational activities are discussed in this section:

- Transportation of discard material and brine filter cake via truck using a haul road and the dumping onto the CDF using an access ramp;
- Compaction of waste material on the CDF with earth-moving equipment;
- Deposition of coal slurry. There is a possibility of the addition of brine to the CDF.
- Handling and disposal of waste;
- Management of runoff and supernatant water.
- Maintenance of haul roads.
- Concurrent rehabilitation of lower CDF layers with fertile soil and vegetation.
- Pumping of contaminated water from the dam to WWTP.
- Pumping of brine from WWTP to brine evaporation dam.
- Dewatering of brine at the Brine Treatment Plant to produce filter cake.
- Discharging treated water from WWTP to Heyshope Dam.

### 10.2.1 Potential Impacts on Air Quality and Climate

The impacts on air quality are expected as a result of the operation of the CDF and the use of haul/gravel roads. The impact on air quality is considered moderate **Medium**. The implementation of the recommended concurrent rehabilitation of the CDF, the rehabilitation of any exposed areas and the wet suppression of gravel roads will likely reduce the severity and spatial extent of the impact, thereby reducing the impacts on potential sensitive receptors. This will reduce the significance of the impact to **Low**.

### 10.2.2 Potential Impacts on Terrestrial Ecology

The operational phase impacts have all been rated as **Medium** and can be reduced to **Low** significance with the implementation of the recommended mitigation measures.

Continued fragmentation and degradation of habitats and ecosystems is likely to occur as the disturbance created during the construction phase will leave the project area vulnerable to erosion and Invasive plant encroachment. An alien invasive management must be implemented, activities must be limited to the demarcated areas and no alien plants should be allowed to be brought to the site to reduce the significance of this impact.

Proximity of infrastructure and human activity to the wetlands may lead to local disturbance of fauna and flora, through noise, light, trampling, etc. Fauna may move away from the site. This impact can be mitigated by limiting activities close to wetlands and facing lighting away from wetland areas.

The spread of faunal alien species will lead to the ongoing displacement and direct mortalities of the faunal community. This can be mitigated by management of lighting, directing towards the operational areas and keeping it to a minimum, avoiding the use of roads at night and including holes (30x30cm) at the bottom of the fence at 250m intervals to allow for free movement of fauna.

### *10.2.3 Potential Impacts on Freshwater Ecology*

The operational phase impacts on the freshwater ecology were rated as **Medium**. These impacts can be reduced through the implementation of the recommended mitigation measures. The other potential impacts identified are:

- Any leakages of untreated effluent from the WWTW will result in the contamination of the water in the wetland features which will impact on the PES of the features.
- Any leakages of untreated effluent from the pipe networks supplying untreated effluent to the WWTW will result in the contamination of the water in the wetland features which will impact on the PES of the features.
- Any leakages of treated effluent from the discharge pipeline may result in additional water entering the wetland features associated with the project. This additional water moving into the wetlands may impact the PES of the features.
- The discharge of treated effluent is directly into the Heyshope Dam. Any changes in the quality of the treated effluent may impact on the water quality in the dam.

### *10.2.4 Potential Impacts on, Soils, Land Capability and Land Use*

There is potential to impact the water quality and quantity of watercourses/wetlands sustained by the hydrogeological flow, using suppression or alteration of the natural flow as a result of the proposed activities. Moreover, contamination of soils during the project may compromise water quality.

Disturbing the inner-soil architecture of the original soil profile will disturb natural flow processes (i.e. a result of infilling or cut-and-fill activities). Excavated soil will be placed in other areas (i.e. on top of other soils) and will have an impact on the flow dynamics of the soil it is dumped on top of. This may reduce rainfall infiltration and induce runoff. Impermeable areas will decrease rainfall infiltration into soils, and hence reduce interflow (A/B and A/bedrock) or lateral flow to downstream wetland areas. The following impacts are anticipated:

- Alteration to natural hydrogeological flow paths.
- Impacts on the macro-soil structure.
- Impacts on the hydrogeological processes supporting the watercourses.

This impact has been rated as a **negative Medium** significance impact, which can be rerated as a **positive Medium** impact by revegetating areas where heavy machinery movement takes place to prevent erosion and the attenuated release of clean stormwater back into the environment. The release of stormwater will offset the rainfall infiltration reduction impacts on soil interflow and may benefit downstream watercourses and wetland units.

Seepage/leakages/overland flow from the CDF, as well as unattended leaks and spillages from vehicles and machinery, may impact soil quality. This is rated as a **Low** significance impact, which can be managed and reduced through the implementation of the recommended mitigation measures.

#### **10.2.5 Potential Impact on Geohydrology**

The operational phase impacts will largely be mitigated through the construction of the facilities in accordance with the designs approved by the DWS. These requirements, which have been provided for in the design, are discussed in Chapter 2 of this report. The following impacts have been identified:

- Groundwater quality: If not managed correctly, the CDF and PCD liner systems may deteriorate/be damaged, which will cause contaminated seepage to migrate from the site (both vertically and laterally). Also, uncontrolled or emergency release - uncontrolled and/or emergency release of effluent from the PCD will cause contaminated seepage to migrate from the site (both vertically and laterally). Seepage may also occur due to repeated overflows from the PCDs and the subsequent saturation of the surrounding soil. The potential impacts on the groundwater quality are rated as **High** significance impacts. Following appropriate management and maintenance measures will greatly reduce the risk of failure of the liner and drainage systems, reducing the impact **Low** significance.

- Groundwater quantity: Groundwater recharge is likely to be reduced due to the use of the liner system below the Discard Dump and PCD. This is considered a **Low** significance impact, due to the localised nature. This cannot be mitigated as liner systems are required to protect the groundwater quality.

#### ***10.2.6 Potential Impact on Hydrology***

Potential seepage from the proposed CDF and runoff from parked vehicles will likely contaminate vadose zone soils.

Surface water contamination may occur due to the following:

- Stormwater runoff from WWTP and CDF would
- Poor stormwater drainage on-site.
- Increased erosion due to vegetation loss.
- Contaminated runoff water into nearby streams from parked vehicles or overflow from PCDs.
- Sedimentation of watercourses due to altered runoff patterns.
- Seepage from the CDF

As the co-disposal facility is designed to contain potential seepage from the coal waste and to capture runoff from the site, the significance of this impact after mitigation is rated as **Low**.

The treatment of decanting from the Heyshope decant containment dam is considered a very positive intervention in terms of limiting the impact on the Heyshope Dam.

#### ***10.2.7 Potential Visual Impacts***

Visual impacts are posed by the increased size of the CDF through the life of the operation, which has been ranked as a **Medium** significance impact. The CDF is located within an existing mining operation; therefore, the visual character landscape will not be greatly transformed.

The impacts created by the nighttime lighting and potentially poor visibility conditions created by dust generation have been rated **Low** significance impacts. These must be mitigated and managed as recommended in the impact assessment matrix and EMPR.

#### **10.2.8 Potential Noise Impacts**

Similar to the construction phase, the noise created is not likely to be above the ambient noise levels of the mining operations, therefore the impact on sensitive receptors (neighbouring community) is considered **Medium**. Mitigation and management measures such as maintaining standard working hours, servicing vehicles and equipment in accordance with a service schedule, noise monitoring and recording and investigating complaints, can reduce the significance of this to **Low** impact.

#### **10.2.9 Potential Cultural Heritage and Paleontological Impacts**

There are no additional anticipated risks to heritage and paleontological resources for the proposed Projects upon completion of construction.

#### **10.2.10 Potential Traffic Impacts**

Traffic volumes are expected to return to what they are currently during the operational phase, therefore no additional impacts are anticipated.

#### **10.2.11 Potential Socio-Economic Impacts**

As discussed in Chapter 4 of this report, the proposed development is crucial to the continuation of mining at MQE. The development CDF will provide the required disposal capacity, thereby allowing for the full LoM to be achieved. This will have a positive socio-economic impact through the maintenance of long-term employment. This has been rated as a positive **Medium** significance impact.

The continuation of operational activities will also continue the generation of nuisance impacts such as dust and noise creation and the maintenance of current traffic volumes. This impact is rated as **Medium** significance and can be reduced to **Low** by the implementation of the proposed mitigation measures.

### **10.3 Assessment of Decommissioning Phase Impacts**

The potential decommissioning phase impacts identified due to the following anticipated operational activities are discussed in this section:

- Termination of co-disposal activities. The capping and rehabilitation of the remainder of the CDF will be undertaken, as well as the rehabilitation of the haul roads and any disturbed areas around the CDF, which may not have been properly rehabilitated. This will involve the placement of topsoil and vegetation and the removal of alien invasive plants where necessary.

- Removal of the equipment such as pipelines, electrical and mechanical equipment (including the pump station); the de-silting of the PCD, removal of concrete foundations and removal of all rubble and waste.
- Installation of long-term stormwater systems or upgrades to the operational stormwater system.
- Termination of treatment activities and brine generation (only if no decant from the old MQE workings takes place) The Geohydrological Assessment (refer to Appendix E-4) indicates that the potential for decant during this phase. This will be confirmed through regular updates of the numerical groundwater model over the LoM.
- Ripping of compacted areas including haul roads
- Monitoring and maintenance: This will involve monitoring the environment, i.e. vegetation, surface water and groundwater monitoring to determine if the rehabilitation, as well as any management measures, have been effective. During this phase planning will be undertaken based on all the data collected during monitoring and detailed studies, to implement any additional measures required to apply for closure of the facility.

#### *10.3.1 Potential Impacts on Air Quality and Climate*

Localised impacts on ambient air quality are anticipated through the generation of wind-borne dust due to decommissioning and rehabilitation activities. Dust has the potential to impact human health and cause ecosystem damage. Sources of dust include travelling on gravel roads, wind-borne dust from exposed areas and removal of structures and foundations, ripping of compacted surfaces.

Due to the temporary nature of the decommissioning phase and the limited footprint areas associated with the proposed Project, the potential impacts were considered to have a relatively high, **Low** significance. With the implementation of the recommended mitigation measures, the impacts can be reduced to moderately **Low**.

Greenhouse Gases (GHGs), which contribute to global climate change, will be generated throughout the construction and decommissioning phases of the proposed Project. Direct GHG emissions include exhaust fumes from equipment, vehicles and backup generators (when required). Allowing fires for cooking or burning of waste or debris may also contribute to this impact. The anticipated impact of the project activities on GHG emissions and climate is expected to be moderate **Low** and can be reduced to **Negligible** with the implementation of the recommended mitigation measures.



### *10.3.2 Potential Impacts on Terrestrial Ecology*

The proposed decommissioning activities have the potential to impact negatively on the terrestrial ecology due to the movement of vehicles machinery and personnel and incorrect handling and disposal of waste. The impacts identified are considered to be **Medium to Low** significance and can be successfully mitigated.

The potential impacts include the potential loss of indigenous vegetation units, the potential increase in alien vegetation; contamination of the area by demolition and domestic waste; the direct mortality of fauna; and the disruption of faunal behaviour due to dust and noise pollution and vibration.

### *10.3.3 Potential Impacts on Freshwater Ecology*

Potential impacts on freshwater resources during decommissioning activities result from inadequate waste management, inadequate stormwater management, leakages from the portable chemical toilets, hydrocarbon spillages from plant and equipment, and leaking or spills from storage facilities.

The cessation of activities and rehabilitation efforts are expected to have a positive impact of **Medium** significance, the remaining impacts are rated as a negative, **Medium** significance.

Seepage, leakages and/or overland flow from the CDF and PCDs will cause soil degradation and compromise soil quality. Prolonged pollution may migrate to the nearby watercourse and/or percolate into the groundwater table.

Erosion and sedimentation caused by decommissioning activities, poor waste management and inadequate stormwater management will deteriorate water quality resulting in a negative effect on aquatic resources due to water quality deterioration as a result of erosion and sedimentation.

### *10.3.4 Potential Impacts on Soils, Land Capability and Land Use*

The activities will generally entail rehabilitation and site clean-ups, with the aim of restoring natural flow processes. Similar impacts to those associated with the construction phase are anticipated but will be limited to areas that are further disturbed/rehabilitated.

It is anticipated that once the CDF is rehabilitated and the area stabilised, new hydrogeology flow regimes will form as a result of the rehabilitated CDF and PCDs, with liners that still prevent infiltration. Impacts are expected on the soil interflow processes and the soil structure and land capability. These are expected to be positive overall and have been rated as positive **Medium**, provided the recommended mitigation measures are implemented.

The presence of the CDF will have long-term implications in terms of altering the natural hydrogeological flow drivers of the subsoils, on which the facility is situated. This applies to the proposed PCDs as well. This will likely impact on the soil interflow processes (alteration to natural hydrogeological flow paths; impacts on the macro-soil structure; and impacts on the hydrogeological processes supporting the watercourses). This has been rated as a negative Medium but will be considered a positive impact if clean stormwater is attenuated back to the natural environment, directly downstream of the development. The release of stormwater will offset the rainfall infiltration reduction impacts on soil interflow and may benefit downstream watercourses and wetland units.

Hydrocarbon leaks and soil erosion are likely to impact the soil if not properly avoided or mitigated. Operation and maintenance of vehicles and machinery resulting in spills or leaks.

#### *10.3.5 Potential Impact on Geohydrology*

During the decommissioning phase, hydrocarbon leaks or spillages may impact on the groundwater if not properly managed. Oil, grease and fuel leaks could lead to hydrocarbon contamination of the vadose zone which could percolate into the shallow aquifer. This has been rated as **Medium** significance but can be reduced to **Low** with the implementation of measures to avoid these occurrences, or properly manage them.

The volume of water infiltrating the CDF will reduce once the final capping and rehabilitation of the CDF is undertaken. This will reduce volumes reporting to PCD and reduce the risk of overflows.

#### *10.3.6 Potential Impact on Hydrology*

The identified risks for this phase have been rated as **Medium to Low**:

- Poor quality seepage and runoff from the CDF (due to poorly maintained liner and drainage system) may impact soil quality and eventually lead to poor quality seepage into the surroundings.
- Poor quality seepage from vehicles accessing the site to do rehabilitation work; and
- Potential surface water sedimentation and contamination as a result of altered runoff patterns and poor stormwater drainage on-site.

Rehabilitation of the CDF is expected to have positive impacts. The reshaping and rehabilitation of the co-disposal facility will be beneficial to the environment. Capping and reducing infiltration into the dump will help mitigate any poor-quality seepage. This positive impact has been rated as **Medium** significance.

### ***10.3.7 Potential Visual Impacts***

The removal of surface infrastructure and associated rehabilitation activities is anticipated to have a positive impact on the aesthetics of the Project area.

During the decommissioning phase, night lighting at the laydown area and for security purposes will be required. The type and positioning of this lighting should be carefully considered in order to contain the light to the areas that need illumination and prevent glare from the activities. This impact has been rated **Low** significance and this can be reduced to **Negligible** with the implementation of mitigation measures.

### ***10.3.8 Potential Noise Impacts***

Similar to the construction phase, the noise created is not likely to be above the ambient noise levels of the mining operations. This, with the shorter duration of the decommissioning activities, means that the impact on sensitive receptors (neighbouring community) is considered **Low**. Mitigation and management measures such as maintaining standard working hours, servicing vehicles and equipment in accordance with a service schedule, noise monitoring and recording and investigating complaints, can further reduce the significance.

### ***10.3.9 Potential Cultural Heritage and Paleontological Impacts***

Considering that no heritage resources were recorded during the site surveys, impact significance has been determined to be **Low**. A Chance Finds Protocol must be implemented should any sites of significance be unearthed/identified during construction. This would involve stopping all work in the area until a qualified specialist has visited the site. Work may only continue after clearance is received from the heritage specialist.

### ***10.3.10 Potential Socio-Economic Impacts***

Nuisance factors such as dust, noise and traffic are expected for the duration of the decommissioning activities. This has been rated as **Medium**, however, the significance can be reduced to **Low** if the recommended mitigation measures are implemented.

The decommissioning phase is expected to create temporary jobs, which will have a positive impact on the area, however, this may also prompt an influx of jobs seekers. Both the positive and negative impacts of job creation are rated as **Low** significance, however clear communication and the application of the existing labour and procurement policies is required to manage community expectations.

## 10.4 Potential Cumulative and Residual Impacts

As defined in the EIA Regulations, “cumulative impact”, in relation to an activity, means the past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity, that in itself may not be significant, but may become significant when added to the existing and reasonably foreseeable impacts eventuating from similar or diverse activities.

The impacts of projects are often assessed by comparing the post-project situation to a pre-existing baseline. Where projects can be considered in isolation, this provides a good method of assessing a project’s impact. However, in areas where baselines have already been affected, or where future development will continue to add to the impacts in an area or region, it is appropriate to consider the cumulative effects of development. This is similar to the concept of shifting baselines, which describes how the environmental baseline at a point in time may represent a significant change from the original state of the system.

### 10.4.1 Air Quality Assessment

The main sources likely to contribute to cumulative particulate impact are surrounding mining operations; materials handling and crushing operations; conveyors, RoM stockpiles, opencast pits, the coal washing plant, agricultural activities; vehicle entrainment on unpaved road surfaces; and household and biomass burning. Furthermore, the Project area is located in the eastern portion of the Highveld Priority Area (HPA) declared in terms of the NEMAQA. The potential cumulative impacts were therefore considered to have a **Medium** significance overall.

### 10.4.2 Terrestrial Ecological Impacts

The development of the proposed infrastructure will contribute to cumulative habitat loss and thereby impact the ecological processes in the region. A rehabilitation plan and Alien Plant management plan must be compiled for each development and must be effectively implemented. The significance rating is **Medium** and can be reduced slightly with the implementation of appropriate mitigation measures.

### 10.4.3 Freshwater Ecological Impacts

There is the potential to increase the input of contamination into the Heyshope Dam and the wetland unit at the site due to leakages from pipeline and the WWTW and BTP, as well as the potential failure of the WWTW to meet the proposed discharge qualities.

These have been rated as a **Medium** significance impacts, which can be reduced to **Low** through the implementation of the recommended mitigation measures.

#### ***10.4.4 Potential Impacts on Soils, Land Capability and Land Use***

The CDF will result in a permanent change to the land capability. The disturbances required for the proposed developments will increase the extent of the land impacted. These impacts include further degradation the soil quality, impact on soil interflow processes (alteration to natural hydropedological flow paths; impacts on the macro-soil structure; and impacts on the hydropedological processes supporting the watercourses), soil compaction, soil erosion, natural nutrient content decreases and loss of natural bio-organisms essential to soil processes. These impacts have been rated as **Medium**.

#### ***10.4.5 Geohydrological Impacts***

The groundwater monitoring results for MQE show that the water quality has been compromised over the course of the mining activities and the numerical model indicates an existing pollution plume (refer to section 6.9.8) with pollution plume gradients higher closer to known mine waste residue sites, and gradually decrease further away towards lower laying areas. The construction of the proposed new facilities in accordance with the NEM: WA requirements and the conditions set out in the WUL (once issued), will prevent the contamination of groundwater provided that the liner and drainage systems are properly maintained. The possibility of seepage from these facilities is therefore expected to be low if regular maintenance is undertaken and the potential for these facilities to contribute to the current pollution plume is expected to be low.

Groundwater contamination from the construction and operational activities such as unmitigated spills and overflows from the PCD, may add to the impact on the quality of groundwater.

The reduction of recharge due to the compaction of soil and the use of liners below the CDF and PCD in conjunction with mining activities is likely to reduce the amount of groundwater within the resource. The lack of groundwater users in the area and the fact that the removal of water from the mining areas is likely to end once mining ends makes this impact of **Low** significance.

#### ***10.4.6 Hydrology Impacts***

As all activities will take place on the same property, there will be cumulative impacts. The proposed WTP and brine storage pond are zoned in an area where existing mine impacts are noted. The proposed construction, operational and decommissioning activities pose additional risks to vadose zone soils and nearby water resources. If not properly mitigated, these activities are likely to increase the extent of the areas contaminated, contribute to the degradation of the surface water quality, as well as increase the sediment load within the watercourses.

#### **10.4.7 Visual Impacts**

The area surrounding the proposed CDF is utilised for mining and mining related activities. In this context, the visual impact of the CDF will not be large because the development will not contrast against the surrounding land use. Also, the proposed CDF will not be visible from a residential or high-volume tourist attraction or major road. The cumulative effect of the CDF to the visual impact of the mine is therefore considered to be **Low**.

The impact created by the additional nighttime lighting has been rated **Low** significance. These must be mitigated and managed as recommended in the impact assessment matrix and EMPR.

#### **10.4.8 Cultural Heritage and Paleontological Impact Assessment**

No heritage resources were recorded during the site surveys, therefore no cumulative impacts on this aspect are anticipated.

#### **10.4.9 Noise Impacts**

The noise created is not likely to be above the ambient noise levels of the mining operations. With the exception of the additional activities during the construction and decommissioning activities, the noise impacts associated with the proposed Project are not likely to have a cumulative effect on noise levels.

#### **10.4.10 Socio Economic Impact Assessment**

The creation of additional jobs related to the project will be limited in number and duration, which will create a Low significance positive impact.

The additional noise and dust created during the construction, operation and decommissioning phases of the mine may potentially affect nearby residents. There is existing tolerance to these impacts due to the current mining activities. Furthermore, the CDF will be located further away from the community than the MQE plant, which means that these impacts are likely to be of **Low** significance.



## 11 KNOWLEDGE, GAPS AND LIMITATIONS

The EIA Regulations require that an account of any assumptions, uncertainties and gaps in knowledge applicable to the preparation of this report is provided.

An impact assessment is a predictive tool to identify aspects of a development that need to be prevented, altered or controlled in a manner to reduce the impact on the receiving environment or determine where remediation activities will need to be incorporated into the overall development/activity plan. This does not mean that the impact will occur at the predicted significance but provides guidance on the formulation of the management and monitoring requirements which need to be incorporated to prevent/reduce/manage the impact.

Four (4) specialist investigations were undertaken to define the baseline environment and predict the impacts of the proposed Project. The assumptions and limitations applicable to the individual specialist studies are outlined within each of the respective specialist reports attached under Appendix E of this EIR and will not be repeated herein.

Findings, recommendations and conclusions provided in this EIR, and all specialist reports, are based on the authors' best scientific and professional knowledge and information available at the time of compilation. Information in this EIR has been obtained from various sources. The following assumptions have been identified:

- It is assumed that all information received from the proponent is correct, with nothing withheld.
- It is assumed that the proponent will be developing the proposed projects as described within this report and that no deviation will be required.
- The impact descriptions and assessment are based on the author's understanding of the proposed Project based on the information provided.

## 12 ENVIRONMENTAL IMPACT STATEMENT

### 12.1 Key Findings of the Impact Assessment

The results of the impact assessment indicated that the most significant impacts on the receiving environment would be those listed below in Table 12-1, Table 12-2 and Table 12-3. The overall environmental sensitivity of the receiving environment is depicted in Figure 12-1, and composite sensitive receptor impact is illustrated in Figure 12-2 below. The correct implementation of the mitigation measures outlined in the EMPr will ensure that all impacts are managed, mitigated or avoided as far as practicably possible.

**Table 12-1: Key Impacts: Construction Phase**

ENVIRONMENTAL ASPECT	IMPACT	WITHOUT MITIGATION	WITH MITIGATION
Air Quality	Generation of inhalable particle emissions and fugitive dust and dust fallout	L	L
	GHG emissions during construction activities	L	L
Terrestrial Ecology	Loss of vegetation within the development footprint	H	M
	Degradation and loss of surrounding natural vegetation	M	L
	<ul style="list-style-type: none"> <li>Direct mortality of fauna due to earthworks, vehicle collisions, accidental hazardous chemical spills, and persecution.</li> <li>Disturbance due to dust and noise pollution and vibration may disrupt behaviour.</li> </ul>	M	L
Freshwater Ecology	Loss of riparian vegetation due to vegetation clearing and earthworks	M	L
	Potential increase in sedimentation of the wetland features.	M	L
	Contamination of the water in the wetlands petrochemical spillages	M	L
	Contamination of the aquatic features due to spillages or leakages from on-site ablution facilities.	M	L
Soils, Land Capability and Land Use	Loss of land capability due to construction of permanent infrastructure (CDF)	M	M
	Soil interflow processes: <ul style="list-style-type: none"> <li>Infilling of wetlands and watercourses inducing alternative flow paths (if infilling occurs).</li> <li>Alteration to natural hydrogeological flow paths.</li> <li>Impacts on the macro-soil structure.</li> <li>Impacts on the hydrogeological processes supporting the watercourses</li> </ul>	M	M
	Soil structure & land capability: <ul style="list-style-type: none"> <li>Exposure of soils, leading to increased runoff from cleared areas and erosion of the</li> </ul>	M	M

	watercourses, thus increasing the potential for sedimentation of the watercourses. • Vegetation loss. • Soil compaction and erosion		
	Soil quality: • Natural nutrient content decreases due to soil exposure. • Loss of natural bio-organisms essential to soil processes.	M	M
	Soil degradation. Compromised soil quality. Prolonged pollution may migrate to the nearby watercourse and/or percolate into the groundwater table.	M	L
	Perched water table dewatering	M	L
Geohydrological Aspects	Disturbing vadose zone during soil excavations/construction activities.	M	L
	Poor quality seepage from machinery used to excavate soils. Oil, grease and fuel leaks could lead to hydrocarbon contamination of the vadose zone which could percolate into the shallow aquifer.	M	L
	Groundwater recharge may increase in some areas and decrease in others	L	L
	Perched water table dewatering	M	L
Hydrological Aspects	Disturbing vadose zone during soil excavations/activities.	H	M
	Surface water contamination and sedimentation from the following activities: • Washing of equipment and vehicles, unattended leaks and spills; • Erosion and sedimentation of watercourses due to unforeseen circumstances (i.e. bad weather); and • Alteration of natural drainage lines which may lead to ponding or increased runoff patterns (i.e. may cause stagnant water levels or increase erosion).	M	L
Hydrological Aspects	Perched water table dewatering	L	L
Visual Impacts	Negative visual impact on aesthetics	M	L
	Poor visibility due to dust creation	M	L
	Visual intrusion due to glare, light trespass and skyglow	L	L
Noise Impacts	Noise disturbance to sensitive receptors	L	L
Heritage & Paleontological Impacts	Loss of / damage to heritage/archaeological/palaeontological resources if unearthed during construction	L	L
Socio-Economic Impacts	Temporary job creation and skills development	L	L
	• Dust & noise could increase as a result of an increase in traffic.	M	L

	<ul style="list-style-type: none"> <li>General construction activities resulting in an increase in fugitive dust emissions</li> </ul>		
--	---	--	--

Table 12-2: Key Impacts: Operational Phase

ENVIRONMENTAL ASPECT	IMPACT	WITHOUT MITIGATION	WITH MITIGATION
Air Quality	Generation of inhalable particle emissions and fugitive dust	M	L
Terrestrial Ecology	Disturbance created during the construction phase will leave the project area vulnerable to erosion and Invasive plant encroachment.	M	L
	This may lead to local disturbance of fauna and flora, through noise, light, trampling, etc. Fauna may move away from the site.	M	L
	Ongoing displacement and direct mortalities of faunal community due to disturbance	M	L
Freshwater Ecology	Contamination of the water in the wetland features, which will impact on the PES of the features, due to leakage of untreated effluent from WWTW	M	L
	Contamination of the water in the wetland features, which will impact on the PES of the features, due to leakage of untreated effluent from pipelines	M	L
	Changes to the hydrological regime of the wetlands due to leakages from the treated discharge pipeline.	M	L
	Pollution of the Heyshope Dam due to treated effluent discharge limits not being met by the WWTW.	M	L
Soils, Land Capability and Land Use	Soil interflow processes: <ul style="list-style-type: none"> <li>Alteration to natural hydropedological flow paths.</li> <li>Impacts on the macro-soil structure.</li> <li>Impacts on the hydropedological processes supporting the watercourses.</li> </ul>	M	M
	Soil contamination	L	L
Geohydrological Aspects	Deterioration of groundwater quality due to seepage from PCDs	H	L
	Deterioration of groundwater quality due to failure of liner or drainage system.	H	L
	Reduction to groundwater recharge over project area	L	L
Hydrological Aspects	Contamination of vadose zone soils	M	L
	Contamination of surface water due to contaminated runoff and sedimentation	H	L
	Poor quality seepage into the subsoils from landfills may impact soil quality and eventually	H	M

	lead to poor quality seepage into the surroundings.		
	Reduction of contamination surface water resource	H	H
Visual Impacts	Visual impact of the CDF due to the increasing size of CDF over the life of the facility	M	L
	Poor visibility conditions	L	L
	Visual intrusion due to glare, light trespass and skyglow	L	L
Noise Impacts	Noise disturbance to sensitive receptors	M	L
Heritage & Paleontological Impacts	None	N/A	N/A
Socio-Economic Impacts	Continued mining is facilitated by the provision of a CDF for the disposal of mine wastes.	M	M
	<ul style="list-style-type: none"> <li>Traffic volumes are anticipated to remain the same.</li> <li>Dust and noise as a result of general operational activities</li> </ul>	M	L

Table 12-3: Key Impacts: Decommissioning Phase

ENVIRONMENTAL ASPECT	IMPACT	WITHOUT MITIGATION	WITH MITIGATION
Air Quality	Generation of inhalable particle emissions and fugitive dust and dust fallout	L	L
	GHG emissions during the demolition activities.	L	L
Terrestrial Ecology	Potential loss of Indigenous vegetation units	L	L
	Potential increase in alien vegetation	M	L
	Contamination of the area by demolition and domestic waste	L	L
	Direct mortality of fauna Disturbance due to dust and noise pollution and vibration may disrupt behaviour.	L	L
	Positive effect on aquatic resources due to removal of surface infrastructure and rehabilitation of the area	M	M
	Soil degradation: Compromised soil quality. Prolonged pollution may migrate to the nearby watercourse and/or percolate into the groundwater table.	M	L
	Negative effect on aquatic resources due to water quality deterioration as a result of erosion and sedimentation, and/or inadequate stormwater management	M	L
	Negative effect on aquatic resources due to water quality deterioration as a result of contamination of the area by hydrocarbon/chemical spillages	M	L

	and/or dumping of material outside of designated areas		
Soils, Land Capability and Land Use	Soil interflow processes: <ul style="list-style-type: none"> <li>• Infilling of wetlands and watercourses inducing alternative flow paths (if infilling occurs).</li> <li>• Alteration to natural hydropedological flow paths.</li> <li>• Impacts on the macro-soil structure.</li> <li>• Impacts on the hydropedological processes supporting the watercourses</li> </ul>	M	M
	Soil structure & land capability: <ul style="list-style-type: none"> <li>• Exposure of soils, leading to increased runoff from cleared areas and erosion of the watercourses, thus increasing the potential for sedimentation of the watercourses.</li> <li>• Vegetation loss.</li> <li>• Soil compaction and erosion</li> </ul>	M	M
	Soil quality: <ul style="list-style-type: none"> <li>• Natural nutrient content decreases due to soil exposure.</li> <li>• Loss of natural bio-organisms essential to soil processes.</li> </ul>	M	M
	Long-term implications due to the presence of CDF Soil interflow processes: <ul style="list-style-type: none"> <li>• Infilling of wetlands and watercourses inducing alternative flow paths (if infilling occurs).</li> <li>• Alteration to natural hydropedological flow paths.</li> <li>• Impacts on the macro-soil structure.</li> </ul> Impacts on the hydropedological processes supporting the watercourses	M	M
	Contamination of the area by petrochemical spillages	L	L
	Soil loss / Soil erosion	M	L
Geohydrological Aspects	Poor quality seepage from machinery. Oil, grease and fuel leaks could lead to hydrocarbon contamination of the vadose zone which could percolate into the shallow aquifer.	M	L
	Reduced volumes infiltrating the CDF reporting to PCD	M	M
Hydrological Aspects	The reshaping and rehabilitation of the co-disposal facility will be beneficial to the environment. Capping and reducing infiltration into the dump will help mitigate any poor-quality seepage.	M	H
	Poor quality seepage into the subsoils from landfills may impact soil quality and eventually lead to poor quality seepage into the surroundings.	L	L
	<ul style="list-style-type: none"> <li>• Potential surface water contamination as a result of poor stormwater drainage on-site.</li> <li>Increased erosion due to vegetation loss.</li> </ul>	L	L



	<ul style="list-style-type: none"> <li>Contaminated runoff water into nearby streams from parked vehicles or unattended leaks or spills.</li> <li>Sedimentation of watercourses due to altered runoff patterns.</li> </ul>		
	Surface water contamination due to overflow from PCD and TSF during storm events	M	L
Visual Impacts	Positive visual impact on aesthetics	L	L
	Visual intrusion due to glare, light trespass and skyglow	L	L
Noise Impacts	Noise disturbance to sensitive receptors	L	L
Heritage & Paleontological Impacts	Loss of / damage to heritage/archaeological/palaeontological resources if unearthed during construction	L	L
Socio-Economic Impacts	Nuisance factors (dust, noise and traffic)	M	L
	Temporary job creation	L	L
	Influx of workers post operations.	L	L

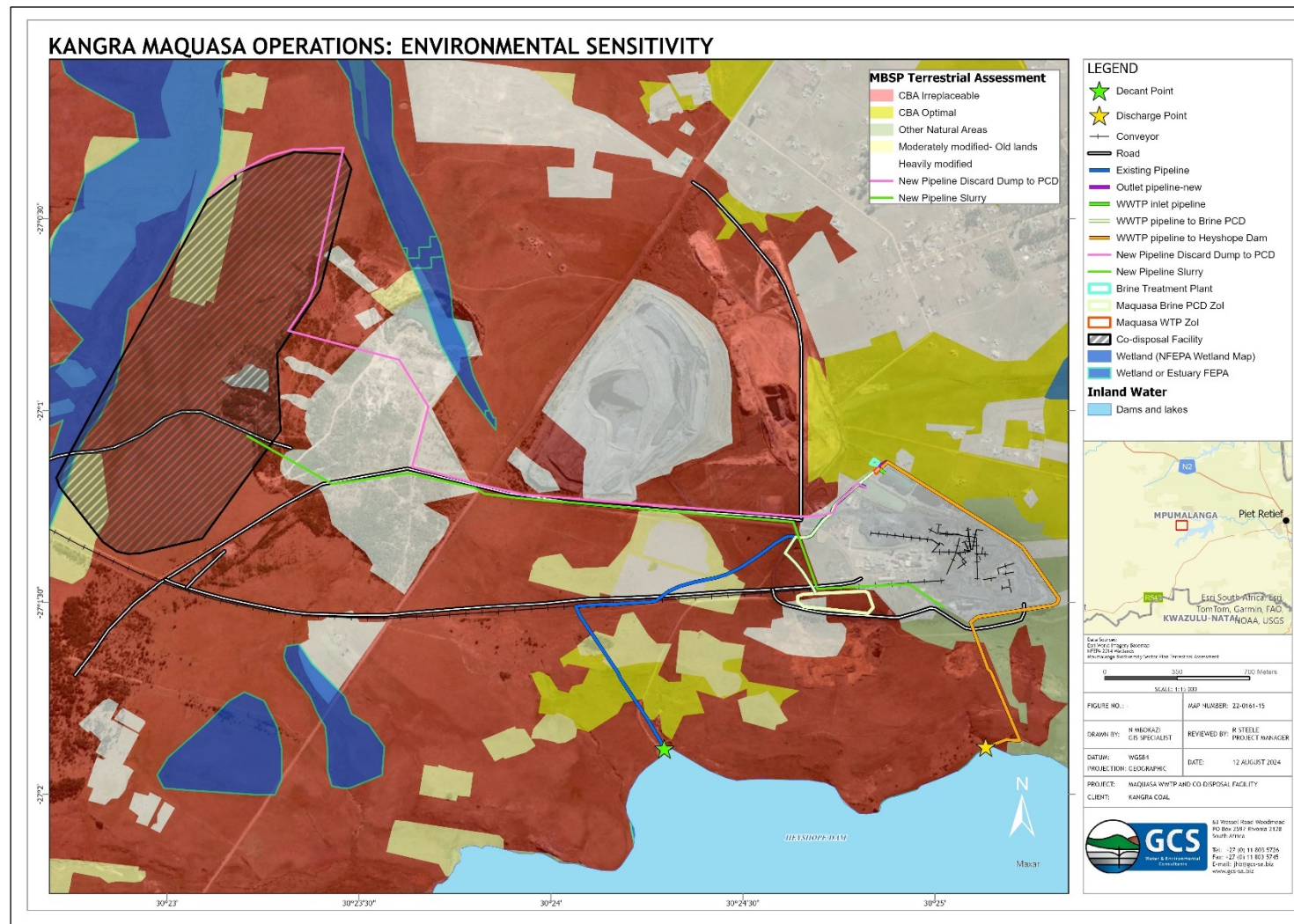


Figure 12-1: MQE CDF and WWTP Project Composite Environmental Sensitivity Map

## 12.2 Opinion regarding authorization of activity/ies

The assessments undertaken during the environmental impact assessment process have not identified any fatal flaws which would preclude the authorisation of the proposed Project. The EAP is confident that all major negative impacts associated with the proposed development have been adequately described and can be mitigated to acceptable levels.

The goal of the proposed Project is to mitigate the negative impacts of decant on the environment and continue contributing to the local economy by allowing the full Life of Mine (LoM) to be realised.

It is the opinion of the EAP that there is no reason not to grant the requested environmental authorisation in respect of the proposed WWTP and CDF and related infrastructure.

## 12.3 Environmental Management Programme Report (EMPr)

GCS has prepared a draft EMPr (DEMPr), which is required as part of the DEIR submission. The purpose of the EMPr is to control the impacts of construction and operational activities. The effective implementation of an EMPr will ensure that the required works are conducted in an environmentally sound manner and that the potential negative impacts of construction and operational activities are minimised and/or prevented.

The DEMPR details the responsibilities and authority of the various parties involved in the BS Expansion Projects and contains environmental specifications to which the contractor and operator are required to adhere throughout the construction and operational phases. The DEMPR will cover impacts that have been identified in the EIA Process and which could potentially arise during the construction and/or operation. The EMPr will cover the following aspects:

- Project background information.
- Identification/listing of project and operational activities.
- Implementation and operational instructions.
- Roles and responsibilities of parties regarding environmental management.
- Environmental training and awareness material for construction staff.
- Environmental specifications e.g., protection of biodiversity and sensitive environments, rehabilitation, public safety and perceptions, traffic control, material and waste management, litter, containment and disposal of hazardous substances (e.g., paints, waste oils) etc.
- Decommissioning/Closure, Rehabilitation & Financial Provisioning.
- Measurement of compliance with the EMPr.

## 12.4 Proposed Conditions of Authorisation

Following the findings of the EIA, it is suggested that the CA include the following conditions in the EA, should they decide to grant such:

- The applicant, or anyone acting on the applicant's behalf, must comply with the applicable legislation, regulatory and permit requirements from the Local Municipality, the District Municipality, the Mpumalanga Department of Agriculture, Rural Development, Land and Environment, DWS and all relevant authorities during the construction and operation phases.
- The recommendations and mitigation measures included in the specialist investigations must be adhered to as far as practicably possible.
- Obtain all licensing and permits from the relevant authorities to be compliant with national, and international laws, policies and acts.
- Correct implementation of all feasible mitigation measures included in the EMPr during the project lifecycle.
- In terms of Environmental Monitoring and Auditing, the following:
  - Appointment of an independent ECO for the duration of the construction phase of the project, to monitor environmental compliance of the Project to all environmental conditions and requirements during all construction phases (pre-construction, construction, post-construction);
  - Appointment of an independent External Auditor on an annual basis to undertake annual environmental compliance audits for the Project.

## **13 CONCLUSION AND WAY FORWARD**

### **13.1 Conclusion**

This DEIR has been compiled where the potential impacts on the environment of listed activities associated with the proposed WWTP and CDF Project were considered, investigated and assessed in compliance with the NEMA and EIA Regulations 2014. This report contains all information that is necessary for the CA to consider the application and to reach a decision regarding the application and includes an assessment of each identified potential impact, including biophysical, ecological, socio-economic and cumulative impacts of the Project on the environment. The impact assessment is more detailed than the preliminary assessment undertaken in the scoping phase, by incorporating all the conditions required by the EIA Regulations 2014, to provide a thorough investigation into all potential impacts.

Based on the conclusion that no environmental fatal flaw was found and that any negative impacts can be mitigated to acceptable levels, GCS recommends that an EA is granted, provided the rehabilitation measures and all other proposed mitigation measures are implemented and the recommendations are considered.

### **13.2 Way Forward**

This DEIR will be submitted to all I&APs for a 30-day comment period. All comments received from I&AP's have been included in the CRR and included as an appendix to the FEIR.

The FEIR will be submitted to the DMRE for a decision in respect of the application.

## 14 EAP DECLARATION AND UNDERTAKING

I, Reneé Steele, on behalf of GCS Water & Environmental (Pty) Ltd, as the appointed Environmental Assessment Practitioner, declare that:

- I act as the independent environmental assessment practitioner in this application;
- I have expertise in conducting environmental impact assessments, 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 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 will take into account, to the extent possible, the matters listed in Regulation 14 of the Regulations when preparing the application and any report relating to the application;
- I herewith undertake that the information provided in this report is correct and that the comments and inputs from stakeholders and Interested and Affected Parties received since the project announcement have been correctly recorded in the report;
- I herewith undertake that the information provided in this report is correct and that the level of agreement with Interested and Affected Parties and stakeholders since the announcement of the project, has been correctly recorded in the report;
- 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, unless access to that information is protected by law, in which case it will be indicated that such information exists and will be provided to the Competent Authority;
- I will perform all obligations as expected from an environmental assessment practitioner in terms of the Regulations;
- I am aware of what constitutes an offence in terms of Regulation 48 and that a person convicted of an offence in terms of Regulation 48(1) is liable to the penalties as contemplated in Section 49B of the Act; and
- I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Regulations.

Signature of the EAP:



Name of Company:

GCS Water and Environmental (Pty) Ltd

Date:

12 September 2024

## 15 REFERENCES

Department of Environmental Affairs. 2017. Guideline on Need and Desirability, Department of Environmental Affairs, (DEA), Pretoria, South Africa.

Department of Environmental Affairs. 2012. Highveld Priority Area Air Quality Management Plan. Government Notice 144, Government Gazette No. 35072.

GCS. April 2013. Kangra Coal Pty (Ltd): Proposed Expansion of Mining Operations: Environmental Impact Assessment and Environmental Management Programme Report.

GCS. June 2014. Soils, Land Use and Land Capability Assessment for the Proposed Kangra Discard Facility.

GCS. June 2015. Hydrogeological Investigation: Discard Storage Facility.

GCS Water & Environment (Pty) Ltd. 2018. Geohydrological Study Update for Maquasa East, Maquasa West and Nooitgezien Operations.

GCS. 15 February 2023. Follow-Up Geohydrological Assessment and Numerical Flow & Transport Model Update for Maquasa & Kusipongo Operations.

GCS. 2 June 2023. Ecological Assessment for the Kangra Coal (PTY) LTD Maquasa Mine Pipeline Disposal, WWTWs, Discard Dump near Piet Retief, Mpumalanga Province.

GCS. 2 June 2023. Wetland Assessment for the Kangra Coal (PTY) LTD Maquasa Mine Pipeline Disposal, WWTWs, Discard Dump near Piet Retief, Mpumalanga.

GCS. 18 October 2022. Hydrology Assessment for the Proposed Co-Disposal Facility & Water Treatment Plant at Kangra Maquasa East Operations.

GCS. 17 November 2022. Waste Classification Assessment Proposed Co-Disposal Facility at Kangra Maquasa East Operations.

GCS. 2023. Water Quality Monitoring Report for the Kangra Coal Maquasa East, Maquasa West & Nooitgesien Operations: Third Quarter, 2022 Monitoring Period.

Gert Sibande District Municipality Amended Integrated Development Plan 2021-2022

Hatch. 20 December 2011. Kusipongo Expansion Project - Concept Discard Dump Report - Issued for Client Review.

Van der Merwe, B. 2008. Environmental Noise Impact Assessment: Site Selection Process. DBAcoustics.

Wetland Consulting Services. 2013. Kangra Maquasa East and Maquasa West Proposed Opencast Expansion Projects: Wetland Delineation, Ecological and Impact Assessment Report.



---

Wernecke, Bianca; Langerman, Kristy E; Garland, Rebecca M and Feig, Gregor. Ambient air pollution on the Highveld: An airshed at a watershed moment? *Clean Air J.* [online]. 2022, vol.32, n.1 [cited 2024-03-07], pp.1-3. Available from: <<http://www.scielo.org.za>

## **APPENDIX A: PROJECT SPECIFIC INFORMATION**

### *Appendix A1 - DFFE Screening Report*

**SCREENING REPORT FOR AN ENVIRONMENTAL AUTHORIZATION AS  
REQUIRED BY THE 2014 EIA REGULATIONS – PROPOSED DEVELOPMENT  
FOOTPRINT ENVIRONMENTAL SENSITIVITY**

**EIA Reference number:** MP 30/5/1/23/2/1/133 & 134 EM

**Project name:** Maquasa WML & EA

**Project title:** Maquasa Co-Disposal Facility and Treatment Plant

**Date screening report generated:** 01/11/2022 10:13:49

**Applicant:** Kangra

**Compiler:** GCS

**Compiler signature:**



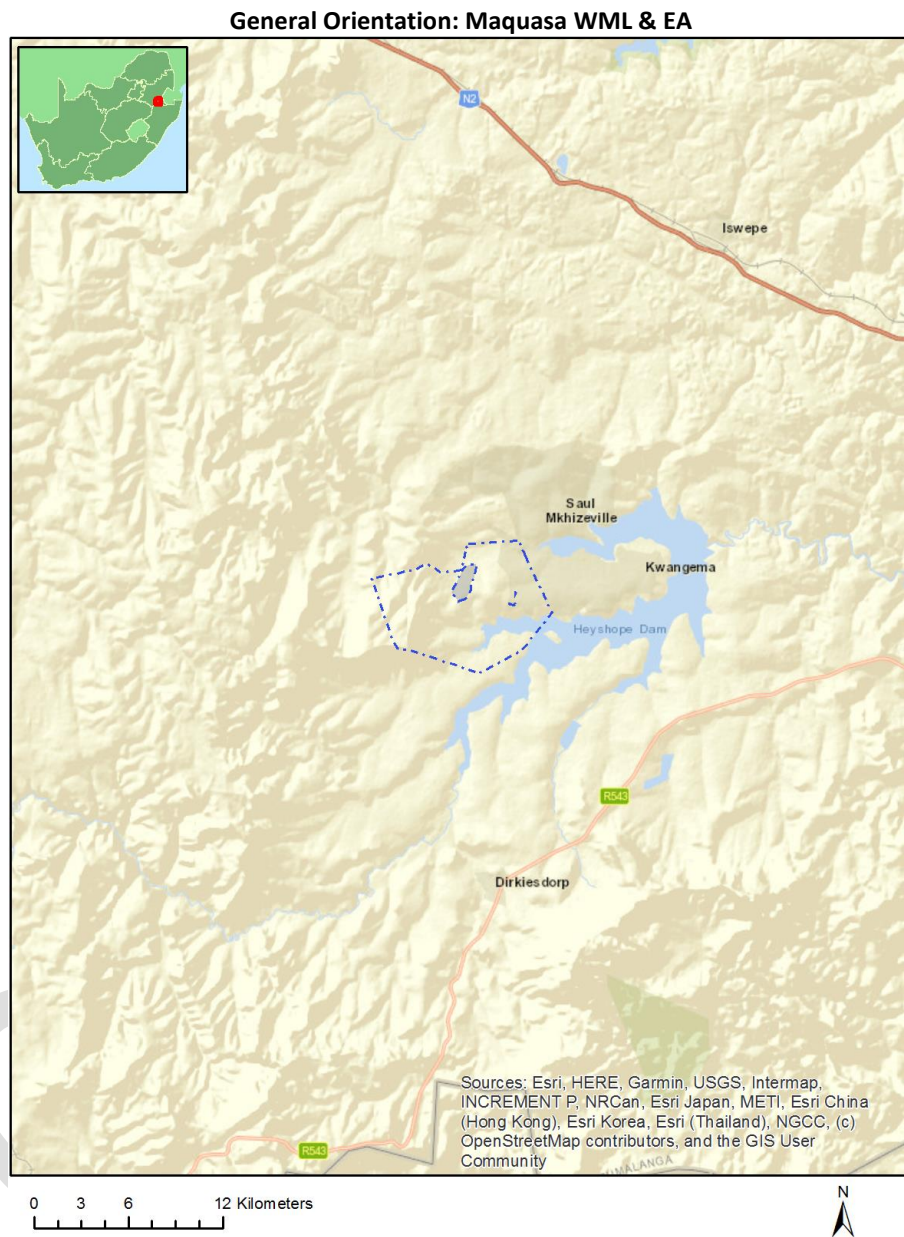
**Application Category:** Mining|Mining Right

## Table of Contents

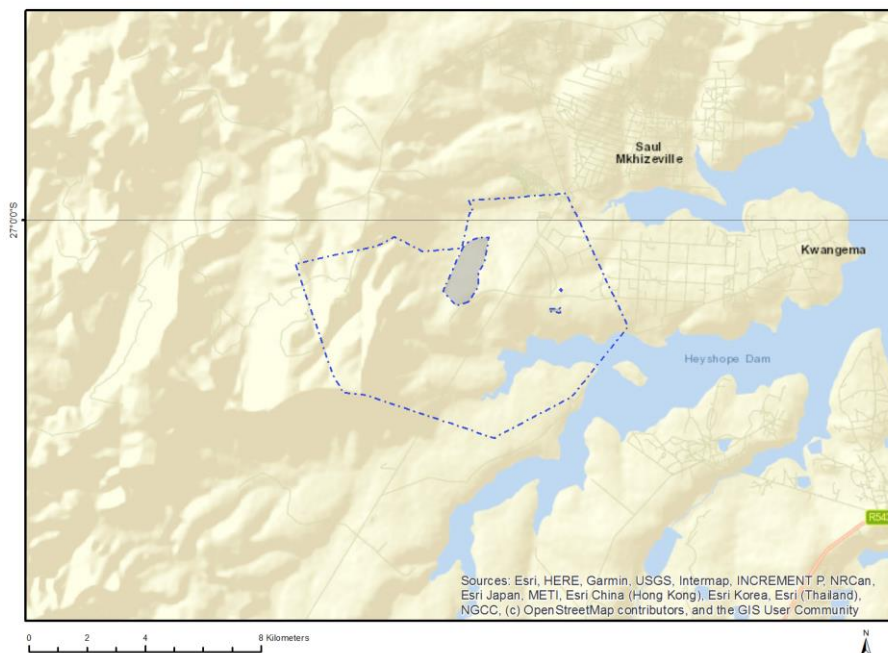
Proposed Project Location .....	3
Orientation map 1: General location .....	3
Map of proposed site and relevant area(s) .....	4
Cadastral details of the proposed site .....	4
Wind and Solar developments with an approved Environmental Authorisation or applications under consideration within 30 km of the proposed area .....	6
Environmental Management Frameworks relevant to the application .....	6
Environmental screening results and assessment outcomes .....	6
Relevant development incentives, restrictions, exclusions or prohibitions .....	6
Map indicating proposed development footprint within applicable development incentive, restriction, exclusion or prohibition zones .....	8
Proposed Development Area Environmental Sensitivity .....	8
Specialist assessments identified .....	9
Results of the environmental sensitivity of the proposed area .....	11
MAP OF RELATIVE AGRICULTURE THEME SENSITIVITY .....	11
MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY .....	12
MAP OF RELATIVE AQUATIC BIODIVERSITY THEME SENSITIVITY .....	13
MAP OF RELATIVE ARCHAEOLOGICAL AND CULTURAL HERITAGE THEME SENSITIVITY .....	14
MAP OF RELATIVE CIVIL AVIATION THEME SENSITIVITY .....	15
MAP OF RELATIVE DEFENCE THEME SENSITIVITY .....	16
MAP OF RELATIVE PALEONTOLOGY THEME SENSITIVITY .....	17
MAP OF RELATIVE PLANT SPECIES THEME SENSITIVITY .....	18
MAP OF RELATIVE TERRESTRIAL BIODIVERSITY THEME SENSITIVITY .....	19

# Proposed Project Location

## Orientation map 1: General location



## Map of proposed site and relevant area(s)



## Cadastral details of the proposed site

Property details:

No	Farm Name	Farm/ Erf No	Portion	Latitude	Longitude	Property Type
1	DUITSCHLAND	27	0	27°4'3.28S	30°25'19.28E	Farm
2	MAQUASA	19	0	27°2'18.7S	30°22'29.32E	Farm
3	ROOIKOP	18	0	27°0'16.17S	30°21'44.03E	Farm
4	ROODEKRAAL	21	0	27°1'28.12S	30°24'39.19E	Farm
5	DRIEFONTEIN	388	0	26°58'51.68S	30°26'27.41E	Farm
6	ROODEKRAAL	21	38	27°0'58.22S	30°25'35.24E	Farm Portion
7	ROODEKRAAL	21	16	27°0'26.35S	30°24'54.11E	Farm Portion
8	ROODEKRAAL	21	47	27°1'31.92S	30°25'30.79E	Farm Portion
9	ROODEKRAAL	21	51	27°1'31.52S	30°25'52.04E	Farm Portion
10	ROODEKRAAL	21	42	27°1'14.65S	30°25'28.95E	Farm Portion
11	ROODEKRAAL	21	27	27°0'37.68S	30°25'4.42E	Farm Portion
12	ROODEKRAAL	21	26	27°0'51.96S	30°24'49.44E	Farm Portion
13	ROODEKRAAL	21	58	26°59'37.54S	30°24'41.15E	Farm Portion
14	ROODEKRAAL	21	34	27°1'2.95S	30°24'59.61E	Farm Portion
15	ROODEKRAAL	21	41	27°1'16.49S	30°25'19.05E	Farm Portion
16	ROODEKRAAL	21	53	27°1'39.79S	30°25'56.23E	Farm Portion
17	ROODEKRAAL	21	5	26°59'40.19S	30°24'56.28E	Farm Portion
18	ROODEKRAAL	21	45	27°1'25.87S	30°25'21.85E	Farm Portion
19	ROODEKRAAL	21	40	27°1'13.64S	30°25'10.17E	Farm Portion
20	ROODEKRAAL	21	60	26°59'55.45S	30°24'29.08E	Farm Portion
21	ROODEKRAAL	21	61	27°0'3.58S	30°24'28.23E	Farm Portion
22	MAQUASA	19	2	27°2'15.86S	30°23'41.71E	Farm Portion
23	ROODEKRAAL	21	21	27°0'22.09S	30°24'31.58E	Farm Portion
24	ROODEKRAAL	21	43	27°1'7.81S	30°25'39.14E	Farm Portion
25	ROODEKRAAL	21	52	27°1'45.59S	30°25'36.67E	Farm Portion
26	ROODEKRAAL	21	14	27°0'15.96S	30°24'42.2E	Farm Portion
27	ROODEKRAAL	21	66	26°59'50.62S	30°24'56.18E	Farm Portion
28	ROODEKRAAL	21	17	27°0'22.01S	30°25'1.01E	Farm Portion

29	DRIEFONTEIN	388	45	27°1'20.61S	30°25'58.61E	Farm Portion
30	ROODEKRAAL	21	20	27°0'31.91S	30°25'2.33E	Farm Portion
31	ROODEKRAAL	21	25	27°0'45.76S	30°24'49.29E	Farm Portion
32	ROODEKRAAL	21	9	27°0'5.31S	30°24'51.75E	Farm Portion
33	ROODEKRAAL	21	12	27°0'10.92S	30°25'12.07E	Farm Portion
34	ROODEKRAAL	21	13	27°0'11.54S	30°24'35.78E	Farm Portion
35	ROODEKRAAL	21	32	27°0'43.46S	30°25'6.68E	Farm Portion
36	ROODEKRAAL	21	37	27°1'1.48S	30°25'27.5E	Farm Portion
37	ROODEKRAAL	21	2	26°59'47.76S	30°24'26.83E	Farm Portion
38	ROOIKOP	18	0	27°1'3.08S	30°21'45.33E	Farm Portion
39	ROODEKRAAL	21	15	27°0'19.93S	30°24'48.67E	Farm Portion
40	ROODEKRAAL	21	30	27°0'45.2S	30°25'25.46E	Farm Portion
41	ROODEKRAAL	21	6	26°59'45.5S	30°24'56.48E	Farm Portion
42	ROODEKRAAL	21	39	27°1'8.67S	30°24'58.36E	Farm Portion
43	ROODEKRAAL	21	50	27°1'35.77S	30°25'42.22E	Farm Portion
44	ROODEKRAAL	21	49	27°1'39.74S	30°25'32.89E	Farm Portion
45	ROODEKRAAL	21	24	27°0'39.63S	30°24'48.69E	Farm Portion
46	ROODEKRAAL	21	62	27°0'6.22S	30°24'20.75E	Farm Portion
47	ROODEKRAAL	21	63	27°0'30.98S	30°24'40.69E	Farm Portion
48	ROODEKRAAL	21	57	26°59'39.54S	30°24'27.1E	Farm Portion
49	ROODEKRAAL	21	23	27°0'34.79S	30°24'44.51E	Farm Portion
50	ROODEKRAAL	21	28	27°0'32.81S	30°25'19.29E	Farm Portion
51	ROODEKRAAL	21	8	27°0'1.83S	30°24'43.86E	Farm Portion
52	ROODEKRAAL	21	10	27°0'9.39S	30°24'57.32E	Farm Portion
53	ROODEKRAAL	21	11	27°0'8.54S	30°25'4.98E	Farm Portion
54	ROODEKRAAL	21	29	27°0'39.02S	30°25'22.07E	Farm Portion
55	ROODEKRAAL	21	35	27°1'3.49S	30°25'12.54E	Farm Portion
56	ROODEKRAAL	21	33	27°0'53.56S	30°24'58.63E	Farm Portion
57	DRIEFONTEIN	388	44	27°1'30.02S	30°26'0.76E	Farm Portion
58	ROODEKRAAL	21	31	27°0'48.77S	30°25'11.57E	Farm Portion
59	ROODEKRAAL	21	18	27°0'20.13S	30°25'11.09E	Farm Portion
60	ROODEKRAAL	21	36	27°1'5.53S	30°25'21.28E	Farm Portion
61	ROODEKRAAL	21	1	27°2'33.2S	30°24'35.33E	Farm Portion
62	ROODEKRAAL	21	56	26°59'56.5S	30°24'56.45E	Farm Portion
63	ROODEKRAAL	21	54	27°1'19.66S	30°25'43.27E	Farm Portion
64	ROODEKRAAL	21	44	27°1'15.65S	30°25'41.76E	Farm Portion
65	ROODEKRAAL	21	59	26°59'55.15S	30°24'15.1E	Farm Portion
66	ROODEKRAAL	21	67	26°59'38.82S	30°24'49.29E	Farm Portion
67	ROODEKRAAL	21	55	27°0'54.7S	30°25'14.39E	Farm Portion
68	ROODEKRAAL	21	0	27°0'45.48S	30°24'13.79E	Farm Portion
69	DRIEFONTEIN	388	43	27°1'10.25S	30°25'51.04E	Farm Portion
70	DRIEFONTEIN	388	319	26°59'43.95S	30°25'10.42E	Farm Portion
71	DRIEFONTEIN	388	74	27°1'40.08S	30°26'8.22E	Farm Portion
72	ROODEKRAAL	21	70	26°59'45.71S	30°24'45.54E	Farm Portion
73	MAQUASA	19	0	27°2'12.92S	30°22'22.32E	Farm Portion
74	MAQUASA	19	1	27°3'10.78S	30°23'19.47E	Farm Portion
75	ROODEKRAAL	21	46	27°1'23.96S	30°25'32.08E	Farm Portion
76	ROODEKRAAL	21	48	27°1'25.62S	30°25'45.65E	Farm Portion
77	ROODEKRAAL	21	19	27°0'26.31S	30°25'16.29E	Farm Portion
78	ROODEKRAAL	21	22	27°0'27.83S	30°24'37.72E	Farm Portion
79	DUITSCHLAND	27	5	27°3'44.52S	30°24'11.87E	Farm Portion
80	DRIEFONTEIN	388	9	26°59'53.37S	30°25'12.69E	Farm Portion

Development footprint<sup>1</sup> vertices:

<sup>1</sup> “development footprint”, means the area within the site on which the development will take place and includes all ancillary developments for example roads, power lines, boundary walls, paving etc. which require vegetation clearance or which will be disturbed and for which the application has been submitted.



Footprint	Latitude	Longitude
1	27°0'27.71S	30°23'1.54E
1	27°0'20.89S	30°23'9.07E
1	27°0'17.07S	30°23'18.81E
1	27°0'17.59S	30°23'30.51E
1	27°0'42.57S	30°23'25.18E
1	27°0'51.66S	30°23'18.93E
1	27°1'4.76S	30°23'19.27E
1	27°1'21.28S	30°23'7.57E
1	27°1'25.13S	30°22'53.97E
1	27°1'10.27S	30°22'39.45E
1	27°0'27.71S	30°23'1.54E
2	27°1'8.05S	30°24'51.19E
2	27°1'8.87S	30°24'52.2E
2	27°1'10.59S	30°24'50.89E
2	27°1'9.6S	30°24'49.84E
2	27°1'8.05S	30°24'51.19E
3	27°1'28.21S	30°24'37.66E
3	27°1'27.62S	30°24'49.6E
3	27°1'30.93S	30°24'50.98E
3	27°1'32.09S	30°24'49.48E
3	27°1'30.69S	30°24'38.98E
3	27°1'30S	30°24'38E
3	27°1'30S	30°24'38E
3	27°1'28.21S	30°24'37.66E

## Wind and Solar developments with an approved Environmental Authorisation or applications under consideration within 30 km of the proposed area

No nearby wind or solar developments found.

## Environmental Management Frameworks relevant to the application

No intersections with EMF areas found.

## Environmental screening results and assessment outcomes

The following sections contain a summary of any development incentives, restrictions, exclusions or prohibitions that apply to the proposed development footprint as well as the most environmental sensitive features on the footprint based on the footprint sensitivity screening results for the application classification that was selected. The application classification selected for this report is:

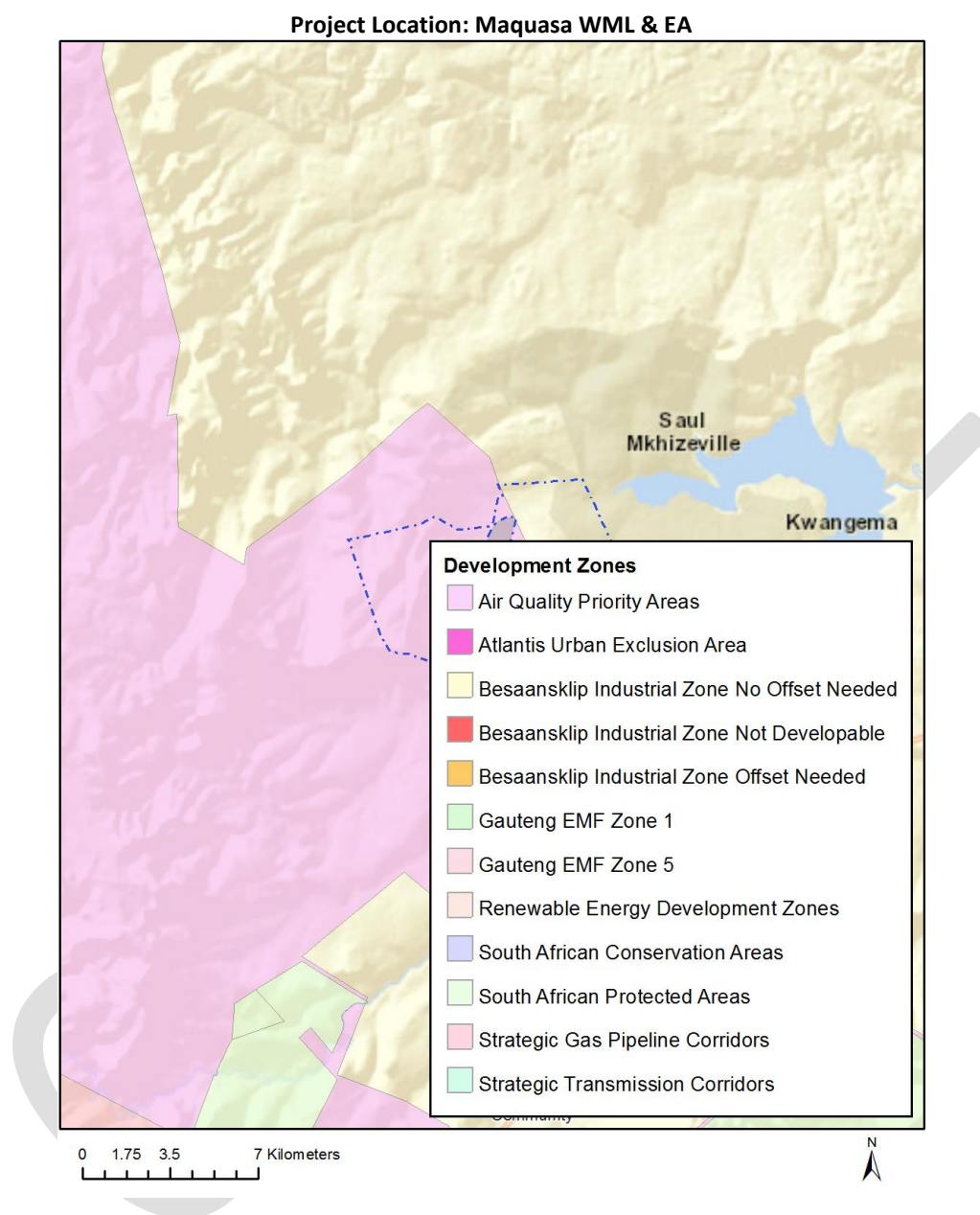
**Mining | Mining Right.**

## Relevant development incentives, restrictions, exclusions or prohibitions

The following development incentives, restrictions, exclusions or prohibitions and their implications that apply to this footprint are indicated below.

Incentive, restriction or prohibition	Implication
Air Quality-Highveld Priority Area	<a href="https://screening.environment.gov.za/ScreeningDownloads/DevelopmentZones/HIGHVELD_PRIORITY_AREA_AQMP.pdf">https://screening.environment.gov.za/ScreeningDownloads/DevelopmentZones/HIGHVELD_PRIORITY_AREA_AQMP.pdf</a>

Map indicating proposed development footprint within applicable development incentive, restriction, exclusion or prohibition zones



### Proposed Development Area Environmental Sensitivity

The following summary of the development footprint environmental sensitivities is identified. Only the highest environmental sensitivity is indicated. The footprint environmental sensitivities for the proposed development footprint as identified, are indicative only and must be verified on site by a suitably qualified person before the specialist assessments identified below can be confirmed.

Theme	Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
Agriculture Theme	X			
Animal Species Theme		X		

Aquatic Biodiversity Theme	X			
Archaeological and Cultural Heritage Theme				X
Civil Aviation Theme				X
Defence Theme				X
Paleontology Theme	X			
Plant Species Theme			X	
Terrestrial Biodiversity Theme	X			

### Specialist assessments identified

Based on the selected classification, and the environmental sensitivities of the proposed development footprint, the following list of specialist assessments have been identified for inclusion in the assessment report. It is the responsibility of the EAP to confirm this list and to motivate in the assessment report, the reason for not including any of the identified specialist study including the provision of photographic evidence of the footprint situation.

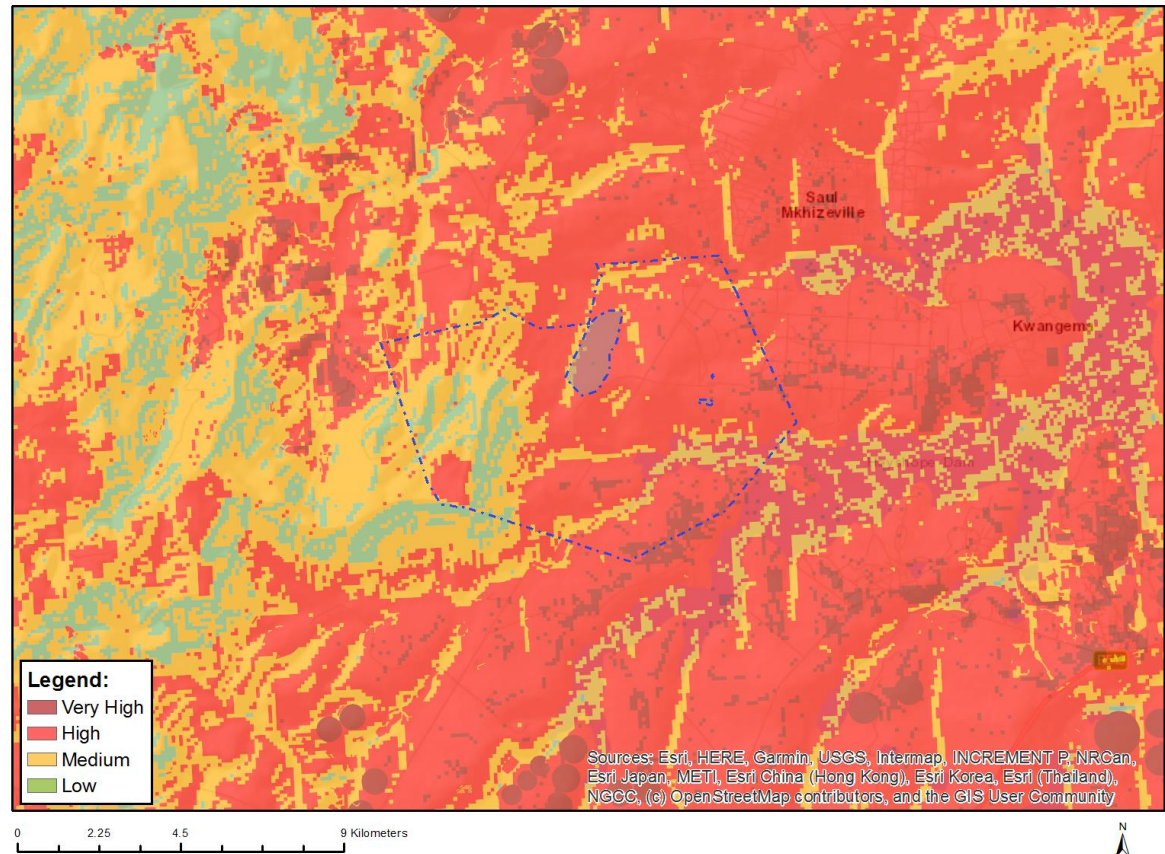
N o	Special ist assess ment	Assessment Protocol
1	Agricultural Impact Assessment	<a href="https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Agriculture_Assessment_Protocols.pdf">https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Agriculture_Assessment_Protocols.pdf</a>
2	Landscape/Visual Impact Assessment	<a href="https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf">https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf</a>
3	Archaeological and Cultural Heritage Impact Assessment	<a href="https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf">https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf</a>
4	Palaeontology Impact Assessment	<a href="https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf">https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_General_Requirement_Assessment_Protocols.pdf</a>
5	Terrestrial Biodiversity Impact Assessment	<a href="https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Terrestrial_Biodiversity_Assessment_Protocols.pdf">https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Terrestrial_Biodiversity_Assessment_Protocols.pdf</a>
6	Aquatic Biodiversity Impact Assessment	<a href="https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Aquatic_Biodiversity_Assessment_Protocols.pdf">https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Aquatic_Biodiversity_Assessment_Protocols.pdf</a>
7	Hydrology	<a href="https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols">https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols</a>

	Assessment	<a href="#">/Gazetted General Requirement Assessment Protocols.pdf</a>
8	Noise Impact Assessment	<a href="https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted_Noise_Impacts_Assessment_Protocol.pdf">https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted Noise Impacts Assessment Protocol.pdf</a>
9	Radioactivity Impact Assessment	<a href="https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted General Requirement Assessment Protocols.pdf">https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted General Requirement Assessment Protocols.pdf</a>
10	Traffic Impact Assessment	<a href="https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted General Requirement Assessment Protocols.pdf">https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted General Requirement Assessment Protocols.pdf</a>
11	Geotechnical Assessment	<a href="https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted General Requirement Assessment Protocols.pdf">https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted General Requirement Assessment Protocols.pdf</a>
12	Climate Impact Assessment	<a href="https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted General Requirement Assessment Protocols.pdf">https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted General Requirement Assessment Protocols.pdf</a>
13	Health Impact Assessment	<a href="https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted General Requirement Assessment Protocols.pdf">https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted General Requirement Assessment Protocols.pdf</a>
14	Socio-Economic Assessment	<a href="https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted General Requirement Assessment Protocols.pdf">https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted General Requirement Assessment Protocols.pdf</a>
15	Ambient Air Quality Impact Assessment	<a href="https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted General Requirement Assessment Protocols.pdf">https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted General Requirement Assessment Protocols.pdf</a>
16	Seismicity Assessment	<a href="https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted General Requirement Assessment Protocols.pdf">https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted General Requirement Assessment Protocols.pdf</a>
17	Plant Species Assessment	<a href="https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted Plant Species Assessment Protocols.pdf">https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted Plant Species Assessment Protocols.pdf</a>
18	Animal Species Assessment	<a href="https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted Animal Species Assessment Protocols.pdf">https://screening.environment.gov.za/ScreeningDownloads/AssessmentProtocols/Gazetted Animal Species Assessment Protocols.pdf</a>

# Results of the environmental sensitivity of the proposed area.

The following section represents the results of the screening for environmental sensitivity of the proposed footprint for relevant environmental themes associated with the project classification. It is the duty of the EAP to ensure that the environmental themes provided by the screening tool are comprehensive and complete for the project. Refer to the disclaimer.

## MAP OF RELATIVE AGRICULTURE THEME SENSITIVITY



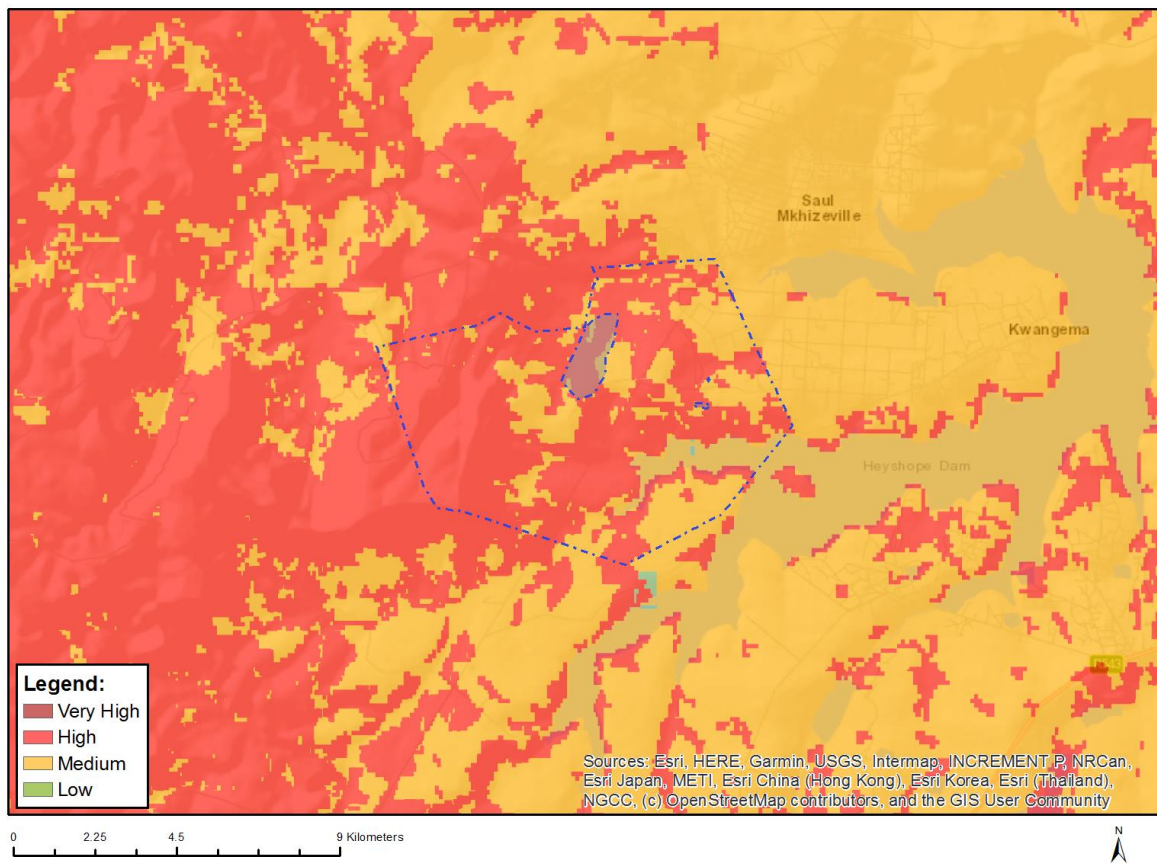
Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

### Sensitivity Features:

Sensitivity	Feature(s)
High	Land capability;09. Moderate-High/10. Moderate-High
Medium	Land capability;06. Low-Moderate/07. Low-Moderate/08. Moderate
Very High	Land capability;11. High/12. High-Very high/13. High-Very high/14. Very high/15. Very high



## MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at [eiadatarequests@sanbi.org.za](mailto:eiadatarequests@sanbi.org.za) listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

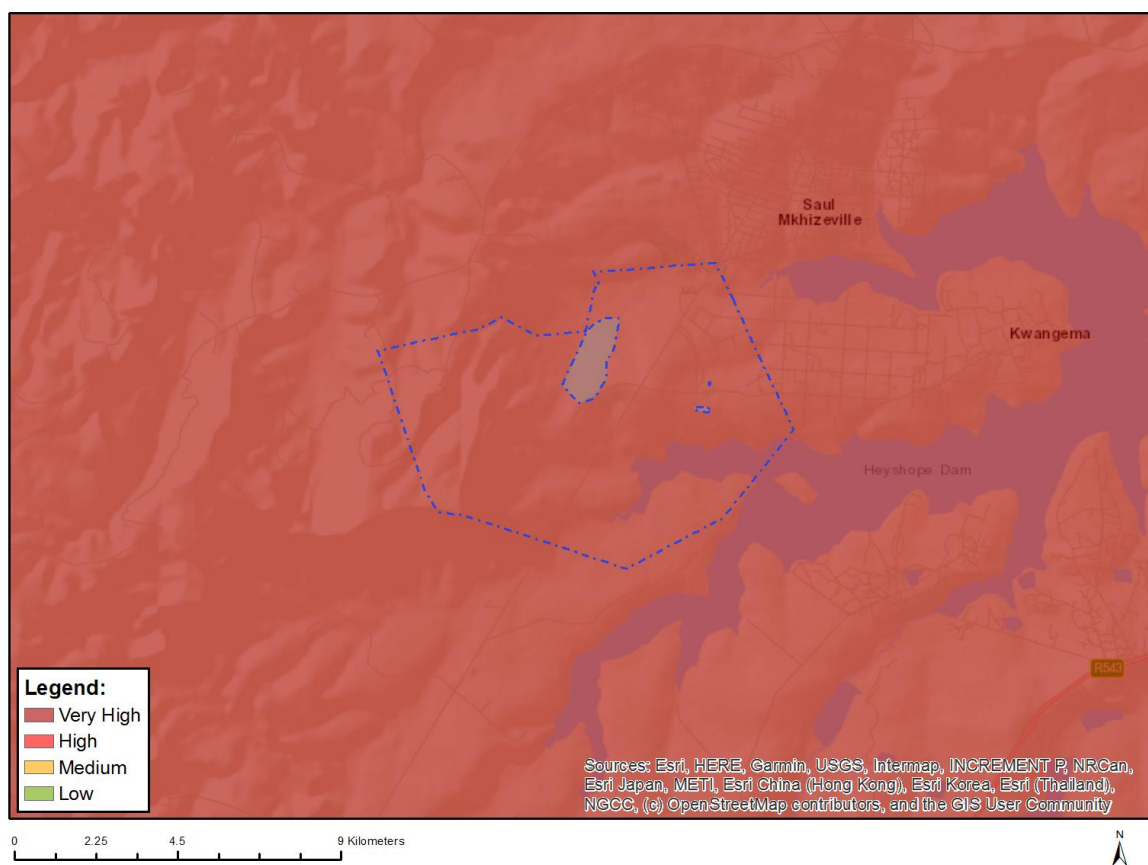
Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

### Sensitivity Features:

Sensitivity	Feature(s)
High	Aves-Balearica regulorum
High	Aves-Eupodotis senegalensis
High	Aves-Sagittarius serpentarius
High	Aves-Geronticus calvus
Medium	Mammalia-Chrysospalax villosus
Medium	Mammalia-Crocidura maquassiensis
Medium	Mammalia-Hydrictis maculicollis
Medium	Mammalia-Ourebia ourebi ourebi
Medium	Invertebrate-Doratogonus praealtus



## MAP OF RELATIVE AQUATIC BIODIVERSITY THEME SENSITIVITY

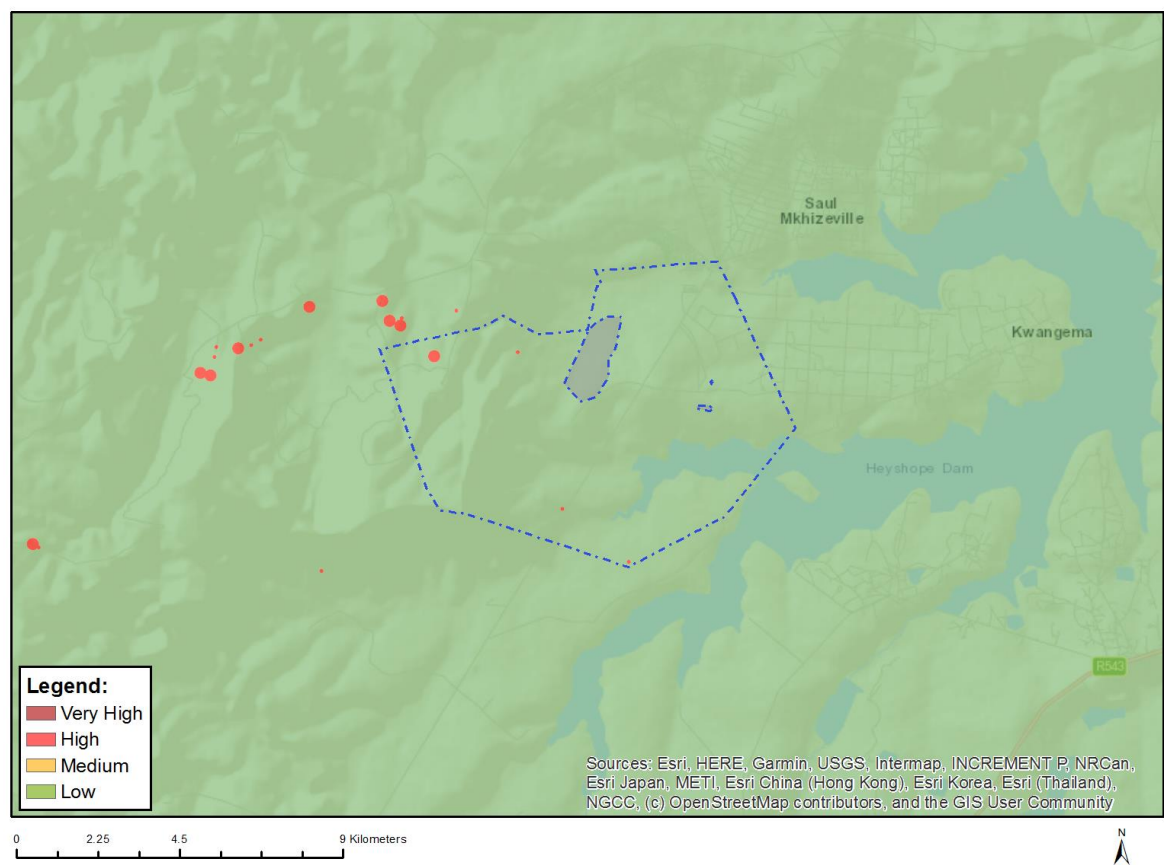


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

### Sensitivity Features:

Sensitivity	Feature(s)
Very High	Aquatic CBAs
Very High	Strategic water source area
Very High	Wetlands and Estuaries
Very High	Freshwater ecosystem priority area quinary catchments

# MAP OF RELATIVE ARCHAEOLOGICAL AND CULTURAL HERITAGE THEME SENSITIVITY

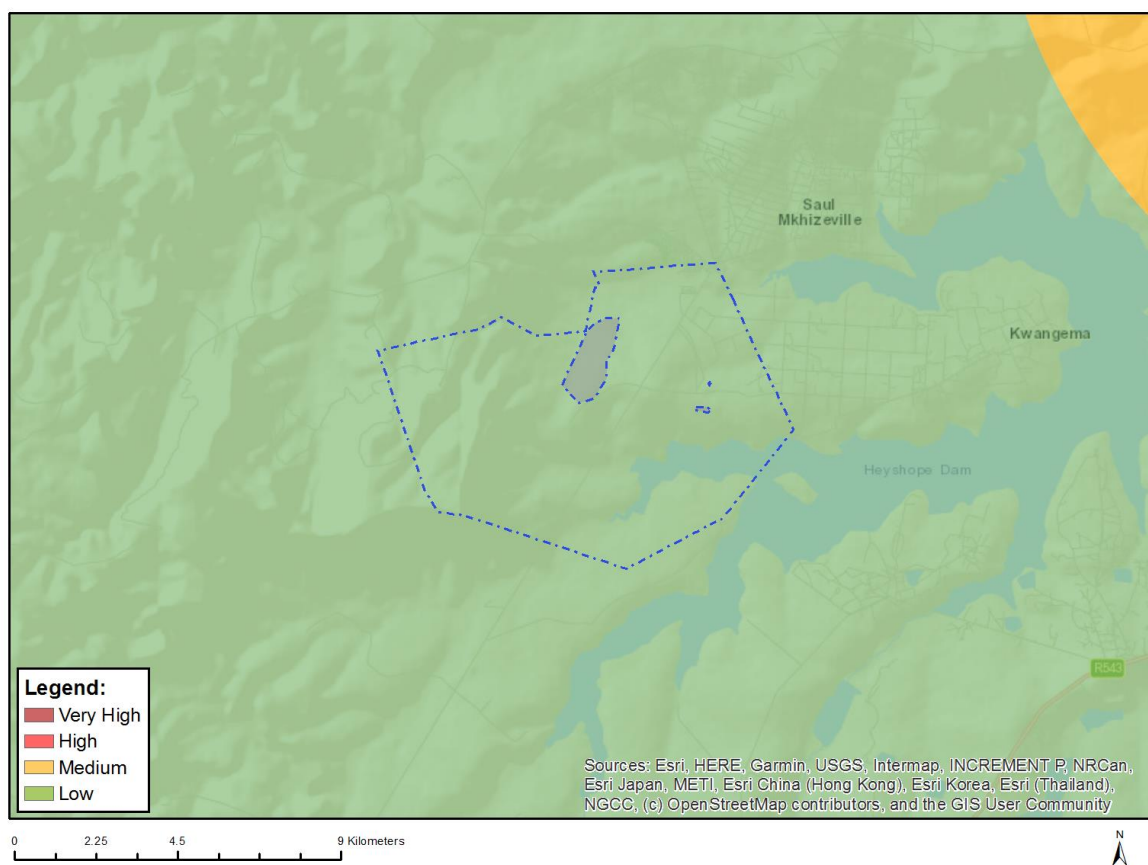


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

## Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity

## MAP OF RELATIVE CIVIL AVIATION THEME SENSITIVITY

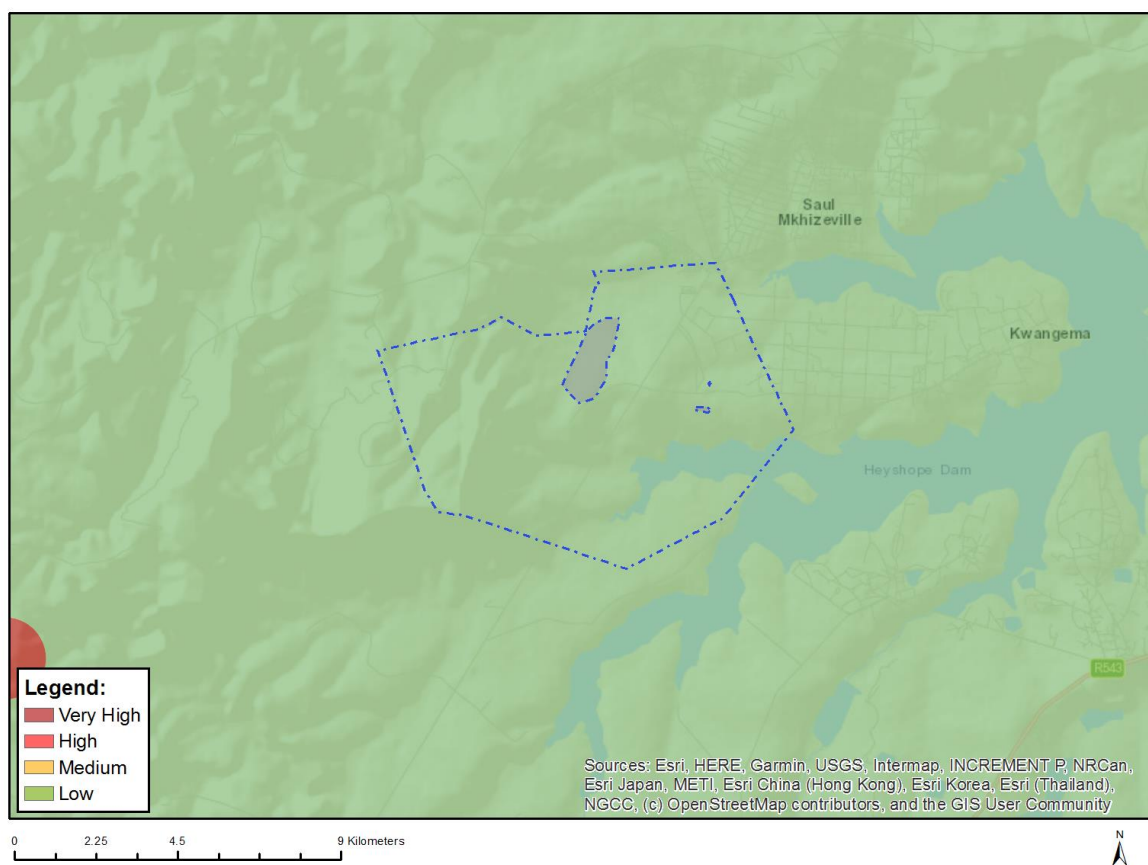


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

### Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity

## MAP OF RELATIVE DEFENCE THEME SENSITIVITY

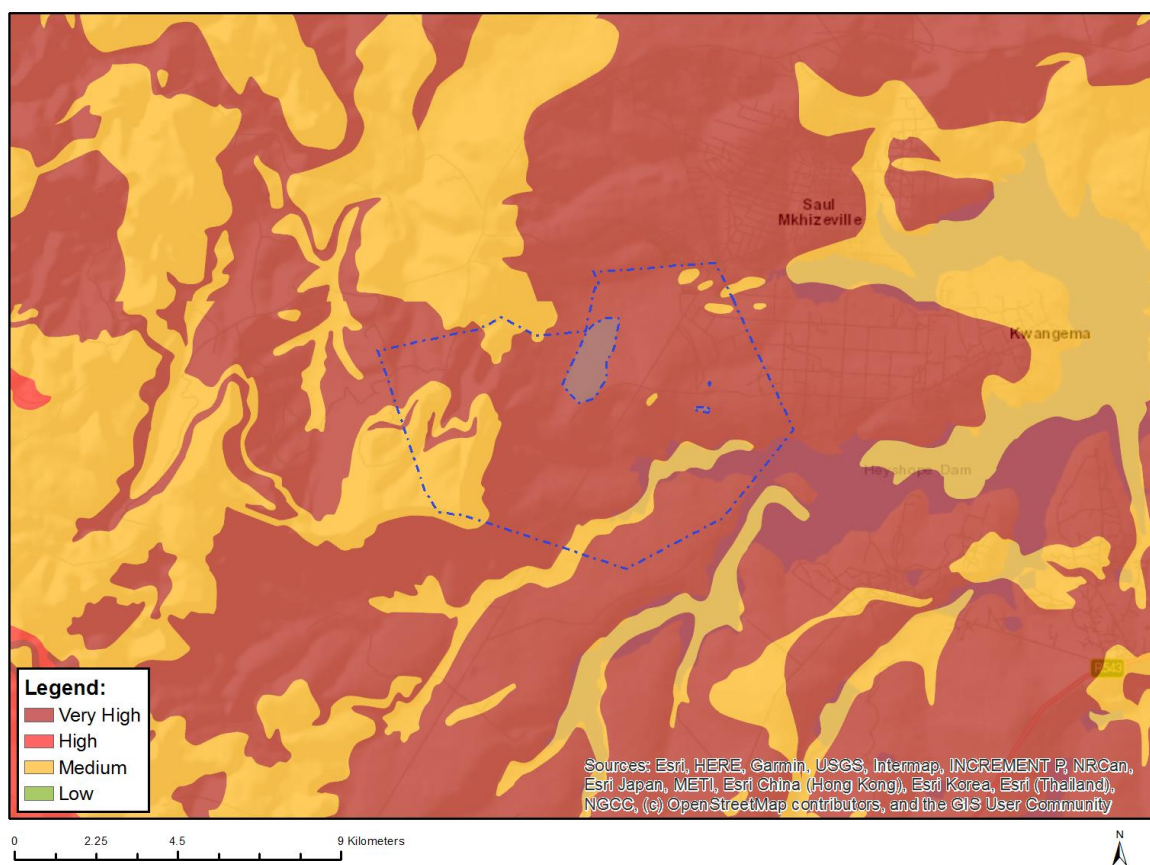


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

### Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity

## MAP OF RELATIVE PALEONTOLOGY THEME SENSITIVITY



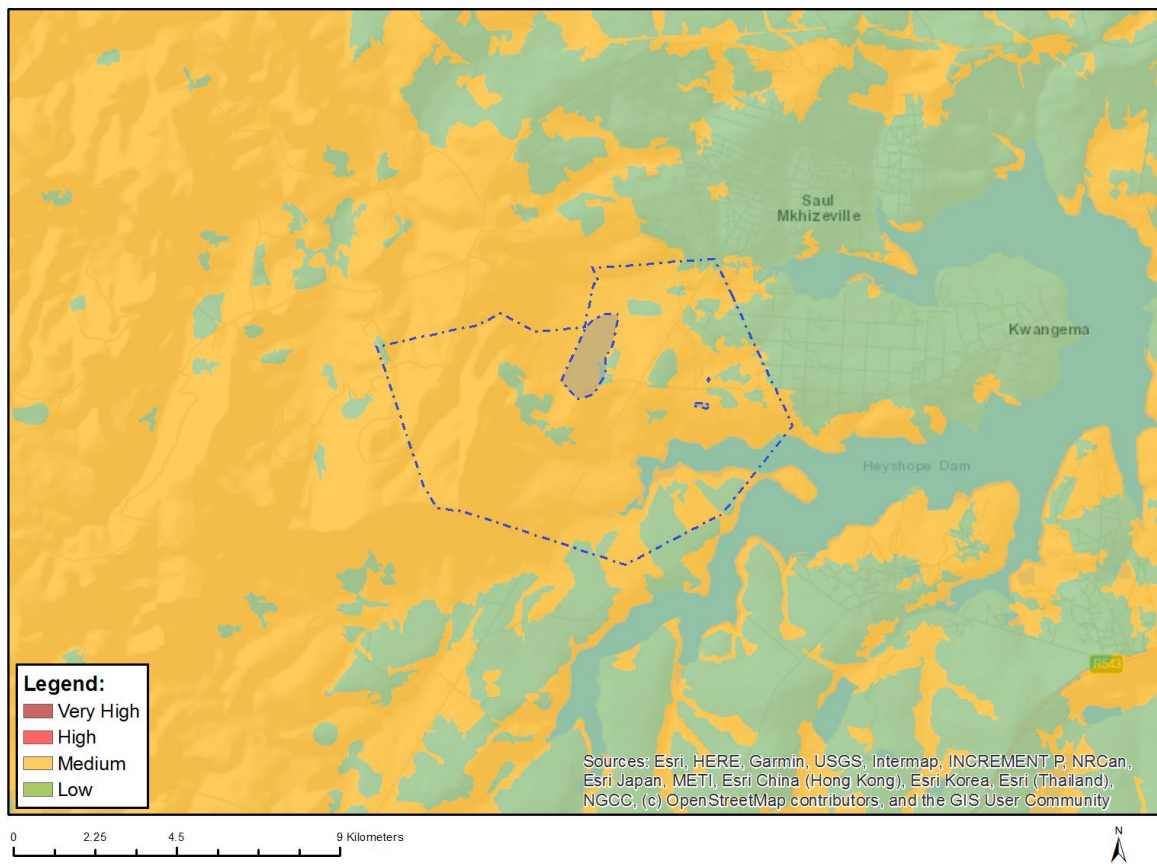
Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

### Sensitivity Features:

Sensitivity	Feature(s)
Medium	Features with a Medium paleontological sensitivity
Very High	Features with a Very High paleontological sensitivity



## MAP OF RELATIVE PLANT SPECIES THEME SENSITIVITY



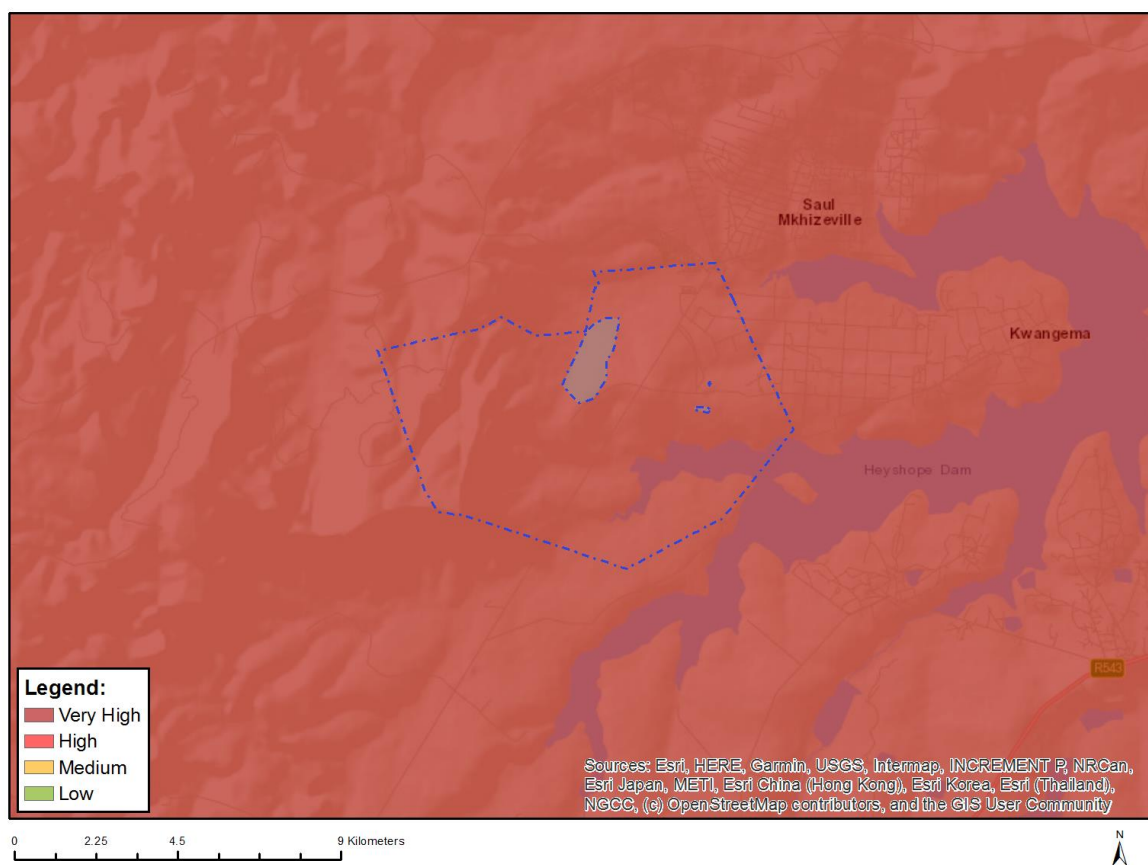
Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at [eiadatarequests@sanbi.org.za](mailto:eiadatarequests@sanbi.org.za) listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

### Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity
Medium	Indigofera hybrida
Medium	Sensitive species 41
Medium	Sensitive species 691

## MAP OF RELATIVE TERRESTRIAL BIODIVERSITY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

### Sensitivity Features:

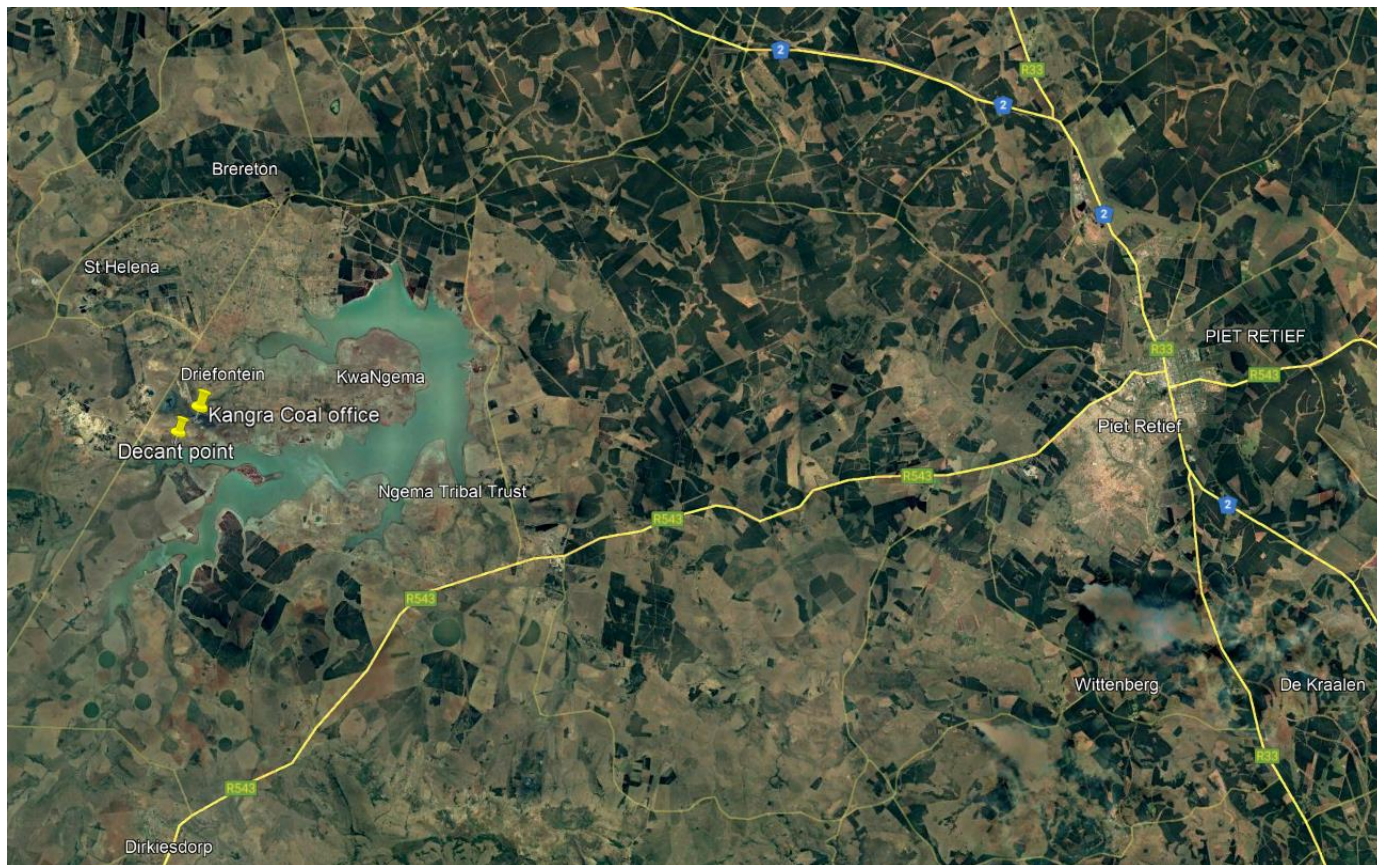
Sensitivity	Feature(s)
Very High	Critical biodiversity area 1
Very High	Critical biodiversity area 2
Very High	FEPA Subcatchments
Very High	Protected Areas Expansion Strategy
Very High	Vulnerable ecosystem



*Appendix A2 - Water Treatment Plant- Proposed Water Qualities and Design Flows Report*

# PROPOSED DISCHARGE WATER QUALITIES AND DESIGN FLOWS FOR THE MAQUASA EAST WATER TREATMENT PLANT

13 APRIL 2022



## EMPLOYER CONTACT:

Niketiwe Dlamini



Kangra Coal (Pty) Ltd

13 Fredman Drive, Fredman Towers  
7th Floor, Sandown, 2196  
Johannesburg  
Tel: 011 783 7996  
Niketiwe.Dlamini@kangracoal.co.za

## CONSULTANT CONTACT:

Bianca Muhl



CONSULTING ENGINEERS CC  
TEL: 034 9823425

119 Deputation Street  
VRYHEID  
3100

Tel: 034 982 3425  
bianca@raws.co.za

# **PROPOSED DISCHARGE WATER QUALITIES AND DESIGN FLOWS FOR THE MAQUASA EAST WATER TREATMENT PLANT**

**13 APRIL 2022**

## **CONTENTS**

1.	QUALITY MANAGEMENT AND APPROVALS .....	4
2.	EXECUTIVE SUMMARY .....	5
3.	INTRODUCTION .....	6
4.	HYDROLOGY GENERAL.....	7
5.	LOCATION OF THE TREATMENT PLANT AND DISCHARGE POINT .....	8
6.	DESIGN FLOW AND WATER BALANCE.....	9
6.1.	GENERAL .....	9
6.2.	WATER USE AREAS .....	12
6.3.	WATER BALANCE RESULTS .....	12
7.	INFLUENT QUALITY .....	16
8.	DISCHARGE WATER QUALITY .....	19
9.	OTHER REQUIREMENTS OF THE TREATMENT PLANT .....	21
10.	REFERENCES .....	21
11.	ANNEXURE.....	21
11.1.	DRAWINGS.....	21

## LIST OF TABLES

Table 1: Quaternary Catchment Information.....	7
Table 2: Monthly Evaporation and Rainfall .....	7
Table 3: Water use areas .....	12
Table 4: Allowed number of exceedances over simulation period .....	13
Table 5: Mean monthly flows over life of mine.....	14
Table 6: PCD water quality to be treated initially .....	17
Table 7: Decant point water quality to be used as operational influent quality of the treatment plant .....	18
Table 8: Discharge water quality.....	20

## LIST OF FIGURES

Figure 1: Kangra operations considered for the treatment plant design .....	6
Figure 2: Monthly rainfall and evaporation, from SAWS Station W5E009. ....	7
Figure 3: Location of proposed treatment plant and discharge location .....	8
Figure 4: Plant water demands calculated .....	11
Figure 5: Spills over 89-year period.....	13
Figure 6: Monthly hydrograph of the required water treatment to minimise spills .....	15

# PROPOSED DISCHARGE WATER QUALITIES AND DESIGN FLOWS FOR THE MAQUASA EAST WATER TREATMENT PLANT

13 APRIL 2022

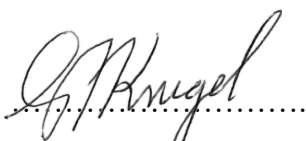
## 1. QUALITY MANAGEMENT AND APPROVALS

Status of report: **Final**

-----

Approved by GFK Consulting Engineers cc:



A handwritten signature in black ink, appearing to read 'F. Krugel', followed by a dotted line for a printed name.

F. Krugel (ECSA reg.no. 910142)

13/04/2022

Date

-----

Recommended by the Employer:



.....  
N. Dlamini

(Environmental Manager)

.....  
Date

-----

Accepted and Approved by the Employer:



.....  
(Print name) .....

.....  
Date

# **PROPOSED DISCHARGE WATER QUALITIES AND DESIGN FLOWS FOR THE MAQUASA EAST WATER TREATMENT PLANT**

**13 APRIL 2022**

## **2. EXECUTIVE SUMMARY**

GFK Consulting Engineers cc was appointed by Kangra Coal (Pty) Ltd to design and implement a strategy to manage and treat the current decanting water which is flowing into the Heyshope dam.

During investigations of the decant point it has become evident that numerous surplus water exists on the Maquasa mine operations.

It is thus recommended by GFK to manage the decant water, including all other surplus water on the mine by pumping it to the current Maquasa East Pollution Control Dams. These PCD's will be used as a centralised point to collect all water from the mine from where it will be pumped to a new proposed water treatment plant located directly adjacent to the se PCD's.

A design flow of 4500m<sup>3</sup>/day for the prescribed treatment plant is determined from the water balance.

No Water Use Licence is available for this specific proposed treatment plant in which the discharge qualities or discharge point are approved. It is however the mine's intention to implement treatment and management of the surplus water.

The treated discharge water qualities and discharge point are therefore proposed in this report as various discharge qualities exist on the current mine WUL's for different operations. None of these have the same discharge qualities and all refer to groundwater, not surface water.

The Resource Quality Objectives (RQO) are currently not determined for the specific Usuthu Catchment area in which this site falls, which would typically then be the qualities to use for such a treatment plant.

The final recommended discharge quality in Table 8: Discharge water quality, was determined by comparing the qualities of various standards available, the existing Water Use Licences of the current Kangra operations in the area and baseline river quality in a nearby stream which has not been affected by mining.

Each constituent was analysed and the most suitable quality for the type of site conditions and circumstances was selected. In most cases this has resulted in taking the most stringent water quality of the different standards.

The discharge point is dependent on the location of the treatment plant. Upgrading of an existing grass lined channel to a concrete lined channel will be required to minimise erosion due to a constant flow. A new 600ND pipe culvert will also be required.



### 3. INTRODUCTION

Kangra Coal operates the Maquasa East, Maquasa West and Maquasa West Extension properties, as well as the most recent Block C and Twyfelhoek extensions. These are located about 60km Northwest of Piet Retief in Mpumalanga.

GFK Consulting Engineers cc was appointed by Kangra Coal (Pty) Ltd to design and implement a strategy to manage and treat the current decanting water which is flowing into the Heyshope dam.

During investigations of the decant point it has become evident that surplus water exists on the Maquasa mine operations which must also be managed.

It is thus recommended by GFK to manage the decant water, including all other surplus water on the mine by pumping it to the current Maquasa East Pollution Control Dams. These PCD's will be used as a centralised point to collect all water from the mine from where it will be pumped to a new proposed water treatment plant located directly adjacent to the se PCD's.

Figure 1 below indicates all the operations which are either already connected or will be connected via a pipe system, which eventually all leads to Maquasa East where the PCD's and water treatment plant are.

All the above mentioned have separate approved Water Use Licenses (WUL's) with different water quality standards.

The objective of this report is to:

- Address the discharge water qualities to which the water from all these operations must be treated after being pumped to the PCD's and treatment facility.
- Indicate the design flows to which the treatment plant will be sized according to ta site wide water balance.

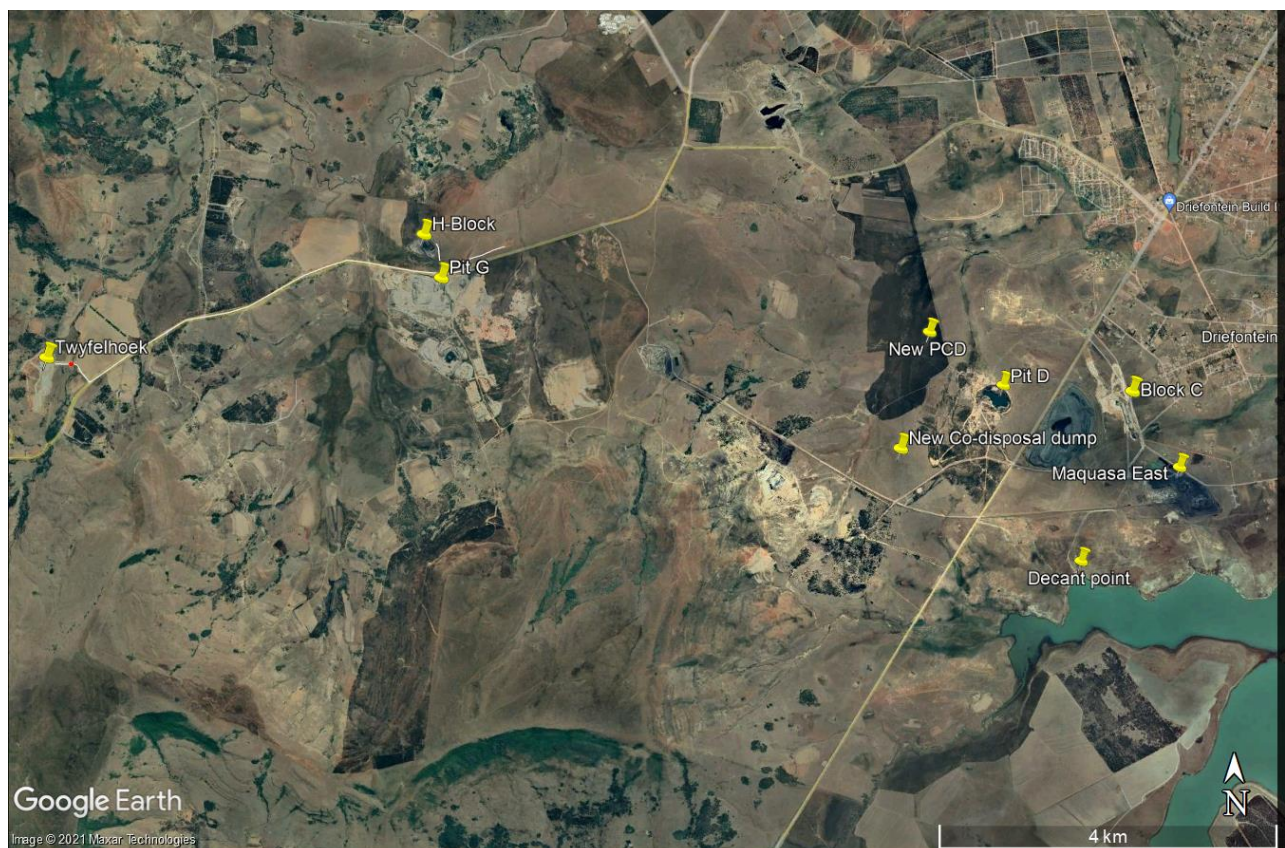


Figure 1: Kangra operations considered for the treatment plant design

#### 4. HYDROLOGY GENERAL

The Maquasa East and West mine is located in the Usutu- Mhlathuze catchment management area and lies within quaternary catchment W51B.

The Twyfelhoek Adit, Pit G and Block H lies within quaternary catchment W52A

The catchment information obtained from WR2012 [1] is indicated in Table 1 below.

Table 1: Quaternary Catchment Information

Quaternary Catchment	BASIC INFORMATION							1920 - 2009
	Catchment area		evap zone	S-pan evaporation		Rainfall		MAR (WR2012)
	Gross (km2)	Net (km2)		MAE WR2005 (mm)	MAE WR90 (mm)	Rainfall zone	MAP (mm)	Net (mcm)
W52A	289	289	13A	1400	1400	W5C	836	31.72
W51B	496	496	13A	1400	1400	W5A	864	51.37

Monthly rainfall and evaporation are obtained from South African Weather Station W5E009. The station is located approximately 12km east of the site.

A MAP of 852mm is observed, while the Mean Annual S-Pan Evaporation from this station is 1632mm.

Table 2: Monthly Evaporation and Rainfall

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
S-Pan Evaporation (mm)	158	166	183	165	139	144	120	106	91	96	121	145	1632
Rain (mm)	110	121	163	138	101	102	46	16	8	8	14	26	852

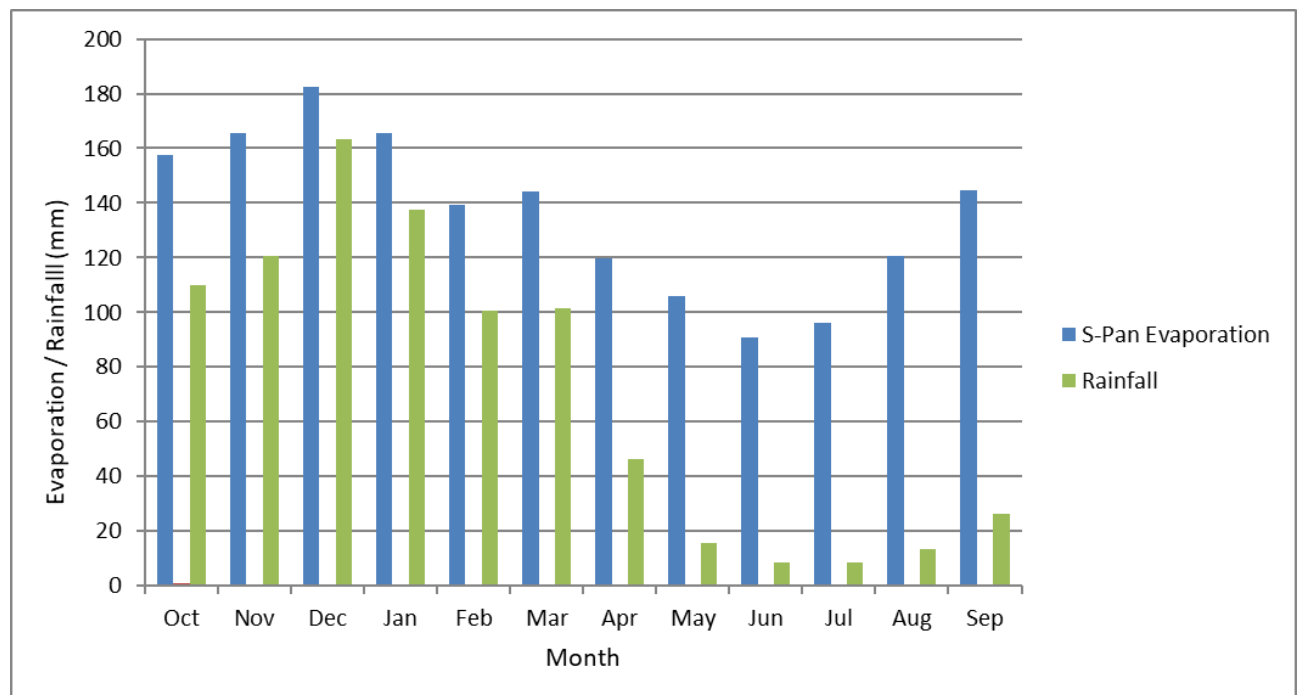


Figure 2: Monthly rainfall and evaporation, from SAWS Station W5E009.



## 5. LOCATION OF THE TREATMENT PLANT AND DISCHARGE POINT

The proposed location of the treatment plant and discharge location is indicated in Figure 3. This location is preferred due to following reasons:

- There is an existing network of pipes from the decant point, Pit D, Block C and other operations on the greater Maquasa operations that all pump water to the existing Maquasa East PCD's.
- The existing pipe network allows all water to be managed at a centralised location, which will allow for better control and monitoring.
- The plant will be in close proximity to the mine offices allowing for easy maintenance access and closely controlled security.
- Electricity is already available at the proposed location, with only minor upgrades to meet the plant electrical requirements.



Figure 3: Location of proposed treatment plant and discharge location

- Treatment plant location is 27° 1'9.40"S ; 30°24'50.73"E
- Final discharge location is 27° 1'2.31"S ; 30°24'47.14"E

The discharge point is dependant on the location of the treatment plant. Refer to drawing number G2021/03/02/100-01 for details of the discharge point. It is proposed to discharge the water into the veld, which will flow into a non-perennial stream and wetland area and eventually into the Heyshope dam.

In essence, the treated water will be discharged into an existing grass lined channel. Due to the constant discharge flow this grass lined channel will need to be concrete lined to prevent erosion.

A new 600ND pipe culvert will be required at location 27° 1'5.03"S ; 30°24'46.45"E. The outlet of the is culvert will then daylight and discharge to the veld.

Where the water crosses the road a 'low level' concrete crossing is recommended to prevent erosion. It should be noted that this road is not a district road, but a local unnamed access road used by the mine and local community to access their houses. A 600ND pipe culvert can also be considered for this road crossing.

## **6. DESIGN FLOW AND WATER BALANCE**

### **6.1. GENERAL**

The primary function of the water treatment plant is to treat the current decanting water from the decant point at the Heyshope dam. However, numerous surplus water exists on the mine. This water is currently managed by storing water the in Maquasa East PCD's, Pit D and Pit G. It is also used to provide water to the plant, for dust control and operations in the mining.

A new discard dump will also be constructed with a new associated PCD. Surplus water from this PCD will also need to be managed.

It is thus recommended by GFK to manage the decant water, including all other surplus water on the mine by pumping it to the current Maquasa East Pollution Control Dams. These PCD's will be used as a centralised point to collect all water from the mine from where it will be pumped to a new proposed water treatment plant located directly adjacent to the PCD's. Existing infrastructure and pipes already exist to make this possible.

Only one new pipe would be required to pump from the new discard dump PCD to the East PCD's.

In essence all the PCD's must Regulation No. GN 704 of the National Water Act (1998) which states that a PCD is not allowed to spill more than once in 50 years which will be used as the baseline requirement to design the flows.

The potential spills of the PCD's are analysed in the water balance, which is done using a monthly time step method, with WRSM 2000 (Pitman model) software. The model is set up using the available 89-year rainfall and quaternary catchment data period available in South Africa. This data record period starts in 1920 and ends 2009.

The water balance model considers all inflows and outflows of the PCD which are summarised as:

#### **Inflows:**

- Decant water from the decant point obtained from the Kangra water meter readings which currently pumps water from the decant point to Pit D and the Maquasa PCD's.
- Stormwater run-off water from Maquasa East and West plant and product stockpile and dirty area.
- Stormwater run-off water and seepage from the existing discard dump to the East PCD's.

- Stormwater run-off water from the Block C pit working area & overburden dumps which is pumped to the East PCD's from the pit sump.
- Stormwater run-off from the new discard dump.
- Stormwater run-off from Pit D and Pit G.
- Groundwater infiltration into the underground mine working area, due to drawdown of the water table for Block C and Twyfelhoek obtained from Gradient Groundwater consulting. The Block C groundwater flows were compared with the water meter flows obtained from Kangra which pumps water from Block C to the Maquasa PCD's.

#### **Outflows:**

- Plant demands from the PCD's. See Figure 4 for calculation of the plant water demands for the 350 ton per hour plant on site.
- Dust control abstraction applicable to the immediate adit/pit working area, haul roads and at the hard parks. This includes the current dust water use obtained from water meter readings, as well as calculated new dust suppression that would be required at the new discard dump.
- Natural evaporation from the PCD and pit sumps.
- Underground mine continues miner: 2300 m<sup>3</sup>/month for two machines for 20 hours/day 27 days/month at 80% utilization. This amount of water is assumed to be "lost" in dust and material transported out and away of the mine with no return flow to the system.
- Drill and blast: 800m<sup>3</sup>/month (used at other mines in the Piet Retief area) for 20 hours/day 27days/month. This figure tallies with volumes used by other mines but is variable as it depends on requirement for blasting and will occur on an ad hoc basis. This amount of water is assumed to be lost for re-use.
- Water treatment of surplus water

It must be noted that the H-Block water has not been taken into consideration for this water balance as it is understood that that area is nearing its completion.

The storage capacity of the PCD's as well as the current pits has also been taken into account. The Pits D & G, currently form an integral part of the system as they function as connecting sumps to pump water from one mining part to the other.

As will be described later in this report, during the dry season when rain fall will be less and surplus water decreased, the additional available capacity at the treatment plant must be used to start treating water from these pits. Over the years these pits can then be dewatered and eventually rehabilitated. In the event that they are rehabilitated provision must be made for connecting pipes from one mine area to the Maquasa PCD.

# Maquasa East: Plant Water Flow Diagram

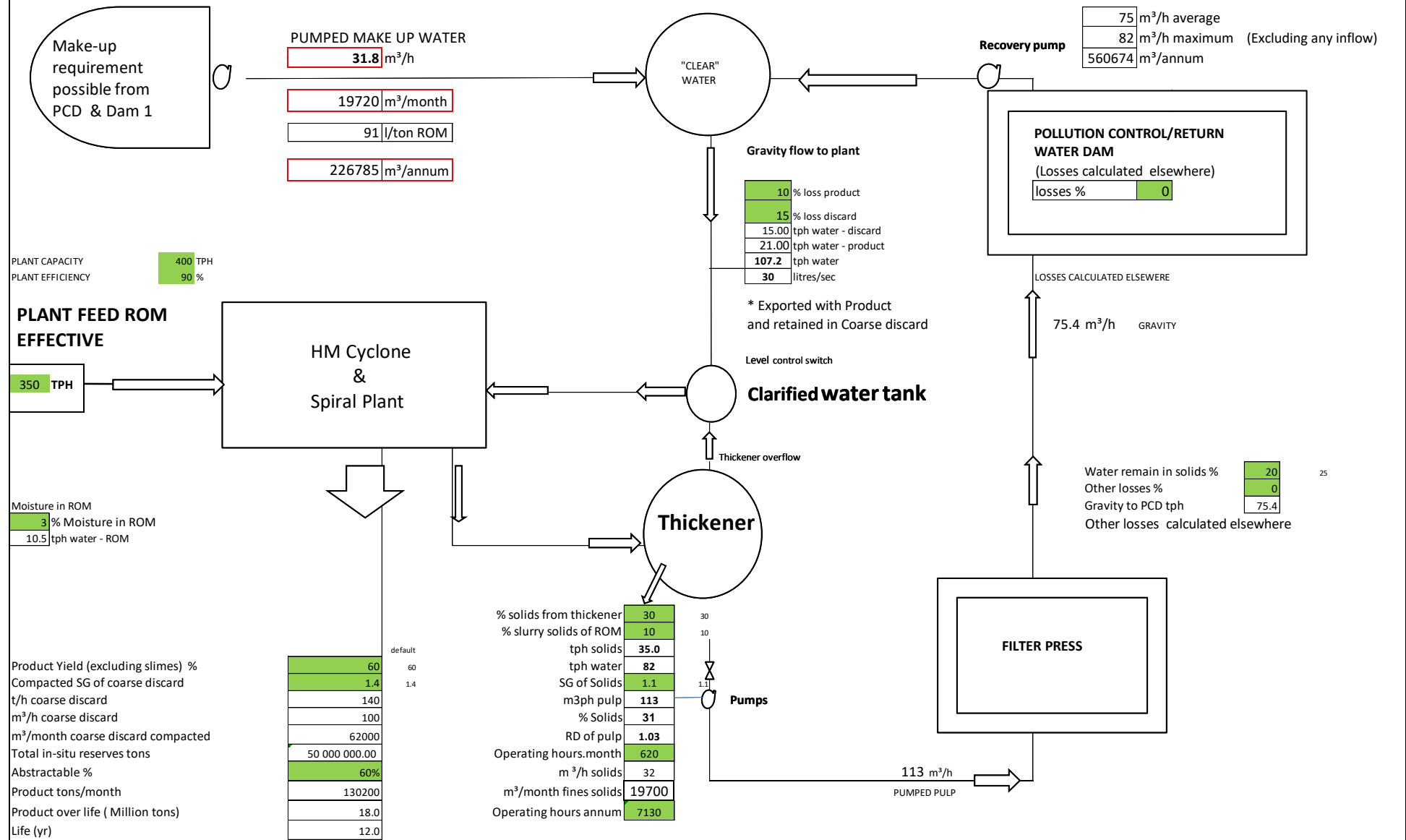


Figure 4: Plant water demands calculated



## 6.2. WATER USE AREAS

The areas contributing to evaporation, runoff and dust control are indicated in Table 3 below.

Table 3: Water use areas

Description	Area (Ha)
Dust control: Haul roads in dirty area	6.18
New discard dump runoff (PCD New)	75.00
Existing discard dump	61.80
Maquasa East dirty runoff area	27.00
Block C opencast runoff	3.00
Pit G & D runoff	4.60
Twyfelhoek runoff area	7.00
PCD 1 East surface area	0.78
PCD 2 East surface area	1.06
PCD 3 East surface area	1.12
PCD New Discard dump	1.38
Pit G Surface area	0.55
Pit D Surface area	3.02
Nooitgesien PCD	2.60
Twyfelhoek sump surface area	0.08

## 6.3. WATER BALANCE RESULTS

The water balance was conducted to determine the surplus water that would be present on the wider mining operations which must be treated.

Regulation No. GN 704 of the National Water Act (1998) which states that a PCD is not allowed to spill more than once in 50 years was used as the baseline requirement to design the flows.

The period under investigation is 20 years as it is envisaged that the mine will still be operating for the next 20 years obtaining reserves from Twyfelhoek and possibly other planned operations.

The water balance is however modelled over a 89-year period. Taking the life of the project and simulation period into consideration, it can be seen from Table 4 that only a 33% probability exists of a spill happening over the 20 years if the model indicates 6 spills over the 89-year simulation.

From Figure 5 it can be seen that the spills are limited to 6 over the analysis period if the maximum of 135 000 m<sup>3</sup>/month water treatment is applied. The maximum flows to minimise spills can be seen in Figure 6.

It should be noted that all flows in the WRSM results must be divided by 100. In order to obtain more accurate results and minimise low flows being ignored by the WRSM (Pitman model), all inputs were multiplied by 100. It is therefore important to divide the results again by 100 for interpretation

The small 'spills' (years 1940 and 1990) in Figure 5 are thus negligible.

Table 4: Allowed number of exceedances over simulation period

LIFE OF PROJECT (LOP)(YEARS)	20
REQUIRED NON EXCEEDANCE RETURN PERIOD (YEARS)	50
FLOOD EVENT DATA BASE AND SIMULATION (YEARS)	89
PROBABILITY OF A 1: 50 YEAR FLOOD DURING LOP (%)	33.2
MAXIMUM ALLOWED NUMBER OF EXCEEDANCES OVER DATA PERIOD TO SATISFY RETURN PERIOD CRITERIA FOR PROJECT LIFE	6

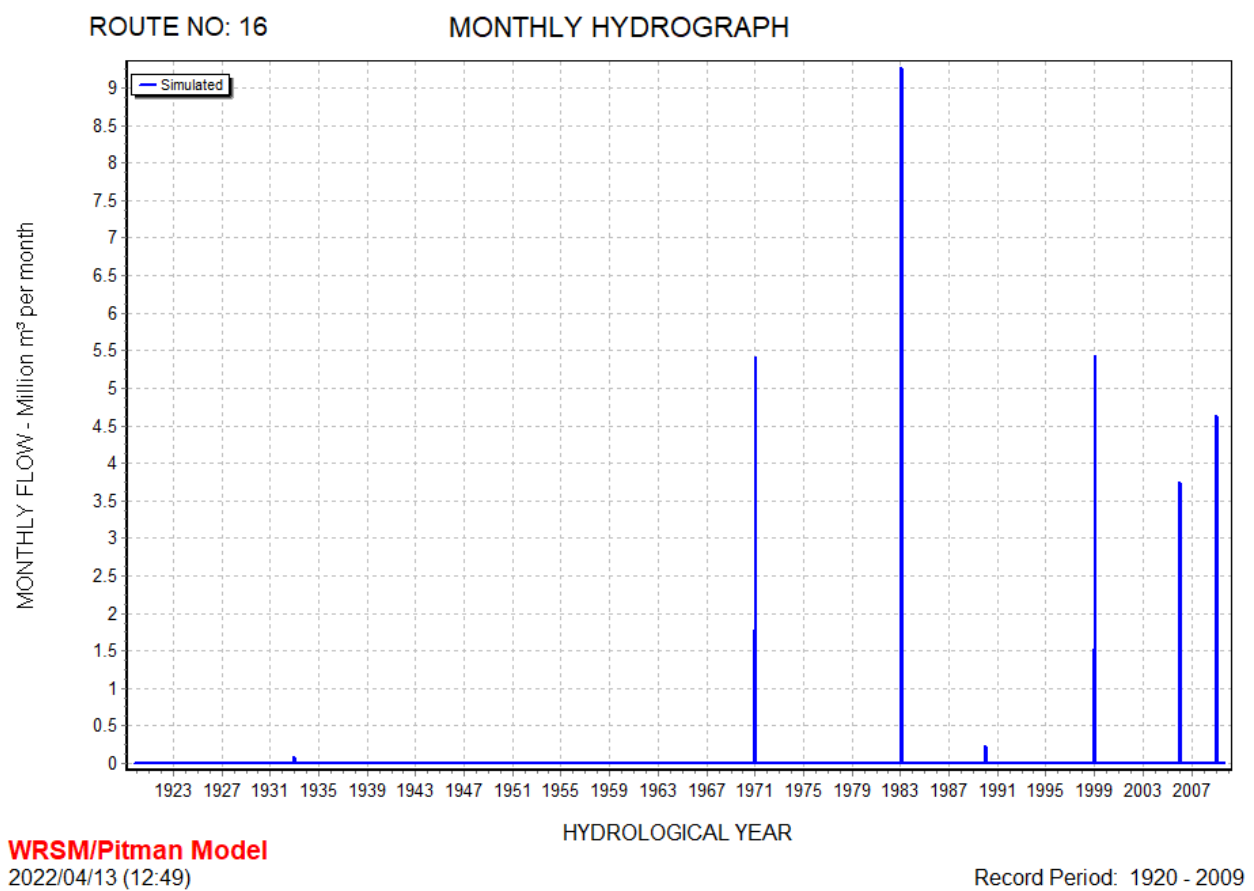


Figure 5: Spills over 89-year period

Table 5: Mean monthly flows over life of mine

<b>INFLOWS</b>	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
Runoff Existing Discard dump (m³)	2200	7000	13000	14400	11000	7000	4000	1800	1000	700	600	500	63200
Runoff Block C (m³)	150	400	700	800	630	430	240	100	50	30	30	40	3600
Runoff Maquasa East PCD's (m³)	1000	3100	5800	6800	5000	3200	1700	800	400	300	100	100	28300
Runoff New Discard dump (m³)	3000	8000	13800	15600	14200	10400	5500	2700	1200	1000	1000	1100	77500
Runoff Twyfelhoek (m³)	300	800	1400	1700	1420	900	500	300	100	50	40	50	7560
Runoff Pit G & D (m³)	200	550	950	1400	950	600	350	150	80	50	50	50	5380
Monthly groundwater inflows Twyfelhoek (m³)	12200	11600	11800	10800	9400	14600	13300	11800	11200	11300	11200	10700	139900
Monthly groundwater inflows Block C (m³)	11140	9120	22640	21570	12890	12840	13510	8890	10190	9180	11420	11180	154570
Decant water	44630	51630	40530	50870	32140	31980	28190	38840	49460	47630	40940	49490	506330
<b>Total inflows (m³)</b>	<b>74820</b>	<b>92200</b>	<b>110620</b>	<b>123940</b>	<b>87630</b>	<b>81950</b>	<b>67290</b>	<b>65380</b>	<b>73680</b>	<b>70240</b>	<b>65380</b>	<b>73210</b>	<b>986340</b>
<b>OUTFLOWS</b>	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	TOTAL
Evaporation PCD's (m³)	615	470	-535	-120	415	520	1755	2430	2255	2400	2920	3155	16280
Evaporation Pits (m³)	670	510	-580	-130	460	575	1915	2650	2460	2610	3170	3420	17730
Monthly Dust Control (m³)	14500	12360	10530	9300	8340	9570	7990	7680	8530	15290	11850	14590	130530
New Dust Control (new discard dump)	550	400	750	830	650	800	850	700	570	530	1100	1180	8910
Drill & blast, Continuous miner(m³)	3100	3100	3100	3100	3100	3100	3100	3100	3100	3100	3100	3100	37200
Plant (m³)	19700	19700	19700	19700	19700	19700	19700	19700	19700	19700	19700	19700	236400
Water treatment (m³) (Surplus water)	33900	57560	59720	77430	49620	56350	40670	38800	41930	29870	23810	29630	539290
<b>Total outflows (m³)</b>	<b>73035</b>	<b>94100</b>	<b>92685</b>	<b>110110</b>	<b>82285</b>	<b>90615</b>	<b>75980</b>	<b>75060.4</b>	<b>78545</b>	<b>73500</b>	<b>65650</b>	<b>74775</b>	<b>986340</b>
Balance (m³)	-1785	1900	-17935	-13830	-5345	8665	8690	9680	4865	3260	270	1565	0

NOTE: The difference in volume between the monthly inflows and outflows indicated in the balance is accounted for in the PCD's storage volumes to allow for the annual inflows and outflows to balance.

Considering all inflows and outflows the average monthly flows are indicated in Table 5. On average 77430m<sup>3</sup>/month water would need to be treated in the peak rainfall season and a lower average of 23810m<sup>3</sup>/month in the winter/drier season.

The treatment plant however must be sized to accommodate the maximum flows of 135 000 m<sup>3</sup>/month to minimise the spills. Sizing the plant for the average flows would result in more spills than allowed according to Regulation GN 704.

However,

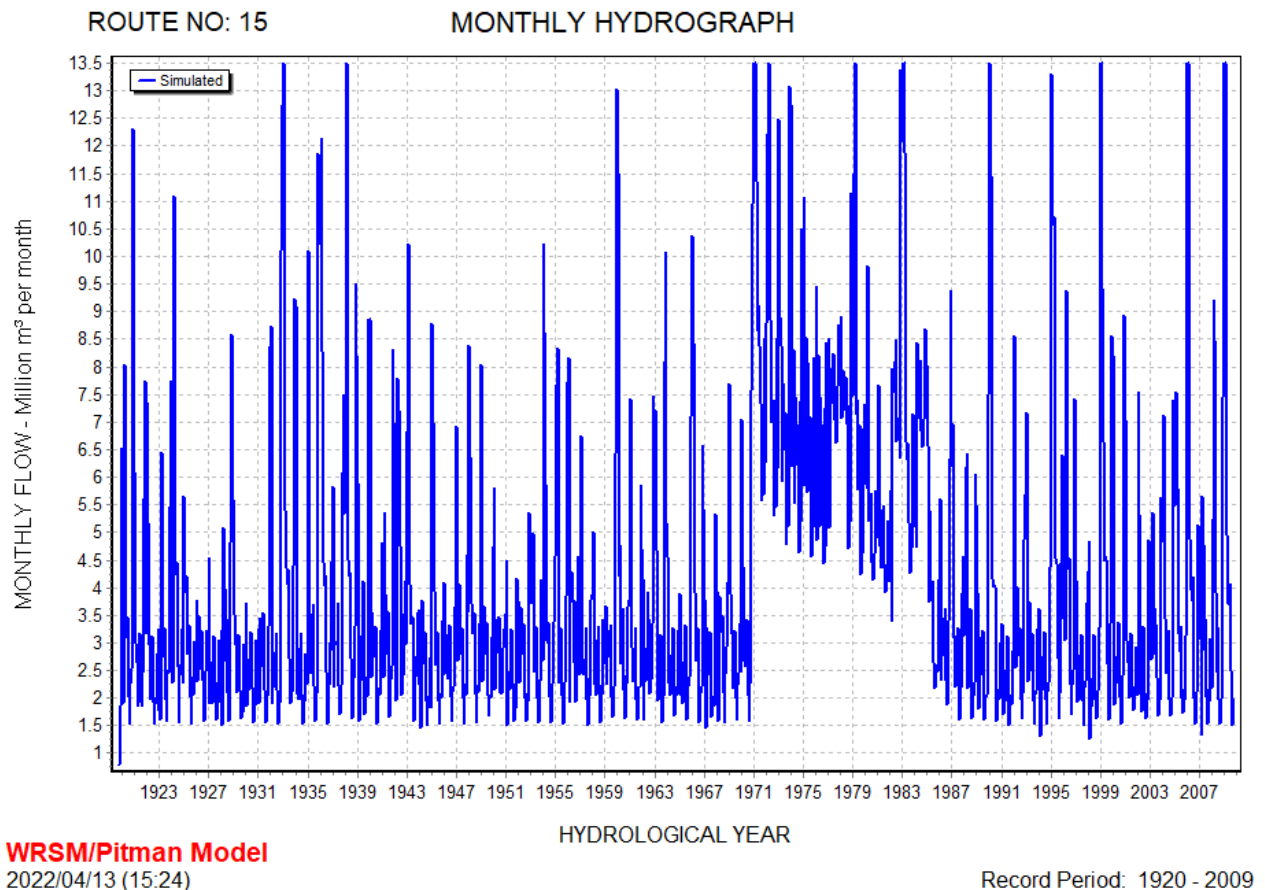


Figure 6: Monthly hydrograph of the required water treatment to minimise spills

**In summary the water treatment plant (WTP) will be designed for the 4 500m<sup>3</sup>/day flow (135000 m<sup>3</sup>/month ÷ 30 days).**

It must also be noted that the water balance is based on historical rainfall data. Even though accuracy is deemed high, the exact rain events will not be repeated as is in the future. In the event that a much higher flood should occur the surplus water should be temporarily stored in the existing Pits D and G until a time where the seasonal flows become less during the winter season, in which these pits can then be dewatered.

Items to also consider during these 20 years:

- Block C of which water will now be treated, has approximately another 1-year life before it is rehabilitated, maximum 2 years. Water from here would then not need to be treated anymore after closure in the next 2 years.

- Block C decant will occur about 11-year after closure (Gradient Groundwater Study). The capacity initially used for the Block C surplus water (above) can then be used to treat the new decant estimated at about 18 m<sup>3</sup>/day to 118m<sup>3</sup>/day.
- After the 20 years the new discard dump will be rehabilitated resulting in significantly less surplus water from the new discard dump.
- The additional capacity in the treatment plant used for the new discard dump which becomes available due to rehabilitation on the dump, can then be used to dewater and treat the Pit D or possibly water that may arise from future planned operations (Donkerhoek). A revised water balance would be required at a later stage.
- During dry months, the additional capacity in available to treat water must be used to start dewatering Pits G and D.

## 7. INFLUENT QUALITY

Initially water from the East PCD's will be treated to create capacity to pump in the decant and other water. Refer to Table 6 below which indicates the current qualities of the PCD.

During operation however water with typical qualities observed as the decant point will be expected. The treatment plant must thus be able to accommodate both these qualities.

Table 6: PCD water quality to be treated initially

SiteName	DateTimeMeas	pH	EC mS/m	TDS mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	MALK CaCO3/L	Cl mg/l	SO4 mg/l	NO3-N mg/l	F mg/l	Al mg/l	Fe mg/l	Mn mg/l	N_Ammoni um mg/l	TotHardne ss mg/l	CaHardness mg/l	MgHardnes s mg/l	NO2-N mg/l
Plant Set Pond Dam 2	2017/12/18	8.10	277.00	2500.00	429.00	81.00	346.00	16.00	170.00	6.30	1760.00	1.30	-0.05	0.00	-0.05	0.64	1.50	1400.00	1070.00	332.00	-0.50
Plant Set Pond Dam 2	2018/01/13	7.60	216.00	1900.00	299.00	65.00	179.00	9.50	65.00	3.20	1190.00	1.10	0.12	0.02	-0.05	0.01	0.21	1020.00	747.00	269.00	-0.50
Plant Set Pond Dam 2	2018/02/06	7.90	240.00	2300.00	238.00	81.00	234.00	11.00	75.00	3.30	1100.00	1.00	-0.05	0.00	-0.05	0.12	0.28	929.00	595.00	334.00	-0.50
Plant Set Pond Dam 2	2018/04/10	8.10	254.00	2400.00	298.00	93.00	299.00	15.00	48.00	3.60	1420.00	-0.10	-0.05	0.02	-0.05	0.00	0.10	1130.00	744.00	382.00	-0.50
Plant Set Pond Dam 2	2018/04/14	7.80	270.00	2400.00	353.00	103.00	262.00	13.00	125.00	5.00	1500.00	0.60	-0.05	0.00	-0.05	0.01	0.03	1310.00	880.00	425.00	-0.50
Plant Set Pond Dam 2	2018/05/20	7.80	317.00	2700.00	374.00	117.00	293.00	14.00	98.00	4.10	1860.00	-0.10	-0.05	0.01	-0.05	0.01	0.16	1420.00	934.00	481.00	-0.50
Plant Set Pond Dam 2	2018/06/09	7.60	347.00	3100.00	381.00	133.00	316.00	15.00	95.00	6.20	1810.00	404.00	-0.05	0.02	-0.05	0.01	0.14	1500.00	952.00	547.00	-0.50
Plant Set Pond Dam 2	2018/07/17	7.70	452.00	3900.00	476.00	187.00	409.00	28.00	165.00	8.80	2310.00	0.30	0.12	0.00	-0.05	0.00	1.20	1960.00	1190.00	770.00	-0.50
Plant Set Pond Dam 2	2018/08/09	7.50	598.00	5600.00	429.00	240.00	508.00	39.00	140.00	12.00	2720.00	-0.10	-0.05	0.02	-0.05	0.01	1.70	2060.00	1070.00	987.00	-0.50
Plant Set Pond Dam 2	2018/09/11	8.00	400.00	3400.00	328.00	165.00	203.00	22.00	170.00	-0.05	1600.00	-0.10	-0.05	0.01	-0.05	0.31	1.20	1500.00	819.00	681.00	-0.50
Plant Set Pond Dam 2	2018/10/14	8.20	386.00	3700.00	552.00	189.00	383.00	25.00	135.00	13.00	2350.00	1.80	-0.05	0.03	-0.05	0.00	0.51	2160.00	1380.00	777.00	-0.50
Plant Set Pond Dam 2	2018/11/12	7.90	384.00	3700.00	387.00	187.00	260.00	25.00	116.00	9.90	1840.00	0.70	-0.05	0.01	-0.05	0.00	0.07	1740.00	966.00	769.00	-0.50
Plant Set Pond Dam 2	2018/12/13	7.70	396.00	3600.00	539.00	172.00	424.00	26.00	5.70	95.00	3040.00	-0.10	-0.05	0.01	-0.05	0.00	0.08	2050.00	1350.00	709.00	-0.50
Plant Set Pond Dam 2	2019/01/01	6.30	269.00	2400.00	383.00	112.00	256.00	16.00	55.00	8.40	1530.00	0.10	-0.05	0.02	-0.05	0.00	-0.01	1420.00	955.00	462.00	-0.50
Plant Set Pond Dam 2	2019/02/01	7.40	234.00	2000.00	307.00	85.00	197.00	14.00	48.00	4.40	1270.00	1.00	-0.05	0.01	-0.05	0.05	0.23	1120.00	767.00	349.00	-0.50
Plant Set Pond Dam 2	2019/03/01	7.50	253.00	2200.00	309.00	101.00	225.00	9.50	55.00	3.80	1470.00	-0.10	-0.05	0.01	1.30	0.00	0.19	1190.00	772.00	416.00	-0.50
Plant Set Pond Dam 2	2019/09/27	8.10	715.00	5000.00	798.00	411.00	929.00	59.00	115.00	19.00	4560.00	0.30	0.09	-0.02	-0.05	0.03		3690.00	1990.00	1690.00	-0.50
Plant Set Pond Dam 2	2019/11/19	7.70	225.00	1900.00	221.00	0.38	192.00	11.00		4.70	1080.00	1.60	0.15	0.02	0.05	86.00	0.45	907.00	553.00	354.00	0.50
Plant Set Pond Dam 2	2019/12/11	7.30	198.00	1600.00	204.00	85.00	178.00	8.50		3.60	1100.00	2.00	0.33	-0.02	-0.05	0.31	0.16	858.00	509.00	349.00	-0.50
Plant Set Pond Dam 2	2020/01/25	7.90	384.00	2700.00	475.00	175.00	369.00	25.00	56.00	10.00	2390.00	0.20	-0.05	-0.02	-0.05	-0.01	0.10	1910.00	1190.00	721.00	-0.50
Plant Set Pond Dam 2	2020/02/25	7.60	349.00	2600.00	510.00	145.00	341.00	16.00	58.00	4.40	2320.00	0.20	-0.05	-0.02	-0.05	-0.01		1870.00	1270.00	597.00	-0.50
Plant Set Pond Dam 2	24/03/2020	7.70	221.00	2200.00	286.00	106.00	156.00	17.00	40.00	3.50	1460.00	0.90	0.11	0.02	-0.05	0.11		1150.00	714.00	436.00	-0.50
Plant Set Pond Dam 2	2020/06/17	7.90	255.00	1800.00	314.00	132.00	238.00	13.00	75.00	6.00	1540.00	0.30	-0.05	-0.02	-0.05	0.02		1330.00	783.00	542.00	-0.50
Plant Set Pond Dam 2	2020/07/24	8.20	252.00	2200.00	255.00	125.00	195.00	13.00	131.00	6.30	1590.00	0.05	-0.05	-0.02	-0.05	-0.01		1150.00	637.00	514.00	-0.20
Plant Set Pond Dam 2	2020/08/27	8.10	279.00	2400.00	326.00	147.00	263.00	15.00	128.00	6.50	1740.00	-0.10	-0.05	-0.02	-0.05	-0.01		1420.00	815.00	607.00	-0.50
Plant Set Pond Dam 2	2020/09/22	8.00	293.00	2600.00	352.00	159.00	293.00	16.00	126.00	7.70	1900.00	0.20	-0.05	-0.02	-0.05	-0.01		1530.00	878.00	656.00	-0.50
Plant Set Pond Dam 2	2020/10/29	7.30	254.00	2300.00	301.00	129.00	168.00	13.00	55.00	4.10	1580.00	0.60	<0.05	0.06	<0.05	0.21		1280.00	751.00	532.00	<0.5
Plant Set Pond Dam 2	2020/11/24	7.70	258.00	1900.00	343.00	128.00	196.00	13.00	48.00	4.90	1610.00	<0.1	0.05	<0.02	<0.05	<0.01		1380.00	856.00	528.00	<0.5
Plant Set Pond Dam 2	2020/12/13	7.50	168.00	1600.00	233.00	65.00	72.00	5.70	128.00	2.20	587.00	1.50	0.45	0.06	<0.05	0.54		849.00	581.00	268.00	<0.5



Table 7: Decant point water quality to be used as operational influent quality of the treatment plant

Date	2016/03/02	2016/06/02	2016/07/02	2016/08/02	2016/09/02	2016/10/02	2016/11/05	2016/12/02	2017/01/06	2017/02/06	2017/03/06	2017/04/06	2017/05/10	2017/06/08	2017/07/06	2017/08/03	2017/09/06	2017/10/05	2018/04/01	2018/07/01	2018/10/01	2019/01/01
pH	7.36	6.98	6.99	7.10	7.39	7.15	7.19	7.15	7.43	7.69	7.37	7.21	7.11	7.08	7.23	7.10	7.43	7.00	7.60	7.40	8.00	7.50
EC mS/m	263.00	293.00	279.00	284.00	276.00	281.00	282.00	279.00	274.00	282.00	277.00	278.00	275.00	270.00	269.00	270.00	263.00	255.00	217.00	214.00	194.00	195.00
TDS mg/l	2126.73	2273.43	2278.37	2377.26	2367.46	2231.46	2294.48	2170.39	2186.39	2406.38	2223.20	2352.32	2255.26	2186.16	2352.88	2399.76	2345.24	2127.64	1900.00	1800.00	1600.00	1700.00
Ca mg/l	300.97	309.54	313.00	332.05	337.00	340.00	370.00	325.00	326.30	388.00	311.00	336.00	318.00	335.00	333.00	362.00	337.00	341.74	276.00	291.00	296.00	252.00
Mg mg/l	101.94	110.14	105.00	112.00	105.00	102.00	105.81	104.74	104.49	109.00	111.00	116.00	117.00	113.00	111.55	107.00	112.00	100.38	90.00	93.00	87.00	82.00
Na mg/l	202.19	213.74	213.00	238.00	213.00	207.00	201.10	198.00	205.88	228.00	206.00	213.00	194.00	193.00	200.88	198.00	205.00	173.46	172.00	170.00	145.00	138.00
K mg/l	11.67	13.12	11.30	13.60	10.30	11.40	11.72	11.30	11.53	12.30	12.60	12.60	11.60	13.10	13.10	12.70	12.40	8.75	13.00	13.00	12.00	13.00
TALK mg/l	264.00	253.00	252.00	242.00	255.00	258.00	244.00	243.00	235.00	245.00	240.60	230.00	234.00	243.00	244.00	241.00	251.00	285.00	288.00	293.00	265.00	247.00
Cl mg/l	6.28	6.08	6.18	6.67	6.70	6.89	6.60	6.65	6.74	6.31	6.42	5.82	5.70	5.60	5.56	6.05	5.84	5.95	6.20	5.40	7.40	7.90
SO4 mg/l	1342.00	1467.00	1476.68	1529.36	1542.00	1408.00	1452.00	1378.00	1390.00	1514.00	1431.00	1529.00	1467.00	1379.00	1540.91	1568.00	1518.95	1322.00	1180.00	970.00	1030.00	870.00
NO3-N mg/l	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	<0.35	0.40	0.55	1.50	<0.1	1.40	1.50
F mg/l	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.09	<0.05	<0.05	<0.05	<0.05
Al mg/l	0.08	0.04	0.11	0.03	<0.01	0.07	0.09	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.003	<0.003	<0.003	0.06
Fe mg/l	0.22	0.42	0.86	0.28	0.03	0.13	0.07	0.07	0.05	0.61	0.11	0.51	0.32	0.36	0.38	0.17	0.07	0.23	<0.05	<0.05	<0.05	<0.05
Mn mg/l	2.76	1.20	1.04	<0.01	0.31	1.01	0.53	0.80	0.40	1.04	0.63	1.31	1.12	1.18	1.10	1.24	1.53	1.62	0.21	0.54	0.23	<0.002
N_Amonia r	<0.45																		<0.01	0.12	0.05	0.02
Tot_Hardne	1171.29	1226.47	1213.95	1290.33	1273.88	1269.02	1359.62	1242.84	1245.06	1417.70	1233.67	1316.68	1275.85	1301.83	1290.86	1344.54	1302.71	1266.67	1060.00	1110.00	1100.00	966.00
Ca_Hardne	751.51	772.91	781.56	829.12	841.49	848.98	923.89	811.53	814.77	968.84	776.57	838.99	794.05	836.50	831.50	903.91	841.49	853.32	689.00	727.00	740.00	629.00
Mg_Hardne	419.78	453.56	432.39	461.22	432.39	420.04	435.73	431.32	430.29	448.86	457.10	477.69	481.81	465.33	459.36	440.63	461.22	413.35	369.00	381.00	359.00	336.00
SS mg/l	20.00	8.80	18.00	11.20	14.40	8.00	130.00	4.40	<0.4	16.00	26.00	16.80	52.80	33.20	7.20	19.60	10.40	36.00	<21	<21	<21	<21
PO4 mg/l			<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03				
Si mg/l	4.27	5.71	4.24	4.34	4.59	4.25	4.95	4.70	4.23	5.60	3.79	5.52	4.48	6.89	6.57	4.12	4.56	6.37	5.10	7.50	7.70	
B mg/l	0.06	0.09	<0.01	0.02	0.03	0.04	0.04	<0.01	<0.01	0.03	0.02	0.02	0.03	0.03	<0.01	<0.01	0.02	0.02	0.04	0.02	0.04	0.05

## 8. DISCHARGE WATER QUALITY

The different Kangra operations ranging from the Maquasa East, West and Nooitgesien to Block C and the new discard dump all operate under separate Water Use Licences (WUL). All these WUL's refer to different discharge water qualities. It must also be noted that these WUL's specifically mention groundwater and not surface water.

The Resource Quality Objectives (RQO) are currently not determined for the specific Usuthu Catchment area in which this site falls. These would be the typical accepted discharge standards for such a site if no qualities are prescribed in the WUL's.

In general the South African Target Water Quality Guidelines of DWS are also used as the basis of determining the discharge qualities.

Various standards and guidelines are available and should be considered when determining the discharge requirements.

It is therefore recommended to consolidate the various standards and guidelines available and set a limit that will be applicable specifically to the new proposed water treatment plant.

The surface discharge water quality proposed for the new water treatment plant is therefore based on evaluation of the following and are indicated in Table 8:

- South African Water Quality Guidelines for Irrigation, Aquatic and Aquaculture (DWS, 1996)
- SANS 241:2015
- World Health Organisation (WHO) standard
- Aquatic standard EPA
- Baseline river quality in nearby streams (Balgathern area) not affected by mining
- Block C WUL
- Maquasa East WUL

The final recommended discharge quality was determined by comparing the qualities of all the above mentioned. Each constituent was analysed and the most suitable quality for the type of site conditions and circumstances was selected. In most cases this has resulted in taking the most stringent water quality of the different standards.

The two final columns in Table 8 refer to the eventual release quality. The 'Maximum recommended for dam' column refers to the quality the water should be just before and when it enters the Heyshope dam.

The 'Final Recommended Effluent Quality for plant design' refers to the quality the treatment plant should be designed for. This allows for a 20% safety factor as it is possible that particularly during first commissioning the plant may not achieve the desired quality. The plant should thus be designed at a 20% stricter margin to ensure that the eventual water which is released into the dam is of an acceptable standard.

The final discharge quality will ultimately depend on those provided by DWS in the Water Use License which will influence the treatment plant design.

Table 8: Discharge water quality

RECOMMENDED FULL LIST OF DETERMINANTS FOR RIVER WATER TO BE TESTED TO PROVIDE A BASELINE FOR MINES, WITH STANDARDS (USED A GUIDELINE TO DETERMINE FINAL RELEASE WATER QUALITY IN CONJUNCTION WITH BASELINE MONITORED QUALITY AND RELEASE QUALITY OF EXISTNG WUL'S OF THE MINE)													FINAL RECOMMENDED EFFLUENT QUALITY FOR PLANT DESIGN (USE THIS COLUMN FOR FINAL PLANT DESIGN AND RELEASE QUALITY OF TREATED WATER) Approximatly 20% safety margin
DETERMINANT	UNITS	DETECTION LIMIT REQUIRED	IRRIGATION WATER STANDARDS DWS SA	AQUACULTURE WATER STANDARDS DWS SA	AQUATIC LIFE WATER STANDARDS DWS SA	DOMESTIC STANDARDS		AQUATIC LIFE EPA	Maquasa Operations WUL water quality (groundwater)	Block C WUL water quality (groundwater). Table 3	Baseline river at Balgarthen (Based on data range from 2010-2020 at monitoring points	MAXIMUM RECOMMENDED FOR DAM. THIS IS WHAT SHOULD BE ACHIEVED IF WATER IS TESTED JUST PRIOR TO	
						SANS 241	WHO						
pH	pH units	0-14 (0.001)	6.5-8.5	6.5-9	pH values should not be allowed to vary from the range of the background pH values for a specific site and time of day, by > 0.5 of a pH unit, or by > 5 %, and should be assessed by whichever estimate is the more conservative.	5-9.7			6.5-8	6.5-9	5.7-8.9	6.5-8	6.5-8.5
Dissolved Oxygen (DO)/BOD	mg/ℓ	0-20 (0.1)		6-9 (Cold water species) 5-8 (Warm water	80% -120% of saturation						80% -120% of saturation	80% -120% of saturation	90% -110% of saturation
Electrical Conductivity	mS/m	0.01-20000 (0.01)	40			170			27	23	22	40	30
Chloride	mg Cl/ℓ	10-500	100			300	250	250	3	3	14	100	80
Ammonia as N	mg N/ℓ	0.11				1.5	1.5	0.9			0.11	0.9	0.7
Ammonia	mg NH <sub>3</sub> /ℓ	0.02		0.025 (Cold water fish) 0.30 (Warn water fish)	0.007			0.2			N/A	0.2	0.16
Ammonium	mg NH <sub>4</sub> /ℓ	0.05						Not toxic			N/A	Test not required	Test not required
Chromium IV	µg CR IV/ℓ	2		20	7			0.3			N/A	7	5.6
Cyanides Free and Total	µg Cn/ℓ	0.1		0.02	1	200	70	2			200	2	1.6
Dissolved Aluminium	µg Al/ℓ	2	5000	0-30 (pH >6.5)	5 (pH<6.5) ; 10 (pH >6.5)	300		1.3	620		2230	10	8
Dissolved Antimony	µg Sb/ℓ	1				20	20	not tested			N/A	20	15
Dissolved Arsenic	µg As/ℓ	6	100	0-50	10	10	10		1		N/A	10	8
Dissolved Beryllium	µg Be/ℓ	1				700		not tested			N/A	700	560
Dissolved Barium	µg Ba/ℓ	1	100					not tested			N/A	100	80
Dissolved Boron	µg B/ℓ	1	500			2400	2400	1200			N/A	500	400
Dissolved Cadmium	µg Cd/ℓ	0.1	10	0.2	0.07	3	3	0.25	10		N/A	0.2	0.16
Dissolved Calcium	mg Ca/ℓ	0.12				150			29	27	73	150	58
Dissolved Cobalt	µg Co/ℓ	3	50		5	500					N/A	5	4
Dissolved Copper	µg Cu/ℓ	0.3		5	0.3	50	50				N/A	0.3	0.24
Dissolved Chromium	µg Cr/ℓ	3	200			2000	2000	100			N/A	100	80
Dissolved Iron	µg Fe/ℓ	4	200 drippers	10	>10% of background Fe	2000	2000		2330	300	380	300	240
Dissolved Lead	µg Pb/ℓ	0.3	200	10	0.2	10	10	0.75	10		N/A	10	8
Dissolved Lithium	µg Li/ℓ	1	2500					not tested			N/A	2500	2000
Dissolved Manganese	µg Mn/ℓ	1	20 crops	100	180	400	400		220	200	470	180	145
Dissolved Magnesium	mg Mg/ℓ	0.07						not tested	9	82	9.22	82	82
Dissolved Mercury	µg Hg/ℓ	0.15		1	0.04	6	6	1.3			6	1.3	1
Dissolved Nickel	µg Ni/ℓ	2	200			70	70	30			N/A	30	24
Dissolved Potassium	mg K/l	0.08				50		not tested	3		3.2	50	40
Dissolved Selenium	µg Se (vi)/ℓ	2	20	300	2	40	10				10	10	8
Disolved Sodium	mg Na/ℓ	0.19				200	50	not tested	21		9.1	50	40
Disolved Uranium	µg U/ℓ	1				30		not tested			30	30	25
Dissolved Vanadium	µg V/ℓ	1	100			200					200	200	160
Dissolved Zinc	µg Zn/ℓ	2	1000	30	2	5000	3000		20			2	1.6
Fluoride	mg F/ℓ	0.26	2		0.75	1.5	1.5		0.31	0.3	0.92	0.75	0.6
Nitrogen as N	mg N/ℓ	0.5	0.5 algae growth		0.5			0.3 ece			0.5	0.5	0.3
Nitrate	mg NO <sub>3</sub> /ℓ	0.19		300		11	50		0.24	0.5	1.1	11	8.8
Nitrite	mg NO <sub>2</sub> /ℓ	0.01		0.05		0.9					0.7	0.9	0.72
Phosphorus as P	mg P/ℓ	0.01						0.03			N/A	0.03	0.024
Phosphate (ortho phosphate)	mg PO <sub>4</sub> /ℓ	0.1		0.1							N/A	0.1	0.08
Sulphate	mg SO <sub>4</sub> /ℓ	0.5	200			500			45	25	45	200	160
Total Alkalinity	mg CaCO <sub>3</sub> /ℓ	2	60-120	20-100				200	100	93	68	100	80
Total Dissolved Solids	mg/ℓ 180°C	10.2		2000	<15% variation of normal TDS cycle	1200			177	130	148	130	100

Constituent used as limit

Difficult to find lab that can test detection limits

## **9. OTHER REQUIREMENTS OF THE TREATMENT PLANT**

The treatment plant installer shall indicate how much brine is expected to be removed per month. Sludge drying beds are proposed on which the brine will be placed to dry. When dried this will be removed by the mine and discarded on the new Class C lined discard dump.

The treatment plant supplier shall also indicate any other possible brine handling solutions.

## **10. REFERENCES**

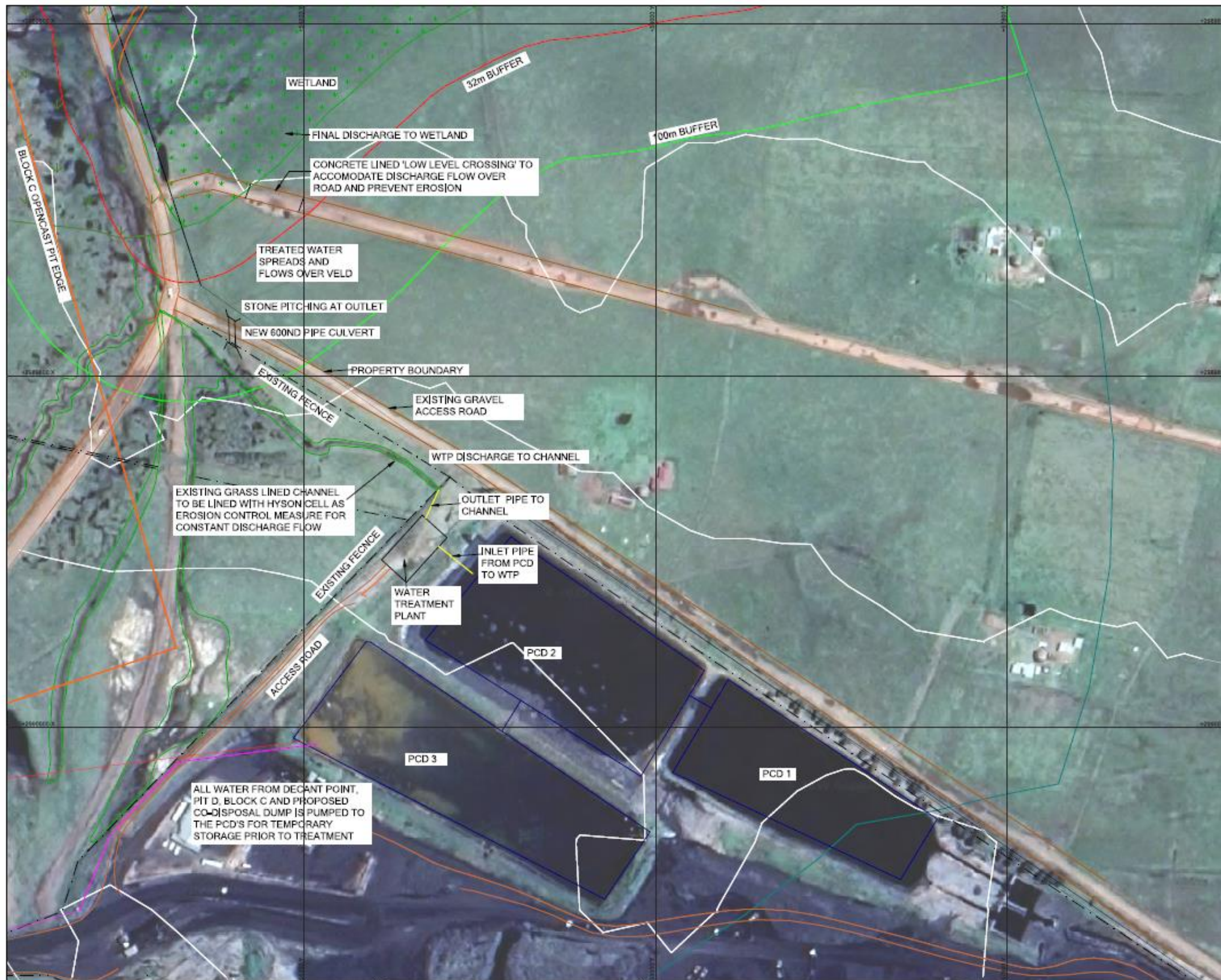
[1] WR2012 : Water Resources of South Africa : Water Research Commission and Royal Haskoning.

[2] SA Atlas of Climatology en Agrohydrology : University of Kwazulu Natal.

## **11. ANNEXURE**

### **11.1. DRAWINGS**





# NOTES

DATUM:  
Transverse Mercator  
WGS 84  
31°E

CONSULTING ENGINEERS CC  
119 Deputasie Street  
P O Box 2266 VRYHEID  
3100  
Tel / Fax: 034 952 3425

## DRAWING REFERENCE

No	Org No	Title

## REVISIONS

No	Description	Date	By

Drawn: B.MUHL  
Designed: B.MUHL  
Checked: G.F.KRUGEL

*G.F. Krugel* 13/04/2022  
Consulting Engineer (ECSA 200870316) Date  
Client Approval

Client: \_\_\_\_\_ Date: \_\_\_\_\_

## EMPLOYER/OWNER

**KANGRA**  
KANGRA COAL PTY LTD  
1st Floor, 15 Freedom  
Drive, Freedom Towers,  
Sandton, 2196,  
Johannesburg, South Africa

PROJECT  
MAQUASA EAST  
WATER TREATMENT

SERVICE  
CIVIL

DRAWING TITLE  
WATER TREATMENT PLANT  
LOCATION AND DISCHARGE  
LAYOUT PLAN

SCALE  
1:1000

G2021/03/02/100-01 19/10/2021  
Drawing No. Date

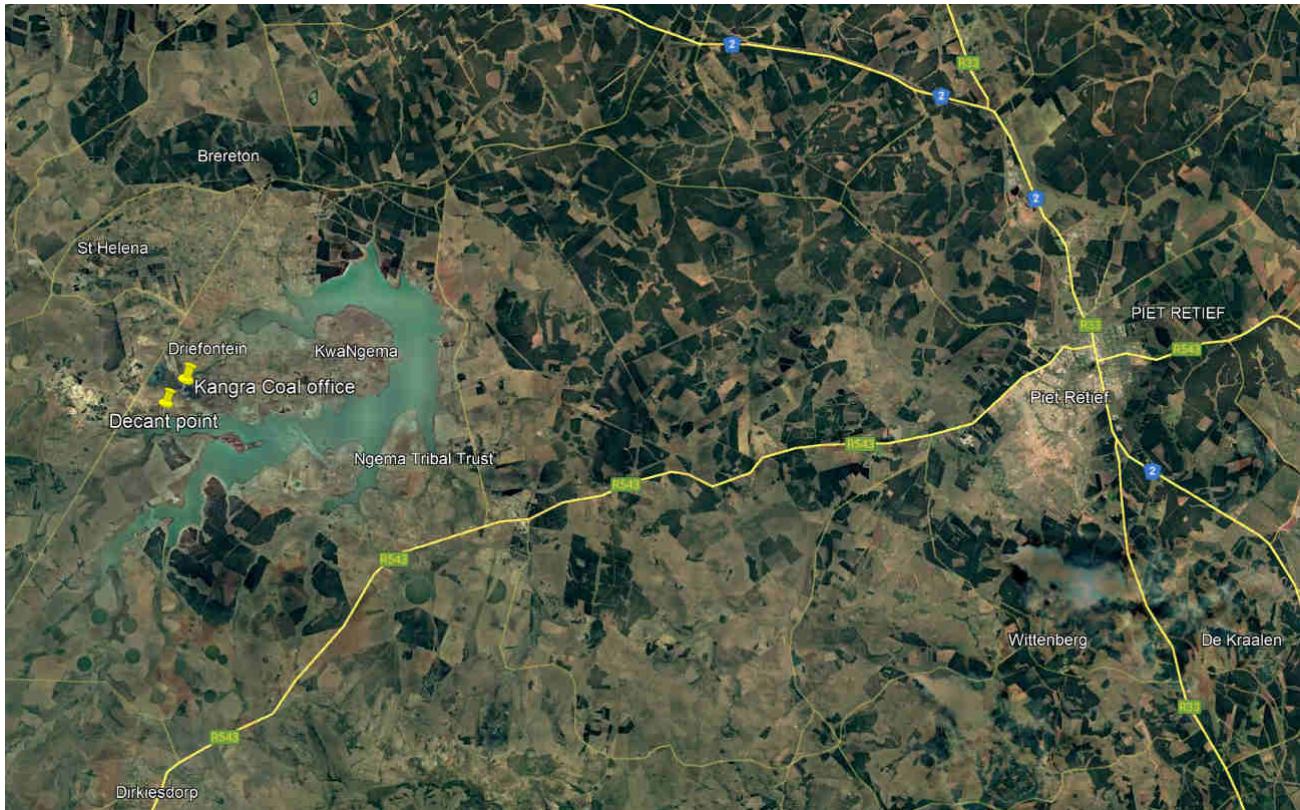


*Appendix A3 - Maquasa Decant Dam Wall Design Report*



# MAQUASA DECANT DAM WALL DESIGN REPORT

9 MAY 2023



## EMPLOYER CONTACT:

Niketiwe Dlamini

**KANGRA**

Kangra Coal (Pty) Ltd

13 Fredman Drive, Fredman Towers  
7th Floor, Sandown, 2196  
Johannesburg  
Tel: 011 783 7996  
Niketiwe.Dlamini@kangracoal.co.za

## CONSULTANT CONTACT:

Bianca Muhl



CONSULTING ENGINEERS CC  
TEL: 034 9823425

119 Deputation Street  
VRYHEID  
3100

Tel: 034 982 3425  
[bianca@raws.co.za](mailto:bianca@raws.co.za)

# MAQUASA DECANT DAM WALL DESIGN REPORT

9 MAY 2023

## CONTENTS

1.	QUALITY MANAGEMENT AND APPROVALS.....	4
2.	EXECUTIVE SUMMARY .....	5
3.	INTRODUCTION .....	6
4.	HYDROLOGY GENERAL.....	7
5.	LOCATION AND BACKGROUND OF THE DECANT POINT .....	8
6.	HEYSHOPE DAM INFORMATION .....	9
7.	STORMWATER MANAGEMENT.....	10
8.	DAM DETAILS.....	10
9.	BOREHOLES .....	12
10.	ROAD .....	13
11.	OTHER INFRASTRUCTURE.....	13
12.	REFERENCES .....	14
13.	ANNEXURE.....	15
13.1.	DRAWINGS.....	15

## LIST OF TABLES

Table 1: Quaternary Catchment Information.....	7
Table 2: Monthly Evaporation and Rainfall .....	7
Table 3: Return flows and flood volumes.....	10
Table 4: Channel size summary .....	10
Table 5: Decant dam capacity .....	11
Table 6: Culverts in spillway capacity .....	11

## LIST OF FIGURES

Figure 1: Kangra operations considered for the treatment plant design .....	7
Figure 2: Monthly rainfall and evaporation, from SAWS Station W5E009. ....	8
Figure 3: Location of decant point in proximity to the mine .....	8
Figure 4: Conceptualisation of well point system by GCS [2] .....	12
Figure 5: Borehole implementation installation.....	13

# MAQUASA DECANT DAM WALL DESIGN REPORT

9 MAY 2023

## 1. QUALITY MANAGEMENT AND APPROVALS

Status of report: **Final**

-----

Approved by GFK Consulting Engineers cc:



  
.....

15/05/2023  
.....

F. Krugel (ECSA reg.no. 910142)

Date

-----

Recommended by the Employer:



.....

.....

N. Dlamini

Date

(Environmental Manager)

-----

Accepted and Approved by the Employer:



.....

.....

Date

(Print name) .....

# MAQUASA DECANT DAM WALL DESIGN REPORT

9 MAY 2023

## 2. EXECUTIVE SUMMARY

GFK Consulting Engineers cc was appointed by Kangra Coal (Pty) Ltd to design and implement a strategy to manage and treat the current decanting water which is flowing into the Heyshope dam.

This report focuses on the specific decant point from which water is currently pumped to the PCD's and Pit D.

The existing infrastructure such as the electrical power source, pumps and pipes can and will be continued to be operated in order to pump the decanting water to the new proposed water treatment plant.

New additions to the decant point are required to cut off ground seepage water, by implementing a borehole well curtain (cut off) as well as creating extra buffer capacity of the current decant sump by increasing the dam wall.

The following details are applicable to the raised dam wall and upgraded pond/dam:

- Full Supply Level (FSL): 1306m
- Crest Level: 1307m
- Dam capacity at FSL: 1530m<sup>3</sup> (refer to Table 5 below) which is able to contain the 1:50-year return flood.

The spillway will be 7m wide and will include 5x1050ND pipe culvers to allow for vehicle access onto the crest. Access is required to service the boreholes.

Eight (8) boreholes will be drilled into the dam wall at 10m centre to centre spacing up to a 1293m level. These boreholes will be connected with a 75ND HDPE pipe discharging into the decant dam.

Each borehole will be fitted with a stainless-steel borehole pump which is connected to the 75ND pipe.

Seepage water intercepted from the boreholes will thus be pumped to surface, where the current water decants into the dam, from where it will be pumped together with the surface decanting water to the future treatment plant with the existing pipe and pump in place.

The existing gravel road leading to the decant point will be continued to be used in future. A short 110m long portion of the road will be diverted where a new 8m wide gravel road will be constructed. The diverted road crossed an existing trench where a 600ND pipe culvert will be installed.

### 3. INTRODUCTION

Kangra Coal operates the Maquasa East, Maquasa West and Maquasa West Extension properties, as well as the most recent Block C and Twyfelhoek extensions. These are located about 60km Northwest of Piet Retief (Mkhondo) in Mpumalanga.

GFK Consulting Engineers cc was appointed by Kangra Coal (Pty) Ltd to design and implement a strategy to manage and treat the current decanting water which is flowing into the Heyshope dam.

During investigations of the decant point it has become evident that existing infrastructure is already in place to manage the decanting water to an extent.

The existing infrastructure such as the electrical power source, pumps and pipes can and will be continued to be operated in order to pump the decanting water to the new proposed water treatment plant.

The new additions to the decant point required to cut off ground seepage water, as well as creating extra buffer capacity of the current decant sump will be described in this report.

During the decant point investigations, it further became evident that surplus water exists on the Maquasa mine operations which must also be managed.

It is thus recommended by GFK to manage the decant water, including all other surplus water on the mine by pumping it to the current Maquasa East Pollution Control Dams. These PCD's will be used as a centralised point to collect all water from the mine from where it will be pumped to a new proposed water treatment plant located directly adjacent to the PCD's.

Figure 1 below indicates all the operations which are either already connected or will be connected via a pipe system, which eventually all leads to Maquasa East where the PCD's and proposed new water treatment plant are.

This report focuses and deals with the decant point specifically. Reference to the Proposed Discharge Water Qualities and Design Flows for The Maquasa East Water Treatment Plant, 13 April 2022 report by GFK should be made regarding the mine wide water balance (includes water from this decant point), treatment qualities and water management of the proposed treatment plant.

The objective of this report is to address the design of the decant dam wall and associated stormwater management thereof.



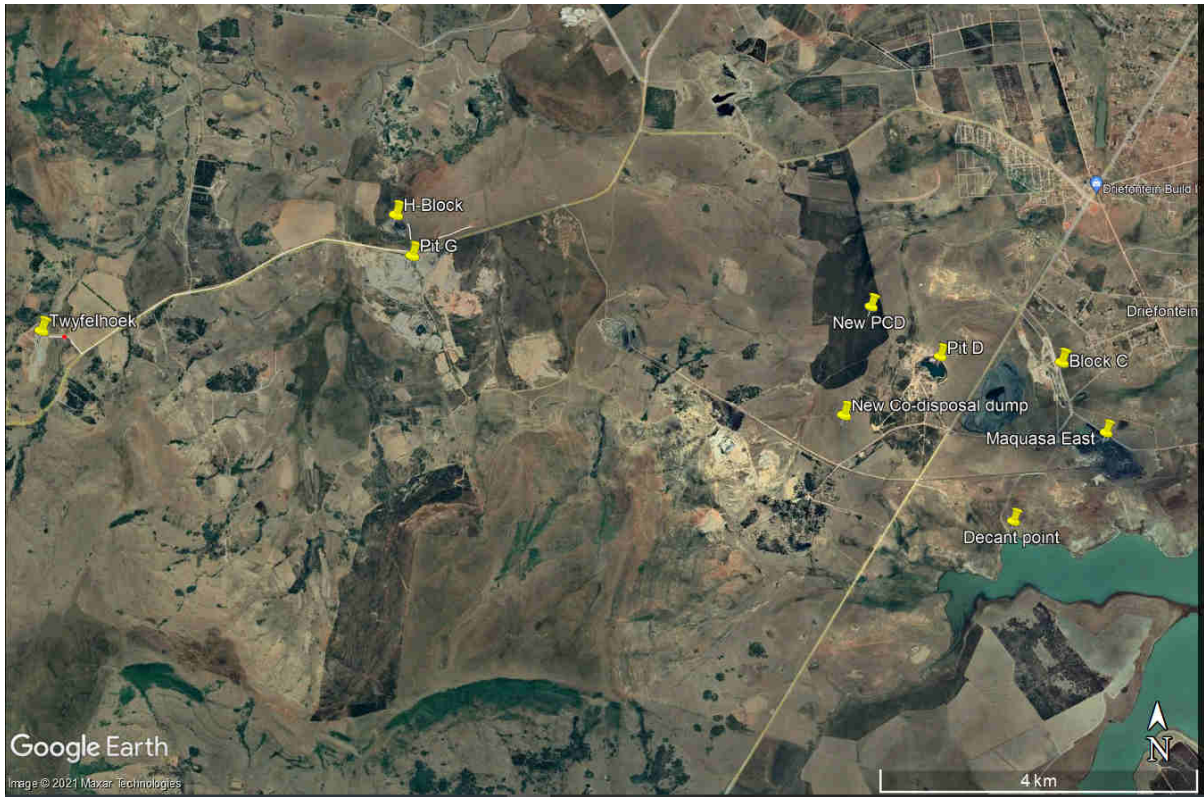


Figure 1: Kangra operations considered for the treatment plant design

#### 4. HYDROLOGY GENERAL

The Maquasa East mine and decant point is located in the Usutu- Mhlathuze catchment management area and lies within quaternary catchment W51B.

The catchment information obtained from WR2012 [1] is indicated in Table 1 below.

Table 1: Quaternary Catchment Information

Quaternary Catchment	BASIC INFORMATION							1920 - 2009
	Catchment area		evap zone	S-pan evaporation		Rainfall		MAR (WR2012) Net (mcm)
	Gross (km <sup>2</sup> )	Net (km <sup>2</sup> )		MAE WR2005 (mm)	MAE WR90 (mm)	Rainfall zone	MAP (mm)	
W52A	289	289	13A	1400	1400	W5C	836	31.72
W51B	496	496	13A	1400	1400	W5A	864	51.37

Monthly rainfall and evaporation are obtained from South African Weather Station W5E009. The station is located approximately 12km east of the site.

A MAP of 852mm is observed, while the Mean Annual S-Pan Evaporation from this station is 1632mm.

Table 2: Monthly Evaporation and Rainfall

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
S-Pan Evaporation (mm)	158	166	183	165	139	144	120	106	91	96	121	145	1632
Rain (mm)	110	121	163	138	101	102	46	16	8	8	14	26	852

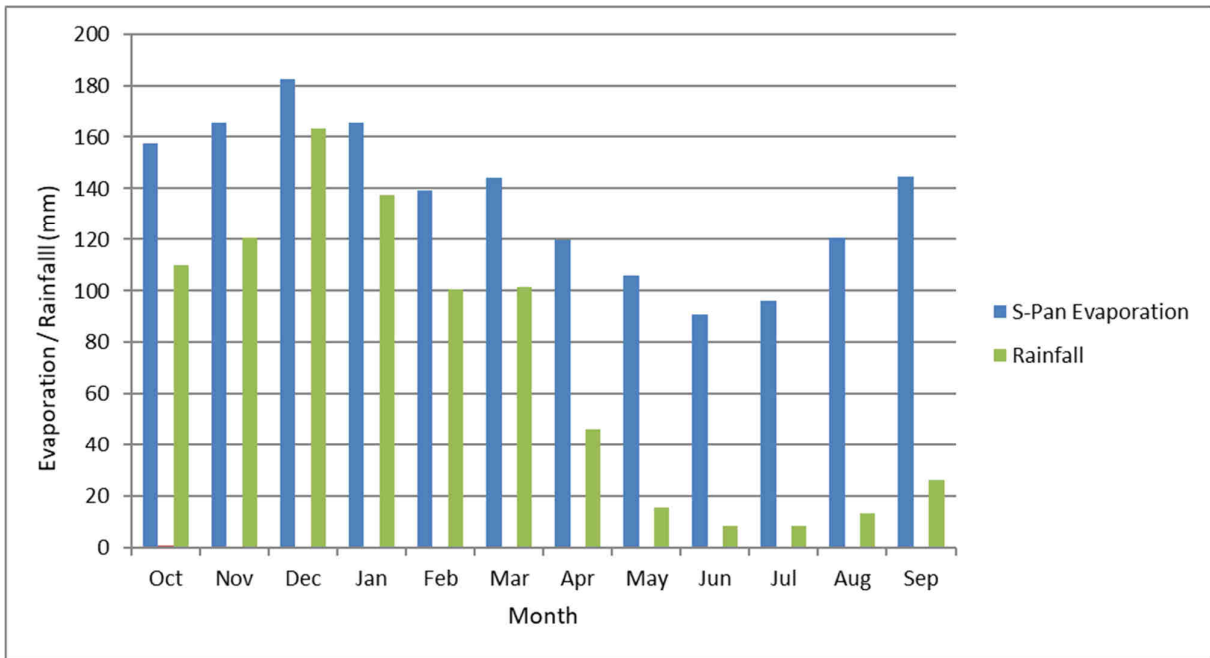


Figure 2: Monthly rainfall and evaporation, from SAWS Station W5E009.

## 5. LOCATION AND BACKGROUND OF THE DECANT POINT

The decant point is located on the edge of the Heyshope dam at the following co-ordinates.

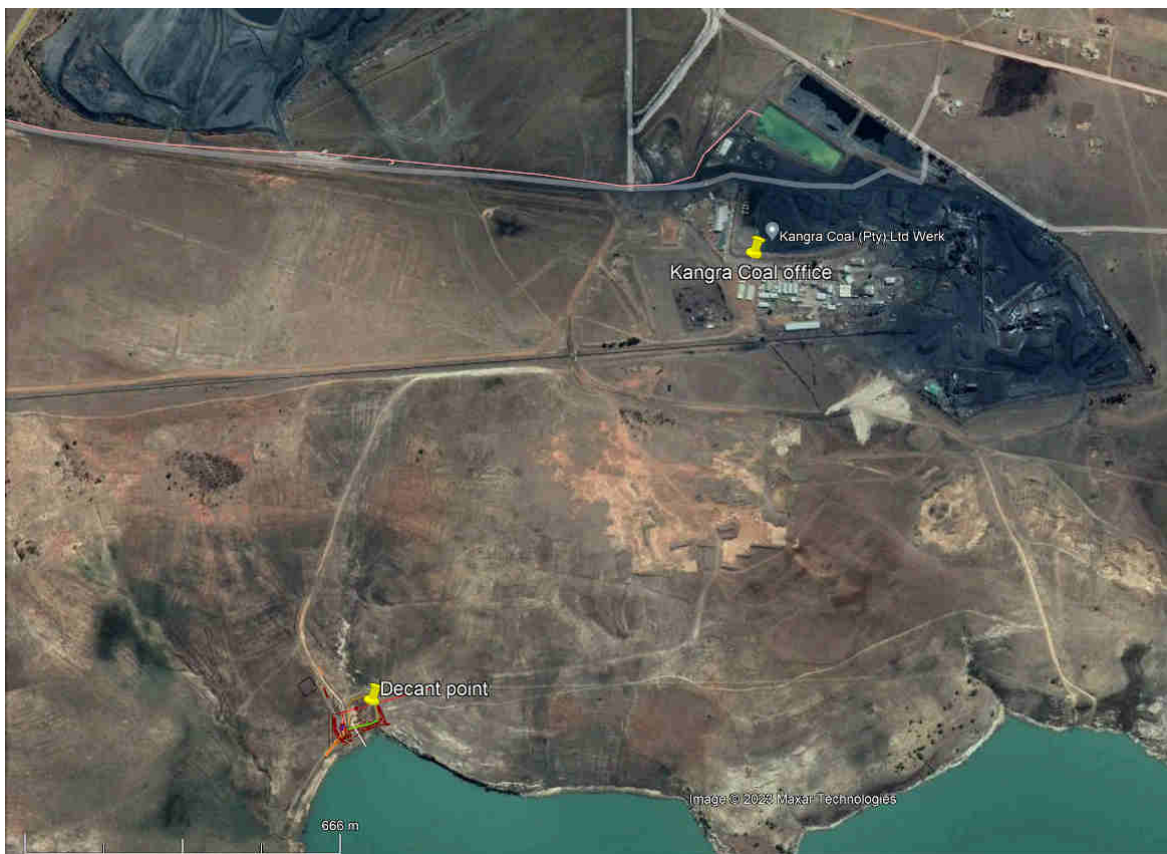


Figure 3: Location of decant point in proximity to the mine

Currently decanting water to the surface is managed in the form of a contamination pond/sump system. Water is allowed to pond up and is then regulated by pumping it out of this sump to the existing Manquasa East PCD and also Pit D.

The decanting water is continuously pumped by Kangra to ensure it does not spill over to the Heyshope dam.

As reported in the GCS Geohydrological Study Update for Maquasa East, Maquasa West and Nooitgesien Operations, 2018 [2], there is seepage water that may be entering the Heyshope Dam underground in addition to the decanting water appearing and currently being managed on surface. Various option in the GCS study have been proposed to manage the decanting water, including the seepage groundwater. The GCS report should be consulted for the detailed description of each proposed method.

In summary these include:

1. Installation of the cut off trench/sump downstream of the decant point
2. Installation of the borehole well point system
3. Installation of a syphon drain system.

All the above would result in pumping the ‘cut off’ contaminated seepage water to a treatment facility.

In addition to the above-mentioned proposals, it was recommended by GCS that the decanting water qualities could be reduced by reducing the recharge to the various mining operations contributing to the decant. It was estimated in the GCS study that rehabilitating Pit D could reduce the decant quantity by 19%. As Pit D is currently used as a buffer storage facility by the mine to manage the surplus water, it would be recommended to start rehabilitation of the Pit D only after the installation and commissioning of the water treatment facility.

The various decant point management options were analysed by GFK to determine the best suited method for implementation and construction.

Due to extremely limited space between the decant point and Heyshope dam Full Supply Level (FSL), as well as the average operating level of the dam, a cut off sump would be impractical for construction. Should such a method be implemented the sump walls would need to be extended (most likely with concrete) to ensure the clean water of the Heyshope dam would not spill over to this sump during flooding.

The syphon system would require a series of experimental boreholes to be drilled according to the GCS report to determine of the hydraulic head would be sufficient to create such a syphon system.

The most feasible solution is the borehole well system proposed to manage the decanting water together with the water decanting to surface.

This report will focus on the implementation of such a well system that will function as a ‘cut-off’ system intercepting groundwater, pumping it to surface and ultimately to the proposed water treatment facility.

## **6. HEYSHOPE DAM INFORMATION**

The following information was confirmed and provided by the Dam Safety office which was considered in the decant dam wall design:

- Non-Overspill Crest (NOC) Level : RL 1306.5 m
- Freeboard between NOC and FSL : 3.5 m
- Full Supply Level : RL 1303 m

## 7. STORMWATER MANAGEMENT

The decant point is currently enclosed by an earth berm and fence. The earth berm allows a majority of the clean water to be diverted around the dam. A portion of the berm and fence (northern side) will be kept as is, with a new dam wall and two diversion channels to be constructed.

All clean stormwater and dirty decant water will be separated. With the stormwater diversion channels and berms in place only direct rainfall and runoff within the decant dam, as well as the actual decanting water will be stored in the decant dam.

The clean stormwater diversion channels will be grass lined. Heavy siltation of the clean water channels in general is not expected as the clean stormwater runoff area is mostly from grasslands. Fairly clean stormwater will thus discharge into the Heyshope dam via dispersion and erosion control structures downstream of the channels.

Shallow sandstone is observed near the water edge of the Heyshope dam. Erosion at the stormwater outlets is thus expected to be minimal.

The peak discharges for the channels and decant area runoff were calculated using the SCS [5] method. The channels were sized using predicated 1:50 year flood intensities as are indicated in Table 4 .

Kikuyu or grass of similar properties is to be established in the channel to avoid erosion. Such Kikuyu grass can handle a velocity up to 2.3m/s. The channel design velocities are 2m/s to minimise erosion. The channel is to be constructed at a slope of 1:150 or flatter to ensure subcritical flow conditions are maintained.

Table 3: Return flows and flood volumes

CATCHMENT NO	CATCHMENT AREA (ha)	STREAM LENGTH (km)	SLOPE STREAM (%)	OVERLAND FLOW LENGTH (km)	OVERLAND SLOPE (%)	OVERLAND ROUGHNESS n	TC	AVE CN	PEAK DISCHARGE (m³/s)		VOLUME (m³)	
									1:50	1:100	1:50	1:100
Decant area	0.4	0.02	3.3%	0.01	3%	0.30	0.10	68	0.6	0.8	999	1143
Channel 1	19.4	0.77	8.7%	0.42	5%	0.30	0.59	68	4.7	5.6	14723	17524
Channel 2	20.7	0.74	9.5%	0.45	5%	0.30	0.62	68	4.8	5.7	15642	18619
Spillway	19.8	0.77	8.7%	0.42	5%	0.30	0.59	68	4.8	5.7	14988	17839

Table 4: Channel size summary

Channel number	Flow (m³/s)	Flow depth (m)	Side slope 1 1: Z	Side slope 2 1: Z	N value	Slope 1: S(m)	Free board (m)	Bottom width (m)	Velocity (m/s)	Top width (m)	Flow Status	Lining Type
C1	4.698	0.8	2	2	0.025	150	0.2	1.34	2.0	5.3	Subcritical	GRASS
C2	4.793	0.7	2	2	0.025	150	0.2	2.08	2.0	5.7	Subcritical	GRASS

## 8. DAM DETAILS

As part of the implementation plan to improve the decanting water management the existing southern berm downstream of the decant point will be upgraded to from a dam wall. The boreholes which will serve as the cut off drain to intercept any groundwater seepage will be drilled into this dam wall.

Raising the dam wall has the added benefit of increasing the storage capacity of the decant water. This will add a buffer capacity to allow for additional storage during pump downtime or maintenance periods.



Additionally, the dam wall will serve a protection to prevent cross-contamination of clean and dirty water during flooding periods and peak rainfall seasons. The Full Supply Level of the decant dam (1360m) is 3m higher than the FSL of the Heyshope dam (1303m) (Refer to Section 6 for the Heyshope dam details).

The following details are applicable to the raised dam wall and upgraded pond:

- Full Supply Level (FSL): 1306m
- Crest Level: 1307m
- Dam capacity at FSL: 1530m<sup>3</sup> (refer to Table 5 below)

Table 5: Decant dam capacity

AREA AT : (m <sup>2</sup> )	FSL mMSL	AREA (m <sup>2</sup> )	VOLUME (m <sup>3</sup> )	FSL DEPTH (m)
LOWEST CONTOUR	1304.0	145	73	1.5
CONTOUR ABOVE	1304.2	349	120	1.7
CONTOUR ABOVE	1304.4	415	197	1.9
CONTOUR ABOVE	1304.6	477	286	2.1
CONTOUR ABOVE	1304.8	548	388	2.3
CONTOUR ABOVE	1305.0	614	504	2.5
CONTOUR ABOVE	1305.2	703	636	2.7
CONTOUR ABOVE	1305.6	1024	979	3.1
CONTOUR ABOVE	1305.8	1362	1217	3.3
FULL SUPPLY LEVEL	1306.0	1774	1530	3.5

The added storage capacity will allow the dam to contain the 1:50 year instantaneous runoff flood. A flood higher than the 1:50-year return period could be expected to spill over, considering the channels are also designed to contain the 1:50-year return flows.

An emergency spillway has been designed to allow for the 1:100-year return floods (5.7m<sup>3</sup>/s) from the decant dam, as well as Channel 1 catchment area, as the channel discharges to the spillway.

A total of 5 x 1050 ND precast pipes will be installed in the spillway to allow for vehicle access to the dam crest to service the boreholes and associated switchgear.

A 200mm thick concrete slab will serve as the cover above the pipes.

Table 6: Culverts in spillway capacity

Culvert no	Runoff m <sup>3</sup> /sec	Culvert entrance loss Coefficient	Pipe friction f	No of pipes	Pipe Internal Diameter (m)	Cover on pipe at inlet (m)	Length (m)	Pipe grade (m/m)	Down stream flow depth (m)	Velocity in pipe m/s	Capacity m <sup>3</sup> /s
Spillway	5.700	1.7	0.02	5	0.986	0.20	4.88	0.05	0.700	1.51	5.77

The dam wall will be zoned with the following sequence:

- Impervious clay core compacted in 150mm layers at 98% Proctor at optimum moisture content (OMC). The clay core will be constructed up the sandstone level with is situated approximately 1m below NGL.
- Sandy material transition zone, 800mm this on the outer sided of the clay core. Bidim or similar approved A7 geotextile is to be placed on the outer side of the sandy material separating the transition material from the outer shells.

- Outer shells consisting of 50-200mm diameter sized rockfill, with an upstream slope of 1:2 and downstream slope of 1:1.5. This rockfill material will be selected from the mine dumps.

Also refer to drawing G2021/03/02/100-06/02 Rev 1 in the Annexure.

Rockfill outer shells are selected to simultaneously act as the protecting rip rap of the dam to prevent erosion of the dam walls. This is particularly important due to rising water levels that can be expected at the Heyshope dam to ensure the decant dam wall toe does not get eroded.

A steeper downstream slope is implemented due to the limited space between the decant point and Heyshope dam.

## 9. BOREHOLES

Boreholes will be installed in the dam wall drilled into the underground sandstone based on the conceptualisation plan by GCS indicated in Figure 4 below.

Refer to drawing G2021/03/02/100-06/02 Rev 1 attached for the implantation by GFK. Eight boreholes will be installed in Phase 1 of the operation spaced at 10m centres.

Only one row of boreholes will be installed during this implementation phase. Due to the close proximity to the Heyshope dam, the risk exists that clean water can also be dewatered.

The GCS report proposes that a concrete wall approximately 15m deep be constructed between the boreholes and the Heyshope dam to prevent the dewatering of the clean water in the Heyshope dam.

Due to the construction impracticability with the close proximity to the dam and the sandstone it was decided to thus rather install only one row of boreholes as far as practically possible from the Heyshope dam.

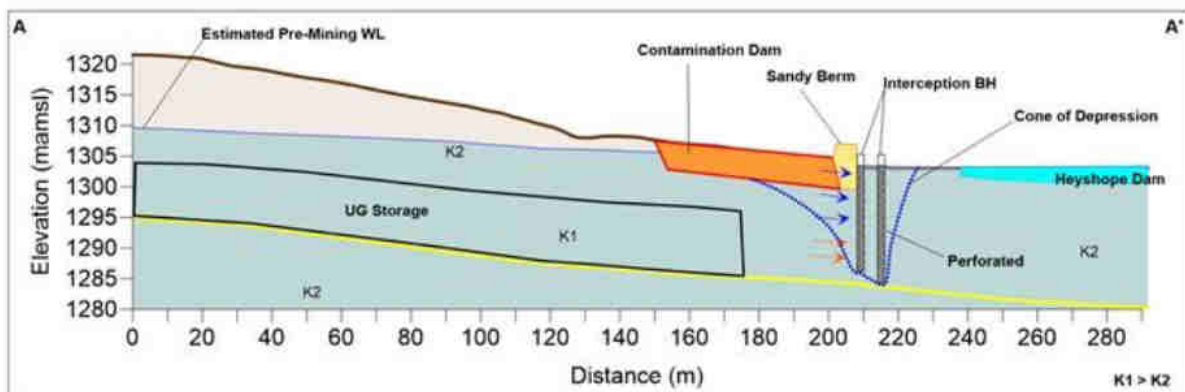


Figure 4: Conceptualisation of well point system by GCS [2]

A cross-section of the proposed borehole installation in the dam wall is indicated in Figure 5 below.



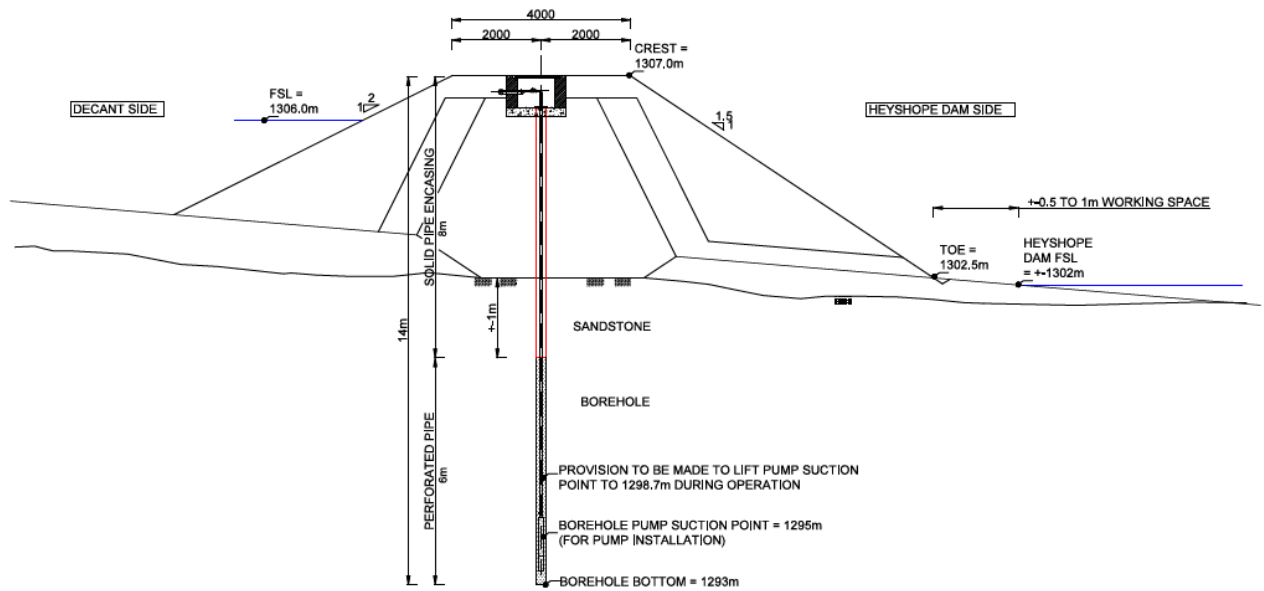


Figure 5: Borehole implementation installation

All the boreholes are connected by a 75ND HDPE pipe running along the top of the dam wall. Each borehole will be fitted with a stainless-steel submersible pump and level probes set to start pumping when the water in the borehole reaches the following conditions.

- Starting condition: liquid level in the water well is at 1299.7m, which is above Lower probe; the Product will run pump
- Stop condition: liquid level in the water well is at 1295.5m; which is below Lower probe; the Product will stop pump running.

Installing the level probes will ensure the pumps will only pump if the water reaches a certain level minimising the risk of continuously pumping and dewatering clean water from the Heyshope dam.

A pump flow rate of 5l/s has been used in the design.

A water meter will be installed to measure quantities pumped from the borehole. This meter functions separately from the water meter already installed at the decant point which measure how much surface decant water is pumped out on a monthly basis.

## 10. ROAD

The existing gravel road will continue to be used for access to the decant point. A small portion approximately 110m long will be diverted from the existing road where a new road will be constructed.

The new diverted road will be 8m wide with standard v-drains (500mm deep) on either side. This diverted road will cross an existing trench, where a 600ND pipe culvert will be installed.

## 11. OTHER INFRASTRUCTURE

Existing infrastructure such as the incoming powerline and transformer will continue to be used.

The existing pipeline from the decant point to the Maquasa East PCD's will also be used.

The fence will be extended around the entire dam facility to ensure no unauthorised access to the decant dam.

## **12. REFERENCES**

- [1] WR2012 : Water Resources of South Africa : Water Reseach Commision and Royal Haskoning.
- [2] G. Consultants, "Geohydrological Study Update for Maquasa East Maquasa West and Nooitgesien Operations," 25 June 2018.
- [3] SA Atlas of Climatology en Agrohdrology : University of Kwazulu Natal.

## **13. ANNEXURE**

### **13.1. DRAWINGS**



Dimensions (mm)					
Nominal Dia.	A	B	C	D	E
450	595	1 150	1 050	2 700	150
600	765	1 380	1 200	3 000	150
750	935	1 610	1 350	3 300	150
900	1 105	1 840	1 500	3 600	230
1 050	1 275	2 070	1 750	3 900	230
1 200	1 445	2 300	1 900	4 200	230

- NOTES :

1. Splitter block and pitching to be provided at all outlets where erosion is likely to occur.
2. Splitter block may be omitted if discharge velocity is less than 0.9 m/s.
3. Cut-off walls may be omitted if structure is founded on rock.
4. For multiple pipe culverts increase dimensions 'E' and 'F' by  $(n-1)(A+460)\text{mm}$  : Where  $n$  = number of pipes  
and  $A$  = nominal diameter of pipes
5. Pipes to be cut flush with headwall.
6. For skew pipe culverts the headwall shall be parallel to the centre line of the road.
7. If corrugated metal pipes are used 4x20mmx150mm long galvanised anchor bolts in the hollows of the corrugation are to be used.
8. All concrete is to be 20MPa.
9. Square mesh fabric (Reference S.M.F.193) is to be placed 50mm from top in all apron slabs and centrally in cut-off walls.
10. Brickwork is to consist of good quality burnt clay common bricks in accordance with SABS 227 Specification, or cement bricks in accordance with SABS 987 Specification, uniform in size and shape layed in stretcher bond style with the skins tied together with galvanised crimped wire wall ties.
11. Brickwork is to be placed every 4th course.
12. Jointing on all visible faces to be pointed
13. No in-fill shall be larger than a half standard brick size unless 15MPa concrete is used.

ISSUED FOR  
CONSTRUCTION

### General Notes and Specifications

1. FINAL POSITION AND LENGTH TO BE CONFIRMED BY ENGINEER ON SITE.

## References

Drawing No.	Title

## Amendments

[illegible]

**CONSULTING  
ENGINEERS CC**


**119 Deputasie Street  
P O Box 2266 VRYHEID 3100  
Tel / Fax: 034 982 3425**



<b>Designed:</b>	<b>Drawn:</b>	<b>Checked:</b>
B MUHL	B MUHL	F KRUGEL

**Approvals:**

**Approvals:**

  
\_\_\_\_\_  
Engineer (G F KRUGEL, Pr  
Eng, ECSA Reg N° 910142):

16/03/2022  
\_\_\_\_\_  
Date

**Client:**



KANGRA COAL PTY LTD

7th Floor, 13 Fredman Drive, Fredman  
Towers, Sandton, 2196,  
Johannesburg, South Africa

**Approvals:**

**Client:** \_\_\_\_\_ **Date** \_\_\_\_\_

Project Name:

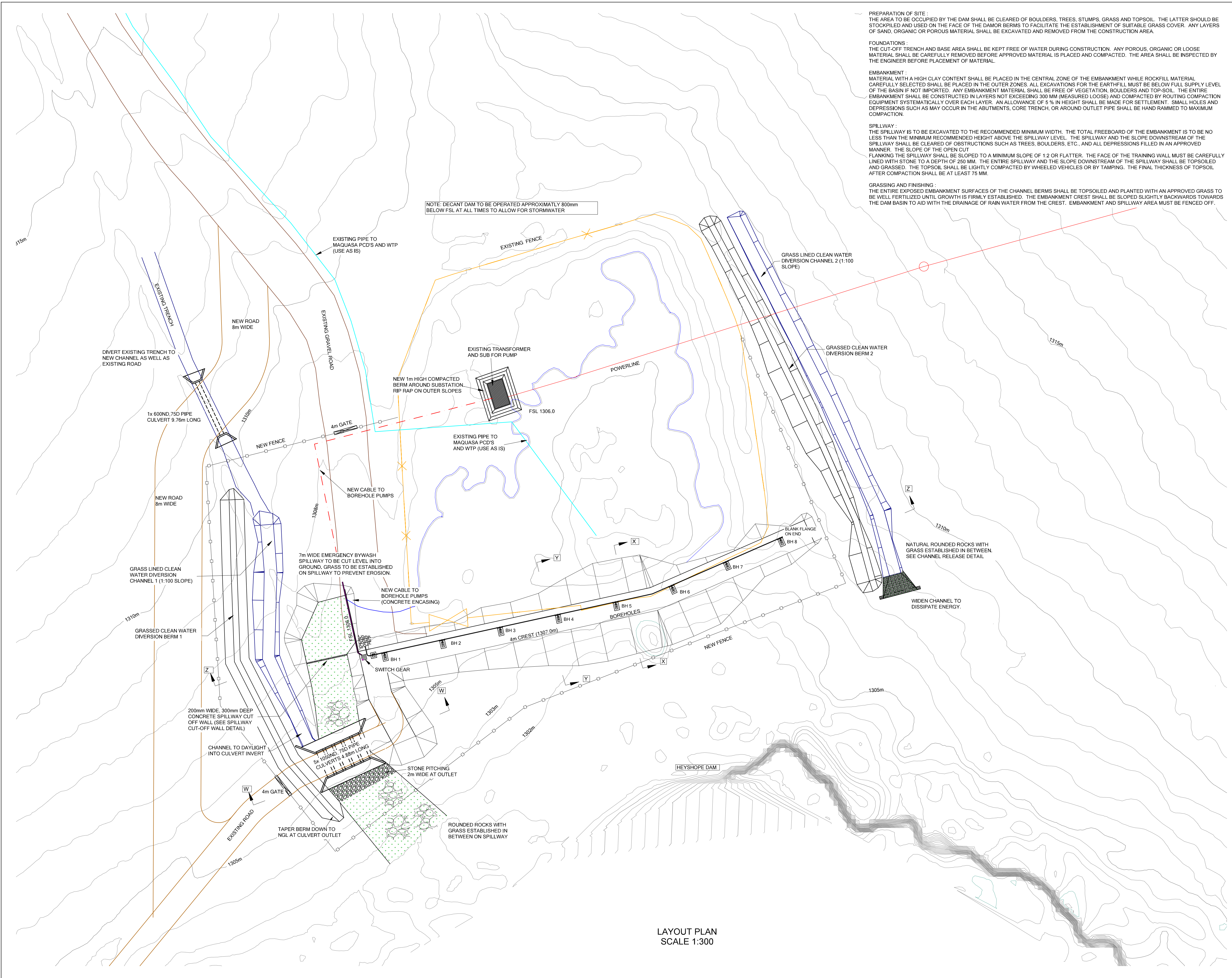
## MAQUASA DECANT

**Drawing Description:**

## STANDARD PIPE CULVERT DETAIL

<b>Scale:</b> AS INDICATED	<b>Plot Date:</b> 10/03/2022
<b>Drawing Sequence N°:</b> G2021/03/02/100/04	





PREPARATION OF SITE :  
THE AREA TO BE OCCUPIED BY THE DAM SHALL BE CLEARED OF BOULDERS, TREES, STUMPS, GRASS AND TOPSOIL. THE LATTER SHOULD BE STOCKPILED AND USED ON THE FACE OF THE DAMOR BERMS TO FACILITATE THE ESTABLISHMENT OF SUITABLE GRASS COVER. ANY LAYERS OF SAND, ORGANIC OR POROUS MATERIAL SHALL BE EXCAVATED AND REMOVED FROM THE CONSTRUCTION AREA.

FOUNDATIONS :  
THE CUT-OFF TRENCH AND BASE AREA SHALL BE KEPT FREE OF WATER DURING CONSTRUCTION. ANY POROUS, ORGANIC OR LOOSE MATERIAL SHALL BE CAREFULLY REMOVED BEFORE APPROVED MATERIAL IS PLACED AND COMPACTED. THE AREA SHALL BE INSPECTED BY THE ENGINEER BEFORE PLACEMENT OF MATERIAL.

EMBANKMENT :  
MATERIAL WITH A HIGH CLAY CONTENT SHALL BE PLACED IN THE CENTRAL ZONE OF THE EMBANKMENT WHILE ROCKFILL MATERIAL CAREFULLY SELECTED SHALL BE PLACED IN THE OUTER ZONES. ALL EXCAVATIONS FOR THE EARTHFILL MUST BE BELOW FULL SUPPLY LEVEL OF THE BASIN IF NOT IMPORTED. ANY EMBANKMENT MATERIAL SHALL BE FREE OF VEGETATION, BOULDERS AND TOP-SOIL. THE ENTIRE EMBANKMENT SHALL BE CONSTRUCTED IN LAYERS NOT EXCEEDING 300 MM (MEASURED LOOSE) AND COMPACTED BY ROUTING COMPACTION EQUIPMENT SYSTEMATICALLY OVER EACH LAYER. AN ALLOWANCE OF 5 % IN HEIGHT SHALL BE MADE FOR SETTLEMENT. SMALL HOLES AND DEPRESSIONS SUCH AS MAY OCCUR IN THE ABUTMENTS, CORE TRENCH, OR AROUND OUTLET PIPE SHALL BE HAND RAMMED TO MAXIMUM COMPACTION.

SPILLWAY :  
THE SPILLWAY IS TO BE EXCAVATED TO THE RECOMMENDED MINIMUM WIDTH. THE TOTAL FREEBOARD OF THE EMBANKMENT IS TO BE NO LESS THAN THE MINIMUM RECOMMENDED HEIGHT ABOVE THE SPILLWAY LEVEL. THE SPILLWAY AND THE SLOPE DOWNSTREAM OF THE SPILLWAY SHALL BE CLEARED OF OBSTRUCTIONS SUCH AS TREES, BOULDERS, ETC., AND ALL DEPRESSIONS FILLED IN AN APPROVED MANNER. THE SLOPE OF THE OPEN CUT FLANKING THE SPILLWAY SHALL BE SLOPED TO A MINIMUM SLOPE OF 1:2 OR FLATTER. THE FACE OF THE TRAINING WALL MUST BE CAREFULLY LINED WITH STONE TO A DEPTH OF 250 MM. THE ENTIRE SPILLWAY AND THE SLOPE DOWNSTREAM OF THE SPILLWAY SHALL BE TOPSOILED AND GRASSED. THE TOPSOIL SHALL BE LIGHTLY COMPACTED BY WHEELED VEHICLES OR BY TAMPING. THE FINAL THICKNESS OF TOPSOIL AFTER COMPACTION SHALL BE AT LEAST 75 MM.

GRASSING AND FINISHING :  
THE ENTIRE EXPOSED EMBANKMENT SURFACES OF THE CHANNEL BERMS SHALL BE TOPSOILED AND PLANTED WITH AN APPROVED GRASS TO BE WELL FERTILIZED UNTIL GROWTH IS FIRMLY ESTABLISHED. THE EMBANKMENT CREST SHALL BE SLOPED SLIGHTLY BACKWARDS TOWARDS THE DAM BASIN TO AID WITH THE DRAINAGE OF RAIN WATER FROM THE CREST. EMBANKMENT AND SPILLWAY AREA MUST BE FENCED OFF.

General Notes and Specifications

References

G2021/03/02/100-06/02	DECANT POINT DAM DETAILS
G2021/03/02/100-08	BOREHOLE PIPES AND PUMP DETAIL

Amendments

Date	Checked	Done by	Description
13/12/2022	F KRUGEL	B MUHL	BOREHOLE POSITION




**CONSULTING ENGINEERS CC**

119 Deputasie Street  
P O Box 2266 VRYHEID 3100  
Tel / Fax: 034 982 3425

Designed:	Drawn:	Checked:
B MUHL	B MUHL	F KRUGEL

Approval Engineer:



13/12/2022

Engineer : G F KRUGEL, Pr.  
Eng. ECSA Reg N° 910142

Date

Client:



**KANGRA COAL (PTY) LTD**  
7th Floor Fredman Towers,  
13 Fredman drive  
Sandown  
2196  
Tel: 011 783 7996

Approval Client:

Client: \_\_\_\_\_ Date \_\_\_\_\_

Project Name:

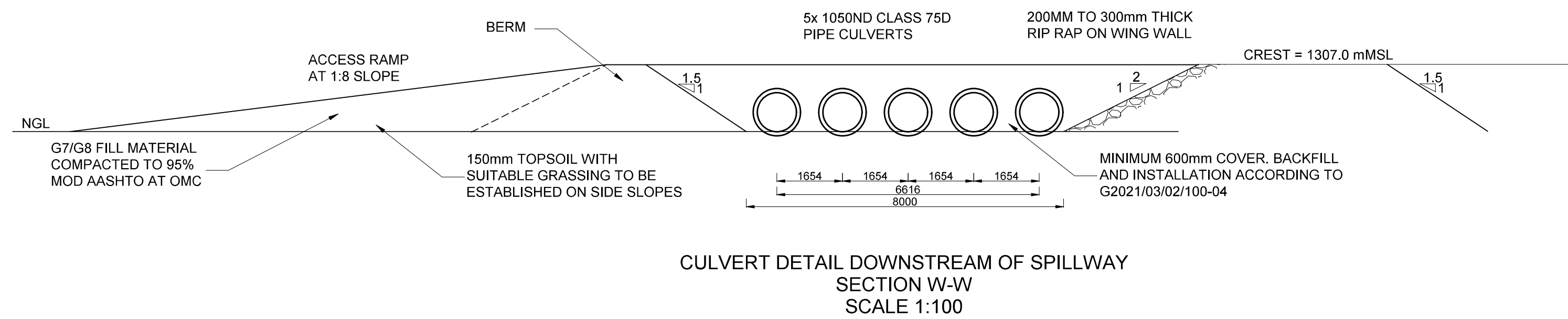
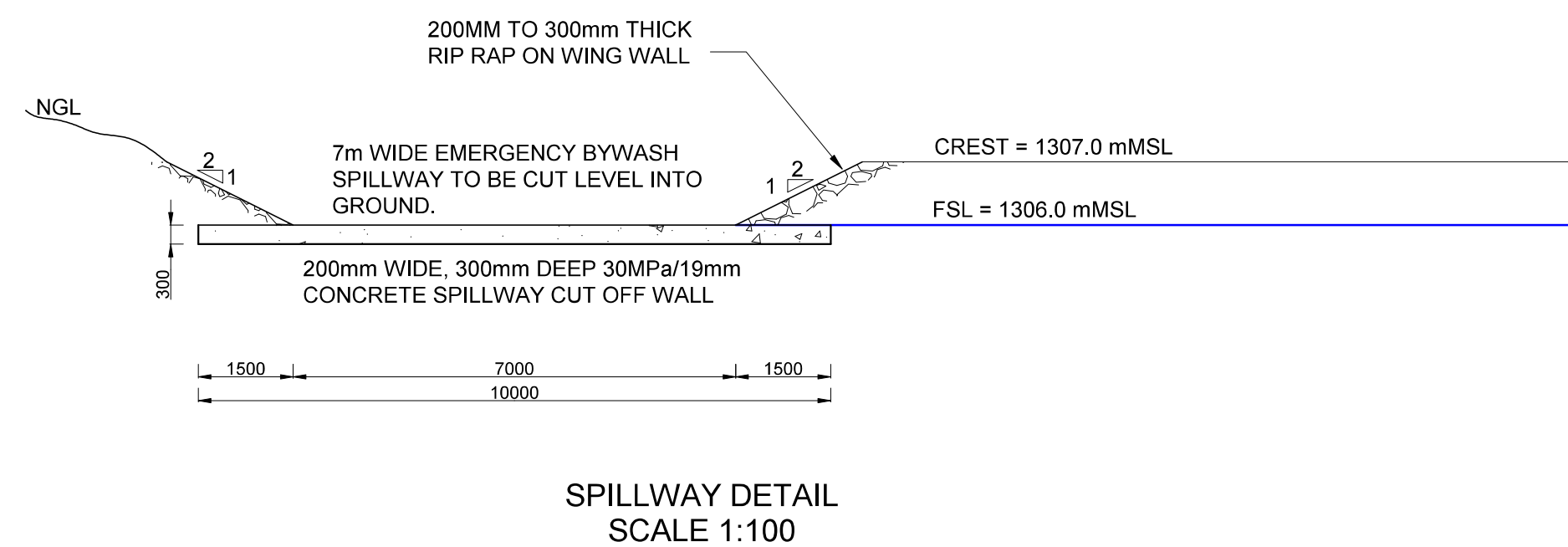
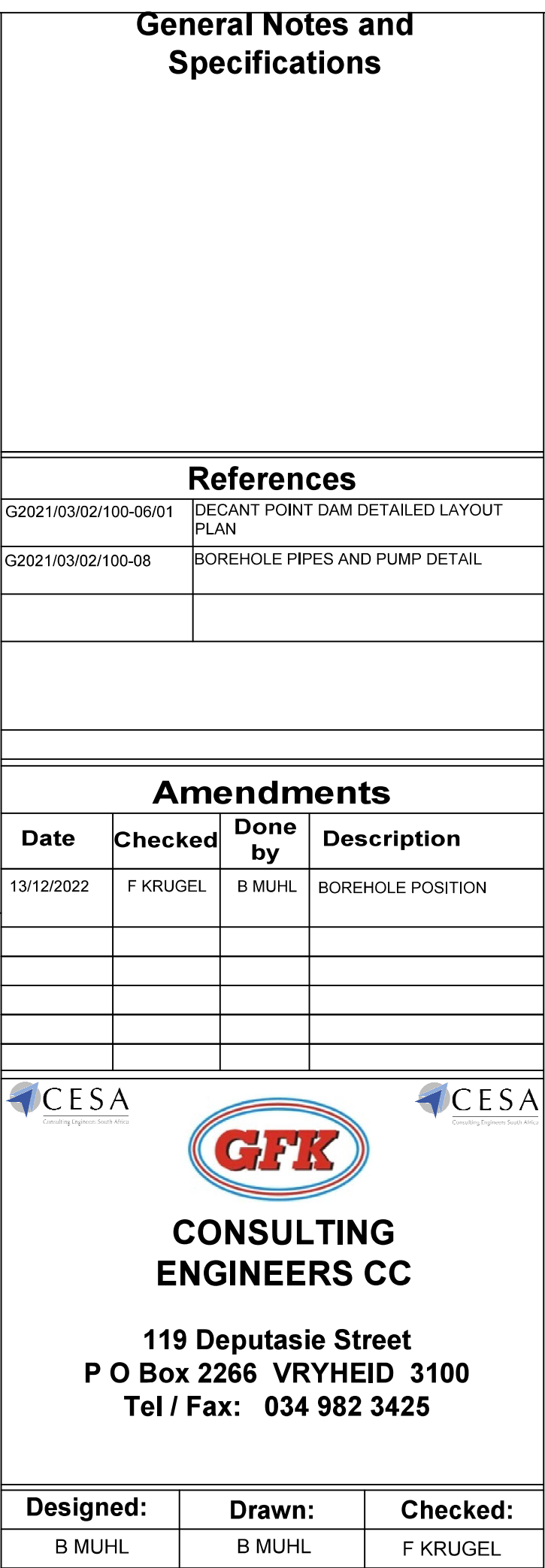
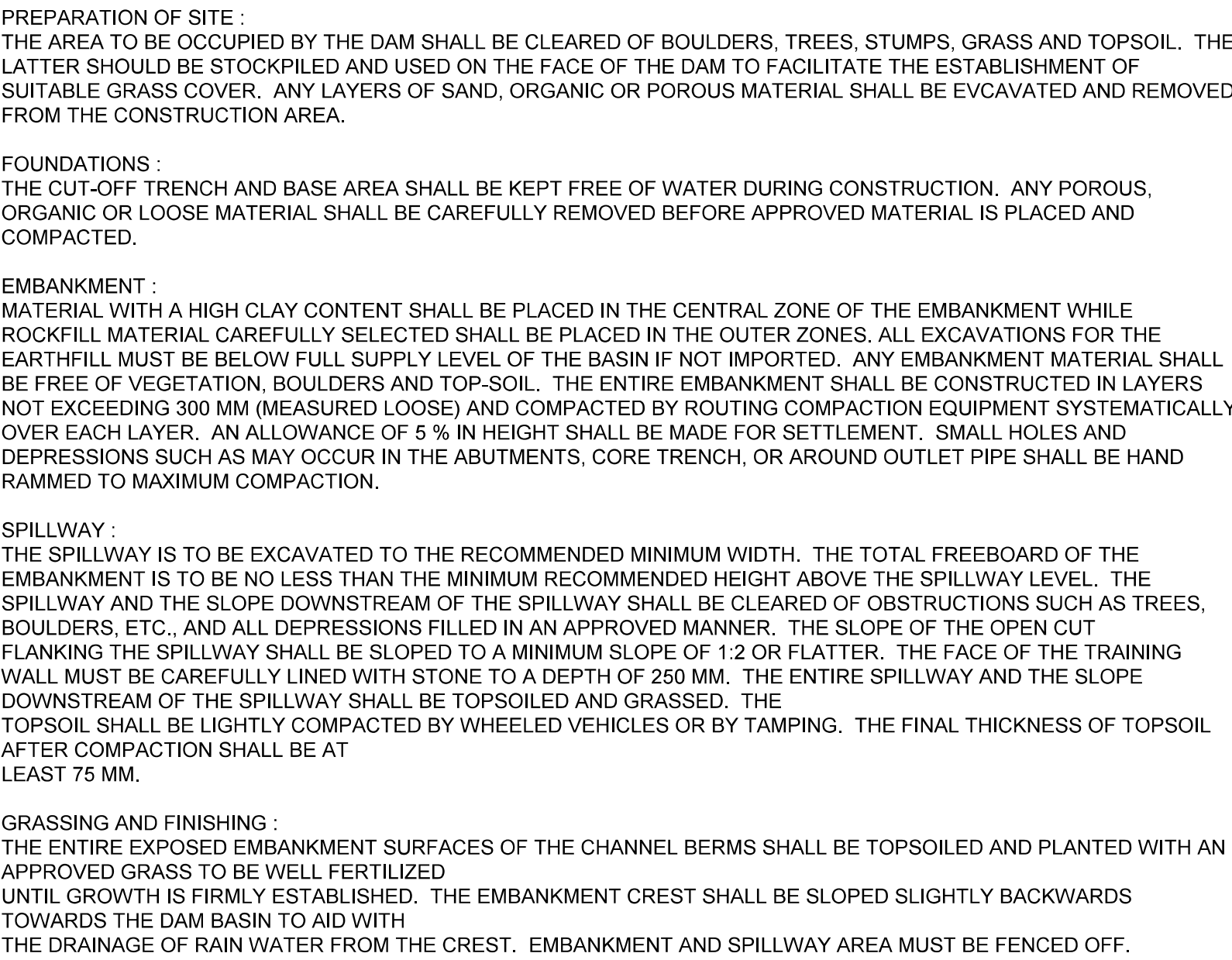
MAQUASA DECANT



Drawing Description:

DECANT POINT DAM  
DETAILED LAYOUT PLAN

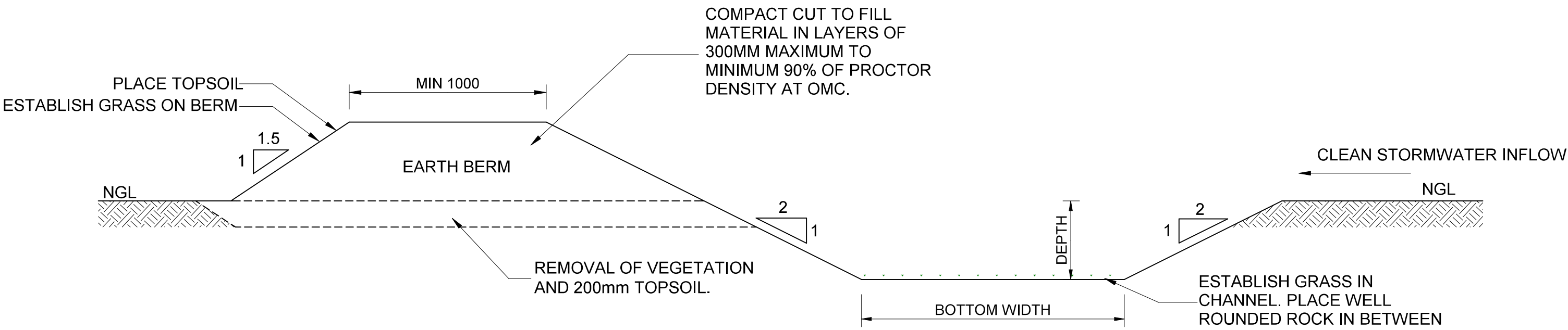
Scale: AS INDICATED	Plot Date: 13/12/2022
Drawing Sequence N°: G2021/03/02/100-06/01 REV1	



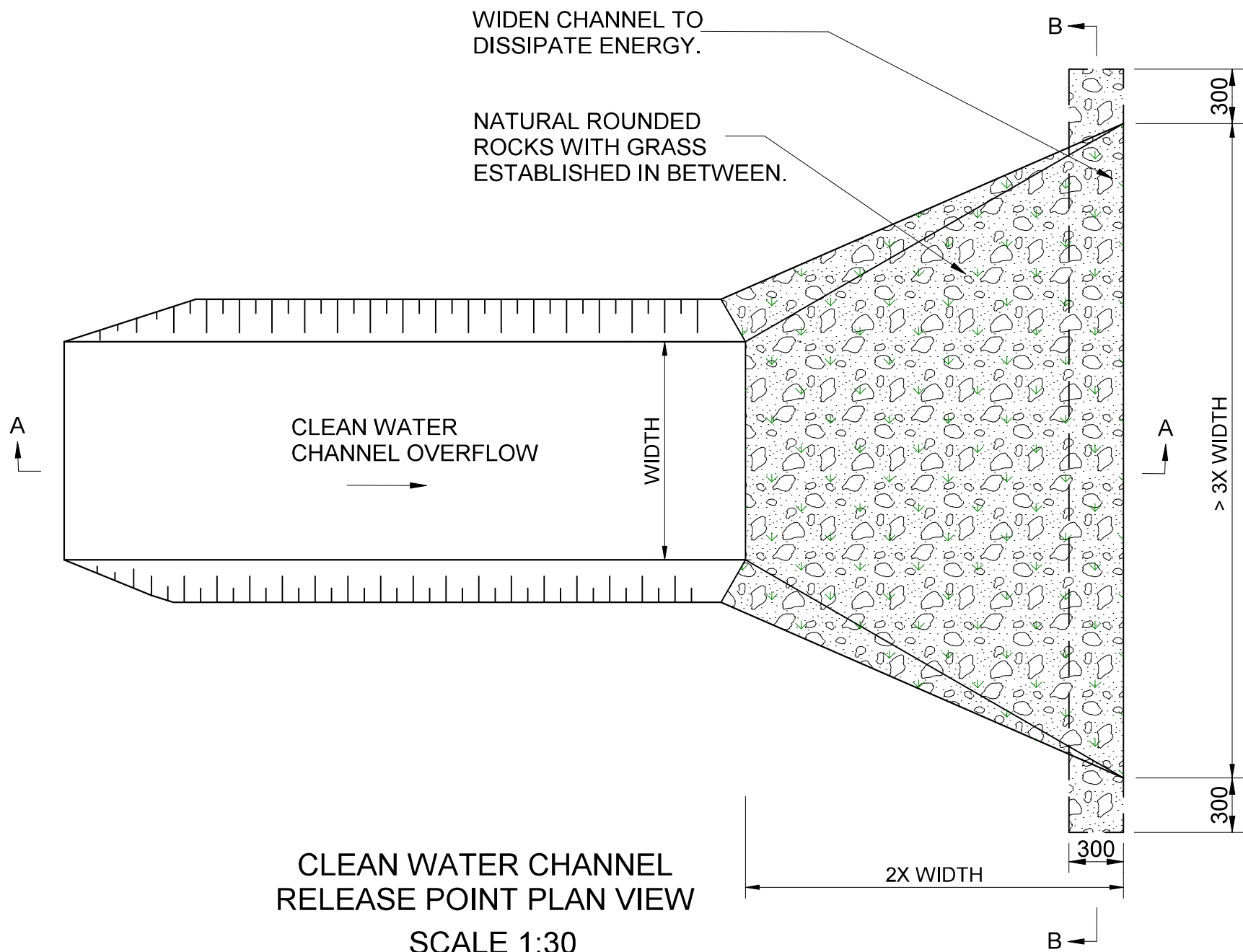


Approval Engineer: 		13/12/2022
Engineer : G F KRUGEL, Pr. Eng. ECSA Reg N° 910142		Date
Client:		
 KANGRA COAL (PTY) LTD 7th Floor Fredman Towers, 13 Fredman drive Sandown 2196 Tel: 011 783 7996		
Approval Client:		
Client: _____		Date _____
Project Name:		
MAQUASA DECANT		
Drawing Description:		
DECANT POINT DAM DETAIL		
Scale: AS INDICATED	Plot Date: 13/12/2022	
Drawing Sequence N°: G2021/03/02/100-06/02 REV1		

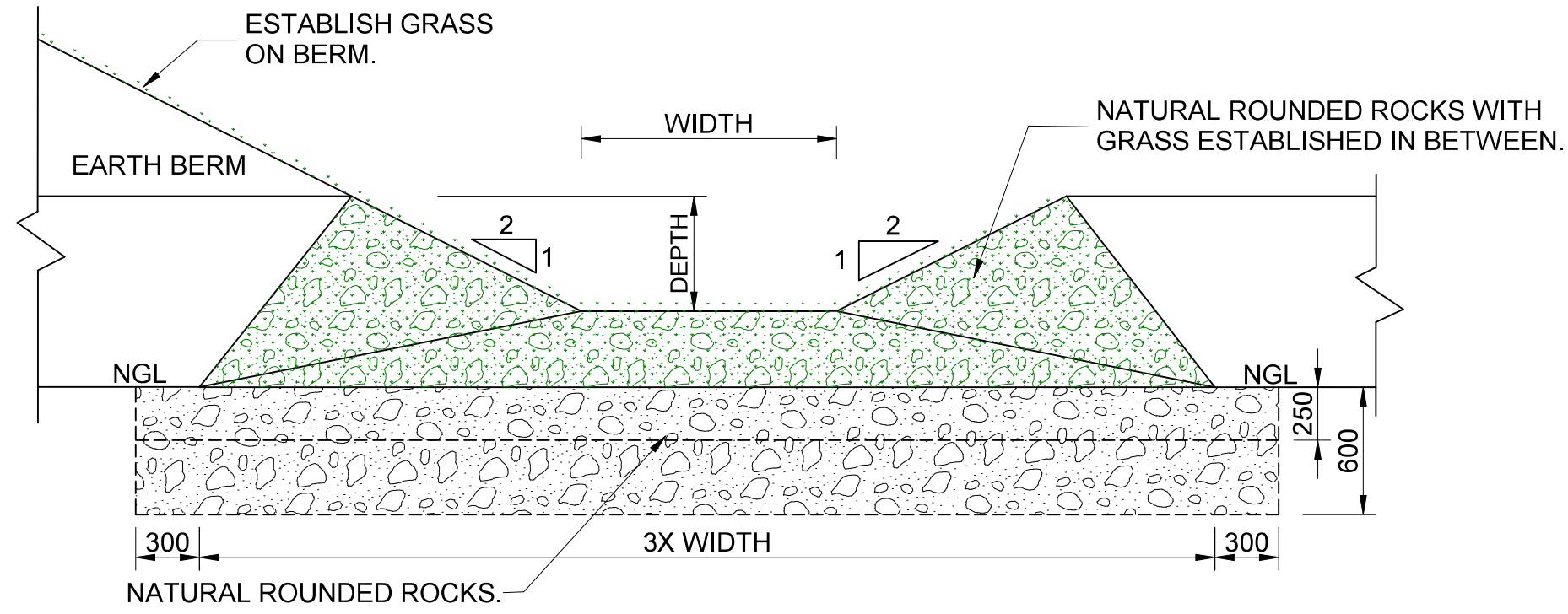




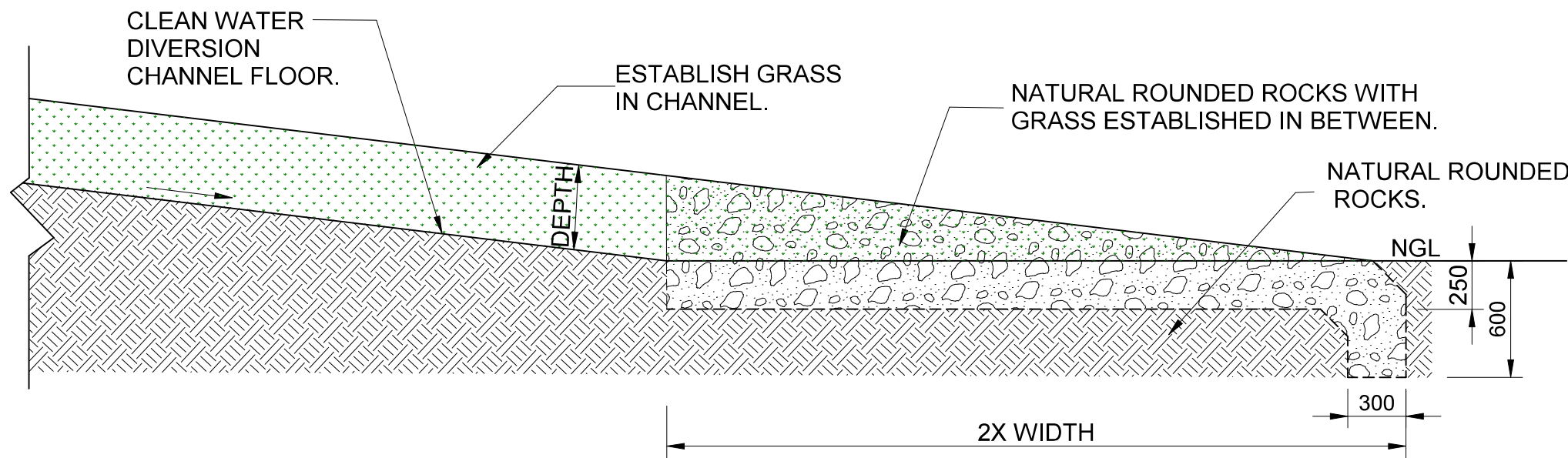
CLEAN WATER DIVERSION  
CHANNEL AND BERM DETAIL  
SCALE 1:30



CLEAN WATER CHANNEL  
RELEASE POINT PLAN VIEW  
SCALE 1:30



SECTION B-B  
SCALE 1:30



SECTION A-A  
SCALE 1:30

General Notes

ALL EARTHWORKS TO SANS 1200

GRASS TO BE WELL ESTABLISHED. PROVISION IS TO BE MADE BY CONTRACTOR TO ALLOW FOR ESTABLISHMENT OF GRASS WITHOUT EROSION DURING CONSTRUCTIONS PHASE.

ALL DIMENSIONS TO BE CONFIRMED WITH ENGINEER ON SITE PRIOR TO CONSTRUCTION

References

Drawing No.	Title
G2021/03/02/100-02	DECANT DAM LAYOUT

Amendments

Date	Checked	Done by	Description





GFK CONSULTING ENGINEERS

119 Deputasie Street  
P O Box 2266 VRYHEID 3100  
Tel / Fax: 034 982 3425

Designed:	Drawn:	Checked:
F.KRUGEL	M.KRUGEL	F.KRUGEL

Approvals:

Engineer (G F KRUGEL, Pr Eng, ECSA Reg N° 910142): \_\_\_\_\_ Date \_\_\_\_\_

Client:



KANGRA COAL (PTY) LTD

13 Fredman Drive, Fredman Towers  
7th Floor, Sandown, 2196  
Johannesburg  
Tel: 011 783 7996

Approvals:

Client: \_\_\_\_\_ Date \_\_\_\_\_

Project Name:

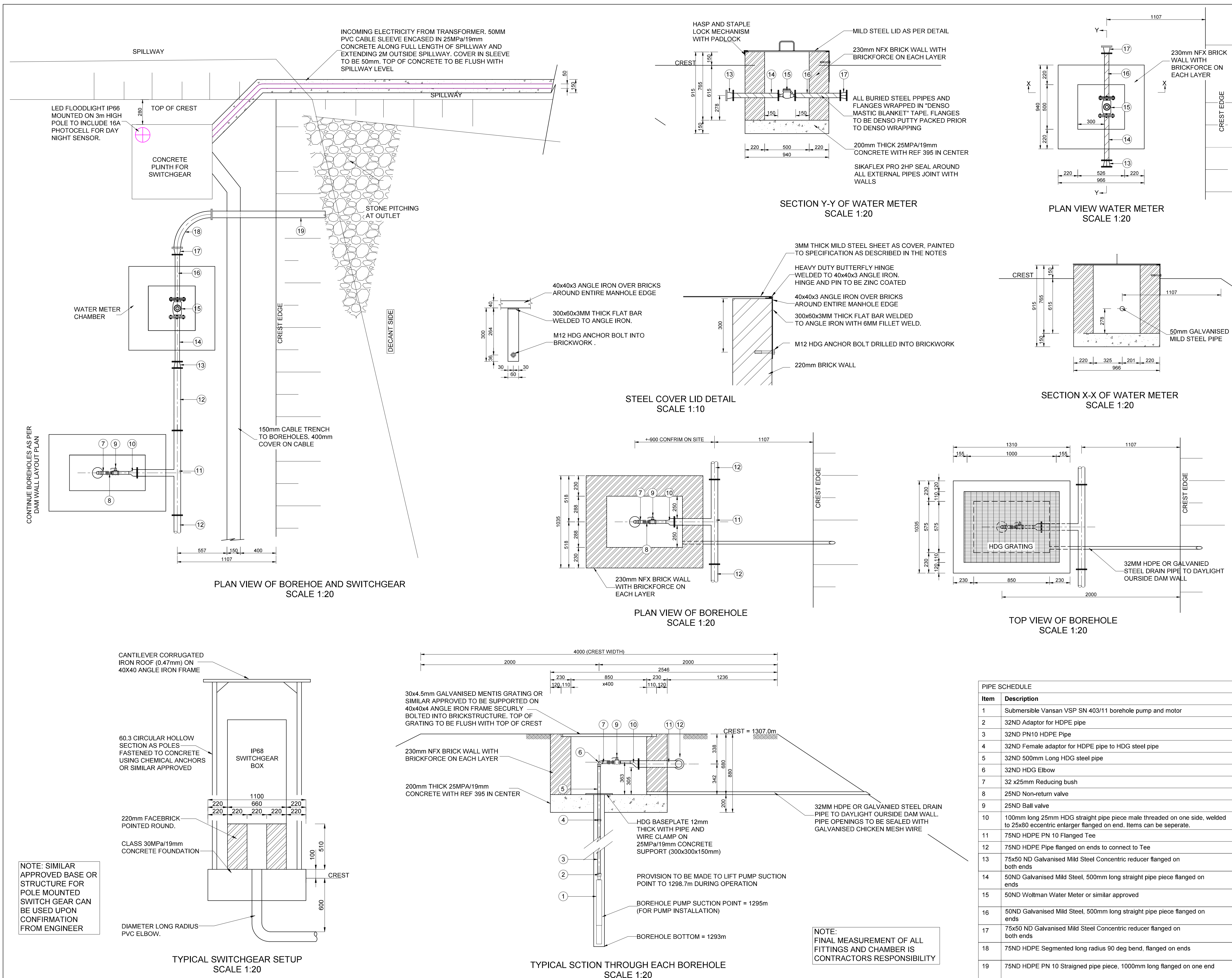
MAQUASA DECANT

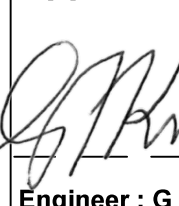
Drawing Description:

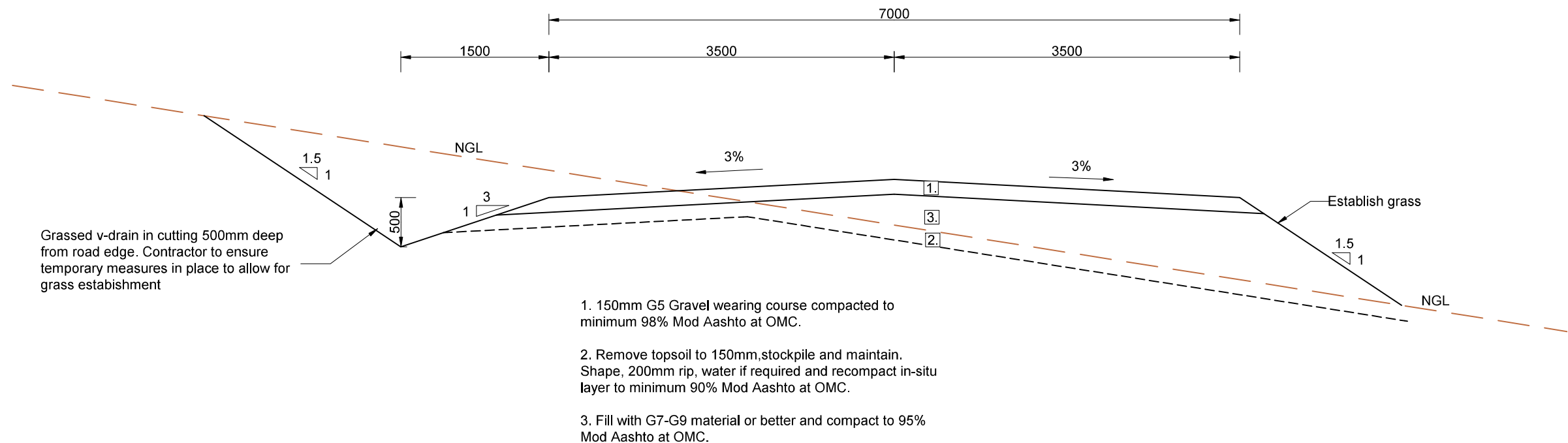
STANDARD CLEAN  
WATER DIVERSION  
CHANNEL AND BERM

Scale: 1:30	Plot Date: 19/04/2022
Drawing No: G2021/03/02/100-07	





General Notes and Specifications			
References			
Amendments			
Date	Checked	Done by	Description
13/12/2022	F KRUGEL	B MUHL	BOREHOLE POSITION
CESA CONSULTING ENGINEERS CC			
119 Deputasie Street P O Box 2266 VRYHEID 3100 Tel / Fax: 034 982 3425			
Designed: B MUHL	Drawn: B MUHL	Checked: F KRUGEL	
Approval Engineer:			
			13/12/2022
Engineer : G F KRUGEL, Pr. Eng. ECSA Reg N° 910142			Date
Client:			
KANGRA COAL (PTY) LTD 7th Floor Fredman Towers, 13 Fredman drive Sandown 2196 Tel: 011 783 7996			
Approval Client:			
Client:			Date
Project Name:			
MAQUASA DECANT			
Drawing Description:			
BOREHOLE PIPES AND PUMP DETAIL			
Scale: AS INDICATED		Plot Date: 13/12/2022	
Drawing Sequence N°: G2021/03/02/100-08 REV 1			



TYPICAL ROAD CROSS-SECTION  
SCALE 1:50

General Notes and Specifications

References

Drawing No.	Title

Amendments

Date	Checked	Done by	Description




**CONSULTING ENGINEERS CC**

119 Deputasie Street  
P O Box 2266 VRYHEID 3100  
Tel / Fax: 034 982 3425

Designed:	Drawn:	Checked:
B MUHL	B MUHL	F KRUGEL

**Approvals:**



19/01/2023

Engineer (G F KRUGEL, Pr Eng, ECSA Reg N° 910142);

Date

**Client:**



**KANGRA COAL (PTY) LTD**

13 Fredman Drive,  
Fredman Towers, 7th Floor  
Sandown  
2196  
Tel: 011 783 7996

**Approvals:**

Client: \_\_\_\_\_ Date: \_\_\_\_\_

**Project Name:**

MAQUASA DECANT

**Drawing Description:**

ACCESS ROAD  
TYPICAL SECTION

Scale: AS INDICATED	Plot Date: 2022/12/09
Drawing Sequence N°: G2021/03/02/100-09	

## **APPENDIX B: EAP INFORMATION**

*Appendix B1 - Project Team CV's*



## GCS Group Environmental Manager

### CORE SKILLS

- Project Management
- Technical & Impact Assessment Guidance
- Environmental Assessment
- Water Use Licencing
- Waste Management Licencing
- Environmental & Waste Auditing and Compliance Monitoring

### DETAILS

#### Qualifications

- B.Sc. Microbiology (Honours) University of Pretoria 1996
- B.Sc. Biological Sciences University of Pretoria 1994

#### Memberships/ Professional Affiliations

- International Association for Impact Assessors of South Africa (IAIA)
- Institute of Waste Management of South Africa (IWMSA)
- SACNASP (No.117348) (South African Council for Natural Scientific Professionals)

#### Languages

- Afrikaans
- English

#### Countries worked in:

South Africa, Zambia, Namibia

### PROFILE

Gerda has over 25 years' experience within the environmental and waste management field and strives to deliver custom environmental services to clients.

Gerda began her career in the environmental field within the government sector, managing environmental aspects and impacts as well as reviewing environmental assessments with the view of authorizing or declining authorization of the developments.

After six years within the government sector she joined a consulting engineering firm where she was ultimately responsible for the Management of the Environmental Sub-Division. Gerda has experience in project and client management, financial management and the compilation and costing of project proposals and tenders. She has been involved in several engineering projects as the Environmental Assessment Practitioner as well as the Environmental Control Officer during construction working closely with the Occupational Health and Safety Officer. Gerda has also been involved in projects where waste licensing as well as water use licensing processes formed an integral part of the services offered. Environmental auditing and compliance monitoring of waste disposal sites also forms part of her experience gained. She also has experience in dealing with projects which involve NEC3 Contracts, the Equator Principles and World Bank IFC Principles.

Gerda has specialist skills in the following areas:

- Project proposals, planning, costing and timing
- Project and Client Management
- Authority Liaison
- Basic Assessments & Scoping/EIA Processes
- Amendment of EA's & EMP's
- S24G Applications
- Facilitation of Public Participation Processes & Stakeholder Engagement
- IWULA & IWWMP Applications
- Environmental Control Officer (ECO) duties
- Environmental Compliance Auditing (IFC Performance Standards & Equator Principles)
- Mentorship & Guidance



## Work Experience

Period	Employer	Position	Role/ Responsibility
2019 to Current	GCS Water and Environment (Pty) Ltd	Environmental Manager	Management of the environmental unit since 2019 up to January 2024 and then the GCS Group Environmental Division since February 2024. Management of applications for rectification in terms of Section 24G of the EIA Regulations, undertaking basic environmental assessment and full Scoping & EIR applications in terms of the Regulations. Management of Integrated Water Use License Applications in terms of the NWA. Undertaking of environmental compliance audits for various construction projects as well as environmental legal audit reviews and environmental due diligence investigations.
2018 to 2019	Terramanzi Group (Pty) Ltd	Senior Environmental Consultant	Management of the environmental unit within the Terramanzi Group. Management of applications for rectification in terms of Section 24G of the EIA Regulations, undertaking basic environmental assessment and full Scoping & EIR applications in terms of the Regulations. Undertaking of environmental compliance audits for various construction projects as well as environmental legal audit reviews and environmental due diligence investigations.
2014 to 2017	GIBB (Pty) Ltd	Senior Environmental Scientist	Management of applications for rectification in terms of Section 24G of the EIA Regulations, undertaking of basic environmental assessment and full Scoping & EIR applications in terms of the Regulations. Management of Integrated Water Use License Applications in terms of the NWA. Undertaking of environmental compliance audits for various construction projects as well as environmental legal audit reviews and environmental due diligence investigations.
2011 to 2013	WorleyParsons RSA	Senior Environmental Scientist & Durban Department Head Environment	Management of the environmental unit in the Durban Office. Management of applications for rectification in terms of Section 24G of the EIA Regulations, undertaking of basic environmental assessment and full Scoping & EIR applications in terms of the Regulations. Management of Integrated Water Use License Applications in terms of the NWA. Undertaking of environmental compliance audits for various construction projects as well as environmental legal audit reviews and environmental due diligence investigations.
2003 to 2011	KV3 Engineers	Senior Environmental Scientist	Management of applications for exemption from compliance with the EIA Regulations, undertaking of basic environmental assessment applications, as well as full environmental impact assessment applications.
2000 to 2003	Gauteng Department of Agriculture, Conservation & Environment	Assistant Director: Waste Management Division	Project management and environmental management pertaining to all developments within a designated area in Gauteng Province. Review of EIAs, formulation of comments and or authorisations within designated area in Gauteng Province. Liaison with waste contractors, industries and others. Management of legal interventions required in terms of environmental legislation within a designated area. Supporting environmental officers at all levels in terms of technical and environmental guidance, input into strategic decisions, resolving complex and potentially challenging issues.
1999 to 2000	Gauteng Department of Agriculture, Conservation & Environment	Senior Environmental Officer: Waste Management Division	
1997 to 1999	Gauteng Department of Agriculture, Conservation & Environment	Environmental Officer: Waste Management Division	
1996	Spartan Private School	Teacher: Natural Science & Biology	Teacher in Biology and Natural Science for Grades 7 to 12.



## Project Experience

Year	Client	Project Description	Role/ Responsibility
<b>Strategic and Environmental Guidance Projects</b>			
1999 to 2003	Gauteng Department of Agriculture, Conservation & Environment	Development of a Health Care Risk Waste Management Strategy for Gauteng.	Part of Development Team
2001 to 2003	Gauteng Department of Agriculture, Conservation & Environment	Development of Minimum Domestic Waste Collection Standards for Gauteng Province.	Part of Development Team
2002	Gauteng Department of Agriculture, Conservation & Environment	Development of new EIA guidelines and regulations for the Gauteng Province.	Part of Development Team
2005	Gauteng Department of Agriculture, Conservation & Environment	GDACE Green Procurement Project: Development of the GDACE Green Procurement Policy, Gauteng	Project Manager & Reviewer
2008	GAUTRAIN Project Engineers (i.e. KV3 Engineers)	Environmental Assistance for the Gautrain Project: Environmental Evaluation of various documentation and engineering designs in terms of their environmental compliance.	Project Manager & Reviewer
2009	Department of Environmental Affairs	Alignment of MIG Project Process with EIA Process: Evaluation of the EIA process as well as the MIG process in order to produce a process alignment guideline to the municipalities to streamline the two processes.	Part of Development Team
2021	CoalTech	Development of "A Manual for the Authorisation of Pitlakes as a Closure Option for South African Coal Mines"	Part of Development Team
<b>Environmental Feasibility and Screening</b>			
2008	Nu Way-property Developments	Management of Environmental Screening and Due Diligence Assessment for several proposed Nu Way-property Developments, Gauteng.	Project Manager
2008	Department of Water Affairs	Mokolo Croc WAP Environmental Feasibility and Screening, Limpopo.	Project Manager & Senior Environmental Assessment Practitioner (EAP)
2016	Kwadukuza Municipality	Environmental Feasibility for Civil Engineering Project Foxhill Road Alignment and Construction, Tongaat, Kwa-Zulu-Natal.	Environmental Project Leader
2016	King Sabata Dalindyebo Local Municipality (C/O OR Tambo District Municipality)	Environmental Screening Investigation of six proposed development corridors for the Mthatha Bulk Water Infrastructure Presidential Intervention - Phase 2: Secondary Bulk Infrastructure project.	Environmental Project Leader
2019 to 2020	Phumaf Holdings (Pty) Ltd	Environmental Screening for various sites within Ekurhuleni Municipality as part of the Gauteng Rapid Land Release Programme (GRLRP) project for the Provincial Department of Human Settlements	Project Manager & Senior EAP

Year	Client	Project Description	Role/ Responsibility
<b>Environmental Opinions &amp; Appeals</b>			
2019 to 2020	Tendele Coal	Environmental Review Report for the Somkhele Anthracite Mine (MR 10041) High Court Case Number 82865.	Project Manager & Senior EAP
2022	CNG Holdings	Environmental Opinion regarding the Environmental Legislative Requirements for the proposed Compressed Natural Gas Motherstation in Avoca, KwaZulu-Natal.	Project Manager & Senior EAP
2021 to 2022	Tendele Coal	Environmental support to the Somkhele Anthracite Mine for the IWULA Appeals Process.	Project Manager & Senior EAP
<b>Development Environmental Assessments</b>			
2003 to 2005	ABSA DevCO	Environmental Impact Assessment for a change of land-use from agricultural to Residential and Town Development of the farm Brakfontein 399 JR, Centurion, Gauteng.	Project Manager & Senior EAP
2005 to 2010	Air Traffic Navigation Services (ATNS)	The project entails the upgrading of existing, and the provision of new air navigation sites (27 in total) throughout South Africa. Civil and electrical infrastructure to the sites needed to be upgraded to accommodate the equipment. Various Environmental Impact Assessments for various individual projects in various provinces within South Africa.	Project Manager & Senior EAP
2006 to 2009	Amathole District Municipality	Elliotdale Rural Sustainable Human Settlement Pilot Project Environmental Impact Assessment. Responsible for the environmental assessment process which was based on a strategic approach for the Elliotdale Rural Housing Project, Elliotdale, Eastern Cape.	Project Manager & Senior EAP
2007	Elkem Ferrovel	Environmental Basic Assessment for the upgrading and expansion of the Ferrovel Plant in Ferrometals, Emalaheni, Mpumalanga.	Project Manager & Senior EAP
2008	ABSA DevCO	Environmental Impact Assessment for a change in land use from agricultural to Residential and Town development of Montana X40, Pretoria, Gauteng.	Project Manager & Senior EAP
2012	Transnet Capital Projects	Environmental Basic Assessment and technical environmental investigations for the proposed expansion of the existing tug jetty and construction of a new tug jetty for Transnet Capital Projects in the Port of Durban, KwaZulu-Natal.	Project Manager & Senior EAP
2014 to 2016	Dube TradePort	Environmental Impact Assessment for the proposed construction of the Dube TradePort TradeZone 2 in La Mercy, KwaZulu-Natal.	Project Manager & Senior EAP
2014 to 2017	Dube TradePort	Environmental Impact Assessment for the proposed Support Precinct 2 Development in La Mercy, KwaZulu-Natal.	Project Manager & Senior EAP
2016 to 2017	Areena Resort	Application for rectification in terms of S24G and associated Environmental Basic Assessment for the alleged unlawful construction activities at the Areena Resort, Great Kei Municipality, Eastern Cape.	Project Manager & Senior EAP
2016 to 2017	Areena Resort	Application for rectification in terms of S24G and associated Environmental Basic Assessment for the alleged unlawful construction activities on Hillsdrift Farm, Great Kei Municipality, Eastern Cape.	Project Manager & Senior EAP
2018 to 2019	Watchman Properties (Pty) Ltd	Environmental Basic Assessment for the proposed Vendome Residential Development on Portion 1 of Farm 1766 and Portion 2 of Farm 1766, Paarl, Western Cape, South Africa.	Project Manager & Senior EAP

## Project Experience

Year	Client	Project Description	Role/ Responsibility
2018 to 2019	Keysha Investments 213 (Pty) Ltd	Environmental Basic Assessment for the proposed River Farm Estate Development and associated infrastructure on remainder of farm Rivierplaas No. 1486, Erf 111 and Erf 197, Paarl, Western Cape, South Africa.	Project Manager & Senior EAP
2018 to 2019	Paarl Vallei Developments (Pty) Ltd	Environmental Basic Assessment for the proposed Paarl Vallei Retirement Village Development, Paarl, Western Cape, South Africa.	Project Manager & Senior EAP
2018 to 2019	Val de Vie Investments (Pty) Ltd	Parallel Substantive Amendment Application process for the authorised Pearl Valley II & Levendal Residential Developments, Paarl, Western Cape, South Africa.	Project Manager & Senior EAP
2019 to 2021	Phumaf Holdings (Pty) Ltd	Environmental Services for: <ul style="list-style-type: none"> <li>• Full Environmental Impact Assessment for the proposed Unitas Park Ext 16 Mixed Use Development;</li> <li>• Basic Environmental Impact Assessment for the proposed Evaton West F Mixed Use Development; and</li> <li>• Basic Environmental Impact Assessment for the proposed Evaton West I Mixed Use Development.</li> </ul>	Project Manager & Senior EAP
<b>Renewable Energy Environmental Assessments</b>			
2011	Farmsecure Carbon	Environmental Basic Assessment and Water Use License Application process for a proposed Biogas Waste to Energy project for a pig farm, Mooiriver, KwaZulu-Natal.	Project Manager & Senior EAP
2018 to 2019	GPIPD - Doornfontein Solar Farm (Pty) Ltd	Environmental Impact Assessment for the proposed 230 MW Doornfontein Photovoltaic Solar Energy Facility (PVSEF) located on Remainder of Farm 118, Doornfontein, Piketberg, Bergervier Local Municipality, Western Cape.	Project Manager & Senior EAP
2018 to 2019	GPIPD - Kruispad Solar Farm (Pty) Ltd	Environmental Impact Assessment for the proposed 150 MW Kruispad Photovoltaic Solar Energy Facility (PVSEF) located on Remainder of Farm 120, Kruispad, Piketberg, Bergervier Local Municipality, Western Cape.	Project Manager & Senior EAP
2018 to 2019	Brandvalley Wind Farm (Pty) Ltd	Part 2 Amendment Application for the authorised 140 MW Brandvalley Wind Energy Facility (WEF) located within the Karoo Hoogland, Witzenberg and Laingsburg Local Municipalities in the Northern and Western Cape Provinces.	Project Manager & Senior EAP
2018 to 2019	Copperton Wind Farm (Pty) Ltd	Non-Substantive Amendment Application to update the information of the Holder of the Environmental Authorisation & an EMPr Amendment Process to update the Airstrip Alignment and to provide an updated "outcomes based" EMPr for the Copperton Wind Energy Facility near Copperton in the Northern Cape.	Project Manager & Senior EAP
2018 to 2019	WKN Windcurrent SA (Pty) Ltd	Environmental Impact Assessment for the proposed 150 MW Haga Haga Wind Energy Facility (WEF) & Environmental Basic Assessment for the associated Haga Haga Overhead Powerline (OHPL) in Haga Haga, Great Kei Local Municipality, Eastern Cape.	Project Manager & Senior EAP
2021 to 2022	Cennergi Holdings	Environmental Impact Assessment and Water Use License Application (GA) process for the proposed 100MW Lephalale Solar Plant located mainly on the Farm Appelvlakte 448 within the Lephalale Local Municipality, Limpopo.	Project Manager & Senior EAP

Year	Client	Project Description	Role/ Responsibility
<b>Mining Environmental Assessments</b>			
2007	Chris Hani Municipality	Environmental Assessment and DME Licence Application on behalf of Chris Hani Municipality. Responsible for exemption application from Mining Permit and Environmental Management Programmes for 17 borrow pits in Middelburg, Eastern Cape.	Project Manager & Senior EAP
2010	Samancor Chrome Limited	The Lwala Greenfields Mine and Smelter EIA and EMP. Responsible for the Environmental impact assessment and technical investigations for the waste management issues for the proposed development of a new chrome smelter project in the Steelpoort area, Limpopo.	Project Manager & Senior EAP
2011	Xtrata Alloys	Xtrata Alloys Western Mines PSV application for authorization in terms of the MPRDA. Responsible for the undertaking of the EIA and compilation of the amended EMPr and technical environmental investigations for the proposed development of an open cast mine in Rustenburg, North West.	Project Manager & Senior EAP
2019 to 2021	Harmony Gold	Environmental Assessment process to obtain environmental authorisation for the proposed expansion of the existing Kareerand Tailings Storage Facility, Dr Kenneth Kaunda District Municipality, North-West Province.	Project Manager & Senior EAP
2019 to 2021	Zululand Anthracite Colliery	Environmental Basic Assessment for the proposed New Mngeni Adit & Associated Infrastructure, Mandlakazi Traditional Authority, KwaZulu-Natal.	Project Manager & Senior EAP
2021 to 2022	Sibanye-Stillwater	Part 2 Amendment Application for the approved Burnstone Gold Mine EA/EMPr located near Balfour within the Dipalaseng Local Municipality, Mpumalanga.	Project Manager & Senior EAP
2021 to 2022	Exxaro Resources	Section 34 EMPr Amendment Application for the approved Grootegeluk Mine EMPr located near Lephalale within the Lephalale Local Municipality, Limpopo.	Project Manager & Senior EAP
2021 to 2022	Boysendal Northam Platinum	Part 2 Amendment Applications for the Boysendal Mine located near Lydenburg, across both Mpumalanga and Limpopo provinces: <ul style="list-style-type: none"> <li>Boysendal North Mine: New Emergency Escape Portal and two new Ventilation Shafts and associated Infrastructure; and</li> <li>Boysendal South Mine: New Ventilation Shafts and associated infrastructure.</li> </ul>	Project Manager & Senior EAP
2022 to 2023	Boysendal Northam Platinum	Integrated Environmental Authorisation Application for the Boysendal South Phase III Expansion, Lydenburg, Mpumalanga: <ul style="list-style-type: none"> <li>Boysendal South Tailings Storage Facility Expansion;</li> <li>Boysendal South Run of Mine Stockyard Stockpile Expansion; and</li> <li>Boysendal South New Merensky Plant.</li> </ul>	Project Manager & Senior EAP
2022 to 2023	Kangra Coal	Integrated Environmental Authorisation Application for the establishment of a Co-Disposal Discard Facility and Wastewater Treatment Plant at the Maquasa East Operations, Piet Retief, Mpumalanga.	Project Manager & Senior EAP
2023	Kangra Coal	Integrated Environmental Authorisation Application for the Umgala/Knights Hill Mining Application, Utrecht, KwaZulu-Natal.	Project Manager & Senior EAP

Year	Client	Project Description	Role/ Responsibility
<b>Waste Management Environmental Assessments</b>			
2003	Assmang Chrome Machadodorp	Environmental Impact Assessment for the permitting of the H:H Hazardous Waste Disposal Facility at Assmang Chrome, Machadodorp.	Senior EAP
2004	Emfuleni Local Municipality	Environmental Impact Assessment for the closure of the Zuurfontein Landfill site for the Emfuleni Local Municipality, Sedibeng, Gauteng	Senior EAP
2004	Ekurhuleni Municipality	Environmental Impact Assessment for the closure of the Sebenza Landfill Site for the Ekurhuleni Municipality, Gauteng.	Senior EAP
2004	Tzaneen Local Municipality	Application for authorisation and EIA for the permitting of an existing solid waste disposal site for the Tzaneen Local Municipality, Mpumalanga.	Senior EAP
2006	Samancor Chrome Middelburg	Environmental Basic Assessment for the permitting of the existing Slag Waste Disposal facility for Samancor Chrome Middelburg, Mpumalanga.	Senior EAP
2006	Samancor Chrome Ferrometals	Environmental Basic Assessment for the permitting of the existing Slag Waste Disposal facility for Samancor Chrome Ferrometals Witbank, Mpumalanga.	Senior EAP
2007	Steve Tshwete Municipality	Environmental Impact Assessments for four Solid waste Transfer Stations for the Steve Tshwete Municipality, Mpumalanga.	Senior EAP
2008	Assmang Chrome Machadodorp	Environmental Impact Assessment for the expansion of the existing Slag Waste Disposal Facility at Assmang Chrome. Responsible for the EIA application for authorization for the proposed expansion project in Machadodorp, Mpumalanga.	Project Manager & Senior EAP:
2010	ArcelorMittal	ArcelorMittal BOF Slag Disposal site licensing of new site and closure of old site, Newcastle, KwaZulu-Natal.	Project Manager & Senior EAP:
2010	Lekwa Municipality	Waste Management License Application for authorization and the conducting of an EIA and technical environmental investigation for the proposed development of two landfill sites for the Lekwa Municipality, Mpumalanga.	Project Manager & Senior EAP:
2015 to 2017	Umgungundlovu Municipality	Advanced Solid Waste Management Project for Umgungundlovu Municipality for proposed Materials Recovery Facilities located in various Local Municipalities, Umgungundlovu Municipality, KwaZulu-Natal.	Project Manager & Senior EAP:
2019 to 2022	Buffalo Coal	Magdalena Colliery Waste Management License Application, Dundee, KwaZulu-Natal.	Project Manager & Senior EAP:
<b>Water and Wastewater Environmental Assessments</b>			
2004	Msukaligwa Municipality	Environmental Impact Assessment for the installation of a water reticulation system at Nganga for the Msukaligwa Municipality, Mpumalanga.	Senior EAP
2006 to 2010	eThekweni Municipality: Water and Sanitation	Proposed upgrading of the WWTW capacity in the Northern Areas of the eThekweni Municipality. Responsible for EIA application for authorization, technical environmental investigations, and waste management license application for the proposed expansion of the WWT capacity in Northern eThekweni, KwaZulu-Natal.	Project Manager & Senior EAP

## Project Experience

Year	Client	Project Description	Role/ Responsibility
2008	Johannesburg Water	Environmental Management Services for Johannesburg Water: Environmental Impact Assessment (Exemption) for various individual projects related to the upgrading of the Bryanston Water Mains, Gauteng.	Project Manager & Senior EAP
2014 to 2017	eThekweni Municipality: Water and Sanitation	Environmental Basic Assessment and Water Use License Application for the Northern Aqueduct Water Augmentation Project (Phase 5), Durban, KwaZulu-Natal.	Project Manager & Senior EAP
<b>Electrical and Linear Environmental Assessments</b>			
2005	Magallies Water	Application for (exemption) authorisation on behalf of Magallies Water for the installation of the Rising Main from the Roodeplaas Waterworks to the Wallmannsthal Reservoir, in Wallmannsthal, Gauteng.	Senior EAP
2010	Moloto Rail Corridor Development	EIA for the Moloto Rail Corridor Development. Responsible for the EIA application for authorization and technical environmental investigations for the proposed Moloto Rail Corridor Development, Moloto, Gauteng.	Project Manager & Senior EAP
2010	ESKOM	Environmental Basic Assessment of for the ESKOM Honingklip 88kV & ESKOM Randjiesfontein 88kV overhead line and Sub-Stations, Johannesburg, Gauteng.	Project Manager & Senior EAP
2010	ESKOM	Environmental Basic Assessment of for the ESKOM Ubertas Strategic Servitude Sub-Station, Johannesburg, Gauteng	Project Manager & Senior EAP
2014 to 2017	Msunduzi Municipality	Environmental Impact Assessment for the proposed Msunduzi IRPTN project, Pietermaritzburg, KwaZulu-Natal	Project Manager & Senior EAP
<b>Environmental and Waste Management Compliance Monitoring and Auditing</b>			
2005 to 2009	Sedibeng District Municipality	Auditing of Zuurfontein and Boitshepi Landfill sites for the Sedibeng District Municipality, Gauteng.	Part of Audit Team
2006 to 2009	ABSA DevCO	Environmental Compliance monitoring in accordance with relevant authorisation conditions and environmental management plans for the Amberfield Development on the farm Brakfontein 399 JR, Centurion, Gauteng.	Project Manager & Environmental Control Officer (ECO)
2007 to 2009	ABSA DevCO	Environmental Compliance monitoring in accordance with relevant authorisation conditions and environmental management plans for the Zambezi Estate Development, Montana, Gauteng.	Project Manager & ECO
2008 to 2009	Steve Tshwete Municipality	Auditing of Middelburg Landfill Site for the Steve Tshwete Municipality, Mpumalanga.	Part of Audit Team
2008 to 2009	ABSA DevCO	Environmental Compliance monitoring in accordance with relevant authorisation conditions and environmental management plans for the Cedar Creek Development, Fourways, Gauteng.	Project Manager & ECO
2017 to 2018	Dube TradePort	Environmental Compliance monitoring in accordance with relevant authorisation conditions and environmental management plans for the construction of TradeZone 2, Dube TradePort, La Mercy, KwaZulu-Natal.	Project Manager & ECO
2017	Richards Bay Minerals	Environmental Legal Compliance Audit to determine the level of compliance of Richards Bay	Project Manager &



## Project Experience

Year	Client	Project Description	Role/ Responsibility
		Minerals' to their various mining, water and waste licenses and environmental authorisations and permits, Richards Bay, KwaZulu-Natal.	Environmental Auditor
2017 to 2018	eThekweni Municipality	Environmental Compliance monitoring in accordance with relevant authorisation conditions and environmental management plans for the construction of the Northern Aqueduct Phase 5, Durban, KwaZulu-Natal.	Project Manager & ECO
2019	Buffalo Coal	Annual EMPr and WUL audits for Coalfields, Aviemore and Magdalena Operations, Dundee, KwaZulu-Natal.	Project Manager & Lead Auditor
2020	Buffalo Coal	Annual EMPr and WUL audits for Coalfields, Aviemore and Magdalena Operations, Dundee, KwaZulu-Natal.	Project Manager & Lead Auditor
2020	Samancor Eastern Chrome Mines	Annual Performance Assessment Audits for the following mines in Limpopo: <ul style="list-style-type: none"> <li>• Doornbosch, Steelpoort and Montrose Mines;</li> <li>• Quartz Mine;</li> <li>• Lwala Mine;</li> <li>• Lannex Mine;</li> <li>• Spitskop Mine; and</li> <li>• Tweefontein Mine.</li> </ul>	Project Manager & Technical Review
2020	ESKOM	ESKOM Biennial PCB Phase-out Compliance Audit, various sites within South Africa.	Project Manager & Lead Auditor
2020	ESKOM	Majuba Power Station Legal Compliance Audit, Volksrust, Mpumalanga.	Project Manager & Lead Auditor
2021	Zululand Anthracite Colliery	Annual IWUL Audit for 2020, Mandlakazi Traditional Authority, KwaZulu-Natal	Project Manager & Technical Review
2021	ESKOM	Kendal Power Station Legal Compliance Audit, eMalahleni Local Municipality, Mpumalanga.	Project Manager & Lead Auditor
2021	Coalition Trading	External Compliance Audit for the Humberdale Landfill Site, in terms of the Waste Management Permit, KwaZulu-Natal	Project Manager & Auditor
2021	Tronox KZN Sands (Pty) Ltd	NEM: WA Norms and Standards External Waste Compliance Audit for the Tronox Central Processing Complex located in Empangeni, KwaZulu-Natal	Project Manager & Lead Auditor
Integrated Water Use License Applications			
2010	FOSKOR	Integrated Water Use License Application for a new storage dam for FOSKOR, Richards Bay, KwaZulu-Natal.	Part of Project Team
2014 to 2015	SANRAL	Integrated Water Use License Applications as required for the proposed SANRAL N2 Road upgrade from Mthunzini to Empangeni, KwaZulu-Natal.	Project Manager & Senior EAP
2014	eThekweni Municipality: Roads	Integrated Water Use License Application for the proposed Realignment of Inanda Arterial Road, Durban, KwaZulu-Natal.	Project Manager & Senior EAP

## Project Experience

Year	Client	Project Description	Role/ Responsibility
2015 to 2017	SMEC (Umzimkhulu Municipality)	Integrated Water Use License Application for the proposed Licensing of the existing Umzimkhulu Waste Water Treatment Works, Umzimkhulu, KwaZulu-Natal.	Project Manager & Senior EAP
2014 to 2016	eThekweni Municipality: Roads	Water Use License Application for the proposed eThekweni BRT Route C1A, Durban, KwaZulu-Natal.	Project Manager & Senior EAP
2019 to 2020	Zululand Anthracite Colliery	Integrated Water Use License Application for the new Mngeni Adit and associated infrastructure, Mandlakazi Traditional Authority, KwaZulu-Natal.	Project Manager & Senior EAP
2019 to 2021	South32 SA Coal Holdings	Integrated Water Use License Application for the Roy Point Mine, Newcastle, KwaZulu-Natal.	Project Manager & Senior EAP
2020 to 2022	Buffalo Coal	Integrated Water Use License Amendment Application for the Magdalena Colliery, Dundee, KwaZulu-Natal.	Project Manager & Senior EAP
2020 to 2022	Buffalo Coal	Integrated Water Use License Application for the Coalfields Processing Plant, Dundee, KwaZulu-Natal.	Project Manager & Senior EAP
<b>Management and Master Plans</b>			
2005	Livingstone Municipality	Development of the Livingstone Integrated Development Plan, Zambia.	Part of the Project Team
2008	Steve Tshwete Municipality	Development of an Integrated Waste Management Plan for the Steve Tshwete Municipality, Mpumalanga.	Part of the Project Team
2008	Kungwini Local Municipality	Development of an EMP (Framework) for Kungwini Local Municipality, Mpumalanga.	Part of the Project Team
2010	KZN Department of Public Works - Southern Region	Compilation of an Environmental Management Plan for the Fort Napier sewage upgrading project, Pietermaritzburg, Kwa-Zulu Natal.	Project Manager & Senior EAP




## Declaration

---

### DECLARATION

I, Gerda Bothma hereby declare that the details furnished above are true and correct to the best of my knowledge and belief and I undertake to inform you of any changes therein, immediately. In case any of the above information is found to be false or untrue or misleading or misrepresenting, I am aware that I may be held liable for it.

Signature:  Date: 21/02/2024



# University of Pretoria

The Council and Senate hereby declare that  
at a congregation of the University the degree

## Baccalaureus Scientiae with specialization in Biological Sciences

with all the associated rights and privileges  
was conferred on

**GERDA DE LANGE**

in terms of the Act and Statute of the University

On behalf of the Council and Senate  
(Sgd) P Smit  
Vice-Chancellor and Principal

On behalf of the Faculty of  
Science  
(Sgd) N Sauer  
Dean

(Sgd) CR de Beer  
Registrar

Date of Conferment  
8 December 1994

Certified a true translation of the original Certificate

  
Registrar

Signed at Pretoria on the third day of September, 2008



# University of Pretoria

The Council and Senate hereby declare that  
at a congregation of the University the degree

## Baccalaureus Scientiae Honores with specialization in Microbiology

with all the associated rights and privileges  
was conferred on

**GERDA DE LANGE**

in terms of the Act and Statute of the University

On behalf of the Council and Senate  
(Sgd) P Smit  
Vice-Chancellor and Principal

On behalf of the Faculty of Biological  
and Agricultural Sciences  
(Sgd) J van Zyl  
Dean  
(Sgd) JA Boon  
Registrar

Date of Conferment  
27 March 1996

Certified a true translation of the original Certificate

  
Registrar

Signed at Pretoria on the third day of September, 2008



**herewith certifies that**

**Gerda Bothma**

Registration Number: 117348

**is a registered scientist**

in terms of section 20(3) of the Natural Scientific Professions Act, 2003  
(Act 27 of 2003)  
in the following field(s) of practice (Schedule 1 of the Act)

Environmental Science (Professional Natural Scientist)

Effective **15 November 2017**

Expires **31 March 2024**



A handwritten signature in black ink, appearing to read 'S. Neph', written over a horizontal line.

Chairperson

A handwritten signature in black ink, appearing to read 'N. S. S. S.', written over a horizontal line.

Chief Executive Officer





## CORE SKILLS

- Project Management
- Environmental Impact Assessment
- Environmental Impact Management
- Water Use Licencing
- Waste Management Licencing
- Integrated Water and Waste management Plans
- Environmental & Waste Auditing and Compliance Monitoring

## DETAILS

### Qualifications

- BSc (Honours) Environmental Monitoring and Modelling University of South Africa, 2020
- BSc Zoology University of KwaZulu-Natal, 2006

### Memberships/ Professional Affiliations

- International Association for Impact Assessors of South Africa (IAIA)
- SACNASP (No.008920) (South African Council for Natural Scientific Professionals)
- Environmental Assessment Practitioners Association of South Africa: Registered Environmental Assessment Practitioner (Reg. No. 2022/4847)

### Languages

- Afrikaans
- English

### Countries worked in:

South Africa

## PROFILE

Ms Reneé Steele has 15 years' experience in the environmental field and strives to provide quality consulting services to client to meet their environmental legislative obligations.

Renee has been involved in a wide range of projects for clients across the industrial, residential, agricultural and mining sectors. These projects have included environmental impact assessments; mining right, mining permit, prospecting permit applications; environmental due diligence; water use licence applications; environmental performance auditing and Environmental Control Officer (ECO) work.

In addition to two formal degrees, Reneé has completed accredited training in respect of the implement of the ISO9001:2015, ISO 14001:2015 and ISO 45001:2018 standards.

Renee has specialist skills in the following areas:

- Project proposals, planning, costing and timing
- Project and client management
- Authority Liaison
- Basic Assessments & Scoping/EIA Processes
- Amendment of Environmental Management Programmes
- Facilitation of Public Participation Processes & Stakeholder Engagement
- Water Use Licence Applications
- Integrated Water and Waste Management Plan compilation
- Environmental Control Officer (ECO) duties
- Environmental Compliance Auditing

## Project Experience

Period	Employer	Position	Role/ Responsibility
2017 to present	Steele Environmental Consulting	Director and Principal Environmental Consultant	<ul style="list-style-type: none"> <li>• Management of projects to ensure projects are completed within the agreed upon or legislated timeframe.</li> <li>• Managing project budgets.</li> <li>• Management of interdisciplinary specialist teams.</li> <li>• Environmental Control Officer duties.</li> <li>• Marketing to new clients and compiling proposals.</li> <li>• Environmental auditing and consulting.</li> <li>• Environmental Impact Assessments.</li> </ul>
2007- 2016	GCS Water and Environmental Consultants	Senior Environmental Consultant	<ul style="list-style-type: none"> <li>• Management of project timeframes to ensure projects were completed within the agreed upon or legislated timeframe.</li> <li>• Liaison with clients, provincial and national authorities, and the public.</li> <li>• Management of interdisciplinary specialist teams.</li> <li>• Managing project budgets.</li> <li>• Undertaking Environmental Impact Assessments, Water Use Licence Applications, Environmental Performance Audits, Water Use Licence audits, Environmental Management Programme amendments and permit applications.</li> <li>• Marketing and compilation of proposals.</li> </ul>

Year	Client	Project Description	Role/ Responsibility
<b>Water Use Licensing &amp; IWWMPs</b>			
2015	Kangra Coal	Ballengeich and Shanduka Siding Remediation IWULA/IWWMP, Newcastle, KwaZulu-Natal	IWWMP Compilation, liaison with authorities.
2014	Exxaro	Glisa Coal Mine Water Treatment Plant: Belfast, Mpumalanga	IWULA/IWWMP compilation.
2012	Exxaro	Matla Colliery Water Treatment Plant: Kriel, Mpumalanga	Review of IWULA submitted, follow up and submission of outstanding information.
2012	Assmang Chrome	Assmang Dwarsrivier GN704 Exemption application: Steelpoort, Limpopo	GN704 inspection, compilation of exemption application.
2012	Transvaal Gold Mining Estates (Pty) Limited	TGME Glynn's Lydenburg and Rietfontein IWULA follow up: Lydenburg and White River	Follow up with the DWS and submission of additional information.
2012	Magaliesberg Water	Magaliesberg Water, Brits, North West Province	WULA compilation.
2012	Mpumalanga Provincial Government: Department of Roads and Transport	P166/R40 Link Road WULA: Nelspruit, Mpumalanga Province	IWULA compilation
2011	Exxaro	Glisa Colliery North Block Complex IWULA amendment: Belfast, Mpumalanga Province	IWULA and IWWMP compilation.
2010	Gold Fields	Gold Fields Centralised Tailings Storage Facility- Integrated Water Use Licence Application (IWULA), Carletonville, Gauteng Province	IWULA and IWWMP compilation.
2010	Total Coal	Forzando North IWULA separation and update: Bethal, Mpumalanga Province	IWULA amendment report compilation.
2010	Assmang Chrome	Dwarsrivier Chrome Mine: Tailings Storage Facility: Steelpoort, Limpopo Province	Public consultation and IWUL compilation.
2009	Namakwa Diamonds	Namakwa Diamonds Water Use Licence Applications, Northern Cape: Various locations within the Northern Cape Province	IWULA compilation.
2009	Rainbow Farms (Pty) Ltd	Rainbow Farms (Pty) Ltd: Water Use Registrations and Licensing: Gauteng, Mpumalanga, KwaZulu-Natal, Eastern Cape, Western Cape	Registration and IWULA Report compilation and follow up.
2008	Mpumalanga Provincial Government: Department of Roads and Transport	P166 Bypass Road: Water Use Licence Application: Nelspruit, Mpumalanga Province	IWULA compilation.
2008	Mpumalanga Provincial Government: Department of Roads and Transport	R40 Road upgrade Water Use Authorisation Application: Nelspruit, Mpumalanga Province	GA application report compilation.
2008	Anglo Platinum	Richmond Mine IWULA, Limpopo Province	IWULA compilation.

## Project Experience

Year	Client	Project Description	Role/ Responsibility
2008	Schamach Wildlife Estate cc	Schamach Wildlife Estates: Water Use Authorisation Application: Modimolle, Limpopo Province	General authorisation application report compilation.
<b>EIA and EMP</b>			
2014	South 32	Roypoint Mine Remediation Project Newcastle, KwaZulu-Natal	Project management, compilation of EIA, EMP and IWULA (handed over before completion due to retrenchment in August 2016).
2013	Kangra Coal	Kangra Coal Maquasa East Discard Dump: Piet Retief, Mpumalanga	Project Manager, public consultation, and compilation of EIA, EMP and IWULA.
2014	Namaqua Nickel Mining (Pty) Ltd	Jacomynspan Mining Right Application: Putsonderwater, Northern Cape Province	Environmental Scoping Report and EIA Report compilation.
2013	Two Rivers Platinum	Two Rivers Platinum New Tailings Storage Facility: Steelpoort, Limpopo	NEMA EIA/EMP Report compilation.
2013	Northam Zondereinde	Northam Zondereinde Mine MPRDA EMP consolidation: Northam, Limpopo	Project management, MPRDA EMP compilation
2013	Northam Zondereinde	Northam Zondereinde Mine NEM: WA Basic Assessment: Northam, Limpopo	Project management, NEM:WA Basic Assessment process (including public consultation).
2012	Total Coal	Coal Briquetting Plant EMP Addendum for Total Coal Forzando North Coal Mine: Bethal, Mpumalanga Province	Compilation of EMP addendum.
2012	Kgosana Mineral and Construction	Mining Permit Environmental Management Plans for Coal Mining Permit Applications: Witbank, Mpumalanga Province	Project management, mining permit application, public consultation and EMP compilation.
2012	Main Street 778 (Pty) Ltd	Mukulu Project EMP & NEMA Process: Hotazel, Northern Cape Province	Project management, NEMA and MPRDA process, including report compilation and public consultation.
2012	Transworld Energy and Mineral Resources South Africa	Kwanyana Block Prospecting Right Application: Bizana, Eastern Cape Province	Report compilation and public consultation.
2012	Transworld Energy and Mineral Resources South Africa	Tormin Mineral Sands Resources Prospecting Right Application: Lutzville Western Cape Province	Report compilation and public consultation.
2011	Witkop Exploration and Mining	Witkop Exploration and Mining- Mining Permit Application: Viljoenskroon, Free State Province	Public notification and ESR compilation.
2010	Assmang Iron Ore	Assmang Iron Ore, Beeshoek Mine: Road Diversion: Beeshoek, Northern Cape Province	Public consultation and EIA/EMP report compilation.

## Project Experience

Year	Client	Project Description	Role/ Responsibility
2010	African Exploration Mining and Finance Corporation	African Exploration Mining and Finance Corporation Prospecting Permit, Cape Town, and Stellenbosch: Cape Town and Stellenbosch, Western Cape Province	Public consultation, compilation of EMP and Stakeholder Engagement Report.
2010	ArcelorMittal South Africa	ArcelorMittal South Africa Vanderbijlpark Works Temporary Storage Area: Vanderbijlpark, Gauteng Province	Compilation of Basic Assessment Report.
2009	Rand Refinery	Rand Refinery Cadmium Furnace Project, Exemption Application: Germiston, Gauteng Province	Public consultation, compilation of exemption application and EMP.
2009	Booyseendal Platinum Limited	Northam Booyseendal Mine: Environmental Authorisation: Roosenekal, Limpopo Province	Environmental Scoping Report compilation.
2009	Moshutwa Trading	Moshutwa Trading Prospecting Permit Application, Lephalale: Lephalale, Limpopo Province	Prospecting right application, public notification, and compilation of EMP and stakeholder engagement report.
2009	NFT Quarries	NFT Quarries Mining Permit Application, East London (Council for Geoscience): East London, Eastern Cape Province	Prospecting right application, public notification, and compilation of EMP and stakeholder engagement report.
<b>Environmental Control Officer</b>			
2017-2023	Booyseendal Platinum Limited	Booyseendal Platinum Mine South Expansion Project	Environmental Control Officer duties
<b>Environmental Performance Audits</b>			
2023	Sitatunga Manganese	East Manganese Mine, Hotazel, Northern Cape	PAR and WUL Audit
2023	Canyon Coal	Rietkuil Siding, IWUL audit, Mpumalanga (2023)	IWUL performance audit
2023	Canyon Coal	Pan Siding, IWUL audit, Mpumalanga (2023)	IWUL performance audit
2023	Menar (Pty) Ltd	Menar Riverside Anthracite Colliery, PAR, Vryheid, KwaZulu-Natal	NEMA Regulation 34 Performance Assessment
2022	Steynol (Pty) Ltd	Steynol Welgedacht siding IWUL Audit	IWUL performance audit
2021	Canyon Coal	Canyon Coal Hakhano Colliery, Middleburg Mpumalanga	IWUL performance audit and NEMA PAR.
2020	Canyon Coal	Rietkuil Siding, IWUL audit, Mpumalanga (2019 and 2021)	IWUL performance audit
2020	Canyon Coal	Pan Siding, IWUL audit, Mpumalanga (2019 and 2021)	IWUL performance audit
2019	Canyon Coal	Canyon Coal Hakhano Colliery, Middleburg Mpumalanga (2019)	IWUL performance audit and NEMA PAR.

## Project Experience

Year	Client	Project Description	Role/ Responsibility
2019	Canyon Coal	Canyon Coal Argent Siding, Mpumalanga	IWUL performance audit
2017	Assmang Chrome	Assmang Chrome Machadadorp Works, Machadorp, Mpumalanga	IWUL, Waste Licence, EMP and environmental authorisation performance audits
2017	Kathu Solar Park	Kathu Solar Park, Kathu, Northern Cape	EMP and IWUL performance audits.
2013	Anglo Coal	Anglo Lephalale Coal Bed Methane GA: Lephalale, Limpopo	Reporting on General Authorisation compliance.
2013	Anglo Platinum Limited	Anglo Platinum Limited: Polokwane Metallurgical Complex (PMC), Polokwane, Limpopo	IWUL compliance audit and reporting.
2012	Northam Zondereinde	Northam Zondereinde Mine Environmental Performance Assessment; Northam, Limpopo	Environmental Performance Assessment (EMP)
2009	SNS Bricks	SNS Bricks, Vereeniging, Environmental Performance Audit: Vereeniging, Gauteng Province (2009).	Environmental Performance Assessment (Environmental Authorisation)
2009	Xstrata	Xstrata Horizon Mine Waste Licence Audit: Rustenburg, North West Province	Environmental Performance Assessment (Waste Licence)
2008	SNS Bricks	SNS Bricks, Vereeniging, Environmental Performance Audit: Vereeniging, Gauteng Province (2008).	Environmental Performance Assessment (Environmental Authorisation)
<b>Due Diligence</b>			
2012	Assmang Iron Ore	Assmang Beeshoek Mine Environmental Legal Gap Analysis: Beeshoek, Northern Cape Province	Environmental Due Diligence Assessment process and report compilation.
2011	Lonmin Platinum	Lonmin Platinum Limpopo: Gap Analysis and Due Diligence Assessment: Lebowakgomo, Limpopo Province	Due diligence assessment and report compilation.
<b>Other</b>			
2009	ArcelorMittal South Africa	ArcelorMittal South Africa Vanderbijlpark Works Dam 10 and CETP Dams Remediation: Vanderbijlpark, Gauteng Province	Compilation of Remediation Alternatives Report.
2009	ArcelorMittal South Africa	ArcelorMittal South Africa- Dunswart Waste Site Remediation: Benoni, Gauteng Province	Site Remediation Alternatives Report compilation.
2010	Department of Water Affairs	Groundwater Information Project: KwaZulu-Natal	Review and capture borehole data and attend monthly feedback meetings with the DWS.



### DECLARATION

I, Reneé Steele hereby declare that the details furnished above are true and correct to the best of my knowledge and belief and I undertake to inform you of any changes therein, immediately. In case any of the above information is found to be false or untrue or misleading or misrepresenting, I am aware that I may be held liable for it.

Signature: \_\_\_\_\_

Date: 20/02/2024



**Environmental Assessment  
Practitioners Association  
of South Africa**



Registration No. 2022/4847

***Herewith certifies that***

**Renee Lynneil Steele**

***is registered as an***

**Environmental Assessment Practitioner**

***Registered in accordance with the prescribed criteria of Regulation 15. (1)  
of the Section 24H Registration Authority Regulations  
(Regulation No. 849, Gazette No. 40154 of 22 July 2016, of the  
National Environmental Management Act (NEMA), Act No. 107 of 1998, as  
amended).***

Effective: 01 March 2023

Expires: 29 February 2024

Chairperson

Registrar







**herewith certifies that**  
**Renee Lynneil Steele**  
Registration Number: 008920  
**is a registered scientist**

in terms of section 20(3) of the Natural Scientific Professions Act, 2003  
(Act 27 of 2003)  
in the following field(s) of practice (Schedule 1 of the Act)  
Environmental Science (Professional Natural Scientist)

Effective    **23 October 2013**

Expires      **31 March 2024**



A handwritten signature in black ink, appearing to read 'S. Neph', is positioned above a horizontal line.

Chairperson

A handwritten signature in black ink, appearing to read 'N. S. S.', is positioned above a horizontal line.

Chief Executive Officer





*We certify that*

**RENEE LYNNEIL FRANCIS**


*having complied with the requirements of the Higher Education Act  
and the Institutional Statute, was admitted to the degree of*

**BACHELOR OF SCIENCE HONOURS**  
*in Environmental Monitoring and Modelling*

*at a congregation of the University  
on 5 October 2020*



Vice Chancellor



Executive Dean



University Registrar

29810355037437G05702





# UNIVERSITY OF KWAZULU-NATAL

The Universities of Durban-Westville and Natal merged  
to become the University of KwaZulu-Natal on 1 January 2004

*This is to certify that*

***Renee Lynneil Francis***

*was admitted this day  
at a congregation of the University  
to the degree of*

***Bachelor of Science  
(Zoology)***

*having satisfied the conditions prescribed for the degree.*



M W Makgoba  
Vice-Chancellor

E Mneney  
Registrar

J A Cooke  
Dean

21 April 2007

LIV PROTECTED

---

## APPENDIX C: PUBLIC PARTICIPATION REPORT





63 Wessel Road, Rivonia, 2128 PO Box 2597, Rivonia, 2128 South Africa  
Tel: +27 (0) 11 803 5726 Fax: +27 (0) 11 803 5745 Web: [www.gcs-sa.biz](http://www.gcs-sa.biz)

# Public Participation Report: Integrated Environmental Authorisation Application for the Proposed Wastewater Treatment Plant and Co-Disposal Facility for Maquasa East Operations

Version: Final  
25 January 2024



GCS Project Number: 22-0161  
DMR Reference: MP 30/5/1/23/2/1/133 EM  
Client reference: KC/003/22



GCS (Pty) Ltd. Reg No: 2004/000765/07 Est. 1987

Offices: Johannesburg (Head Office) | Durban | Gaborone | Lusaka | Maseru | Windhoek | Ostrava

Directors: AC Johnstone (CEO) | A Gunn (COO) | A Wilke | M Van Rooyen | W Sherriff (Financial) | N Marday (HR)

**Public Participation Report:  
Integrated Environmental Authorisation Application for the Proposed Wastewater Treatment  
Plant and Co-Disposal Facility for Maquasa East Operations**

**Version: Final**



**25 January 2024**

**Kangra Coal (Pty) Ltd**

**DOCUMENT ISSUE STATUS**

<b>Report Issue</b>	<b>Final</b>		
<b>GCS Reference Number</b>	22-0161		
<b>Title</b>	Public Participation Report:  Integrated Environmental Authorisation Application for the Proposed Wastewater Treatment Plant and Co-Disposal Facility for Maquasa East Operations		
	<b>Name</b>	<b>Signature</b>	<b>Date</b>
<b>Author</b>	Reneé Steele		January 2024
<b>Document Reviewer</b>	Gerda Bothma		January 2024

**LEGAL NOTICE**

This report or any portion thereof and any associated documentation remain the property of GCS until the mandatory effects payment of all fees and disbursements due to GCS in terms of the GCS Conditions of Contract and Project Acceptance Form. Notwithstanding the aforesaid, any reproduction, duplication, copying, adaptation, editing, change, disclosure, publication, distribution, incorporation, modification, lending, transfer, sending, delivering, serving or broadcasting must be authorised in writing by GCS.

In compliance with the Protection of Personal Information Act, No. 37067 of 26 November 2013, please ensure the following:

- Any personal information provided herein has been provided exclusively for use as part of the public participation registration process, and may therefore not be utilised for any purpose, other than that for which it was provided.
- No additional copies may be made of documents containing personal information unless permission has been obtained from the owner of said information.
- All documentation containing personal information must be destroyed as soon as the purpose for which the information was collected has run out.

---

## CONTENTS PAGE

<b>1</b>	<b>INTRODUCTION .....</b>	<b>1</b>
<b>2</b>	<b>SUMMARY OF THE ENVIRONMENTAL AUTHORISATION CONSULTATION PROCESS .....</b>	<b>1</b>
2.1	STAKEHOLDER DATABASE .....	1
2.2	PRE-APPLICATION CONSULTATION .....	2
2.3	SCOPING PHASE PUBLIC PARTICIPATION .....	2
<b>3</b>	<b>COMMENTS AND RESPONSE SUMMARY .....</b>	<b>3</b>
	COMMENTS RECEIVED DURING THE PROJECT ANNOUNCEMENT AND SCOPING CONSULTATION PHASE .....	4
<b>4</b>	<b>CONCLUSION .....</b>	<b>6</b>

## LIST OF APPENDICES

APPENDIX A: Stakeholder Database.....	7
APPENDIX B: Advertisements .....	8
APPENDIX C: Site Notices .....	11
APPENDIX D: Background Information Document .....	15
APPENDIX E: Documents for Public Review .....	16
APPENDIX F: Notifications and Delivery Receipts.....	19

## 1 INTRODUCTION

Kangra Coal (Pty) Ltd's (Kangra) Maquasa mining operation is located approximately 45km west of Piet Retief and just off the N12 national road on a secondary road leading to the Heyshope Dam, within the Mpumalanga Province. Kangra intends to construct a wastewater treatment plant (WWTP) for the treatment of effluent, and a new co-disposal facility (CDF), including supporting and associated infrastructure, at their Maquasa East (MQE) Operations.

Kangra requires the environmental authorisation prior to the commencement of the proposed development:

- An Integrated Environmental Authorisation (IEA) and Waste Management License (WML). This requires a Scoping and Environmental Impact Reporting (S&EIR) process and the compilation of an Environmental Management Programme (EMPr), in terms of the National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA), National Environmental Management: Waste Act, 2008 (Act 59 of 2008) (NEMWA), and Environmental Impact Assessment (EIA) Regulations (2014, as amended) (IEA Application); and
- An Integrated Water Use License (IWUL), in terms of the NWA.

Chapter 6 of the Environmental Impact Assessment (EIA) Regulations published in Government Notice R 982 in Government Gazette No. 38282 of 4 December 2014 (as amended), sets out the requirements for the public participation process. This report provides a summary of the issues, concerns and responses raised during the PPP thus far, as well as evidence of the public participation undertaken this far.

## 2 SUMMARY OF THE ENVIRONMENTAL AUTHORISATION CONSULTATION PROCESS

### 2.1 Stakeholder Database

A stakeholder database or list of Interested and Affected Parties (I&APs) was compiled and will be updated during the PPP and as more I&APs register (refer Appendix A for the database which excludes contact details). The database was compiled using lists of contact details of I&APs from previous environmental applications for MQE; using information provided by the applicant's community liaison officers; and including responses from I&APs during the current public participation.

The stakeholder database includes landowners of the properties over which the development is proposed; surrounding landowners and occupants; local and provincial government, commenting authorities (e.g. Department of Water and Sanitation and Mpumalanga Department of Economic Development, Environment and Tourism (MDEDET)); relevant residents' associations, agricultural unions, community-based organisations, water user associations, and any catchment management authority and Non-Governmental Organisation (NGOs); environmental organisations, forums, groups and associations; and private sector organisations (businesses, industries) in the vicinity.

## 2.2 Pre-application Consultation

During preapplication, all I&APs were provided to opportunity to register for proposed project. The integrated application process was announced to I&APs by means of the following:

- An advertisement was placed in the Excelsior News on the 27th of January 2023 (Refer to Appendix B-1); and
- Site Notices were placed all around the project area (Refer to Appendix C-1).

## 2.3 Scoping Phase Public Participation

The continuation of the integrated application process, the commencement of the Scoping Phase, and the availability of the Draft Scoping Report (DSR) was announced to I&APs by means of the following:

- An advertisement was placed in the Excelsior News on the 24th of November 2023 (Refer to Appendix B-2);
- A Background Information Document (BID) was compiled and distributed to all I&APs on the stakeholder database. A Registration and Comment Sheet was distributed with every BID, inviting stakeholders to register as I&APs and to provide their comments on the proposed development (Refer to Appendix D);
- Site Notices were placed all around the project area (Refer to Appendix C-2); and
- Placement of copies of the notification documentation and the BIDs on the GCS website (<https://www.gcs-sa.biz/public-documents/>). (Refer to Appendix E). The GCS website is used to make documents electronically available to stakeholders. The website address was published in the advertisement, BIDs, site notices and all other communication.

The DSR was available for public comment for 30 days, with the comment period ending on 16 January 2024. The DSR was available for review at the following public venues:

- Piet Retief Library, 10B Retief Street
- Maquasa East Security Office, Maquasa East Mine

- Thusong Service Centre, Driefontein Community

The Report is also available electronically via the GCS Website (Refer to the proof under Appendix E).

***No public meetings were held during the scoping phase. A public meeting is planned for the EIA phase and will be advertised during the EIA Phase public participation.***

### 3 COMMENTS AND RESPONSE SUMMARY

The issues, concerns and comments received have been recorded and responded to within the table overleaf.

Please note that all responses in *italics* and/or **bold** are from the EAP and responses from the Applicant are in ***orange bold italics***.



ISSUE OR CONCERN	CONTRIBUTOR	DATE AND MEANS OF CONTRIBUTION	RESPONSE
<b>Comments received during the project announcement and scoping consultation phase</b>			
<p>Dear Sir/Madam</p> <p>DFFE Directorate: Biodiversity Conservation hereby acknowledge receipt of the invitation to review and comment on the project mentioned on the subject line. Kindly note that the project has been allocated to Mrs P Makitla and Ms Tebego Kgaphola (Copied on this email).</p> <p>In addition, kindly share the shapefiles of the development footprints/application site with the Case Officers. Please provide us with a google drive link as we are failing to access dropbox and wetransfer links.</p> <p>Please note: All Public Participation Process documents related to Biodiversity EIA review and any other Biodiversity EIA queries must be submitted to the Directorate: Biodiversity Conservation at Email: BCAdmin@dfpe.gov.za for attention of Mr Seoka Lekota.</p>	<p>Mr. Seoka Lekota Control Biodiversity Officer Grade B: Biodiversity Conservation</p> <p>Department of Forestry, Fisheries &amp; the Environment</p>	<p>04 December 2023 - Email Correspondence</p>	<p><b><u>EAP Response via Email on 15 January 2023</u></b></p> <p>Good day,</p> <p>Thank you kindly for your email. Please find below the google drive link as requested. We have included the draft report and its appendices as well as the shapefiles requested. <a href="https://drive.google.com/drive/folders/19XarBJ8c_dyaRJH51MqN WmnTtqb1FadL?usp=sharing">https://drive.google.com/drive/folders/19XarBJ8c_dyaRJH51MqN WmnTtqb1FadL?usp=sharing</a></p> <p>please kindly confirm whether the shared link is working correctly and that access to the content is working.</p> <p>Kind regards, Gerda Bothma</p>
<p>The Directorate: Biodiversity Conservation has reviewed and evaluated the reports.</p> <p>The Directorate: Biodiversity Conservation has reviewed and evaluated the reports and does not have any objection to the draft Scoping Report and the Plan of Study for EIA.</p> <p>To ensure the continued persistence of ecosystems and that national conservation targets are achieved, it is essential that impacts on sensitive and highly localised habitats are minimized or avoided altogether.</p> <p>The EIA report must comply with the procedures for the assessment and minimum criteria for reporting on identified environmental themes in terms of sections 24(5) (A) and (H) and 44 of the National</p>	<p>Mr. Seoka Lekota Control Biodiversity Officer Grade B: Biodiversity Conservation</p> <p>Department of Forestry, Fisheries &amp; the Environment</p>	<p>16 January 2024 - Letter sent via email</p>	<p><b><u>EAP Response via Email on 17 January 2023:</u></b></p> <p>Dear Tebego,</p> <p>Thank you kindly, well received.</p> <p>Kind regards, Gerda Bothma</p>

ISSUE OR CONCERN	CONTRIBUTOR	DATE AND MEANS OF CONTRIBUTION	RESPONSE
<p>Environmental Management Act, 1998. Additionally, the National List of Threatened Ecosystems was revised therefore the draft EIA report must refer to the Revised National List of Threatened Terrestrial Ecosystems, 2022.</p> <p>In conclusion, the Public Participation Process documents related to Biodiversity EIA for review and queries should be submitted to the Directorate: Biodiversity Conservation at Email; <a href="mailto:BCAdmin@dfpe.gov.za">BCAdmin@dfpe.gov.za</a> for the attention of Mr. Seoka Lekota.</p>			
<p>The sensitivity of the area in which proposed development is likely to occur will be assessed in accordance with the Mpumalanga Biodiversity Sector Plan (MBSP, 2014 as updated 2022) land use guidelines. This sensitivity is assessed in terms of both terrestrial and freshwater assessments.</p> <p>In the MBSP, sensitive areas are identified in terms of Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs). CBAs and ESAs are deemed to be necessary to ensure protection of biodiversity, environmental sustainability, and human well-being. CBAs are required to meet both national and provincial biodiversity targets and should remain natural.</p> <p>Recommendation: Please consult the MBSP online public portal when planning. The MTPA takes note of the content of the draft scoping report and looks forward to receiving the final scoping report once it is ready for comment.</p>	Mr M.H. Vilikazi Chief Executive Officer	7 December 2023- Letter sent via email	<p><b><u>EAP Response in CRR:</u></b></p> <p>These comments will be incorporated in the EIA Phase.</p>

## 4 CONCLUSION

This report forms part of the Scoping and Environmental Impact Assessment process for the Integrated Environmental Authorisation Application for the proposed wastewater treatment plant and co-disposal facility for Maquasa East Operations. The aim of the report was to summarise the issues, concerns and responses raised during the application process undertaken thus far, in line with the legislated requirements. This report will be updated and will be presented to the authorities and other I&APs together with the consultation and final reports as a full record of issues raised, including responses on how the issues were considered during the application process.

## **APPENDIX A: STAKEHOLDER DATABASE**

REF. NO.	SECTOR	TITLE	FIRST NAME	SURNAME	Position	ORGANISATION
1	Provincial Authority	Mr	A	Tshivhandekano		Department of Mineral Resources
2	Provincial Authority	Ms	M. J.	Musekene		Department of Water Affairs
3	Provincial Authority	Ms	T	Mahlaku		Mpumalanga Department of Economic Development, Environment and Tourism
4	Provincial Authority	Mr	L	Shabane		Department of Agriculture
5		Mr	Jan	Venter		Department of Agriculture: Natural Resource Investigation Unit- Ermelo
6	Provincial Authority	Mrs	Nkosazana	Machete		South African Heritage Resource Agency
7	Provincial Authority	Mr	Simon	Shoba		Mpumalanga Tourism and Parks Agency
8	Provincial Authority	Mr	Frans	Krige		Mpumalanga Tourism and Parks Agency
9	Provincial Authority	Mrs	Celia	De Waal	EIA Data Capturer LUA, Biodiversity Conservation: Scientific Services	Mpumalanga Tourism and Parks Agency
10	Provincial Authority	Mr.	R.P.	Leeba		Department of Education
11	Provincial Authority		Matshilele	Ramovha		Department of Mineral Resources
12	Provincial Authority	Mr	Sam	Nkosi		Land Claims Commissioner- Mpumalanga
13	Local Authority (Municipality)	Cllr	A. T.	Thwala		Mkhondo Local Municipality Ward Councillor (1 Driefontein)
14	Local Authority (Municipality)	Cllr	B. J.	Vilakazi		Mkhondo Local Municipality PR Councillor (1 Driefontein)
15	Local Authority (Municipality)	Cllr	J. L. T.	Brussow		Mkhondo Local Municipality Ward Councillor (7 Piet Retief)
16	Local Authority (Municipality)	Cllr	V. D.	Nkosi		Mkhondo Local Municipality PR Councillor (7 Piet Retief)
17	Local Authority (Municipality)	Ms.	B.	Myeni		Mkhondo Local Municipality MMC: Planning & Economic Development
18	Local Authority (Municipality)	Mr.	P.	Hlatshwayo		Mkhondo Local Municipality MMC: Infrastructure & Technical Services
19	Local Authority (Municipality)	Mr.	S.	Myeni		Mkhondo Local Municipality Ward Committee (1 Driefontein)
20	Ward Councillor	Ms	F.	Nyembe		Gert Sibande District Municipality
21	Ward Councillor	Mr	P .	Magagula		Gert Sibande District Municipality
22	Provincial Authority		Lloyd	Bokoba		DWA: CME
23	Provincial Authority		Tornado	Kunene		DWA
24	Provincial Authority		S.E	Shange		DWA: East Ops
25	Provincial Authority		M.P	Ngcobo		DWA: Revenue
26	Provincial Authority		Glenda	Asaram		DWA
27	Provincial Authority		Bhabha	Mkhungo		DWA
28	Provincial Authority		Elias	Mamanyoha		DWA
29	Provincial Authority		Frans	Isaacs		DWA.CME
30	Provincial Authority	Mr	Tebogo	Kgaphola	Directorate: Biodiversity Mainstreaming and EIA Branch: Biodiversity and Conservation	Department of Forestry Fisheries and the Environment
31	Provincial Authority	Mr	Seoka	Lekota	Control Biodiversity Officer Grade B: Biodiversity Conservation	Department of Forestry Fisheries and the Environment
32	Parastatal/Service Provider		Tony	Sibiya		Inkomati CMA
33	Parastatal/Service Provider		Cholo	Derrick		Usutu River
34	Parastatal/Service Provider		W. L	Weber		Auysspruit F/A
35	Parastatal/Service Provider		Joseph	Mabunda		ICMA
36	Businesses		Dannie	Naude		NTE
37	Businesses		Raj	Moodley		NTE
38	Businesses		Graham	Shand		private
39	Businesses		Mike	Treble		TWK Agriculture Ltd
40	Businesses	Mr	Simeon Foreman	Motha		Intuthuko Business Development Centre (Pty) Ltd & Digital Business College
41	Businesses	Mr	Mangoba	Nhlapho		
42	Businesses	Mr	Dumisani	Simelane		Intuthuko Business Development cc.
43	Businesses	Mr	Sanele	Mwali		Vukuzenzele Civils Holdings (Pty) Ltd
44	Interested and Affected Parties		G.F	Loubser		Community NEPA
45	Provincial Authority	Mr.	Kerry	Taljad		Tourism
46	Local Authority (Municipality)	Ms	Gcinile	Mbatha		Mkhondo Municipality
47	District Municipality	Ms	Tebogo	Mogakabe		Gert Sibande Municipality
48	Parastatal/Service Provider	Mr	Modisa	Phakedi	Project Manager	ESKOM
49	Parastatal/Service Provider	Ms.	Zarina	Vali		Mkhondo Library
50	Businesses	Mr	Sieghard	Knöcklein		KZK Urban Planning Studios
51	Businesses	Mr	David	Lindley	Project Executant	Mondi
52	Businesses					Mondi
53	Businesses	Mr	F J	van den Berg	Private	NZ Woodhill
54	Schools	Mr.		Bouwer	Principal	Hoër Skool Piet Retief
55	Adjacent Landowner	Mr	B.R	Treble	Farmer	Treble Farms
56	Adjacent Landowner	Mr	J.F	Weber	Farmer	Bodenstadt Boerdery
57	Non Governmental Organisation					WWF
58	Non Governmental Organisation				Manager	GroundWork
59	Non Governmental Organisation	Mr	Jeremy	Carr	Private	Forestry Co-operative Limited

REF. NO.	SECTOR	TITLE	FIRST NAME	SURNAME	Position	ORGANISATION
60	Interested and Affected Parties	Mrs	Gudrun	Loubser	Private	Community MEPA
61	Interested and Affected Parties	Mr	Bheki	Nkosi	Emerging Farmer	Mkhondo Farmer's Association, CMF and monitoring committee member
62	Interested and Affected Parties	Mr	Mduduzi	Nkala		Mkhondo Farmer's Association
63	Interested and Affected Parties	Mr	Vincent	Ncube		Community Member
64	Interested and Affected Parties	Mr	Johan	Linda		Driefontein
65	Interested and Affected Parties	Mr	Jeremia	Nkosi		Driefontein
66	Interested and Affected Parties	Mr	Mandla	Nxumelo		Driefontein
67	Interested and Affected Parties	Mr	Thulani	Thulani Mkwanaazi		Driefontein
68	Interested and Affected Parties	Mr	Dumsane	Buthelezi		Driefontein
69	Interested and Affected Parties	Mr	Jabulani	Sanguni		Driefontein
70	Interested and Affected Parties	Mr	A	Mkhwanazi		Driefontein
71	Interested and Affected Parties	Ms	Nompumelelo Yvonne	Gama		Driefontein
72	Interested and Affected Parties	Ms	Lethiwe Octevia	Nkosi		Driefontein
73	Interested and Affected Parties	Mr	Mandla	Nkwanyana		Driefontein
74	Interested and Affected Parties	Mr	Richmen	Vilekezi		Driefontein
75	Interested and Affected Parties	Mr	Nlelusi	Nladonsela		Driefontein
76	Interested and Affected Parties	Mr	Sabatha	Hlalshwayo		Driefontein
77	Interested and Affected Parties	Mr	Siphiwe	Phungwaya		Driefontein
78	Interested and Affected Parties	Mr	Zakhele	Nkosi		Driefontein
79	Interested and Affected Parties	Mr	Vusi	Hlatshwayo		Driefontein
80	Interested and Affected Parties	Mr	Zwelithini	Khoza		Driefontein
81	Interested and Affected Parties	Mr	Lucky	Thela		Driefontein
82	Interested and Affected Parties	Mr	Mduduzi	Phakathi		Driefontein
83	Interested and Affected Parties	Mr	Thembi	Nkosi		Driefontein
84	Interested and Affected Parties	Ms	Florence	Mthethwa		Driefontein
85	Interested and Affected Parties	Mr	Sbusiso	Maseko		Driefontein
86	Interested and Affected Parties	Ms	Precious	Hlatshway		Driefontein
87	Interested and Affected Parties	Mr	Milo	Sibiya		Driefontein
88	Interested and Affected Parties	Ms	Nonto	Sibisi		Driefontein
89	Interested and Affected Parties	Mr	Lucky	Msibi		Driefontein
90	Interested and Affected Parties	Mr	Themba	Methula		Driefontein
91	Interested and Affected Parties	Mr	Mike	Madonsela		Driefontein
92	Interested and Affected Parties	Ms	Junia	Vilakazi		Driefontein
93	Interested and Affected Parties	Mr	Mandla	Yende		Driefontein
94	Interested and Affected Parties	Ms	Wendy	Gama		
95	Interested and Affected Parties	Ms	Thembi	Nkosi		
96	Interested and Affected Parties	Ms	N.T	Nkosi		Medical Center
97	Interested and Affected Parties	Ms	Conny	Zungu		
98	Interested and Affected Parties	Mr	Enock	Mdluli		Community Member
99	Interested and Affected Parties	Mr.	J	Mntambo		Driefontein
100	Interested and Affected Parties	Mr.	J	Zondo		Driefontein
101	Interested and Affected Parties		M.S	Sangweni		Driefontein
102	Interested and Affected Parties		T.N	Sibande		Driefontein
103	Interested and Affected Parties	Ms.	Thembi	Vilakazi		Driefontein
104	Interested and Affected Parties	Ms.	Nkosiniphile	Mambane		Driefontein
105	Interested and Affected Parties	Mr.	Sipho	Lunga		Driefontein
106	Interested and Affected Parties	Mr.	James	Mpanza		Driefontein
107	Interested and Affected Parties	Mr	Johan	Weber		Anysspruit Farmers Association
108	Interested and Affected Parties	Mr	Sipho	Dlamini		Siphssihle Investments
109	Interested and Affected Parties	Mr	J	Loubser		
110	Interested and Affected Parties	Mr	Njabalo	Dlamini		African sun bussiness solutions
111	Interested and Affected Parties	Mr	Soza	Nkua		Shanduka
112	Interested and Affected Parties	Mr	Howard	Vilakazi		DCF
113	Interested and Affected Parties	Miss	Khabonina	Nkosi		
114	Interested and Affected Parties	Miss	Nomsa	Shabanga		
115	Interested and Affected Parties	Mr	Thulani	Mkhwanazi		Driefontein
116	Interested and Affected Parties	Mr	Sibongile	Mandonsela		Driefontein
117	Interested and Affected Parties	Mr	Mzwakhile	Simelane		Driefontein
118	Interested and Affected Parties	Mr	Job	Mkudnasi		
119	Interested and Affected Parties	Mr	Skumbuzo	Nhlabotu		Driefontein Kap
120	Interested and Affected Parties	Mr	Anderson	Lefende		
121	Interested and Affected Parties	Ms	Thembisile	Nkosi		



REF. NO.	SECTOR	TITLE	FIRST NAME	SURNAME	Position	ORGANISATION
122	Interested and Affected Parties	Mr	Mucube	Nusuthu		Drierontein Forum
123	Interested and Affected Parties	Mr	Mxolisi	Ngwenya		Drierontein
124	Interested and Affected Parties	Ms	Rhee	Hlatshwayo		C.D.W
125	Interested and Affected Parties	Ms	Mpume	Nkosi		Driefontein
126	Interested and Affected Parties	Ms	Lindiwe	Hlophe		Drierontein
127	Interested and Affected Parties	Ms	Thandi	Mampu		Drierontein
128	Interested and Affected Parties	Ms	Fikile	Madonzela		Drierontein
129	Interested and Affected Parties	Mr	Skumbuzo	Nkosi		Drierontein
130	Interested and Affected Parties	Mr	William	Njangase		Drierontein
131	Interested and Affected Parties	Mr	Sibusiso	Nkosi		Drierontein
132	Interested and Affected Parties	Mr	Thabo	Mkwanazi		Drierontein
133	Interested and Affected Parties	Mr	Sifiso	Mthimkulu		Drierontein
134	Interested and Affected Parties	Mr	Sizwe	Mbhokazi		Drierontein
135	Interested and Affected Parties	Mr	Lungelo	Nkumane		Drierontein
136	Interested and Affected Parties	Mr	Bonginkosi	Mahlaba		Drierontein
137	Interested and Affected Parties	Mr	Muzi	Buthelezi		Drierontein
138	Interested and Affected Parties	Mr	Nkosinathi	Ndlosi		Drierontein
139	Interested and Affected Parties	Mr	Eric	Hlatshwayo		Drierontein
140	Interested and Affected Parties	Ms	Thokozile	Mabuza		Drierontein
141	Interested and Affected Parties	Mr	Peace	Simelane	Chairperson	Drierontein Community Forum
142	Interested and Affected Parties	Ms	Ntswaki	Mabanne		Drierontein
143	Interested and Affected Parties	Ms	Fikile	Tshabalala		
144	Interested and Affected Parties	Mr	David	Shabangu		
145	Interested and Affected Parties	Mr	John	Ngwenya		
146	Interested and Affected Parties	Ms	Sarah	Ndlamlenze		
147	Interested and Affected Parties	Mr	Innocent	Xulu		
148	Interested and Affected Parties	Mr	Mthunzi	Ngwenya		
149	Interested and Affected Parties	Ms	Lindiwe	Tshabalala		
150	Interested and Affected Parties	Mr	Sitha	Gama		
151	Interested and Affected Parties	Ms	Zodwa	Gumede		Department of Health, Gauteng (I&AP on behalf on Driefontein community)
152	Non Governmental Organisation					Endangered Wildlife Trust
153	Non Governmental Organisation	Mr	Bradley	Gibbons	Senior Field Officer, African Crane Conservation Programme	Endangered Wildlife Trust
154	Non Governmental Organisation				EIA	Endangered Wildlife Trust
155	Non Governmental Organisation					WESSA
156	Non Governmental Organisation	Mr	Malcolm	Suttill		WESSA
157	Non Governmental Organisation	Mr	Simon	Gear	Plicy and Advocacy Manager	Bird Life South Africa
158	Non Governmental Organisation					Earthlife Africa
159	Non Governmental Organisation	Ms	Heidi	Nieuwoudt	Project Manager	Working for Wetlands
160	Non Governmental Organisation					Wakkerstroom Tourism Association
161	Non Governmental Organisation	Mr	Angus	Burns	Manager	WWF-SAGrassland Programme
162	Non Governmental Organisation	Mr	J	Dini	Programme Manager	SA National Biodiversity Institute
163	EAP	Ms	Jane	Mahaba		GCS
164	EAP	Ms	Renee	Steele		GCS
165	APPLICANT	Mr	Harry	Jennings		Kangra Coal
166	APPLICANT	Ms	Fredah	Moatshe	Environmental Officer	Kangra Coal
167	APPLICANT	Mr	Simphiwe	Ndlovu	Environmental Intern	Kangra Coal
168	APPLICANT	Mr	Simo	Yende	Community Liaison Officer	Kangra Coal
169	APPLICANT	Mr	Nkosinathi	Kunene	Community Liaison Officer	Kangra Coal

## **APPENDIX B: ADVERTISEMENTS**

## **APPENDIX B-1: PRE-APPLICATION**

**BLAS** Tel./Fax 017 826 3585  
9 De Wet Street  
082 958 7838 Like us on Facebook

**AUTOSTYLING & FISHING TACKLE**



**FOR ALL YOUR CAR ACCESSORIES, MAGS AND TYRES, VISIT US!**

# Excelsior

## NUUS • NEWS



THE ONLY REGISTERED, RECOGNISED AND APPROVED LOCAL NEWSPAPER SERVING PIET RETIEF AND SURROUNDING DISTRICTS  
DIE ENIGSTE GEREISTREERDE, ERKENDE EN GOEDGEKEURDE PLAASLIKE KOERANT WAT PIET RETIEF EN OMGEWING BEDIEN

JAARGANG VOLUME **61** No. **24** 27 January 2023  
27 Januarie 2023

Tel. (017) 826 2176 & 826 2191 • Fax (017) 826 2177 • Cell. 082 7800 269 (Editor)  
e-mail: excelsior@lantic.net • www.excelsiornews.co.za

**R2.00**  
Inclusive - Ingesluit



**Kate-Merie**  
060 721 9337  
reporter2@excelsiornews.co.za



**David**  
071 810 5356  
reporter1@excelsiornews.co.za

**Babies  
Charity Braai**

PRHS News  
**100%  
Pass Rate**

**Skolesport**

# Community demands justice



**Manne wat KAN braai  
Braai met Charka**



SECURITY SECURITY SECURITY SECURITY SECURITY SECURITY SECURITY

**WGI SECURITY**  
MONITORING  
ARMED RESPONSE

24 Hour Monitoring  
Armed Response  
Gate Motor Installation  
Garage Door Automation  
Camera Installation  
Electric Fence Installation

**017 826 0002**  
Abrie Gunter - 082 877 9062

SECURITY SECURITY SECURITY SECURITY SECURITY SECURITY SECURITY

**FELIM**  
ELECTRICAL & BOARDS

**CUT AND  
EDGE  
CHEAPEST  
IN TOWN  
WITH  
BOARDS  
AND  
CUTTING**

017 826 0208  
Kempville • Piet Retief

 <b>Roots</b> Mall@Mfula FROM 27 JANUARY TILL 2 FEBRUARY 2023 PLUS MANY MORE SPECIALS! <small>No traders. Quantities limited.</small>	 <b>MAMMA'S RUSSIANS 2 KG</b> <b>84<sup>99</sup></b>	 <b>A-GRADE CHUCK/ BRISKET</b> <b>94<sup>99</sup> /kg</b>	 <b>MUTTON CHOPS</b> <b>69<sup>99</sup> /kg</b>
 <b>COKE 1.5 L 2 FOR</b> <b>29<sup>99</sup></b>	 <b>SHONALANGA BRAAIPAP</b> <b>12.5 KG</b> <b>104<sup>99</sup></b>	 <b>EGGS LARGE</b> <b>109<sup>99</sup></b>	 <b>OROS</b> <b>2 L</b> <b>39<sup>99</sup></b>



**WHO  
WHAT  
WHERE  
WHEN**

## PREMISES TO LET

**75 Kruger Street • Piet Retief  
Mpumalanga • 2380**

**Premises is located at the  
Post Office Complex**

**Shop size: 120 m<sup>2</sup>**

**Rent: POA**

**For enquiries contact:**

**078 611 1537/083 656 9352**

**E-mail: ayobprop@gmail.com**

**F.A.N. Nutsmanne  
Handy Men**  
TEL. 071 515 2309  
Mechanical • Electrical • Boiler Making • Plumbing • Carpentry  
fan.handyman@gmail.com  
For all your domestic and industrial  
maintenance needs  
**BUILDING TEAM AVAILABLE!  
AVAILABLE 24/7**

**Wholesalers of:  
Diesel • Petrol • Paraffin Fuels**  
**Wholesale prices to all our customers**  
**Deliveries all over RSA**  
Established in 1994 - 25 years of Excellent Service  
KZN • Mpumalanga • Limpopo  
Schalk Mostert • 082 322 6942  
www.ecodieselfuel.co.za

**eco Fuel**  
Wholesale Diesel  
Licence Number: W/2014/0198

## ONS HET JOU HULP NODIG

**CMR PIET RETIEF**

**ONS KORT SKENKINGS VIR DIE VOLGENDE:**

- Niebederfbare kos • Klere • Skoene •
- Linne en komberse • Meubels en huis-  
bykomstighede • Boumateriaal en verf •
- Enige items wat jy nie nodig het nie  
(bottels, blikke, plastiek) vir herwinning •
- Enige kontantdonasies welkom •

Kwalifiseer vir Artikel 18A kwitansie (vir donasies)

Kontak gerus die kantoor vir enige navrae  
017 826 3422 tussen 07:30 - 16:00

## TO LET CBD SHOP SPACE

**260m<sup>2</sup> with adjoining  
storeroom of 100m<sup>2</sup>**

**Known as "Piet Retief Pharmacies"**  
**Available from 1 March 2023**

**Contact 082 878 5560**

**To advertise here contact**

**Excelsior**

**017 826 2176/2191**

Media statement issued by the office of the Provincial Commissioner in Mpumalanga

## Update on court appearances - fifth suspect nabbed



The suspects, Blessing Nhlakani-pho Ntombela (30 years) and Blessing Bongani Dlamini (38 years) appeared briefly before the Piet Retief Magistrate's Court on the charges of murder and attempted murder.

The case has been postponed to 30 January 2023 for a formal bail application. They were both remanded in custody.

They were arrested on Sunday 22 January at Mkhondo in relation to the murder of a ward Councillor, Mr

Sbonelo (Mthembu) Ntshangase (36), and his friends, Mr Sandile Khumalo (51) and Mr Sizwe Mbingo (40).

The Provincial Commissioner of Mpumalanga, Lieutenant General Semakaleng Daphney Manamela, has

vowed that nothing will stop her to arrest any person committing a crime in Mpumalanga.

This comes after a fifth suspect Andile Mondli Gamede (32) was arrested at Mkhondo on Monday 23 January.

He appeared before the Piet Retief Magistrate's Court on Wednesday 25 January 2023 on charges of three counts of murder, attempted murder and the theft of a firearm. The case has been postponed to 30 January and he has been remanded in custody.

According to the report, the victims were allegedly shot by armed suspects in Mkhondo, also known as Piet Retief. It is further alleged that the suspects reportedly fired multiple shots at Mr Ntshangase who was in the yard, and also shot Mr Mbingo inside a bakkie who sadly died at the scene whilst Mr Khumalo was also shot in the yard. Thereafter the suspects fled in an unknown direction.

## Minister Cele attended funeral

David Mkhonta

On Saturday 21 January the Minister of Police joined thousands of mourners who came to pay their last respects to the councillor, Sibone-

lo Mthembu, Mr Sandile Khumalo and Mr Sizwe Mbingo who died on Friday the 13th of January 2023.

Minister Bheki Cele took to the

podium and announced to the bereaved families and members of the public at the Magudulela Stadium, where the funeral service of the community members was held,

that they have established an investigative team that will be based in Mkhondo from a national level to investigate all political related cases reported since 2009.

He explained how they dealt with such cases in KwaZulu-Natal and said the same strategy would be implemented in Mkhondo. "No one must die because he is a councillor, we can't afford or make it a norm that councillors must live to die," vowed Mr Cele.



## HPR nuus

Kate-Merie Ferreira

Die eerste week van skool was 'n besige een vir die leerlinge van Hoërskool Piet Retief, maar hulle is bly vir elke geleentheid wat hulle gegun word.

aan die Mpumalanga padfietskampioenskap deelgeneem. Sy het in die tydtoetswedren en in die padfietswedren meegeding en beide afdelings gewen. Welgedaan, Kylie!

Simone Damaske kan baie trots wees op haarself! Sy het haar GR.1 viool praktiese eksamen met 89% deur Trinity College in London, geslaag. Hou so aan Simone!

Dié Impi's staan vir niks terug nie! Ons is baie trots op julle.

Marcus Kruger en Bianca Taljaard het onlangs die toekennings vir die beste senior seun en die beste senior dogter tydens die Mpumalanga-swegala te Middelburg verwerf. Baie geluk!

Kylie Lerm het op Saterdag 21 Januarie



Kylie Lerm



Marcus Kruger en Bianca Taljaard



Simone Damaske



Customer Service: 010 590 9270

It's your choice

26 JANUARY TO 5 FEBRUARY 2023


**Roots<sup>®</sup>**  
**BUTCHERY**

# MONTH END SPECIALS

## Happy New Year 2023

On behalf of the Roots Butchery family, we would like to wish you and your loved ones a happy and prosperous 2023.


**Roots<sup>™</sup>** BUTCHERY


DIAL \*120\*1527# for store contacts  
(subject to R0.10 charge per use)

ITEMS MAY DIFFER FROM REGION TO REGION. ERRORS AND OMISSIONS EXCLUDED -  
WE RESERVE THE RIGHT TO LIMIT QUANTITIES.

FOLLOW US ON:


[www.rootsbutchery.co.za](http://www.rootsbutchery.co.za)



UPDATED

Emergency Numbers/  
Noodnommers

Attached, please find the relevant contact numbers  
in case of an emergency/  
Vind aangeheg noodnommers om te skakel in 'n noodgeval

Electricity/Elektrisiteit .....	082 804 1247
Water & Sanitation/Water & Sanitasie .....	076 063 0460
Stock Theft/Veefdiefstal .....	079 692 0610
Water Reticulation (Mkhondo and Satellite) .....	076 063 0460
Rural Water Supply .....	082 881 0447
Cemetery .....	073 498 9750/079 276 7339
Storm Water .....	073 498 9750/079 276 7339
Roads .....	079 276 7339
Fire and Rescue .....	071 331 8152/079 872 8989
Traffic Department/Verkeersdepartement .....	076 562 0956
Fire/Accident related Emergencies/ Brandweer en ongeluks- verwante noodgevalle .....	(English/Afrikaans) 079 872 8989
..... (Zulu)	071 331 8152
RH Piet Retief Private Hospital .....	017 826 9217
Casualties/Ongevalle .....	017 826 9208
Private Ambulance/Privaat Ambulans (ICU Care) ...	083 570 0911
Piet Retief Hospitaal (Staat) .....	017 824 1200
Piet Retief Police .....	017 824 2608
PR CSC (Community Service Centre).....	072 286 8875
Provincial Ambulance/Provinsiale Ambulans .....	017 632 1875

Garden of Life

# Consolidated Training Report Skills Programme

**Overview:**  
The Proprietor of Heyshoop Farm in support of skills development funded the skills programme “Garden of Life” for unemployed individuals residing on his farms and in and around the Piet Retief area.

The programme targeted 40 individuals, all of which formed part of a group referred to as Historically Disadvantaged Individuals. They consisted of both male and females of various age groups. The aim was to develop ag-

ricultural skills and to empower them through agriculture to create sustainable micro farms.

**Demographics:**  
The ratio being: 18 females to 15 males of various ages. The youth was well represented. None of the attending candidates indicated or displayed any disability.

**Scope of Work:**  
The scope of work indicates the following:

- Skills Programmes must be relevant to learner needs.
- Must demonstrate initiatives around areas of empowerment.

**Group Dynamics:**  
The group dynamics at first was strained but this was expected as these individuals all come from different environments. They however developed a bond as the day progressed and viewed themselves as a team. They further quickly settled and began working together for the benefit of the group.

**Venue:**  
The venue to a certain extent complied with an Optimal Learning Environment as it had seating suitable for adult learning. The area was well lit and the training area was well ventilated. All support teaching aids were present and easily accessible. All Covid-19 protocols could be observed.

It must however be guarded that when choosing a venue that it must be learner friendly and accessible to the learner. Traveling long distances could impact on learner attendance and affect learner concentration.

**Overview of training:**  
Training commenced at 09:00 and ended at 14:00 (15 January 2023). Learners’ needs and aspirations were identified. One of these needs was that a large percentage of the learners’

mother-tongue (isi-Zulu) speakers and displayed little or no command of the English language. This was further amplified by them being semi-literate or illiterate.

This challenge was negated with the use of a Zulu speaking facilitator. To further assist the learning process the facilitator scaled down the presentation to meet the level of comprehension of these learners. This was done by using practical examples to reinforce and embed knowledge.

Myths and expectations around employment and financial reward were addressed and dispelled.

Learners at first were not enthusiastic and showed distress. This however is not uncommon with learners with low literacy levels. They however grasped concepts that were foreign to them on commencement of training. The constant asking of questions and lively debates was an indication that learning was taking place.

**The following was provided during the training sessions:**

- Writing materials & stationery
- White board & pens
- Flip chart paper
- Coke bottles
- Attendance registers
- Feedback forms
- Seeds
- Seedlings
- Planting calendars
- Bibles

**Practical:**  
To supplement the theoretical component of the learners, they were further presented with one irrigation system (Hydroponics) (Garden of Life) as the practical component of their training.

Learners enjoyed the practical component of the training intervention as it involved activities they enjoyed.

They further demonstrated understanding of the concept of Hydroponics and its value. Environmental matters such as waste management were understood and they showed an interest in maintaining the environment and the impact it has on farming.

**Exit Strategy:**  
Garden of Life and its team subscribe to a principle of Holistic Development and have designed a strategic exit plan for these learners. The process includes the replication of the gardens at home. It was recommended that they source at least 10 tyres per household within the area they reside in, to commence the establishing of the said gardens.

Garden of Life has further taken into consideration that although all the candidates have signed up for the training, not all will proceed in becoming micro farmers and would grow vegetables for their family’s needs only.

In order to monitor and mentor these candidates a WhatsApp group (Buddy Group) will be established where the said learners could share challenges and milestones. This not only allows for monitoring participation but, also acts as a catalyst in motivating learners to continue. The

Garden of Life team will further assist with challenges and will highlight milestones achieved.

They are to develop their gardens and produce evidence of a productive garden. Learners have also indicated that they will acquire land from known sources and start growing vegetables suitable for the environment.

**Way Forward:**  
It is recommended that during the monitoring phase candidates who show an interest in agriculture should be afforded the opportunity in obtaining qualifications in Plant Production. This would give the candidate a greater understanding of agriculture as it provides the learner with the skills in producing a better crop.

**Conclusion:**  
The training went smoothly and apart from small logistical hiccups, the programme was concluded successfully. This however is consistent with projects of this size and nature.

Commendation must further be given to Mr Tommy Ferreira who ensured that all logistics were in place and that learners arrived to the training at no cost to them. His efforts and organisational skills are greatly appreciated.

## Our deepest sympathy

**After the untimely deaths of another councillor and two more men who were most probably in the way, arrests have been made and court procedures followed.**

The *Excelsior News* would like to express our condolences to the families who lost their loved ones and

wishes them all of the best.

The *Excelsior News* will only publish reports from the SAPS in this matter and will not jeopardise any investigation through speculation.

May justice prevail. Injustice will automatically fall under its own weight and meet with its end.

**KANGRA**

NOTIFICATION OF COMMENCEMENT OF ENVIRONMENTAL AUTHORISATION PROCESSES FOR KANGRA'S MAQUASA EAST OPERATIONS:

- Application for Integrated Environmental Authorisation for the proposed Water Treatment Plant & Co-Disposal Facility
- Application for Integrated Water Use Licence for the proposed Water Treatment Plant & Co-Disposal Facility

GCS Ref. No: 22-0161

DMRE Ref. No.: MP30/5/1/2/2/133MR(10200MR)

DWS REF. NO.: 11/W51B/CGI/4938

Kangra Coal (Pty) Ltd (Kangra) has an existing coal mine located in Driefontein, near Piet Retief in the Mpumalanga Province. The mine is located in the Mkhondo Local Municipality within the Gert Sibande District Municipality. The Maquasa East (MQE) operations include the historical opencast and underground operations under Mining Right (MP)30/5/1/2/2/133MR (10200MR). Kangra is proposing to construct a new water treatment plant (WTP) for the treatment of decant and surplus contaminated water and a new co-disposal facility which will accommodate discard produced from the beneficiation plant, slurry/filter cake and potentially brine from the WTP.

Authorisation is being sought for the following:

- Integrated Environmental Authorisation in terms of the NEMA 2014 EIA Regulations for listed activities:
  - o Listing Notice 1 (GNR327): Activity 25 & 27
  - o Listing Notice 2 (GNR325): Activity 5 & 15
  - o Listing Notice 3 (GNR324): Activity 12 & 14
  - o Waste Management Activity (GNR921): Category B - Activity 7, 10 & 15
- Integrated Water Use Licence in terms of Section 21 of the NWA
  - o Section 21 (c), (f), (g) & (i)
- SAHRA Authorisation in terms of Section 38 of the NHRA

The proposed projects are located on Ptn of Rem of Farm Maquasa 19 IT, Ptn of Mineral Area 1 on the Rem extent of Farm Rooikop 18 HT, Ptns 1&2 of Farm Kransbank 15 HT, Rem extent of Farm Maquasa 19 HT, and Farm Roodekraal 21 HT, held under the existing Mining Right (MR).

GCS Water and Environmental Consultants (Pty) Ltd has been appointed as the independent Environmental Assessment Practitioner to undertake the necessary environmental processes for the above-mentioned projects in support of the application to the relevant Competent Authorities; the Mpumalanga Department of Mineral Resources and Energy (DMRE), the Department of Water and Sanitation (DWS) and the Mpumalanga Department of Heritage Resources.

Interested and Affected Parties (I&APs) are invited to participate by registering your interest and to provide comments and raise issues of concern regarding the proposed projects. You have until the 10th of February 2023 to register as an I&AP in the first round of stakeholder engagement and to raise initial issues about the proposed project. Please include this reference number - 22-0161 - in all correspondence.

This notification forms part of the initial public consultation process as required by the National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA) EIA Regulations (2014, as amended) and the National Water Act, 1998 (Act 36 of 1998) (NWA). Further notifications pertaining to this project will be issued in due course.

To register as an I&AP and to receive more information please contact:

GCS Pty Ltd


GCS Reference: 22-0161

Contact Person: Gerda Bothma/Anelle Lötter,

Tel.: 011 803 5726,

E-mail: gerdab@gcs-sa.biz/anelle@gcs-sa.biz

Post: PO Box 2597, Rivonia, Johannesburg, 2128







# LPR Interhuis

Kate-Merie Ferreira

Laerskool Piet Retief se personeel en leerlinge het op Saterdag 21 Januarie vroegoggend by die skool se atletiekveld aangemeld om die jaar se eerste sportbyeenkoms af te skop.

Die interhuis was die perfekte geleentheid vir leerlinge om met hulle talente te spog en vir 'n plek in hierdie jaar se atletiekspan te veg.

Dit was 'n baie warm dag, die hoogspringmatte was veral warm nadat dit vir 'n ruk in die son gebak het en die langafstandatlete se oë het naderhand gebrand soos die sweet daarin geloop het, maar die jong atlete het volhard en steeds hulle beste gelever.

Die leerders is in vier spanne verdeel - Duikers, Suni's, Oribi's en Steenbokke. Die Suni-span wat heldergeel klere gedra het, het die meeste punte deur die loop van die dag aangtken en is daarom as die wenspan gekroon. Baie geluk! Hendrik Verwey het die trofee namens die span ontvang.

'n Hoogtepunt van die dag was toe Lerato Masango die O/12 meisies gewigstootrekord gebreek het. Sy het die swaar bal 'n volle 8.77m ver gegooi, die vorige rekord was 8.72m. Welgedaan Lerato!

Lerato Masango (U/12), broke the school's shot-put record. She threw the heavy ball a staggering 8.77m! The previous record was 8.72m. Well done Lerato! If you keep this up, maybe you might break the U/13 record at the next interhouse.

Die volgende atlete het 'n trofee tydens die prysuitdeling ontvang:

Beste middellafstandatlete:

• Seun: Hendrik Verwey (O/13) - Suni - 1500m

• Dogter: Mia Potgieter (O/13) - Oribi - 800m

Beste veldatlete:

• Seun: Arno Swanepoel (O/10) - Steenbok - gewigstoot

• Dogter: Lerato Masango (O/12) - Suni - gewigstoot

Beste baanatlete:

• Seun: Zion Sheick (O/10) - Suni - 70m hekkies

• Dogter: Mpilo Nkonyane (O/10) - Steenbok - 70m hekkies

Victor Ludorum:

• Arno Swanepoel (O/10) - Steenbok (Totaal van 1762 - ASA2020 punte)

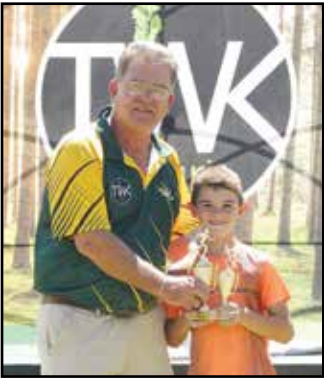
Victrix Ludorum:

• Zanoxolo Magoro (O/11) - Duiker (Totaal van 1938 - ASA2020 punte)

Baie geluk aan elke atleet wat erkenning ontvang het. Aan die leerlinge wat nie 'n trofee ontvang het nie - oefen hard en probeer volgende jaar weer! Solank jy net jou beste gegee het, is dit al wat saak maak!

Die graad R-spannetjie wat aan 'n 60 meter wedloop deelgeneem het, het baie gelukkig gevoel dat hulle ook ingesluit was by die dag se verrigtinge. Hulle trotse ouers het vir hulle by die eindpunt gewag. Hierdie resies is jaarliks goeie oefening vir die groep om hulle voor te berei vir dit wat vir hulle wag as hulle eendag na die laerskool toe gaan.

Baie dankie aan elke besigheid en ouer wat iets vir die dag geborg het, asook aan die ouers wat hulle tyd opgeoffer het en kos voorberei het of as beampte gedien het. 'n Spesiale dankie aan die onderwysers wat hard gewerk het om alles vir die dag voor te berei en seker gemaak het dat reëlins glad verloop.



i20 - Made for memories...

Hyundai i20 Motion from only:  
**R4 399 pm\***  
0% DEPOSIT

\*T's & C's apply. Country-wide deliveries. Trade-ins welcome.

Move boldly in a new Creta!

Hyundai Creta from only:  
**R6 200 pm\***  
0% DEPOSIT

Hyundai  
Ermelo

017 819 2553

6 De Emigratie Street,  
Ermelo.

morne@dewits.co.za /  
info@dewits.co.za

www.dewits.co.za

7: 200 000 km  
Mileage/Service Plan

4: 60 000km  
Service Plan

NEW  
THINKING.  
NEW  
POSSIBILITIES.



Promosieartikel

# Die Imperador 3.0 - Presies wat jy op die plaas kort

Kate-Merie Ferreira

Die Imperador 3.0 is die wêreld se eerste 3-in-1 plaasmasjien en is nou by Stucky Agri Equipment in Piet Retief beskikbaar.

Dié masjien spog met 'n hipermoderne kunsmisstrooier, dit kan chemiese besproeiing met gemak hanteer en dien boonop ook as 'n pneumatiese saaiër. Die Imperador 3.0 se besproeiingsstelsel is in die middel van die masjien, wat dit meer stabiel maak. 'n Boer kan tussen die drie opsies wat dit bied verander deur slegs 'n knoppie te druk. So maklik soos dit!

Een boer getuig dat een van die gunsteling voordele van die masjien is dat die besproeiingsstelsel van die kajuit af sigbaar is en hy só seker kan maak dat

hy elke deel van sy land besproei. Die spuitarms van die besproeiingsstelsel is 27 en 30 meter lank en daar is ongeveer 50cm tussen elke stuifkop.

Die hoogtebeheer van die Imperador is indrukwekkend, met 'n minimum van 0.8m en 'n maksimum van 2.63m.

Vir meer inligting oor hierdie indrukwekkende masjien of enige ander agri-toerusting, skakel asseblief vir mnr. Jimmy Muller op 076 135 6256. Stucky Agri verkoop ook CLAAS, CLARK, Geringhoff en Deutz Fahr produkte.

**The Imperador 3.0 is the newest advancement in farming technology.**

This three-in-one machine is all you need to guarantee efficiency and effectiveness while giving

your crops the best chance at successful growth.

This machine possesses a central-boom sprayer, a spreader and a pneumatic seeder. Imperador 3.0 provides these three operations at different times, by using the same path.

The total boom width is 27 and 30 metres, with 50cm between each nozzle. The application height is from 0.8 metres to 2.63 metres. The central booms ensure more stability than competing brands and guarantees 58% more of the chemical solution on target.

For more information regarding this product or other Agri-equipment, kindly contact Mr Jimmy Muller on 076 135 6256.



Berig deur HPR

# HPR Interhuis 21 Januarie



Nie eers die "hittiegolf" kon Saterdag ons geesdrif demp nie.

Al was dit die eerste byeenkoms van die seisoen, was daar reeds pragtige prestasies en niks minder as twaalf rekords is op die dag gebreek nie!

Dit was duidelik dat atlete wat ingeskakel het by die voorbereidingsprogram, nou die vrugte pluk van hulle harde werk. Ons wil graag vir Rochelle Taljaard wat selfs gedurende die Desember-vakansie met hier-

die atlete gewerk het, baie dankie sê vir die reusebydrae en impak wat sy maak om HPR-atletiek te bevorder.

Dankie ook aan die HPR-Ondersteunersklub vir hulle bydrae in hierdie verband. Ons sien uit na van-

jaar se Interhoër wat op 18 Februarie by Generaal Hertzog in Witbank gaan plaasvind.

Baie dankie ook aan Superspar vir die besondere medaljes, dit was verseker 'n reuse-motivering vir ons atlete!

## TROFEEWENNERS:

		ATLEET	Ouderdom	ITEM	PRESTASIE (ASA PUNT)
1.	Beste Baanatleet	Khaya Dube	O/19	100m	10.30 (892) (Rekord)
2.	Beste Veldatleet	Corrie Kotzé	O/14	Gewigstoot	9.84m (763)
3.	Beste Hekkiesatleet	Fisokuhle Shabalala	O/14		100mH
4.	Beste Dogters Middel- en Langafstandatleet	Kyla Oosthuizen	O/15	800m	2:42.70 (648)
5.	Beste Seuns Middel- en Langafstandatleet	Jayden Ehlers	O/19	3000m	10:55.80 (621)
8.	Victrix Ludorum Junior – Baan	Fatimah Hasani	O/15		2007
9.	Victrix Ludorum Junior - Veld	Gizelle van den Berg	O/14		1695
10.	Victor Ludorum Junior - Baan	Fisokuhle Shabalala	O/14		2132
11.	Victor Ludorum Junior - Veld	Carlo Niebuhr	O/15		1663
12.	Victrix Ludorum Senior -Baan	Megan Filter	O/17		2093
13.	Victrix Ludorum Senior - Veld	Ankia Uys	O/17		1789
14.	Victor Ludorum Senior - Baan	Khaya Dube	O/19		2417
15.	Victor Ludorum Senior - Veld	Renco Venter	O/16		1734
16.	Beste Atleet: Seuns	Khaya Dube	O/19		3689
17.	Beste Atleet: Dogters	Megan Filter	O/17		3353
WENSPAN				BLOU	1215.5 punte
TWEDE PLEK				GROEN	1198.0 punte
DERDE PLEK				ROOI	1130.5 punte
GEESBEKER					GROEN

## NEW RECORDS:

ATHLETE	ITEM	AGE	PERFORMANCE	ASA POINT
Carl-Hein Creydt	100mH	U/14	15.50	709
Fisokuhle Shabalala	100mH	U/14	14.50	789
	300mH		0:43.50	619
	200m		24.70	671
Kamogelo Mohlala	High jump	U/14	1.63	620
Khaya Dube	Triple jump	U/19	13.78	704
	100m		10.30	892
	200m		22.00	794
Mpilo Nkosi	100m	U/16	11.40	728
Wandile Gumede	100m	U/19	10.50	847
Corrie Kotzé	Shot-put	U/14	9.84	763
	Relay	U/19	0:44.90	756

please say

**YES**

to organ donation

If you needed an organ transplant, would you accept an organ from a donor?

Please say yes to organ donation. Many families said yes and saved the lives of mothers, children and fathers. Your child might need a life-saving transplant one day. If we are not prepared to be organ donors, is it fair for us to ask for a life-saving organ transplant if we need one from someone else?

It is possible that a medical professional might ask you to consider organ donation. Your decision will make a life-saving difference. Please say yes to organ donation.

Tell your family today

**SAVE SEVEN LIVES**

One Organ Donor can save seven lives  
You can save seven lives  
Register now - it's easy  
0800 22 44 11 (toll free)  
www.odf.org.za

ORGAN DONOR FOUNDATION



## Learners shine at Interhouse



**Senior Victrix Ludorum- Nthando Vilakazi**  
David Mkhonta included the long

**On Saturday 21 January, Maranatha School held its Interhouse athletics competition for the year 2023.**

The weather was perfect and the learners were enthusiastic to get to the start line and compete.

Learners set off in a 100m sprint and others participated in various items that

ers cheered the athletes on from the side lines as they competed against each other.

The 100m sprint saw tons of both spectators and fellow scholars standing with great anticipation to see who would outrun the competitors and be crowned champion.

“Well done to everyone who participated. We are proud of your achievements and if you did not receive a medal, we are also proud of you for trying your best,” the sports teacher said.

This was the first year that Maranatha hosted an Inter-house on their own premises and they are grateful for the support of teachers, staff and parents, all of whom contributed in making the day a huge success.

*Results:*

- Ntando Vilakazi

G/11 smashed the



*Senior Victor Ludorum- Zekhethelo Salie*

1200m record with a time of 04:50.

- Andile Gumede broke the boys u/12 long jump record with a distance of 4.25m, he also broke the shot-put record and set a new record with a distance of 9.03m.

- Lulama Thabete broke the G/11 high jump record. The new record is 1.11m.

- Phumelela Mnyakeni B/11 set

a new high jump record with a height of 1.31m.

- Zekhethelo Salie B/13 jumped 1.40m for a new high jump record.

It was evident from the happy shouts and broad smiles that the day was truly enjoyed by all, despite the scorching heat!



**sasol**  
reaching new frontiers

**N2 Piet Retief**  
**017 826 2941**



Offer applies to:  
1 x **Crackly's Snackpack** 40g-50g  
and 1 x **aQuellé Still/ Sparkling Water** 500ml  
**R34.90**



Buy 1 x **Burger Pie**  
and 1 x **Energade/ Orós** 500ml for  
**R39.90**



Offer applies to:  
2 x **Cadbury Bubbly** 87g  
**R41.90**



Offer applies to:  
2 x **Cappy Juice** 330ml  
**R19.90**



Offer applies to:  
2 x **Magnum** 90ml-100ml  
**R53.90**



Offer applies to:  
2 x **Lay's 36g**  
**R13.90**

**Promotion period from 19 January - 1 March 2023, while stocks last**

# A solution for unlawful parking

David Mkhonta

**Concrete sleepers and poles were seen on the sidewalks around the Dutch Reformed Church in Smit and Du Toit Streets.**

This is aimed to address unlawful parking in town mostly by trucks and vehicles, who during the day park in the shade of trees there and in the evenings to overnight. Truck drivers are once again taking over the streets of Piet Retief especially at night, with almost every major road in town being occupied by these giants.

The drivers use side streets to park their heavy vehicles, which causes more damage than the MLM could ever be able to fully repair. Sidewalks also suffer in the process. Truck drivers drive over storm-water drains which cause irreparable damage.

[illegible]



# An upgraded activity?

Muller Street hands down wins the title of the broadest road in town.

One can only hope that when the rain starts, it doesn't turn into a river . . .



# Filled butternut roast

Vegan meals don't have to be overcomplicated and expensive.

- Ingredients:**
- 1 large butternut
  - 1 brinjal
  - 1 large marrow
  - 2 tbsp (30ml) olive oil
  - 1 red onion, chopped
  - 1 clove garlic, chopped
  - ¼ cup (60ml) sultanas
  - ½ packet (50g) raw almonds, chopped
  - 3 tbsp (45ml) pumpkin seeds
  - 3 tbsp (45ml) sherry or vegetable

- stock
- ½ cup (125ml) couscous, cooked
  - Handful parsley, chopped
  - Juice (60ml) and grated peel of 1 lemon
  - Salt and milled pepper
  - Fresh herbs, for serving
- Method:**
1. Halve butternut, remove seeds and score flesh.
  2. Steam or microwave butternut for 5-10 minutes.
  3. Halve brinjal and large marrow


- and steam for 3-5 minutes, or until tender. Scoop out a little flesh from each vegetable half to create a cavity and reserve shells.
4. Heat olive oil in a pan and sauté onion until soft.
  5. Add garlic and fry for another minute, or until fragrant.
  6. Stir in sultanas, almonds and pumpkin seeds and fry for another minute.
  7. Add sherry or vegetable stock, reduce for a minute and then remove from heat. Stir through couscous, parsley and lemon juice and peel.
  8. Season and divide stuffing mixture into three portions.
  9. Preheat oven to 180°C. Fill each vegetable shell with stuffing.
  10. Place brinjal shells inside butternut shells, then place marrows inside brinjals.
  11. Sandwich butternut shells and secure with butcher's string. Drizzle with
  12. Slice and



oil. Place on a baking tray and bake for 45-50 minutes, or until cooked through.

serve with fresh herbs.

Source: <https://www.pnp.co.za/recipes>



## Vacancies

The TWK Group, with it's head office in Piet Retief, Mpumalanga, requires the services of suitably qualified and highly motivated candidates to be appointed in the following vacant positions:

Division	Position	Location
Constantia	Driver: Assistant	Camperdown
	Production Supervisor	Wellington
	Weighbridge Clerk	Secunda
Corporate Services	IT Technician	Piet Retief
	Talent & Performance Clerk	Piet Retief
Grain	Clerk (Admin)	Piet Retief
	General Worker (Seasonal)	Piet Retief:
		Mkhondo Silo
	General Worker (Seasonal)	Piet Retief:
		Panbult Silo
	Supervisor	Piet Retief:
		Mkhondo Silo
	Supervisor	Piet Retief:
		Panbult Silo
		Pretoria
Finance	Accountant	Piet Retief/ Pretoria
	Broker (Life Insurance)	Mbombela
	Broker (Life Insurance)	Middelburg
	Broker (Short-Term Insurance)	Bethal
	Broker (Short-Term Insurance)	Mbombela
	Broker (Short-Term Insurance)	Secunda
	Broker (Short-Term Insurance)	Vanderbijlpark
	Clerk (Claims)	Bethal
	Para-Planner	Mbombela
Isuzu	Sales Consultant	Ermelo
	Sales Consultant	Ermelo
	(Used Vehicles)	
Sunshine Seedling Services	Finance Clerk	Pietermaritzburg
Trade	Cashier	Empangeni
	Cleaner	Ermelo
	Depot Manager	Winterton
	Salesman (Parts)	Bethal
	Salesman (Parts)	Pietermaritzburg
TWK Motors	Dealer Principal	Piet Retief
	Sales Consultant (Trucks)	Piet Retief

**In order to apply for a vacancy, please visit our website at <http://www.twkagri.com> access the Careers tab and click Apply Now**

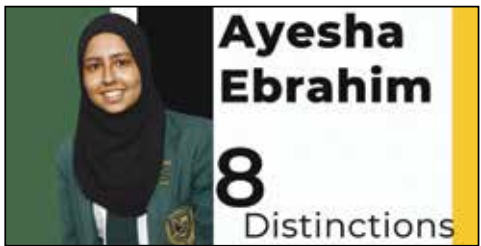
**Please note that registration of applicants is compulsory and that any other method of application will not be considered.**

## PRHS 2022 Matric Results

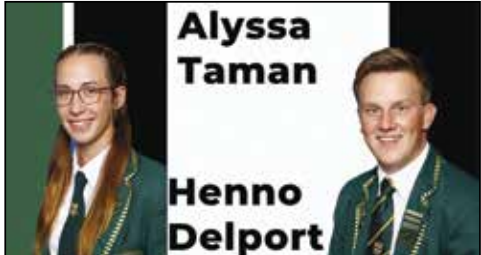
# 100% Pass Rate

Information received by PRHS

**Piet Retief High School celebrates a 100% matric pass rate for the National School Certificate Examinations written at the end of 2022!**



Ayesha Ebrahim was the best performing matric learner in 2022 - we are very proud!



These learners received six distinctions each - congratulations!



- jects being taught at the school managed to obtain an average of 60% and above. Physical Sciences received an average of above 70% and German an average of 82%.
- With hard work and grit put in by each learner, the collective achieved 106 distinctions.
- The school's top performer was Ayesha Ebrahim who achieved an average of 92% and seven distinctions as well as a distinction in Alpha Maths. Other matriculants with top-averages were Alyssa Taman and Henno Delpert with six distinctions each. Demi von Wissel, Husnaa Arbee, Husnaa Mansoor and Alex Ferreira received five distinctions each.
- Ayesha Ebrahim:**
- English Home Language - 86%
  - Afrikaans First Additional Language - 90%
  - Mathematics - 95%
  - Life Orientation - 91%
- Engineering Graphics and Design - 90%**
- Life Sciences - 93%
  - Physical Sciences - 98%
  - Alpha Mathematics - 85%
- Alyssa Taman:**
- English Home Language - 82%
  - Afrikaans First Additional Language - 90%
  - Life Orientation - 85%
  - Geography - 86%
  - Life Sciences - 80%
  - Physical Sciences - 82%
- Henno Delpert:**
- Afrikaans Huis-taal - 82%
  - English First Additional Language - 80%
  - Life Orientation - 84%
  - Engineering Graphics and Design - 84%
  - Life Sciences - 84%
  - Physical Sciences - 85%
- Demi von Wissel:**
- English Home Language - 80%
  - Afrikaans First Additional Language - 88%
  - Life Orientation - 88%
  - Geography - 87%
  - Information Technology - 83%
- Husnaa Arbee:**
- Afrikaans First Additional Language - 86%
  - Life Orientation - 89%
  - Business Studies - 84%
  - Life Sciences - 81%
  - Physical Sciences - 85%
- Husnaa Mansoor:**
- Afrikaans First Additional Language - 86%
  - Life Orientation - 81%
  - Accounting - 91%
  - Life Sciences - 82%
  - Physical Sciences - 82%
- Alex Ferreira:**
- Afrikaans Huis-taal - 87%
  - English First Additional Language - 84%
  - Life Orientation - 88%
  - Geography - 87%
  - Information Technology - 83%



The matrics of 2022 were nervous but excited to receive their results after a long time of waiting



## Excelsior NUUS • NEWS

**INTEKENGELD R690 PER JAAR**  
(Posgeld Ingesluit) Vooruitbetaalbaar  
**SUBSCRIPTION RATES R690**  
**PER ANNUM**  
(Including Postage) Payable in Advance.

### CLASSIFIED SMALLS KLEINADVERTENSIES

Die koste van advertensies onder Huishoudelike Kennisgewings en Geklassifiseerde Advertensies is R48.50 vir die eerste 20 woorde en R2.90 per woord vir elke woord daarna.

Vir genoemde advertensies moet vooruitbetaal word en advertensies sal nie telefonies aanvraag word nie.

The cost of advertising in Domestic Notices and Classified Advertisements in R48.50 for the first 20 words and R2.90 per word thereafter.

These advertisements must be prepaid and cannot be accepted over the telephone.

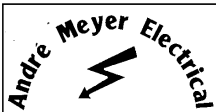
### TO LET

**FLATS** to rent. 1 and 2 bedrooms from R3 850 per month. Please contact 082 740 3628

**SELF** catering rooms and bachelor flats to let. Contact 082 821 0458/7

### WANTED KNOWN

**BLINDS** - Want to revamp your home? Contact us for a free quotation on all types. Professional service guaranteed. Elrina 017 826 2570/2778. Park Furnishers



- All Electrical Work •
- Centurion Systems •
- Electric Fencing •
- Pivot Repairs •
- Borehole Pump Repairs •
- Diesel Generators •
- Kirby Vacuum Cleaners •

Tel./Fax: (017) 826 0036  
Cell: 082 901 1156

### ROLF'S TOWING



**017 826 0182**  
**082 565 4078**

### WETENSWAARDIG

**VIR** alle drukbe-nodighede kontak ons gerus vir gratis kwotasies. Excelsior Printers. Krugerstraat 19, Tel. 017 826 2176/2191, Fax 017 826 2177, e-mail excelsior@lantic.net

## BLAS

**NISSAN HARDBODY**  
**SINGLE CAB**  
**BEEKMAN**

**PRE-OWNED CANOPY**  
**FOR SALE - R7 999!!!**  
**WHATSAPP OR CALL**  
**082 958 7838**

Tel./Fax 017 826 3585  
9 De Wet Street

### Fun-Pin Inflatable Rentals JUMPING CASTLES

We have a variety of inflatable rentals for hire

- 3.7 m x 3.7 m Rainbow Jumping Castle
- 4.5 m x 4.5 m Harry Potter Jumping Castle
- 12 m Double Water Slide
- 14 m Single Water Slide
- 8 m x 3 m Island
- 15 m x 5 m Gladiator Track
- Sand-Art



Contact Gerda - 082 326 9002  
Charmaine - 082 899 2636  
Office - 017 826 3861

## Update on N2 Pongola situation

Kate-Merie Ferreira

Protests on the N2 Pongola road rendered it inaccessible to heavy motor vehicles, more specifically side tippers from Monday 16 January to Monday 23 January but, the authorities seem to have control of the situation now.

On Monday 23 January at approximately 12:25, Mr Anton Nortje of the Mkhondo Fire and Rescue Unit shared a voice message stating that the road was open to side tippers once again, as a task force from the National Department of Transport was deployed to Itshelejoba, where the road had been closed to side tippers by protesters for a week. Motorists were warned that the situation could change at any moment and to be vigilant when driving there.

Provincial traffic officers were placed at the Paulpietersburg intersection, where truckers turn off the N2 to take an alternative route, to inform them that the N2 road was open to them again. Some

transporters decided that it was not worth it to use the N2 and instructed their drivers to continue on the alternative route (Paulpietersburg, Vryheid, etc.). They did not want to be stuck at Itshelejoba if the situation turned volatile again.

Traffic officers also visited the local truck stop to inform the drivers of the situation, so that they can make an informed decision about which route to use.

The R33 Paulpietersburg road is taking strain under the weight of the hundreds of side tippers that are forced to drive there once again. The road has become almost untraversable for small vehicles and the damage on it is extensive yet, transporters feel they have no other choice but to use this route. They lose a lot of money if their trucks get stuck for a day between Piet Retief and Pongola. Hopefully the community, government and trucking companies can come to an agreement that will make the road safer for all who use it.

### ANNEXURE 2

**INVITATION FOR PUBLIC COMMENTS IN APPLYING FOR A LIQUOR LICENCE IN TERMS OF SECTION 35(2)(a) OF THE MPUMALANGA LIQUOR LICENSING ACT, 2006. I, TANYA ELIZABETH GROBLER, ID Number: 970909 0098 085, an adult female hereby invite written public comments concerning my application for a liquor licence to the Mpumalanga Liquor Authority to trade under the name: THE DINER ON WEST END, I make this application for myself.**

For the retail sale of liquor for consumption on the premises where the liquor is sold.

#### BUSINESS PREMISES:

**Physical Address: SHOP 2, CORNER OF WEST END AND RETIEF STREETS, PIET RETIEF, 2380** situated within the Mkhondo Local Municipality, being an address in the Republic of South Africa and within the borders of Mpumalanga Province.

**Postal Address: PO Box 135, PIET RETIEF, 2380**

**Telephone Number: 076 138 7988**

**Cellphone Number: 076 138 7988**

**E-mail: info@liquoract.com**

**ADDRESSES TO WHICH COMMENTS MUST BE SUBMITTED:**

Comments should be made in writing and be addressed to the municipality concerned and a copy to the applicant, to reach the said addresses within thirty (30) days of this publication.

#### Municipality's Address:

Mkhondo Municipality Piet Retief:

33 Mark & De Wet Streets, eMkhondo, 2380

#### Applicant's Address:

PO Box 3556, Ladysmith, 3370

E-mail: info@liquoract.com

## Thank you to the Mkhondo Fire and Rescue

The Ndawonye principal, SMT and SGB would like to send words of gratitude to Anton Nortje and Mr Mkhabela from the Mkhondo Fire and Rescue Department for assisting

the school with water.

“Always when we call, they respond as quickly as they can. Your continued support is always appreciated.”

Ms MR Magagula  
081866 9329

## Thank you

**Noluvo Minentle Godlimpi.**

The Godlimpi family of eMagadeni Mkhondo wants to express its heartfelt appreciation for the love and support that the Methodist and Galilee Church in Christ showed us during the tragic and sad loss of their beloved daughter,

Noluvo Minentle Godlimpi. We also thank the Godlimpi family, as well as the Xaba family and the entire Mkhondo family for their wonderful presence and support during the sad loss. May God richly bless you all and do continue to show your love to other families.

## Parkrun results



Kate-Merie Ferreira

**61 people took part in the Piet Retief Parkrun on Saturday 21 January on the gravel road next to Piet Retief High School.**

*The top 10 participants were:*

1. Andre Vorster - 24:35
2. Tebogo Junior Ntuli - 27:03
3. Unknown
4. Mbongeni Thabede - 27:10
5. Unknown
6. Unknown
7. Pushie Chetty - 29:06
8. Unknown
9. Unknown

10. Unknown

A gentle reminder to please register on the Parkrun website and take your barcode with you when you participate. That will ensure that the volunteers are able to capture your time and upload it to the website so that you can keep track of your fitness journey.

Thank you to the volunteers who made this event possible and to the loyal participants who keep this event going. Next time, feel free to invite a friend!



**ISAZISO SOKUQALWA KOMGUDU WOKUGUNYAZWA**  
**KWANGOKWEMVELO KWEMISEBENZI**  
**ENGASEMPUMALANGA ENGEKA KANGRA'S MAQUASA:**

- **Ukufaka Isicelo Sokugunyazwa Kwangokwemvelo Okudidiyele okungokweSizinda Sokuhlanza Amanzi kanye Nesizinda Sokulahla Udoti Ohlukene**
- **Ukufaka Isicelo Semvume Edidiyele Yokusetshenziswa Kwamanzi engeyeSizinda esihlongozwayo Sokuhlanza Amanzi kanye Nesokulahla Udoti Ohlukene**

**GCS Ref. No.: 22-0161**

**DMRE Ref. No.: MP30/5/1/2/2/133MR (10200MR)**

**DWS REF. NO.: 11/W51B/CGI/4938**

U Kangra Coal (Pty) Ltd (Kangra) unemayini yamalahle evela ikhona esendaweni yase Driefontein, eduze kwase Piet Retief esiFundazweni saseMpumalanga. Imayini ikuMasipala uMkhondo ongaphansi kukaMasipala weSifunda iGert Sibande. Imisebenzi yeMaquasa East (MQE) ixuba ukumbiwa okuvulekile phezulu kanye nemisebenzi yokumba kuguduzwe emathunjini omhlaba ngaphansi kweLungelo Lokumbiwa Kwezimbiwa elingu (MP)30/5/1/2/2/133MR(10200MR). U Kangra uhlongoza ukwakha isizinda sokuhlanza amanzi (WTP) ukuze kuhlanzwe amanzi akhishiwe anukubezekile kanye nokwakha isizinda sokuwalahla esizokwazi ukwamukela amanzi angcolile akhizizeka esuka esizindeni sokuhlunga, udaka oselome lwaqina kanye nosawotana ongaqhamuka kwi WTP.

Kudingeka ukugunyazwa kwalokhu okulandelayo:

- **Ukugunyazwa Kwangokwemvelo Okudidiyele okumayelana neMigomo ye EIA ka 2014 engeye NEMA yalemisebenzi esohlwini:**
  - o **Isaziso Esisohlwini 1 (GNR327): Umsebenzi 25 no 27**
  - o **Isaziso Esisohlwini 2 (GNR325): Umsebenzi 5 no 15**
  - o **Isaziso Esisohlwini 3 (GNR324: Umsebenzi 12 no 14**
  - o **Umsebenzi Ongowokuphathwa Kodoti/Ukungcola (GNR921): Isigabana B - Umsebenzi 7, 10 no 15**
- **Imvume Edidiyele Yokusetshenziswa Kwamanzi ngokweSigaba 21 se NWA**
  - o **Isigaba 21 (c), (f), (g) no (i)**
- **Ukugunyazwa yi SAHRA ngokweSigaba 38 se NHRA**

Amaprojecti ahlolongozwayo asendaweni u Ptn ye Rem yePulazi iMaquasa 19 IT, engu Ptn yendawo iMineral Area 1 engeyengxenywe ye Rem yePulazi iRookop 18 HT, kumaPtn 1 no 2 ePulazi iKransbank 15 HT, kwingxenywe ye Rem engeyePulazi iMaquasa 19 HT, kanye nePulazi iRoodekraal 21 HT, elawulwa ngaphansi kweLungelo Lezimbiwa (MR) elivele likhona.

U GCS Water and Environmental Consultants (Pty) Ltd uqashiwe njengoNgoti abazimele Bocwaningo Lwemvelo ukuze bezobhekana nemigudu ebalulekile yocwaningo lwemvelo lwalamaprojecti abalulwe ngenhla ukuze kuxhaseke isicelo esiya kwiZiphathimandla Ezifanele; eMnyangweni Wezamadla Nezimbiwa waseMpumalanga (DMRE), uMnyango WezaManzi Nendle (DWS) kanye noMnyango WezaMaGugu eMpumalanga.

Amaqembu Abathintekayo Nabafisa Ukubambiqhaza (I&APs) ayamenywa ukuba abambe iqhaza ngokuthi abhalise iqhaza lawo nokuthi banikeze uvo lwabo futhi babeke izingqinamba ezibathintayo mayelana namaprojecti ahlolongozwayo. Unesikhathi esingaye siyofika kumhlaka 10 February 2023 sokubhalisela ukuba yi I&AP emzukulwisaneni wokuqala wohlelo lokuxhumana nababambi beqhaza kanye nokuthi ubeke izingqinamba mayelana neprojecti ehlongozwayo. Uyacelwa ukuba ufake lenombolo engu – 22-0161 – kukhona konke ukuxhumana.

Lesisaziso siyinxenywe yomgudu wokuqala wokuxhumana nomphakathi njengoba kudinga iMigomo ye EIA (ka 2014, njengoba ichitshiyelwe) yoMthetho kaZwelonke Wokuphathwa kweMvelo, ka 1998 (uMthetho 107 ka 1998) kanye noMthetho kaZwelonke Wamanzi, ka 1998 (uMthetho 36 ka 1998) (NWA). Ezinye izaziso ezimayelana naleprojecti zizokhishwa ngokuhamba kwesikhathi

**Ukuze ubhalise njenge I&AP nokuba uthole ulwazi oluthe thuthu uyacelwa ukuba uxhumane no:**

**GCS Pty Ltd**

**GCS Reference: 22-0161**

**Okuxhunyanwa naye:** Gerda Bothma/Anelle Lötter,  
Ucingo: 011 803 5726,

E-mail: gerdab@gcs-sa.biz/anellel@gcs-sa.biz

Iposi: PO Box 2597, Rivonia, Johannesburg, 2128



PRINTED AND PUBLISHED BY:

**EXP (PTY) LTD**

19 Kruger Street, PO Box 258, Piet Retief 2380  
Tel. (017) 826 2191 / 826 2176 - Fax (017) 826 2177  
Cell: 082 7800 269 - e-mail: excelsior@lantic.net

#### COPYRIGHT

Advertisements/News Items/Photos: Except where original material has been supplied by the client, all advertisements/news items/photos are the copyright of the above company and may not be reproduced in any form without the written permission of the copyright holders, EXP (PTY) LTD.



**CERTIFIED  
DISTRIBUTION  
COPIES:  
3500 PER  
WEEK**



Excelsior News subscribes to the Code of Ethics and Conduct for South African Print and Online Media that prescribes news that is truthful, accurate, fair and balanced. If we don't live up to the Code, please contact the Public Advocate at 011 484 3612, fax: 011 484 3619. You can also contact our Case Officer on khanyim@budsman.org.za or lodge a complaint on our website: www.presscouncil.org.za



**COMMUNITY PRESS ASSOCIATION**  
5th Floor, North Wing, Nedbank Gardens,  
33 Bath Avenue, Rosebank, Gauteng, RSA  
P.O. Box 47184, Parklands 2121  
Tel. (011) 447 1264/5/6 - Fax (011) 447 1289  
e-mail: cpa@printmedia.org.za



# Sasol reaches out to the community



SANRAL staff offered massages to customers of Sasol



Visitors could spin this wheel to win a prize

Kate-Merie Ferreira

The Sasol N2 team recently held an event on their premises, where they engaged with their customers and told them more about their amazing rewards programme.

The aim of the day was to motivate customers to sign up for the Sasol rewards programme. If you sign up, you receive 30 reward points for each litre of fuel that you buy at a Sasol filling station. These points can then be used to buy at any Sasol Quick Shop. They also gave their customers the opportunity to win merchandise, such as t-shirts, water bottles and hats, by spinning a wheel.

A SANRAL-team also had a stall, where they talked to visitors about the improvements that they are making to the N2 and to improve road safety by handing out pamphlets with information about the rules of the road. A highlight of the day was when they offered massages to the visitors. December and January can be stressful for a lot of people and it was nice to be able to relax for a few minutes.

Jumping castles were available for kids to enjoy while their parents were busy. All in all, it was a successful day.

# Alpha & Omega welcomes new staff



Back: Mr Dieter Lubbe (Pastoral care and Computers Senior Phase), Mr Mbongeni Siyaya (Maths Gr 8-10, Life Science (Gr 10) and LO (Gr 8-9), Mr Angelo Dames (Intern), Mrs Annalize Delpont (Principal Primary School)  
Front: Mrs Erika Martens (Gr 2A), Ms Sinenhlanhla Ndala (Maths Gr 5-7, EMS Gr 7), Mrs Rochelle Brits (Gr 4 Maths, NS and Afrikaans and NS Gr 7)  
Absent: Mrs Sonja Otto and Mrs Carol Lubbe



## REQUEST FOR DONATIONS

We had a very busy December at GRIP and are in need of products for Care Packs.

- Toothbrushes •
- Toothpaste •
- Soap •
- Face cloths •
- Deodorant •

**GRIP Mkhondo Shelter is in desperate need of products for Care Packs for Gender Based Violence and Rape survivors**

**For donations please contact Sindisiwe Msimango on: 072 872 5402**

# Huis Immergroen woeker in hulle tuin

Kate-Merie Ferreira

Daar is iets heil-saam aan die grond tussen jou vingers en die reuk van die natuur na die reën - dit doen iets aan jou siel.

Die inwoners van Huis Immergroen, veral die met groen vingers en 'n liefde vir tuinmaak, werk al vir die afgelope week daaraan om die tehuis se groentetuin in 'n "hothouse" te omskep, sodat hulle hul groente in vrede kan plant, sonder die las van muisvoëls. Baie dankie aan mnr. Remo Beneke wat sy kennis gedeel het en waardevolle insette tydens die proses gelewer het.

Die tehuis bedank

ook graag dié gemeenskapslede wat vir hulle groente geskenk het. Die inwoners het hand gegee om die boontjies te kerf en het sommer die geleentheid gebruik om saam om die kombuistafel te kuier. Net soos die goeie ou dae van samesyn in hulle eie

kombuise saam met hulle gesinne. Oom Gunter, wat by Huis Immergroen aansterk, is 'n talentvolle orrelis en die personeel en inwoners hoor gereeld hoe hy in die kapel speel. Dit is voorwaar 'n bederf om die pragtige liederde in die gange van die

tehuis te hoor. Baie sterkte aan tannie Alicia Paul met haar operasie in Nelspruit. Die inwoners en personeel wens ook spoedige beterskap aan tannie Martie Potgieter, wat tans aansterk na 'n siekbed. Immergroen liefde.



Spesiale oomblike om die kombuistafel



Die groente sal nou kans kry om te groei – weg van peste en plae

## AVAILABLE AT

# Excelsior

19 Kruger Street • 017 826 2176/2191



## HIGH QUALITY PRINTING OF BUILDING PLANS AT THE BEST PRICES

- FULL COLOUR • BLACK & WHITE •
- AVAILABLE UP TO SIZE 1 188 X 840 MM



# Burgers for Babies Charity Braai



Baby Hailey is a real fighter

Kate-Merie Ferreira  
The Care Bear Charity Organisation in Ermelo is hosting a charity braai on Friday 27 January and Saturday 28 January to raise much needed funds for baby Ashley and baby Hailey.

Baby Ashley came to the attention of the Care Bears after she was found abandoned in an empty erf in Mkhondo when she was only six days old. Baby Hailey was born prematurely

and weighed only 550g at her birth at seven months. Hailey and Ashley have a long road ahead of them. Both of these babies need medical care, as well as diapers, wipes, milk and other necessities. The Care Bears are therefore selling burgers at Four Sisters Butchery in Ermelo, for R30 each. All of the proceeds will go towards assisting these two babies. The organisation has opened a separate bank account, specifically

for this purpose. You can even support this initiative from Piet Retief, as they are selling “virtual burgers”. What that means, is that you can order a burger and pay for it and it will then be delivered at the Ermelo CMR Child-care or the SAVF House. If you have any enquiries or would like to make a donation, please contact Juliet Basson on 060 905 7150 or Chantal Boonstra on 072 460 1654. Orders can also be placed with them. *If you feel that you want to give to these two special babies, you can also make a payment into the following account:* TymeBank JA Basson Account number: 51067635033 We thank you in advance.

## Is this the new norm?

David Mkhonta

On a busy Monday morning 16 January, two trucks were spotted parked on the wrong side of the road. Why?

Truly ridiculous! Even if there was no available parking space - can one then opt to be ignorant? Whose lives are being endangered, and

whose responsibility will it be should any accident occur? Not to even mention that this already busy road was truly congested with them parking there.

The traffic officers should be on the look out for drivers who are blatantly ignoring any form of the law. No one is above the law.



# A partnership that will transform us all

David Mkhonta

On Thursday 19 January, the Piet Retief Miracle Centre joined hands with Christ for Mama Africa. Christ for Mama Africa handed over various books to the centre which will cater for many needs of the people in the community, both educational and social.

The partnership was established for community development and aims to develop a culture of reading by offering a place for residents to go sit and read. “This partnership will play a pivotal role in the development because a number of learners in Kwa-Ntombazane, Phola Park have guardians who comprise of old people who cannot read nor write. So, this centre will also assist learners with their assignments. Not only will this service be offered at the centre, but they will also assist distance learners who cannot afford the transport fees to go to the town library. They are welcome to come and do their studies at the centre together with those that are making on-line applications for universities,” said Mlamuli Khumalo. “We are looking forward to this partnership to pride us all with dignity as we will soon be transformed citizens,” he concluded.



# Chicken shortages and price hikes looming

Kate-Merie Ferreira

Ongoing load shedding is affecting chicken production and if it continues, consumers can expect steep price hikes, as well as a chicken shortage.

According to Izaak Breitenbach, General Manager of the South African Poultry Association (SAPA), there are enough chickens to meet the demand but, due to ongoing power cuts, abattoirs can not keep up with their work and they simply don't have enough time in a day to complete orders. Some fast-food outlets like KFC were forced to close

their doors or scale back their menus recently due to a shortage of chicken. Now there's a warning, the shortage caused by power cuts will possibly spill over into the retail and wholesale markets in South Africa as well.

Members of SAPA have had to take 10 million chickens out of production in the past six weeks due to the crisis. As it was announced earlier this week, South Africans can expect load shedding for the next two years, this crisis is likely to become worse with time.

Source: 702.co.za



1-10 million chickens had to be removed from the production line

## PHANDA

### BEEF BURGER MEAL

R49<sup>90</sup>

## MO'MJOJO

### 

R89<sup>90</sup>

**Steers Piet Retief**  
T: (017) 826 3501 | C: (066) 570 8362  
37 Church Street, Piet Retief





ISSN 1996-2991



9 771996 299105

083 627 5248 • 082 322 6942  
AUTHORISED BY ALL INSURANCE COMPANIES

AA RECOVERY

SOS International

MUTUAL & FEDERAL

Est. 1994 - 25 years of service

SM TOWING SERVICES

E-mail: smbardown@gmail.com • Office: 034 413 1543 • Cell: 082 612 8531

PONGOLA • PIET RETIEF • HLUHLWE

time for a re-brand?

We will take care of it for you, we specialise in:

- brochures
- full colour printing
- business cards
- flyers
- letterheads

**Excelsior**

Tel.: 017 826 2176/2191 • Fax: 017 826 2177  
excelsior@tantic.net • 19 Kruger Street, Piet Retief

# Piet Retief VLU



Nuwe bestuur vlnr: Janeen Herrington, Helena Joubert, Wilana Claassen, Santie du Toit, Sonja du Toit, Lydia Vermaak

Ons nuwe voor-  
sitster, Wilana  
Claassen, open die  
eeste takvergade-  
ring van 2023 met  
'n gedeelte uit Fil.  
3.

In vers 13 staan  
"... maar een ding  
is seker: ek vergeet  
dit wat agter my  
lê, en strek my uit  
na dit wat voorlê." Die klem lê op die  
woordjie strek. Al die slegte dinge van  
die verlede moet ons  
doelbewus agterlaat  
en vergeet, en strek  
na die goeie wat

voor ons is. Dit verg  
moeite en energie  
om te strek en moet  
ons ons beywer om  
dit wat goed is na te  
jaag.

Ons kuier aan huis  
van Christa Stry-  
dom, wat 'n deeg-  
like demonstrasie  
aanbied oor brood-  
bak. Die agenda  
begin dus daarmee  
sodat dit betyds ge-  
bak kan word vir  
die verversings later.  
Wit- en bruinbrood  
asook rolletjies met  
verskillende saad-  
jies versier, word

gedemonstreer. Ge-  
durende die verga-  
dering het die geur  
van brood wat bak,  
ons omgewe.

Nuwe lede word  
verwelkom uit Es-  
watini by name  
Vossie Snyman, Su-  
san Prins en Roné  
Prins. 'n Gedugte  
span want dis ma,  
dogter en kleindog-  
ter. Elease is terug  
met haar pragtige  
seuntjie wat stroop-  
soet was. Die nuwe  
bestuur word voorg-  
estel en die sekretre-  
resse, Santie, lig ons

in hoe die struktuur  
van die vergaderings  
en program deur die  
jaar sal verloop. Die  
tesouriere, Sonja,  
verduidelik die best-  
eding van die lede-  
gelde binne die VLU  
en die belangrikheid  
van fondsinsamel-  
ings. Helena gee  
inligting oor die ar-  
tikels wat in 2023  
voorgestel is vir  
Tambuki streek sow-  
el as Suid-Afrika.  
Met die streekverga-  
dering is belangrike  
riglyne gegee en het  
sy dit oorgedra aan  
die dames. Sy in-  
spireer ons om almal  
iets te probeer skep,  
maar waarsku om  
betyds te begin met  
die tydrowende ar-  
tikels. Werksklasse  
word deur die jaar  
beplan om wenke te  
gee en vaardighede  
aan te leer.

'n Mooi resep-



Broodbakster van formaat -  
Christa Strydom

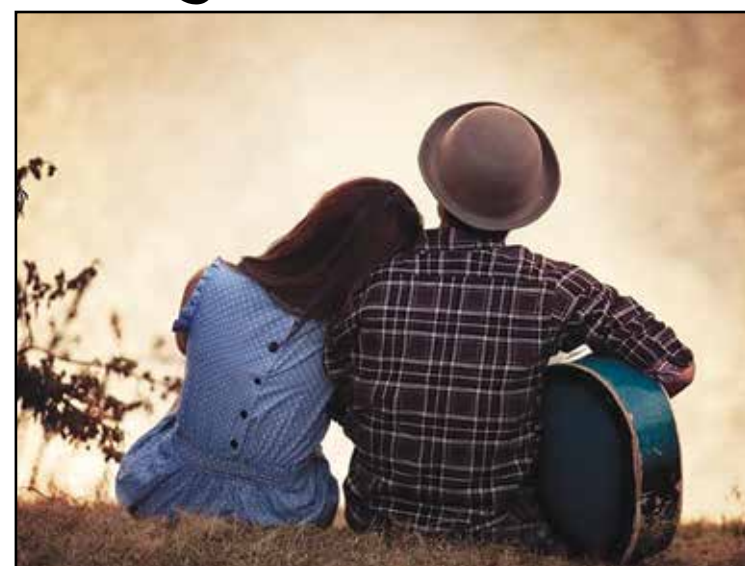
teboek, "Botter en  
Liefde", word aan  
die lede, Suzette,  
Sonja, Janeen, Lydia  
en Helena geskenk  
wat vyf of meer  
artikels ingeskryf  
het vir die konfe-  
rensie in Februarie.  
'n Trooskombersie  
word deur Wilana  
aan Janeen Her-  
rington oorhandig  
wat die tak se liefde

en gebede simboli-  
seer met die siekte  
van haar dogter.

Ons vermoed die  
eggenotes van die  
dames moes maar  
self vir aandete sorg,  
want die dames het  
behoorlik gestrek en  
gesmul aan die heer-  
like warm brood,  
botter en konfyt wat  
Christa baie keurig  
voorgesit het.



## Gedagte van die week



Hebreërs 10: 24-25 "En laat ons kyk hoe ons mekaar kan  
aanspoor tot liefde en goeie dade, sonder om saam te vergader,  
soos sommige die gewoonte het om dit te doen, maar mekaar aan  
te moedig - en des te meer as u die dag nader kom."

## PIET RETIEF WEATHER

FRIDAY 27 JANUARY 2023	SATURDAY 28 JANUARY 2023	SUNDAY 29 JANUARY 2023	MONDAY 30 JANUARY 2023	TUESDAY 31 JANUARY 2023	WEDNESDAY 1 FEBRUARY 2023	THURSDAY 2 FEBRUARY 2023
29°   16°C	31°   16°C	27°   14°C	23°   15°C	25°   15°C	29°   16°C	28°   16°C
PARTLY CLOUDY	SUNNY	THUNDERSTORMS	SCATTERED THUNDERSTORMS	THUNDERSTORMS	THUNDERSTORMS	THUNDERSTORMS

New range of Hino 300  
coming soon.



Watch  
this  
space



Japie Kühn | Sales Manager

T: (017) 826 2314 • C: (071) 600 6774

E: jkuhn@twkagri.com

A: 11 De Wet Street, Piet Retief, 2380

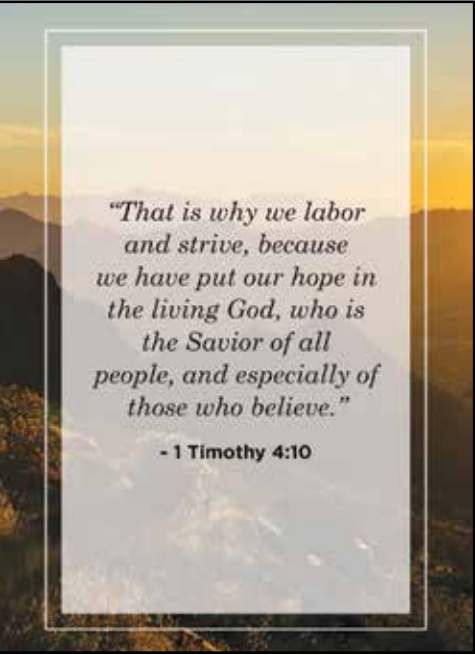




## **APPENDIX B-2: SCOPING**

Thought of the week

Community outreach programme



reside. He further mentioned that companies are utilising such platforms, like the service provided by the Department of Employment and Labour to recruit when hiring, whereby they verify the skills they need from the department's database and then contact those candidates for interviews. He encouraged the youth to send their CVs so that they are documented with the department of labour to assist with job opportunities.



ment of Labour, also mentioned that they will arrange in the future to educate the youth on how they can effectively compile their CVs.

Mr Mkhathswa from the Department of Home Affairs provided much

needed information on the importance of birth and marriage certificates. People applauded his presentation when he mentioned that marriage certificates only cost R20-00 and they promise to visit his office for the service.

Mpho Makade from the Depart-

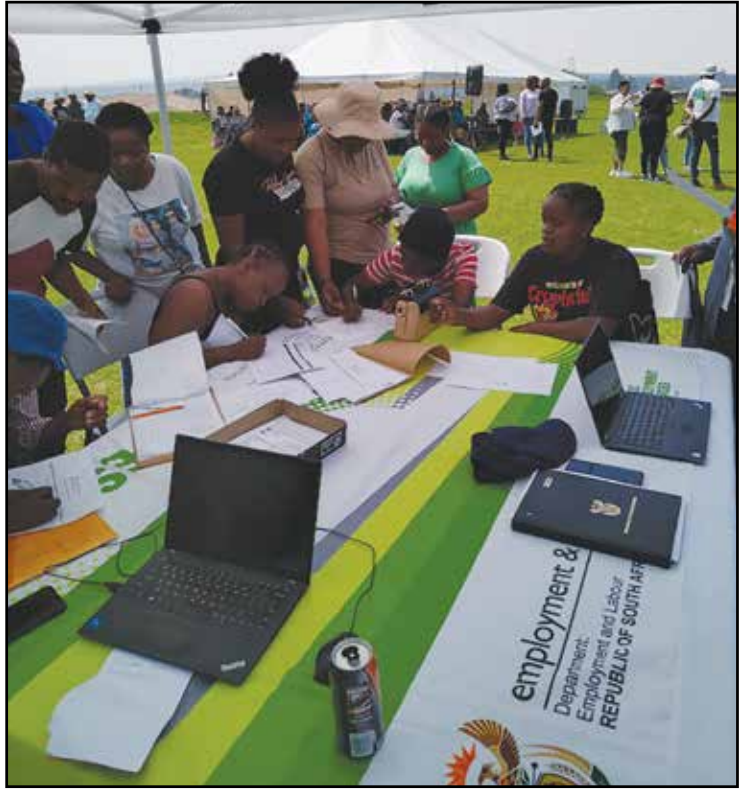
David Mkhonta  
The Speaker of Council, Cllr Mdu-duzi Ngwenya, hosted a community outreach programme at Ajax Sports Ground, Ward 8, on Friday 17 November.

The programme was implemented in partnership with local government departments such as the Department of Health, Department of Home Affairs, Department of Social Development, South Africa Social Security Agency, Department of Basic Education and the Department of Employment and Labour.

The purpose of the outreach programme was to provide communities with much needed information regarding services rendered by the different government departments.

Though the programme was launched and piloted at Ward 8, it is aimed to run across all wards within Mkhondo and it's further expected to be fully rolled out in 2024.

"The Office of the Speaker is responsible for public participation as a government wing of communication, aimed at bringing information to communities," the speaker said. He pleaded with members of the community to make use of such opportunities by taking advantage of government services brought closer to where they



Deterioration of Brand Street

Fanie Vermaak  
More than a year ago the western part of Brand Street, Piet Retief was resurfaced at a cost of millions of rands.

A visit to this street last week revealed the rapid deterioration of Brand Street, the presence of potholes and cracks on the paved

and concrete road are visible everywhere. Obviously the high volume of trucks is contributing to the dilapidation of the street as well as many other streets in Piet Retief. But, it is also appropriate to highlight that the deterioration of Brand Street is due to human behaviour,

and obviously the responsible authority's lack of effectively maintaining it as well as their reluctance to stop the washing of vehicles in the street. The drainage systems are blocked and filthy. The current horrendous state of this street is an eyesore and doesn't portray a beautiful picture of our town.



KANGRA

NOTIFICATION OF COMMENCEMENT OF ENVIRONMENTAL AUTHORIZATION PROCESSES FOR KANGRA'S MAQUASA EAST OPERATIONS:

- Application for Integrated Environmental Authorisation for the proposed Water Treatment Plant & Co-Disposal Facility
- Application for Integrated Water Use Licence for the proposed Water Treatment Plant & Co-Disposal Facility

GCS Ref. No.: 22-0161

DMRE Ref. No.: MP30/5/1/2/2/133MR (10200MR)

DWS REF. NO.: 11/W51B/CGI/4938

Kangra Coal (Pty) Ltd (Kangra) has an existing coal mine located in Driefontein, near Piet Retief in the Mpumalanga Province. The mine is located in the Mkhondo Local Municipality within the Gert Sibande District Municipality. The Maquasa East (MQE) operations include the historical opencast and underground operations under Mining Right (MP30/5/1/2/2/133MR (10200MR). Kangra is proposing to construct a new waste water treatment plant (WWTP) for the treatment of decant and surplus contaminated water and a new co-disposal facility which will accommodate discard produced from the beneficiation plant, slurry/filter cake and potentially brine from the WWTP.

Authorisation is being sought for the following:

- Integrated Environmental Authorisation in terms of the NEMA 2014 EIA Regulations for listed activities:
  - Listing Notice 1 (GNR327): Activity 26 & 27
  - Listing Notice 2 (GNR325): Activity 5 & 15
  - Listing Notice 3 (GNR324): Activity 12 & 14
  - Waste Management Activity (GNR921): Category B – Activity 7, 10 & 11
- Integrated Water Use Licence in terms of Section 21 of the NWA
  - Section 21 (c), (f), (g) & (i)
- SAHRA Authorisation in terms of Section 38 of the NHRA

The proposed projects are located on the Remaining Extent (RE) of Farm Roodekraal 21 HT, RE of Farm Rooikop 18 HT, RE of Farm Maquasa 19 HT, and Farm Roodekraal 21 HT, held under the existing Mining Right (MR).

GCS Water and Environmental Consultants (Pty) Ltd has been appointed as the independent Environmental Assessment Practitioner to undertake the necessary environmental processes for the above-mentioned projects in support of the application to the relevant Competent Authorities; the Mpumalanga Department of Mineral Resources and Energy (DMRE), the Department of Water and Sanitation (DWS) and the Mpumalanga Department of Heritage Resources.

DRAFT SCOPING REPORT IS AVAILABLE FOR PUBLIC COMMENT

FROM 24 NOVEMBER 2023 TO 16 JANUARY 2024

The Draft Scoping Report is available as follows:

Printed Copies	
Piet Retief Library, 10B Retief Street, Piet Retief	Maquasa East Security Office, Maquasa East Mine, Driefontein
Thusong Service Centre, Driefontein Community	

Electronic Copy	
Website Download	<a href="https://www.gcs-sa.biz/public-documents/">https://www.gcs-sa.biz/public-documents/</a>

For a copy of a Background Information Document or the Draft Scoping Report and to register as an Interested and Affected Party, please contact:

GCS Pty Ltd

Gerda Bothma

Tel.: 011 803 5726

E-mail: [gerdab@gcs-sa.biz](mailto:gerdab@gcs-sa.biz); or

Mail: PO Box 2597, Rivonia, Johannesburg, 2128

Interested and Affected Parties are invited to participate by providing written comments and raising issues of concern.



# 'n Straatpartytjie

Fanie Vemaak

“Wie hou dan nou nie van ‘n lekker straatpartytjie nie? Dit is ook ‘n goeie verskoning om jou ‘bure’ beter te leer ken.

Op Vrydagaand 17 November het die inwoners van Van Dykstraat en omliggende strate, die straat toege- maak vir ‘n heerlike straatbraai. Dit was gehou voor die huis van Elke Gevers en die straat is omskep in ‘n opelug braai- area. Gerhard Böhm- mer het gesorg vir die ligte en lekker musiek.

Talle inwoners van die buurt het hul stoele, eetgoed en braaivleis ge- bring en die vure het gesellig gebrand terwyl inwoners mekaar ontmoet en kuier. Die weer was perfek en ons was ook bevoorreg om saam te kon kuier met ‘n familie vanaf Duitsland vir wie dit ook ‘n ‘eerste’ was.



## Graduation ceremony presents exceptional talent!

David Mkhonta

On Saturday 18 November, Bhekulwazi Pre-Primary School held its graduation ceremony.

According to the principal, Mrs Mhlanga, all learners can thrive and become individuals who are self-sufficient and knowledgeable. Their skills and development are guided and supported by educa-

tors who adhere to the educational policies. Parents showed their appreciation with non-stop applause as the learners demonstrated their talent, confidence and expertise. This encapsulates the school’s ethos that a child’s success is built on a solid foundation.

She further mentioned that the school offers a ho-

listic education and fosters strong bonds between staff and learners where nurturing, support and empathy are essential character traits in the development of each learner. “Enthusiasm and passion are essential for academic success and this school encourages these qualities. Academic excellence is heavily influenced by the school’s policy and learners’ exposure

to modern teaching methods that create excellent learning opportunities,” she added.

Mrs Mhlanga expressed her gratitude, appreciation and congratulated the staff and learners and she wished the class of 2023 and their families a prosperous New Year.

Parents were overjoyed to attend the graduation ceremony.



# Traffic sign replaced

Fanie Vermaak

Excelsior News reported in last week’s edition dated 17 November on the dangerous situation at the Smit/Pretorius Street intersection which was not equipped with a ‘stop sign’.

On Monday the 20th of November Excelsior News attended a meeting at PG Bison between the Mkhondo Local Municipality, The Business Chamber of Commerce and the Local Ratepayers Association as well as PG Bison.

The Executive Mayor, CLLR Ngelosi Ndhlovu, was also in attendance accompanied by other officials from the MLM. It was a very positive meeting held in good spirit and with one common goal and that is to make Mkhondo a better place for everyone.

One of the issues that were brought to the attention of the Executive Mayor at this meeting by Excelsior News, was the dangerous situation at the Smit/Pretorius Street intersection.

We are pleased to report that within one day a new ‘stop sign’ was installed at this intersection.

Well done MLM!



# KANGRA

**ISAZISO SOKUQALWA KOMGUDU WOKUGUNYAZWA KWANGOKWEMVELO KWEMISEBENZI ENGASEMPUMALANGA ENGEKA KANGRA’S MAQUASA:**

- Ukufaka Isicelo Sokugunyazwa Kwangokwemvelo Okudidiyele okungokweSizinda Sokuhl- anza Amanzi kanye Nesizinda Sokulahla Udoti Ohlukene
- Ukufaka Isicelo Semvume Edidiyele Yokusetshenziswa Kwamanzi engeyeSizinda esihlon- gozwayo Sokuhlaza Amanzi kanye Nesokulahla Udoti Ohlukene

**GCS Ref. No.: 22-0161**

**DMRE Ref. No.: MP30/5/1/2/2/133MR (10200MR)**

**DWS REF. NO.: 11/W51B/CGI/4938**

U Kangra Coal (Pty) Ltd (Kangra) unemayini yamalahle evela ikhona esendaweni yase Driefontein, eduze kwase Piet Retief esiFundazweni saseMpumalanga. Imayini ikuMasipala uMkhondo ongaphansi kukaMa- sipala weSifunda iGert Sibande. Imisebenzi yeMaquasa East (MQE) ixuba ukumbiwa okuvulekile phezulu kanye nemisebenzi yokumba kuguduzwe emathunjini omhlaba ngaphansi kweLungelo Lokumbiwa Kwezimbiwa elingu (MP)30/5/1/2/2/133MR (10200MR). U Kangra uhlongoza ukwakha isizinda soku- hlaza amanzi angcolile (WWTP) ukuze kuhlanzwe amanzi akhishiwe anukubezekile kanye nokwakha isizinda sokuwalahla esizokwazi ukwamukela amanzi angcolile akhiqizeka esuka esizindeni sokuhlunga, udaka oselome lwaqina kanye nosawotana ongaqhamuka kwi WWTP.

Kudingeka ukugunyazwa kwalokhu okulandelayo:

- Ukugunyazwa Kwangokwemvelo Okudidiyele okumayelana neMigomo ye EIA ka 2014 engeye NEMA yalemisebenzi esohlwini:
  - Isaziso Esisohlwini 1 (GNR327): Umsebenzi 26 no 27
  - Isaziso Esisohlwini 2 (GNR325): Umsebenzi 5 no 15
  - Isaziso Esisohlwini 3 (GNR324): Umsebenzi 12 no 14
  - Umsebenzi Ongowokuphathwa Kodoti/Ukungcola (GNR921): Isigabana B – Umsebenzi 7, 10 no 11
- Imvume Edidiyele Yokusetshenziswa Kwamanzi ngokweSigaba 21 se NWA
  - Isigaba 21 (c), (f), (g) no (i)
- Ukugunyazwa yi SAHRA ngokweSigaba 38 se NHRA

Amaprojecti ahlongozwayo atholakala endaweni esele yePulazi iRoodekraal 21 HT, yeRem yePulazi iRooskop 18 HT, yeRem yePulazi Maquasa 19 HT, kanye nePulazi Roodekraal 21 HT, elawulwa ngaphansi kweLungelo Lezimbiwa (MR) elivele likhona.

U GCS Water and Environmental Consultants (Pty) Ltd uqashiwe njengoNgoti abazimele Bocwaningo Lwemvelo ukuze bezobhekana nemigudu ebalulekile yocwaningo lwemvelo lwalamaprojecti abalulwe ngenhla ukuze kuxhaseke isicelo esiya kwiZiphathimandla Ezifanele; eMnyangweni Wezamandla Nezim- biwa waseMpumalanga (DMRE), uMnyango WezaManzi Nendle (DWS) kanye noMnyango WezamaGugu eMpumalanga.

**UMBIKO WOKULUNGA KWESIKOPI UYATHOLAKALA UKUZE UPHAWULE UMPHAKATHI KUSUKA 24 NOVEMBER 2023 UKUYA KU-16 JANUARY 2024**

Umbiko weSikophu Osalungiswa utholakala kanjena:

Amakhophi Aphrintiwe	
Piet Retief Library, 10B Retief Street, Piet Retief	Maquasa East Security Office, Maquasa East Mine, Driefontein
Thusong Service Centre, Driefontein Community	
Ikhophi ye-elektronikhi	
Ukulanda lwebhusayithi	<a href="https://www.gcs-sa.biz/public-documents/">https://www.gcs-sa.biz/public-documents/</a>

**Ukuze uthole ikhophi yoMqulu Wolwazi Lwesendlelelo noma uMbiko Osalungiswa Wesikophu futhi ubhalise Njengomuntu Onentshisekelo Nothintekayo, sicela uthinte:**

**GCS Pty Ltd**  
Gerda Bothma  
Ucingo: 011 803 5726  
E-mail: [gerdab@gcs-sa.biz](mailto:gerdab@gcs-sa.biz); noma  
Iposi: PO Box 2597, Rivonia, Johannesburg, 2128

**Abanentshisekelo Nabathintekayo bayamenywa ukuthi babambe iqhaza ngokunikeza imibono ebhaliwe futhi baveze izinto ezibakhathazayo.**



## **APPENDIX C: SITE NOTICES**

## **APPENDIX C-1: PRE-APPLICATION**



## NOTIFICATION OF COMMENCEMENT OF ENVIRONMENTAL AUTHORISATION PROCESSES FOR KANGRA'S MAQUASA EAST OPERATIONS:

- Application for Integrated Environmental Authorisation for the proposed Water Treatment Plant & Co-Disposal Facility
- Application for Integrated Water Use License for the proposed Water Treatment Plant & Co-Disposal Facility

GCS Ref. No: 22-0161 DMRE Ref. No.: MP30/5/1/2/2/133MR(10200MR) DWS Ref. No.: 11/W51B/CGI/4938

Kangra Coal (Pty) Ltd (Kangra) has an existing coal mine located in Driefontein, near Piet Retief in the Mpumalanga Province. The mine is located in the Mkhondo Local Municipality within the Gert Sibande District Municipality. The Maquasa East (MQE) operations include the historical opencast and underground operations under Mining Right (MP)30/5/1/2/2/133MR(10200MR). Kangra is proposing to construct a new water treatment plant (WTP) for the treatment of decant and surplus contaminated water and a new co-disposal facility which will accommodate discard produced from the beneficiation plant, slurry/filter cake and potentially brine from the WTP.

Authorisation is being sought for the following:

- Integrated Environmental Authorisation in terms of the NEMA 2014 EIA Regulations for listed activities:
  - Listing Notice 1 (GNR327): Activity 25 & 27
  - Listing Notice 2 (GNR325): Activity 5 & 15
  - Listing Notice 3 (GNR324: Activity 12 & 14
  - Waste Management Activity (GNR921): Category B – Activity 7, 10 & 15
- Integrated Water Use License in terms of Section 21 of the NWA
  - Section 21 (c), (f), (g) & (i)
- SAHRA Authorisation in terms of Section 38 of the NHRA

The proposed projects are located on Ptn of Rem of Farm Maquasa 19IT, Ptn of Mineral Area 1 on the Rem extent of Farm Rooikop 18 HT, Ptns 1&2 of Farm Kransbank 15HT, Rem extent of Farm Maquasa 19HT, and Farm Roodekraal 21 HT, held under the existing Mining Right (MR). (Refer to the map below)

GCS Water and Environmental Consultants (Pty) Ltd has been appointed as the independent Environmental Assessment Practitioner to undertake the necessary environmental processes for the above-mentioned projects in support of the application to the relevant Competent Authorities; the Mpumalanga Department of Mineral Resources and Energy (DMRE), the Department of Water and Sanitation (DWS) and the Mpumalanga Department of Heritage Resources.



## ISAZISO SOKUQALWA KOMGUDU WOKUGUNYAZWA KWANGOKWEMVELO KWEMISEBENZI ENGEKA KANGRA'S MAQUASA EAST

- Ukufaka Isicelo Sokugunyazwa Kwangokwemvelo Okudidiyele okungokweSizinda Sokuhlanza Amanzi kanye Nesizinda Sokulahla Udoti Ohlukene
- Ukufaka Isicelo Semvume Edidiyele Yokusetshenziswa Kwamanzi engeyeSizinda esihlongozwayo Sokuhlanza Amanzi kanye Nesokulahla Udoti Ohlukene

GCS Ref. No: 22-0161 DMRE Ref. No.: MP30/5/1/2/2/133MR(10200MR) DWS Ref. No.: 11/W51B/CGI/4938

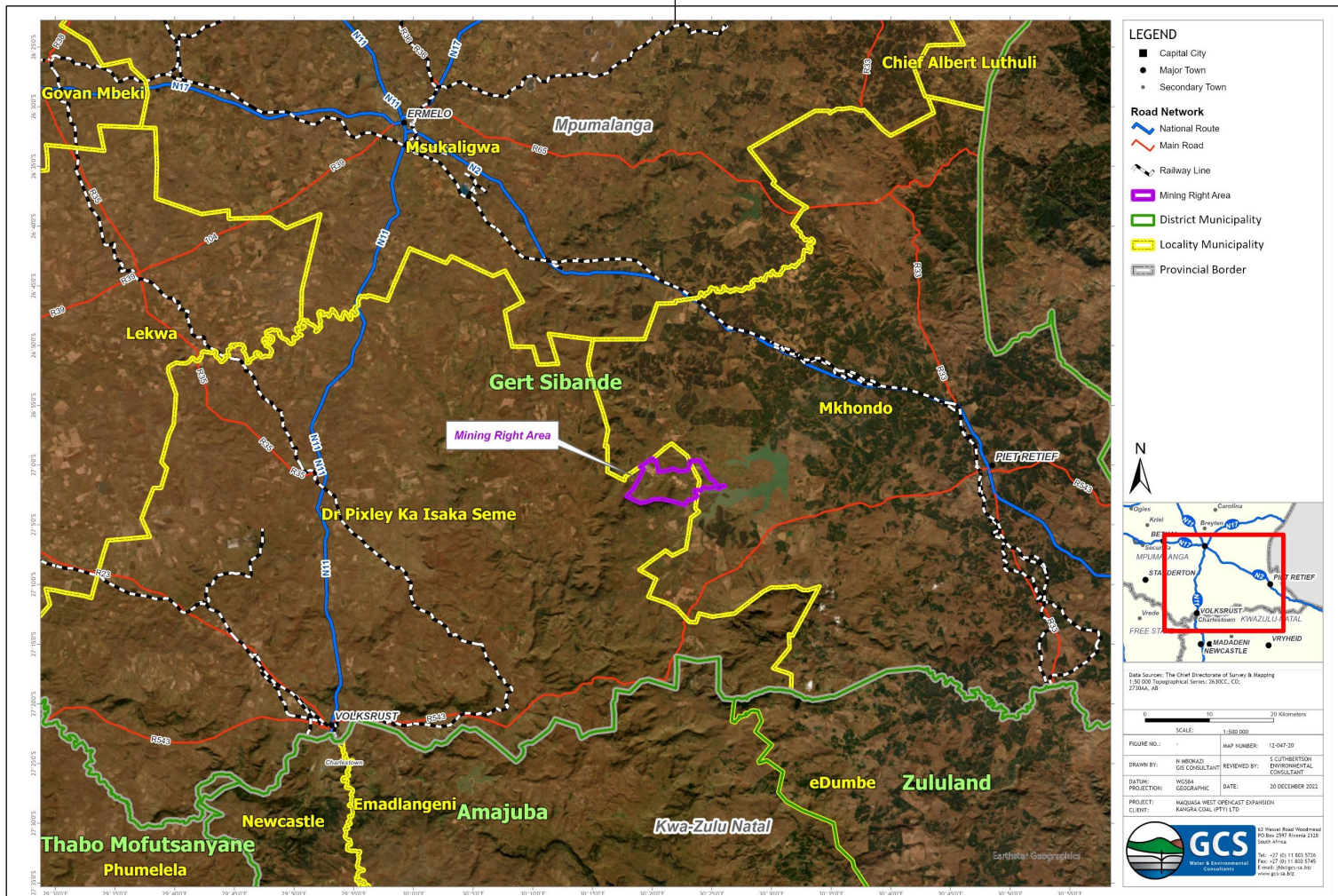
U Kangra Coal (Pty) Ltd (Kangra) unemayini yamalahle evela ikhona esendaweni yase Driefontein, eduze kwase Piet Retief esiFundazweni saseMpumalanga. Imayini ikuMasipala uMkhondo ongaphansi kukaMasipala weSifunda iGert Sibande. Imisebenzi yeMaquasa East (MQE) ixuba ukumbiwa okuvulekile phezulu kanye nemisebenzi yokumba kuguduzwe emathunjini omhlaba ngaphansi kweLungelo Lokumbiwa Kwezimbiwa elingu (MP)30/5/1/2/2/133MR(10200MR). U Kangra uhlongoza ukwakha isizinda sokuhlanza amanzi (WTP) ukuze kuhlanzwe amanzi akhishiwe anukubezekile kanye nokwakha isizinda sokuwalahla esizokwazi ukwamukela amanzi angcolile akhiqizeka esuka esizindeni sokuhlunga, udaka oselome lwaqina kanye nosawotana ongaqhamuka kwi WTP.

Kudingeka ukugunyazwa kwalokhu okulandelayo:

- Ukugunyazwa Kwangokwemvelo Okudidiyele okumayelana neMigomo ye EIA ka 2014 engeye NEMA yalemisebenzi esohlwini:
  - Isaziso Esisohlwini 1 (GNR327): Umsebenzi 25 no 27
  - Isaziso Esisohlwini 2 (GNR325): Umsebenzi 5 no 15
  - Isaziso Esisohlwini 3 (GNR324: Umsebenzi 12 no 14
  - Umsebenzi Ongowokuphathwa Kodoti/Ukungcola (GNR921): Isigabana B – Umsebenzi 7, 10 no 15
- Imvume Edidiyele Yokusetshenziswa Kwamanzi ngokweSigaba 21 se NWA
  - Isigaba 21 (c), (f), (g) no (i)
- Ukugunyazwa yi SAHRA ngokweSigaba 38 se NHRA

Amaprojecti ahlolongozwayo asendaweni u Ptn ye Rem yePulazi iMaquasa 19IT, engu Ptn yendawo iMineral Area 1 engeyengxenywe ye Rem yePulazi iRookop 18 HT, kumaPtn 1 no 2 ePulazi iKransbank 15 HT, kwingxenywe ye Rem engeyePulazi iMaquasa 19 HT, kanye nePulazi iRoodekraal 21 HT, elawulwa ngaphansi kweLungelo Lezimbiwa (MR) elivele likhona. (Bheka ebalazweni elingezansi)

U GCS Water and Environmental Consultants (Pty) Ltd uqashiwe njengoNgoti abazimele Bocwaningo Lwemvelo ukuze bezobhekana nemigudu ebalulekile yocwaningo lwemvelo lwalamaprojecti abalulwe ngenhla ukuze kuxhaseke isicelo esiya kwiZiphathimandla Ezifanele; eMnyangweni Wezamazandla Nezimbiwa waseMpumalanga (DMRE), uMnyango WezaManzi Nendle (DWS) kanye noMnyango WezamaGugu eMpumalanga.



## YOUR PARTICIPATION IS IMPORTANT

Interested and Affected Parties (I&APs) are invited to participate by registering your interest and to provide comments and raise issues of concern regarding the proposed projects. You have until the 10<sup>th</sup> of February 2023 to register as an I&AP in the first round of stakeholder engagement and to raise initial issues about the proposed project. Please include this reference number – 22-0161 – in all correspondence.

This notification forms part of the initial public consultation process as required by the National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA) EIA Regulations (2014, as amended) and the National Water Act, 1998 (Act 36 of 1998) (NWA). Further notifications pertaining to this project will be issued in due course.

**To register as an I&AP and to receive more information please contact:**

GCS (Pty) Ltd: Gerda Bothma / Anelle Lötter, Tel: 011 803 5726,

Email: [gerdab@gcs-sa.biz](mailto:gerdab@gcs-sa.biz) / [anellel@gcs-sa.biz](mailto:anellel@gcs-sa.biz),

Postal Address: PO Box 2597, Rivonia, Johannesburg, 2128

**Publication Date: 20 January 2023**

## UKUBAMBA IQHAZA KWAKHO KUBALULEKILE

Amaqembu Abathintekayo Nabafisa Ukubambiqhaza (I&APs) ayamenywa ukuba abambe iqhaza ngokuthi abhalise iqhaza lawo nokuthi banikeze uvo lwabo futhi babeke izingqinamba ezibathintayo mayelana namaprojecti ahlolongozwayo. Unesikhathi esingaye siyofika kumhlaka 10 February 2023 sokubhalisa ukuba yi I&AP emzukulwisaneni wokuqala wohlelo lokuxhumana nababambi beqhaza kanye nokuthi ubeke izingqinamba mayelana neprojecti ehlongozwayo. Uyacelwa ukuba ufake lenombolo engu – 22-0161 – kukhona konke ukuxhumana.

Lesisaziso siyinxenye yomgudu wokuqala wokuxhumana nomphakathi njengoba kudinga iMigomo ye EIA (ka 2014, njengoba ichitshiyelwe) yoMthetho kaZwelonke Wokuphathwa kweMvelo, ka 1998 (uMthetho 107 ka 1998) kanye noMthetho kaZwelonke Wamanzi, ka 1998 (uMthetho 36 ka 1998) (NWA). Ezinye izaziso ezimayelana naleprojecti zizokhishwa ngokuhamba kwesikhathi.

**Ukuze ubhalise njenge I&AP nokuba uthole ulwazi oluthe thuthu uyacelwa ukuba uxhumane no:**

GCS (Pty) Ltd: Gerda Bothma / Anelle Lötter, Ucingo: 011 803 5726,

I email: [gerdab@gcs-sa.biz](mailto:gerdab@gcs-sa.biz) / [anellel@gcs-sa.biz](mailto:anellel@gcs-sa.biz),

Ikheli: PO Box 2597, Rivonia, Johannesburg, 2128

## **APPENDIX C-2: SCOPING**





## NOTIFICATION OF COMMENCEMENT OF ENVIRONMENTAL AUTHORISATION PROCESSES FOR KANGRA'S MAQUASA EAST OPERATIONS:

- Application for Integrated Environmental Authorisation for the proposed Water Treatment Plant & Co-Disposal Facility
- Application for Integrated Water Use License for the proposed Water Treatment Plant & Co-Disposal Facility

GCS Ref. No: 22-0161

DMRE Ref. No.: MP30/5/1/2/2/133MR(10200MR)

DWS Ref. No.: 11/W51B/CGI/4938

Kangra Coal (Pty) Ltd (Kangra) has an existing coal mine located in Driefontein, near Piet Retief in the Mpumalanga Province. The mine is located in the Mkhondo Local Municipality within the Gert Sibande District Municipality. The Maquasa East (MQE) operations include the historical opencast and underground operations under Mining Right (MP)30/5/1/2/2/133MR(10200MR). Kangra is proposing to construct a new waste water treatment plant (WWTP) for the treatment of decant and surplus contaminated water and a new co-disposal facility which will accommodate discard produced from the beneficiation plant, slurry/filter cake and potentially brine from the WWTP.

Authorisation is being sought for the following:

- Integrated Environmental Authorisation in terms of the NEMA 2014 EIA Regulations for listed activities:
  - Listing Notice 1 (GNR327): Activity 25 & 27
  - Listing Notice 2 (GNR325): Activity 5 & 15
  - Listing Notice 3 (GNR324: Activity 12 & 14
  - Waste Management Activity (GNR921): Category B – Activity 7, 10 & 15
- Integrated Water Use License in terms of Section 21 of the NWA
  - Section 21 (a), (c), (f), (g) & (i)
- SAHRA Authorisation in terms of Section 38 of the NHRA

The proposed projects are located on the Remaining extent (RE) of Farm Roodekraal 21 HT, RE of Farm Rooikop 18 HT, RE of Farm Maquasa 19HT, and Farm Roodekraal 21 HT, held under the existing Mining Right (MR). (Refer to the map below)

GCS Water and Environmental Consultants (Pty) Ltd has been appointed as the independent Environmental Assessment Practitioner to undertake the necessary environmental processes for the above-mentioned projects in support of the application to the relevant Competent Authorities; the Mpumalanga Department of Mineral Resources and Energy (DMRE), the Department of Water and Sanitation (DWS) and the Mpumalanga Department of Heritage Resources.



## ISAZISO SOKUQALWA KOMGUDU WOKUGUNYAZWA KWANGOKWEMVELO KWEMISEBENZI ENGASEMPUMALANGA YE MAQUASA ENGEKAKANGRA:

- Ukufaka Isicelo Sokugunyazwa Kwangokwemvelo Okudidiyele okungokweSizinda Sokuhlaza Amanzi kanye Nesizinda Sokulahla Udoti Ohlukene
- Ukufaka Isicelo Semvume Edidiyele Yokusetshenziswa Kwamanzi engeyeSizinda esihlongozwayo Sokuhlaza Amanzi kanye Nesokulahla Udoti Ohlukene

GCS Ref. No: 22-0161

DMRE Ref. No.: MP30/5/1/2/2/133MR(10200MR)

DWS Ref. No.: 11/W51B/CGI/4938

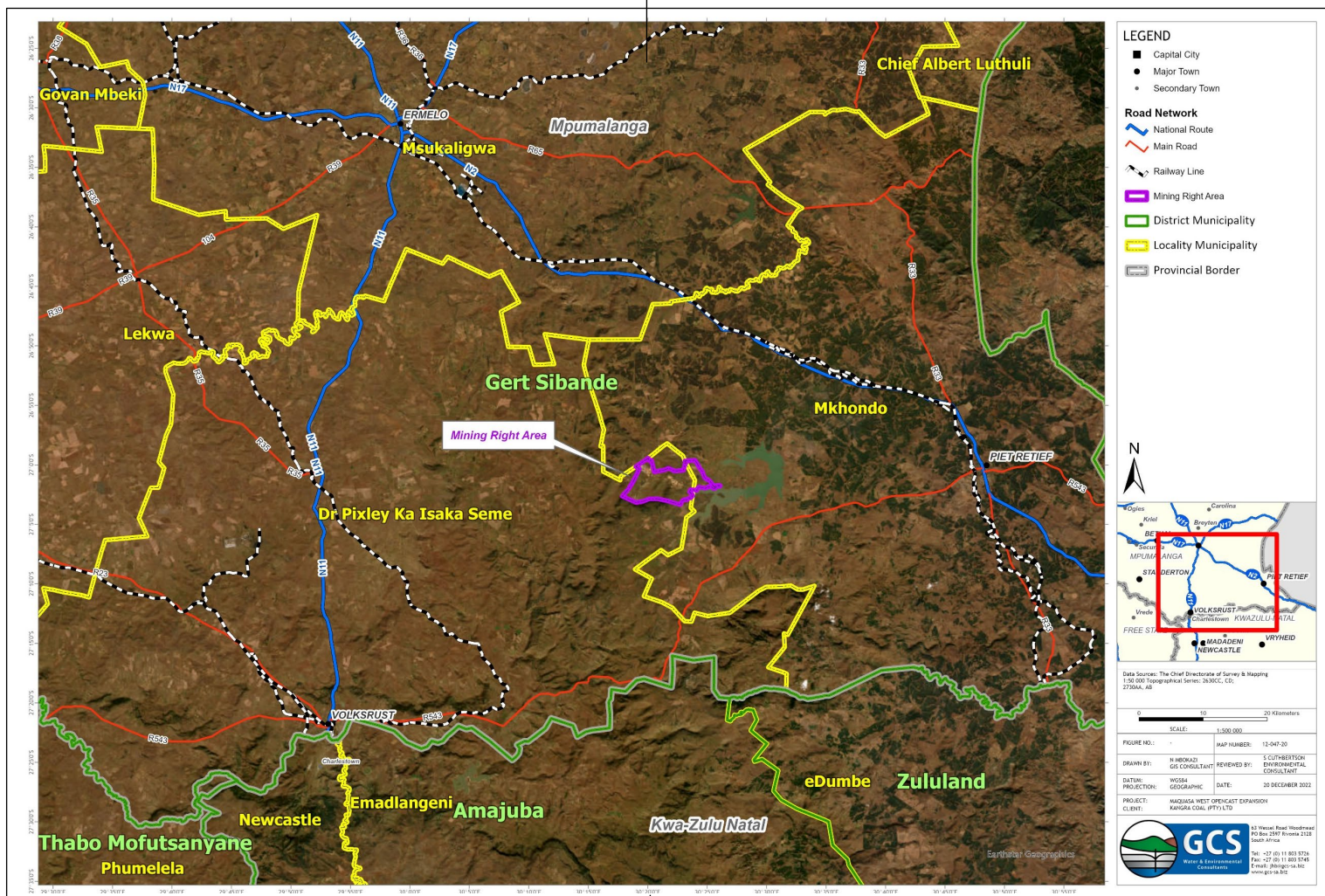
UKangra Coal (Pty) Ltd (Kangra) unemayini yamalahle evele ikhona esendaweni yase Driefontein, eduze kwasePiet Retief esiFundazweni saseMpumalanga. Imayini ikuMasipala uMkhondo ongaphansi kukaMasipala weSifunda iGert Sibande. Imisebenzi yeMaquasa East (MQE) ixuba ukumbiwa okuvulekile phezulu kanye nemisebenzi yokumba kuguduzwe emathunjini omhlaba ngaphansi kweLungelo Lokumbiwa Kwezimbiwa elingu (MP)30/5/1/2/2/133MR(10200MR). UKangra uhlongoza ukwakha isizinda sokuhlaza amanzi angcolile (WWTP) ukuze kuhlazwe amanzi akhishiwe anukubezekile kanye nokwakha isizinda sokuwalahla esizokwazi ukwamukela amanzi angcolile akhiqizeka esuka esizindeni sokuhlunga, udaka oselome lwaqina kanye nosawotana ongaqhamuka kwiWWTP.

Kudingeka ukugunyazwa kwalokhu okulandelayo:

- Ukugunyazwa Kwangokwemvelo Okudidiyele okumayelana neMigomo yeEIA ka2014 engeyeNEMA yalemisebenzi esohlwini:
  - Isaziso Esisohlwini 1 (GNR327): Umsebenzi 25 no 27
  - Isaziso Esisohlwini 2 (GNR325): Umsebenzi 5 no 15
  - Isaziso Esisohlwini 3 (GNR324: Umsebenzi 12 no 14
  - Umsebenzi Ongowokuphathwa Kodoti/Ukungcola (GNR921): Isigabana B – Umsebenzi 7, 10 no 15
- Imvume Edidiyele Yokusetshenziswa Kwamanzi ngokweSigaba 21 se NWA
  - Isigaba 21 (a), (c), (f), (g) no (i)
- Ukugunyazwa yi SAHRA ngokweSigaba 38 se NHRA

Amaprojecti ahlongozwayo atholakala endaweni esele yePulazi iRoodekraal 21 HT, yeRem yePulazi iRooikop 18 HT, yeRem yePulazi Maquasa 19HT, kanye nePulazi Roodekraal 21 HT, elawulwa ngaphansi kweLungelo Lezimbiwa (MR) elivele likhona. (Bheka ebalazweni elingezansi)

IGCS Water and Environmental Consultants (Pty) Ltd uqashiwe njengoNgoti abazimele Bocwaningo Lwemvelo ukuze bezobhekana nemigudu ebalulekile yocwaningo lwemvelo lwalamaprojecti abalulwe ngenhla ukuze kuxhaseke isicelo esiya kwiZiphathimandla Ezifanele; eMnyangweni Wezamandla Nezimbiwa waseMpumalanga (DMRE), uMnyango WezaManzi Nendle (DWS) kanye noMnyango WezamaGugu eMpumalanga.



## YOUR PARTICIPATION IS IMPORTANT

Interested and Affected Parties (I&APs) are invited to participate by registering your interest and to provide comments and raise issues of concern regarding the proposed project.

**DRAFT SCOPING REPORT IS AVAILABLE FOR PUBLIC COMMENT FROM 24 NOVEMBER 2023 TO 16 JANUARY 2024**

The Draft Scoping Report is available as follows:

**Printed Copies:** Piet Retief Library, 10B Retief Street, Piet Retief  
Maquasa East Security Office, Maquasa East Mine, Driefontein  
Thusong Service Centre, Driefontein Community

**Electronic Copy:** <https://www.gcs-sa.biz/public-documents/>

**For a copy of a Background Information Document or the Draft Scoping Report and to register as an Interested and Affected Party, please contact:**

GCS (Pty) Ltd: Gerda Bothma; Tel: 011 803 5726; Email: [gerdab@gcs-sa.biz](mailto:gerdab@gcs-sa.biz);  
Postal Address: PO Box 2597, Rivonia, Johannesburg, 2128

**Publication Date: 23 November 2023**

## UKUBAMBA IQHAZA KWAKHO KUBALULEKILE

Amaqembu Abathintekayo Nabafisa Ukubambiqhaza (I&APs) ayamenywa ukuba abambe iqhaza ngokuthi abhalise iqhaza lawo nokuthi banikeze uvo lwabo futhi babeke izingqinamba ezibathintayo mayelana namaprojecti ahlongozwayo.

**UMBICO WOKULUNGA KWESIKOPI UYATHOLAKALA UKUZE UPHAWULE UMPHAKATHI KUSUKA 24 NOVEMBER 2023 UKUYA KU-16 JANUARY 2024**

**Umbiko weSikophu Osalungiswa utholakala kanjena:**

**Amakhophi Aphrintiwe:** Piet Retief Library, 10B Retief Street, Piet Retief  
Maquasa East Security Office, Maquasa East Mine, Driefontein  
Thusong Service Centre, Driefontein Community

**Ikhophi ye-elektronikhi:** <https://www.gcs-sa.biz/public-documents/>

**Ukuze uthole ikhophi yoMqulu woLwazi lweseNdlalelo noma uMbiko osalungiswa wesikophu nokuuthi ubhalise Njengomuntu Onentshisekelo Nothintekayo, sicela uthinte :**

GCS (Pty) Ltd: Gerda Bothma; Ucingo: 011 803 5726; I email: [gerdab@gcs-sa.biz](mailto:gerdab@gcs-sa.biz);  
Ikheli: PO Box 2597, Rivonia, Johannesburg, 2128



# Placement of Site Notices

Wednesday, 22 November 2023

LOCATION	GPS CO-ORDINATES	PROOF
Kangra Coal Maquasa East Mine Entrance	27° 1'22.77"S, 30° 24'48.60"E	 
Thusong Service Centre - Driefontein	26° 59'37.72"S, 30° 24'52.46"E	

<p>Driefontein Community Hall</p>	<p>26° 59'34.23"S, 30° 24'52.30"E</p>	
<p>Mkhondo Public Library</p>	<p>27° 0'22.46"S, 30° 48'7.90"E</p>	
<p>Mkhondo Local Municipal Offices</p>	<p>27° 0'29.18"S, 30° 48'8.39"E</p>	



Piet Retief  
Post Office

27° 0'16.33"S,  
30° 48'6.36"E



## **APPENDIX D: BACKGROUND INFORMATION DOCUMENT**

## **BACKGROUND INFORMATION DOCUMENT APPLICATION FOR INTEGRATED ENVIRONMENTAL AUTHORISATION AND INTEGRATED WATER USE LICENCE**

### **PROPOSED WASTEWATER TREATMENT PLANT AND CO-DISPOSAL FACILITY FOR THE MAQUASA EAST OPERATIONS, MKHONDO LOCAL MUNICIPALITY, GERT SIBANDE DISTRICT, MPUMALANGA PROVINCE.**

#### **Purpose of this document**

---

The purpose of this document is to provide all Interested and Affected parties (I&APs) with information about the proposed project and to introduce and explain the Water Use License Application (WULA) and Environmental Impact Assessment (EIA) processes. This Background Information Document (BID) also aims to explain the public participation process that is prescribed by the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and invites all I&AP's to comment on issues and concerns related to the project.

#### **Introduction and Project Background**

---

Kangra Coal (Pty) Ltd (Kangra) has an existing coal mine located in Driefontein, near Piet Retief in the Mpumalanga Province. The mine is located in the Mkhondo Local Municipality within the Gert Sibande District Municipality. The Maquasa East (MQE) operations include the historical opencast and underground operations under Mining Right (MP)30/5/1/2/2/133MR. Kangra is proposing to construct a water treatment plant as well as a co-disposal facility at their Maquasa East operations. (Refer to Figure 1)

GCS Water and Environment (Pty) Ltd (GCS) has been appointed to undertake the integrated environmental authorisation (IEA) and water use license application (WULA) processes and associated Public Participation Processes (PPP) required for the proposed project in order for compliance with NEMA, the National Water Act

(NWA) (Act 36 of 1998, as amended), and/or Supporting Environmental Management Acts (SEMA's). This background information document (BID) provides the background details for the proposed development, associated exercises undertaken in order to comply with the required authorisation process, and acts as a baseline document for all I&APs.

#### **Project Description**

---

The purpose of the proposed wastewater treatment plant (WWTP) is to treat decant water as well as surplus contaminated water within the mining operations. MQE is currently decanting clear groundwater from old underground workings at an average rate of 1 800m<sup>3</sup>/d. The WWTP will employ 'active' treatment of the wastewater as it was found that passive treatment is not feasible nor possible due to decant point's location, the high flow rates and the discharge quality required. Brine resulting from the WWTP will be piped and stored in a new proposed brine pollution control dam (PCD).

The proposed co-disposal facility falls within the exact footprint of the previously authorised (MDARDLE Ref: 17/2/3/GS-240) MQE Discard Dump. As a result of changing operational requirements, and the lapsing of the previous authorisation, there is now a need to license a new co-disposal facility at MQE.

The co-disposal facility will accommodate discard produced at the beneficiation plant, slurry/filter cake and potentially brine from the WWTP.



The co-disposal facility's design will be similar to the authorised discard dump: a three-compartment side hill-type facility with a footprint of approximately 65ha. A phased development approach, over a period of 20 years, is envisaged: Phase 1 - 7 years; Phase 2 - 7 years and Phase 3 - 6 years capacity. (Refer to Figure 2)

## Project Location

Province:	Mpumalanga
District:	Gert Sibande District Municipality
Local Municipality:	Mkhondo Local Municipalities
Extent:	140 hectares
Zoning:	Mining
Ownership:	Kangra Coal (Pty) Ltd
Current Use:	Mining
Nearest Towns:	Piet Retief
	Remaining extent (RE) of Farm
Farm Portions	Roodekraal 21 HT.
affected:	Farm Roodekraal 21 HT
	RE of Farm Rooikop 18 HT
	RE of Farm Maquasa 19HT

## Project Applicant

Applicant:	Kangra Coal (Pty) Ltd
Representative:	Niketiwe Dlamini
Address:	Farm Driefontein, Saul
	Mkhizeville, Mkhondo
	P.O. Box 745, Piet Retief, 2380

## Regulatory Context

### National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA)

Section 24 of NEMA requires that certain listed activities, which may have an impact on the environment, trigger the need for environmental authorisation from a relevant authority before commencing with the activities. Such activities are listed under Regulations Listing Notice 1 GNR 324,

Listing Notice 2 GNR 325 and Listing Notice 3 GNR 327 (2014 as amended) of NEMA (as amended).

Applicable Listed Activities for this application is:

#	Activity Description
Listing Notice 1 (GN R327)	
9	The construction of pipelines with a Ø of more than 0.36m and throughput of more than 120l/s, for the supply of water/stormwater reticulation for the co-disposal facility.
10	The construction of pipelines with a Ø of more than 0.36m and throughput of more than 120l/s, for the supply of process/waste/return water or effluent reticulation for the co-disposal facility and the discharge pipeline from the wastewater treatment plant to the Heyshope Dam.
19	The construction of both projects may result in the infilling/depositing and the removal/moving of more than 10m <sup>3</sup> of material from a watercourse.
24	Various new 16m wide haul roads is required for the proposed new CDF, and the total length of these roads will exceed 1km in length.
25	The construction of a wastewater treatment plant with a maximum throughput capacity of 4 500m <sup>3</sup> per day.
27	The proposed activity footprint is approximately 65ha in total extent, as such, the clearance of potentially indigenous vegetation for the construction of the proposed wastewater treatment plant, brine PCD and co-disposal facility will be approximately 68ha which is in excess of the 1ha threshold.
Listing Notice 2 (GN R325)	
6	The construction and operation of the wastewater treatment plant, brine PCD and co-disposal facility requires a Water Use License for the water uses triggered in terms of Section 21 of the NWA.
15	The proposed activity footprint is approximately 65ha in total extent, as such, the clearance of potentially indigenous vegetation for the construction of the proposed project will be approximately 68ha which is in excess of the 20ha threshold.
Listing Notice 3 (GN R324)	
12	The proposed project falls within a Critical Biodiversity Area, as such, the clearance of potentially indigenous vegetation for the construction of the project will potentially exceed the 300m <sup>2</sup> threshold.
14	The proposed project falls within a CBA and NPAES Focus area. The development footprint encroaches on various watercourses and as such the proposed structures to be constructed will exceed the 10m <sup>2</sup> threshold.

## National Environmental Management: Waste Act, 2008 (Act 59 of 2008) (NEMWA)

Section 20 of NEMWA requires that certain listed waste management activities, need a waste management license from a relevant authority before commencing with the activities. Such waste management activities are listed under Regulations GNR 921 (as amended).

Applicable Waste Management Activities for this application is:

#	Activity Description
Category B	
7	The proposed co-disposal facility entails the "The disposal of any quantity of hazardous waste to land".
10	The proposed project entails the construction of a facility for an activity governed by the regulations.
11	The proposed project entails the establishment of a "residue stockpile".

Considering the above, a full Scoping and Environmental Impact Assessment (S&EIR) process is to be undertaken.

## National Water Act, 1998 (Act 36 of 1998) (NWA)

A Water Use License Application is to be compiled and submitted to the Department of Water and Sanitation (DWS) to ensure the legality of the proposed project's water uses. The Water Use License Application will be conducted for the project in parallel with the EIA and EMP process for any activity in terms of Section 21 of the NWA.

The water uses triggered as part of the project which require authorisation in terms of Section 21 of the NWA involves:

Section 21:	
(c)	Impeding or diverting the flow of water in a watercourse
(f)	Discharging of waste or water containing waste
(g)	Disposing of water in a manner which may detrimentally impact on a watercourse
(i)	Altering the bed, banks, course or characteristic of a watercourse

## National Heritage Resources Act, 1999 (Act 25 of 1999) (NHRA)

The protection and management of South Africa's heritage resources are controlled by the NHRA. Historically important features, such as graves, archaeology and culturally significant symbols, spaces and landscapes are protected by the NHRA. A permit from the South African Heritage Resources Agency (SAHRA) is required in terms of Section 38 of the NHRA for certain categories of development, which the proposed activities trigger. An application in this regard will thus be lodged during the EIA process.

## Structure of the Environmental Impact Assessment Process

The EIA is a legislative tool used to ensure that the potential environmental impacts that may occur due to the proposed development are avoided or mitigated, if authorisation is granted. The 'environment' includes social, economic and biophysical aspects which the EIA must assess equitably.

The EIA process is divided into two phases, the Scoping Phase and the Impact Assessment Phase.

### Scoping Phase:

The Scoping Phase aims to:

- Investigate and gather information on the proposed site, to establish an understanding of the area.
- Establish how the proposed development activities will potentially impact on the environment.
- Identify IAPs and relevant authorities by conducting a Public Participation Process
- Identify potential environmental impacts through investigation and PPP.
- Describe the proposed project and potential Alternatives.

### Impact Assessment Phase:

During this phase, all issues/impacts and proposed alternatives identified in the Scoping Phase are assessed and are rated in terms of their significance. Where necessary, recommendations are made for the mitigation of potential negative impacts, or enhancement of potential positive impacts.

An Environmental Management Programme will also be compiled that will prescribe environmental specifications for the construction, operational and decommissioning phases of the project. As with the Scoping phase, a PPP is an integral part of the Assessment Phase.

## Public Participation Process

The Public Participation Process (PPP) aims to inform a wide range of I&APs (*any person or organisation that has a direct, business, financial, personal or other interest in, or may be directly or indirectly affected by, the proposed project*) about the proposed development and the environmental process to be followed. It is a tool to allow the public to exchange information and to express their views and concerns on the proposed development for which the EIA is being conducted. The PPP assists in identifying potential issues and concerns that need to be addressed in the impact assessment by highlighting relevant information to be included in the assessment. PPP enables more accurate and descriptive analysis and helps to focus and enhance decision-making.

The EIA will be open and transparent to the public through this process with all registered IAPs continuously updated on events throughout the process. All contributions from IAPs must be fully documented, evaluated and responded to in the EIA.

### Activities of the PPP:

The public is invited to register as an I&AP and take part in the PPP through:

- Media Notices placed in newspapers
- Distribution of the BID
- Site notice boards
- Public Open Days/Focus Group Meetings (as appropriate)
- Submission of comments on the media notices, BID, Draft Scoping and Impact Assessment Reports

### How you can participate:

Interested and affected parties I&APs may forward their written comments along with their name, contact details and an indication of any direct business, financial, personal or other interest which they have in the application by post or email to:

#### PUBLIC PARTICIPATION - CONTACT DETAILS

**Contact Person(s):** Gerda Bothma  
011 803 5726

**Email:** [gerdab@gcs-sa.biz](mailto:gerdab@gcs-sa.biz)

**Postal Address:** PO Box 2597  
Rivonia  
Johannesburg  
2128



### Next steps:

The Draft Scoping Report, which details the project, the baseline conditions of the affected area and the potential impacts identified, will be available for public review from 24 November 2023 until 16 January 2024.

This report will also describe how the EIR will address issues and concerns raised during the assessment process.

Copies of the Report is available for review as follows:

- **Printed Copies:**
  - Piet Retief Library, 10B Retief Street, Piet Retief
  - Maquasa East Security Office, Maquasa East Mine, Driefontein
  - Thusong Service Centre, Driefontein Community
- **Electronic Copy:**  
<https://www.gcs-sa.biz/public-documents/>

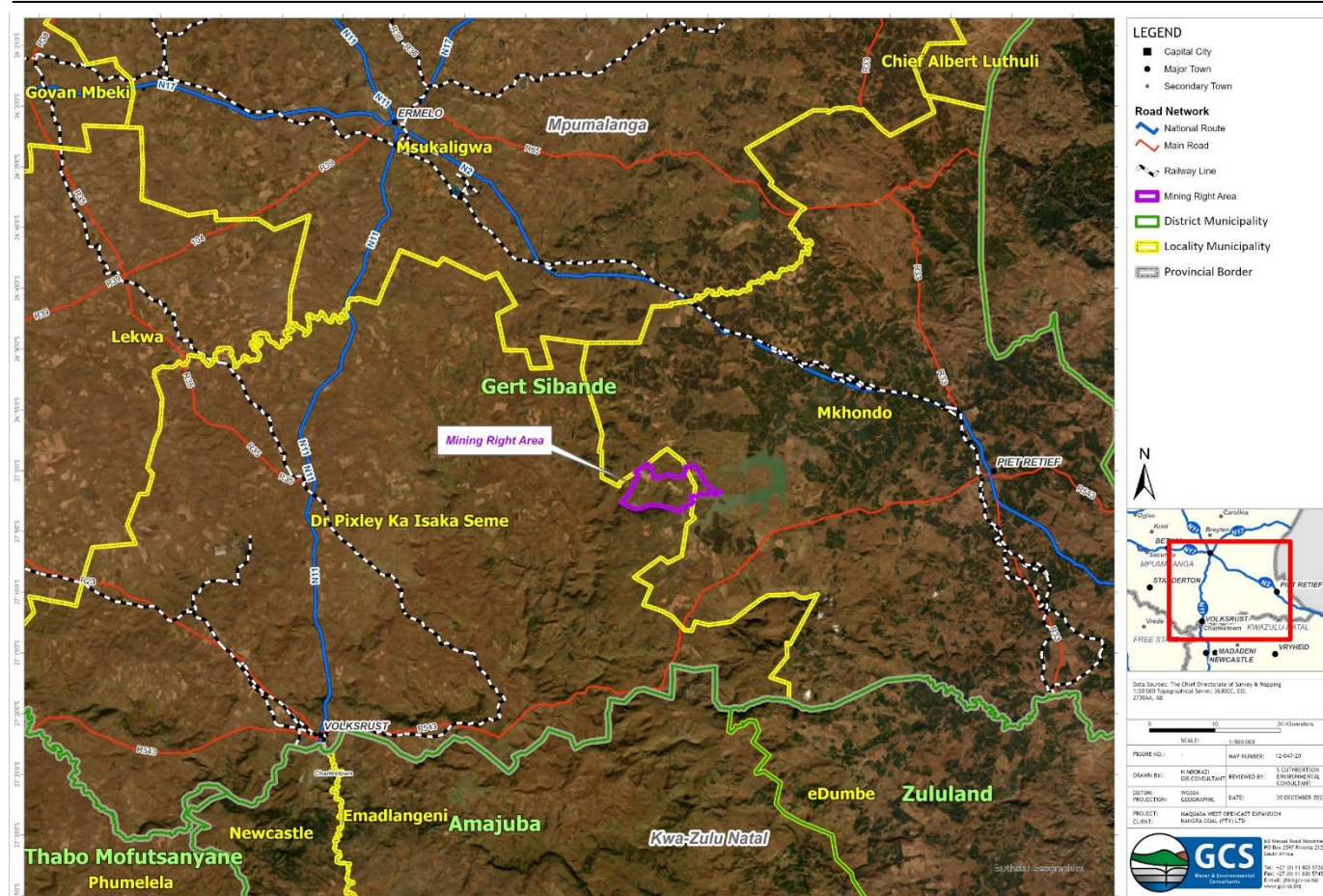
We will inform you of the dates and venues of any meetings to be held during the public consultation process.

If you wish to raise any initial issues or concerns regarding the proposed project, or if you would like to register as an I&AP, please contact the public participation office as detailed above.

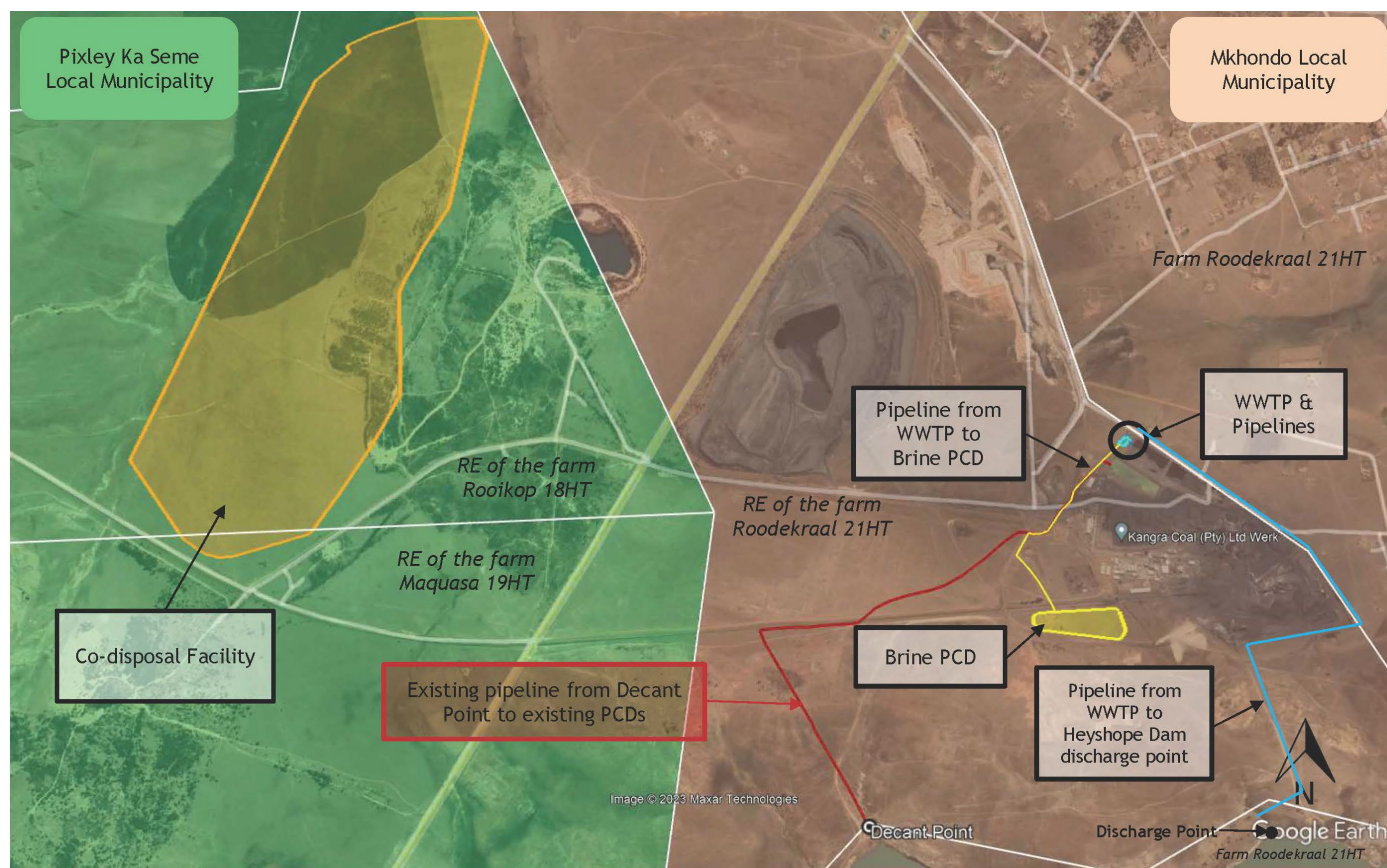
#### PLEASE TAKE NOTE

As per the requirement of the Protection of Personal Information Act (POPI), Act No.14 of 2013 you are herewith notified that you may exercise your right to leave the Interested and Affected Party (I&AP) List. Should you elect to remain a part of the I&AP List for the project, it will be accepted that you have consented to being a part of the list and that your personal information will be noticeable to any GCS Water and Environment (Pty) Ltd employee engaged with the public participation process. All such employees agree not to make use of such personal information for whatsoever reason, without obtaining the consent of the relevant person(s). As such, by participating in this process, you consent to the use of your contact information and comments for the purposes of the authorisation and licensing processes as per the regulations.





**Figure 1: Site Locality Map and Regional Boundaries**



**Figure 2: Site Layout of proposed project**



**Kangra Coal (Pty) Ltd**  
**Piet Retief, Mpumalanga**  
**Background Information Document**

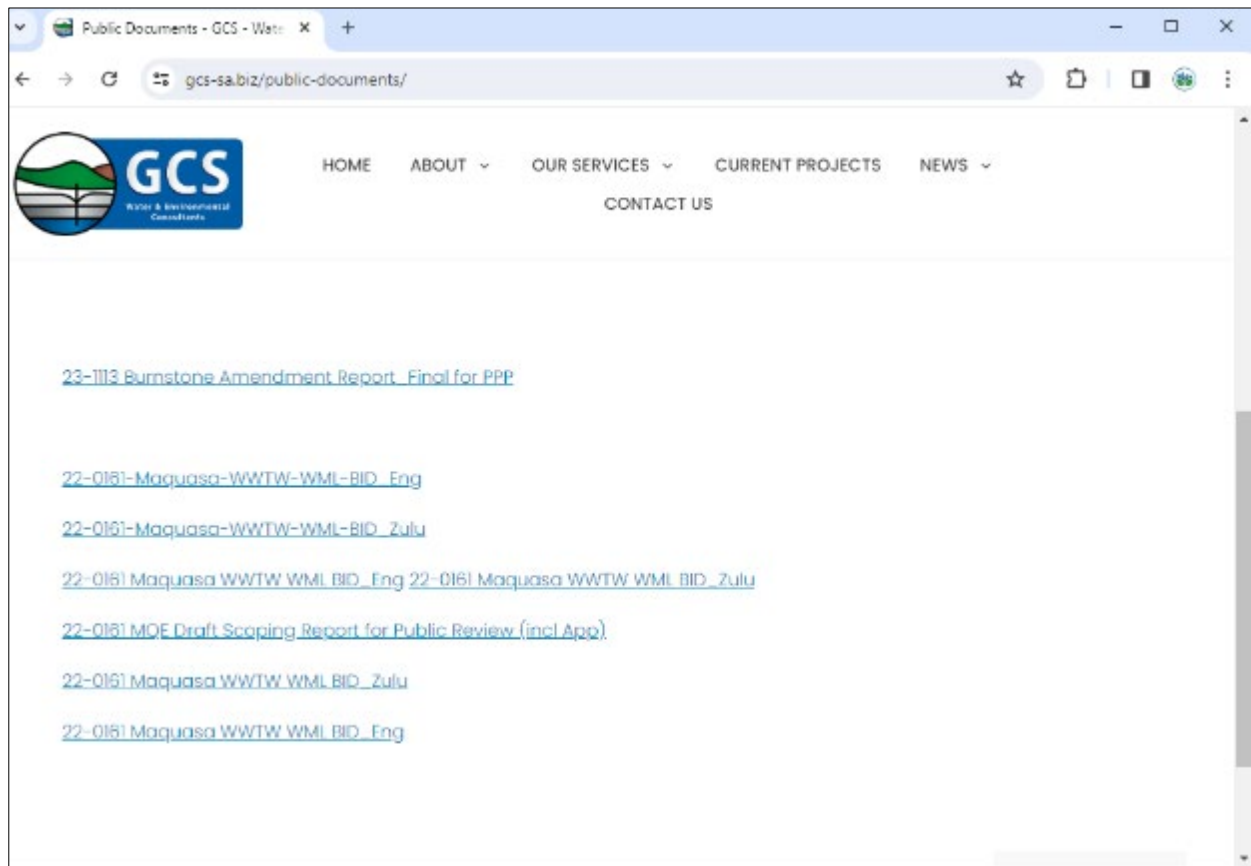
I&AP Comment and Registration Form  
 GCS Ref No: 22-0161

Name:		Surname:	
Organisation / interest:			
Postal / Residential address			
		Area:	Code:
Contact details		Tel:	(    )
		Fax:	(    )
		Mobile:	(    )
		Email:	
Please mark with an X to indicate whether you would like to participate in the process:			
Yes, I would like to participate in this process and receive periodic updates			<input type="checkbox"/>
No, I am not interested in participating and do not wish to receive further information			<input type="checkbox"/>
Preferred method of communication	Email	Fax	Post
Date commented	(DD / MM / YYYY)		
Please indicate any issues, comments and concerns with regards to the proposed project			
Please indicate in which aspects you would require more information			
Please indicate the contact details of any other I&APs whom you think should be contacted			
Name:	Surname:		
Tel:	(    )	Fax:	(    )
Mobile:	(    )		
Email:			
<p>In order to be registered as an I&amp;AP for this project, fax, mail, or e-mail the completed registration form to Gerda Bothma at:</p> <p>Tel: (011) 803 5726</p> <p>Email: <a href="mailto:gerdab@gcs-sa.biz">gerdab@gcs-sa.biz</a></p> <p>Post: PO Box 2597, Rivonia, 2128</p>			



[illegible]

## **APPENDIX E: DOCUMENTS FOR PUBLIC REVIEW**





63 Wessel Road, Rivonia, 2128 PO Box 2597, Rivonia, 2128  
South Africa  
Tel: +27 (0) 11 803 5726 Fax: +27 (0) 11 803 5745  
Web: www.gcs-sa.biz

## Delivery Notice

Date:	29 November 2023	
Company:	Mpumalanga Tourism and Parks Agency	From: Gerda Bothma
Attention:	Celia de Waal (EIA Data Capturer)	
RE:	<p>Copy of Draft Scoping Report as requested:</p> <p>Application for Integrated Environmental Authorisation for a new Wastewater Treatment Plant and Co-Disposal Facility for Kangra Maquasa East Operations.</p>	

Quantity	Item
1 x hard copy	Draft Scoping Report

Please acknowledge receipt of documentation:

C de Waal  
Print name

C de Waal  
Signature

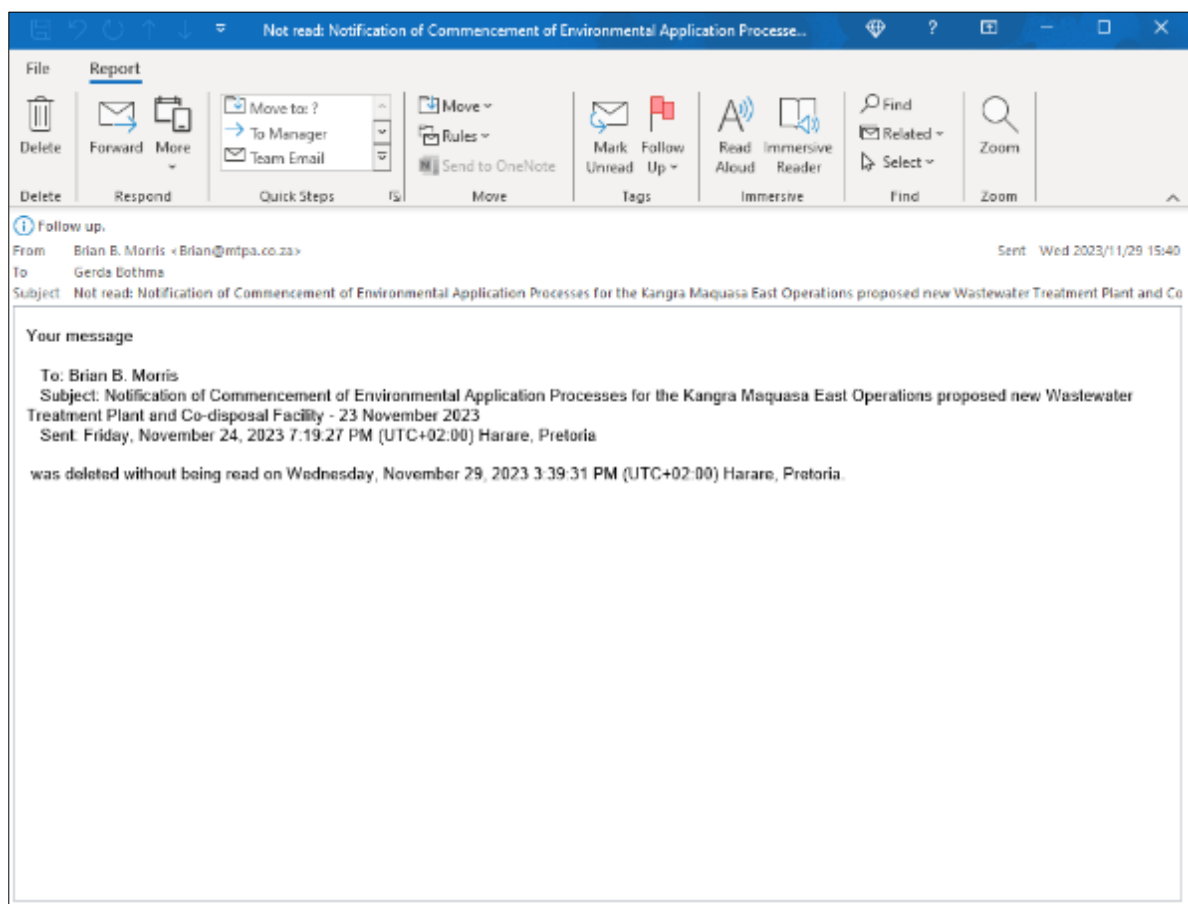
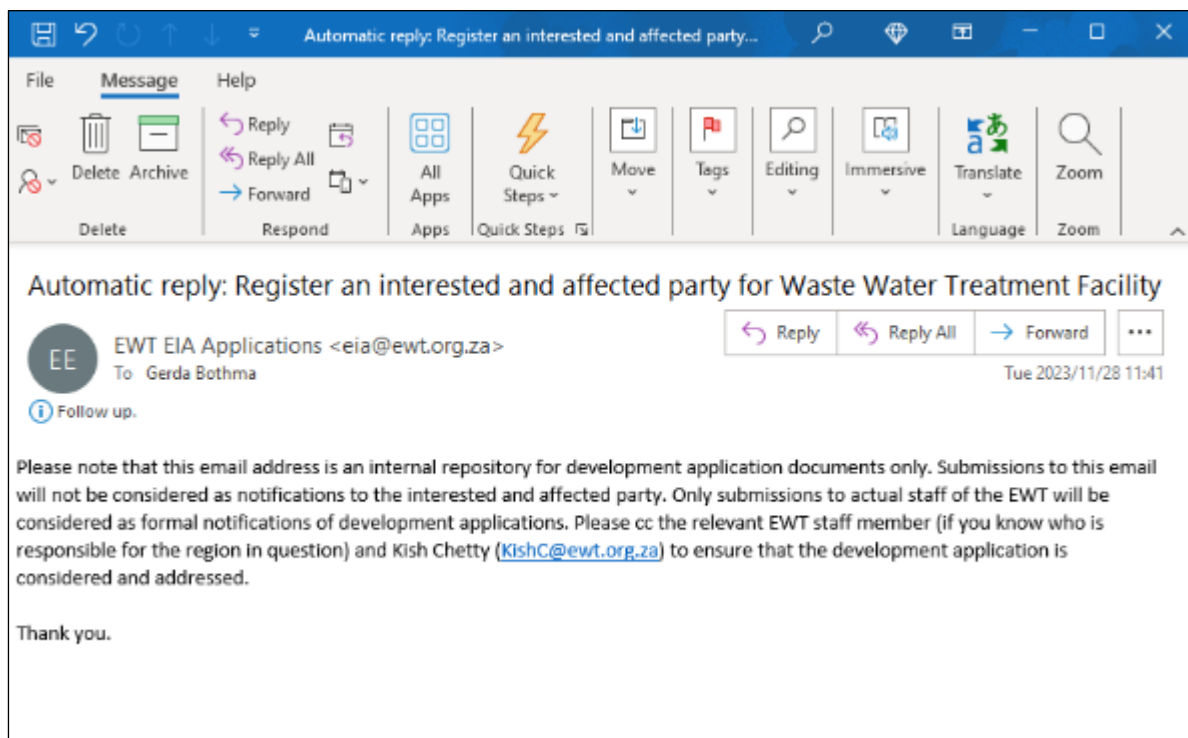
EIA Datacapture 2023/11/30  
Position Date

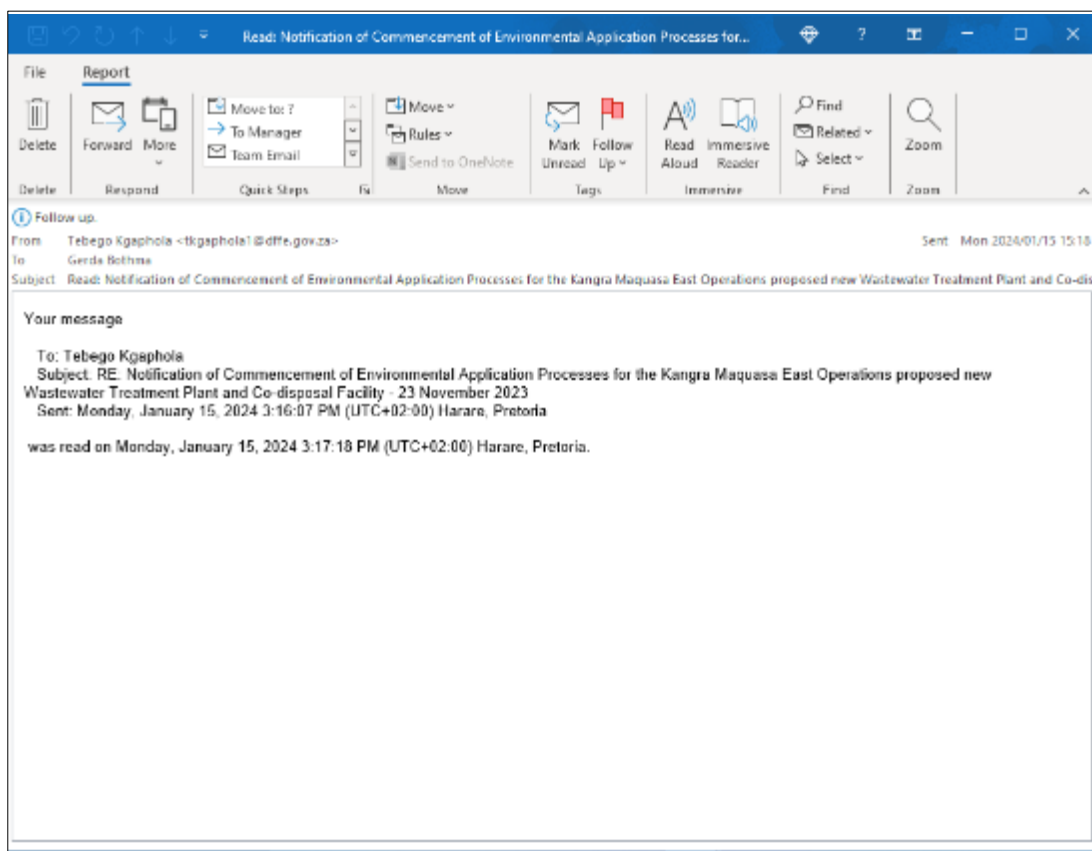
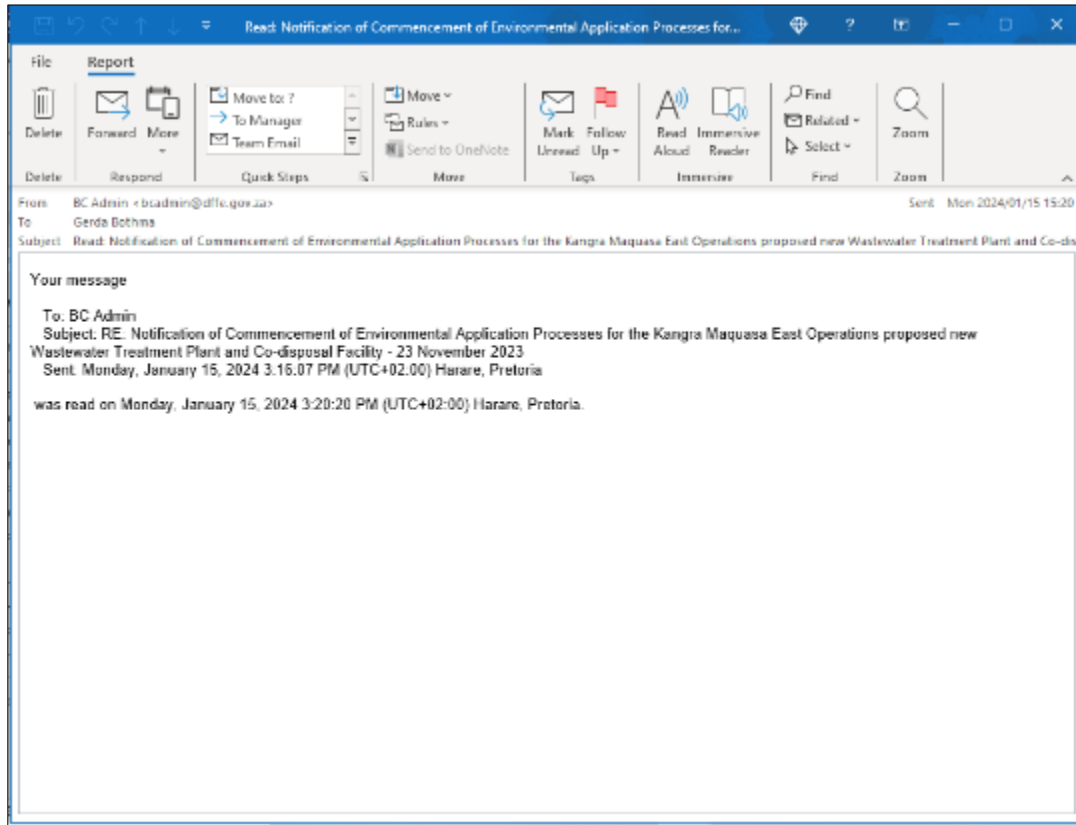
**MPUMALANGA TOURISM  
& PARKS AGENCY**  
Private Bag X1088, Lydenburg 1120  
Tel: (013) 235 2395/6/7  
Fax: 013 235 2732

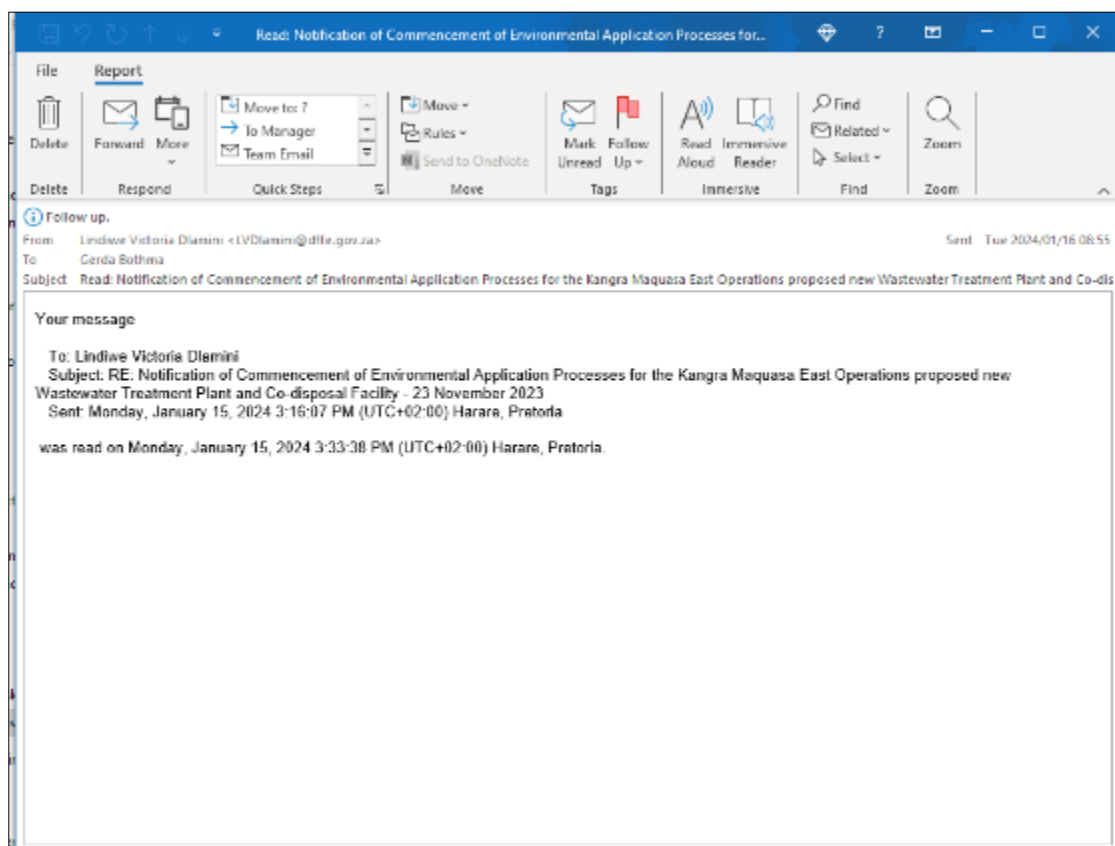
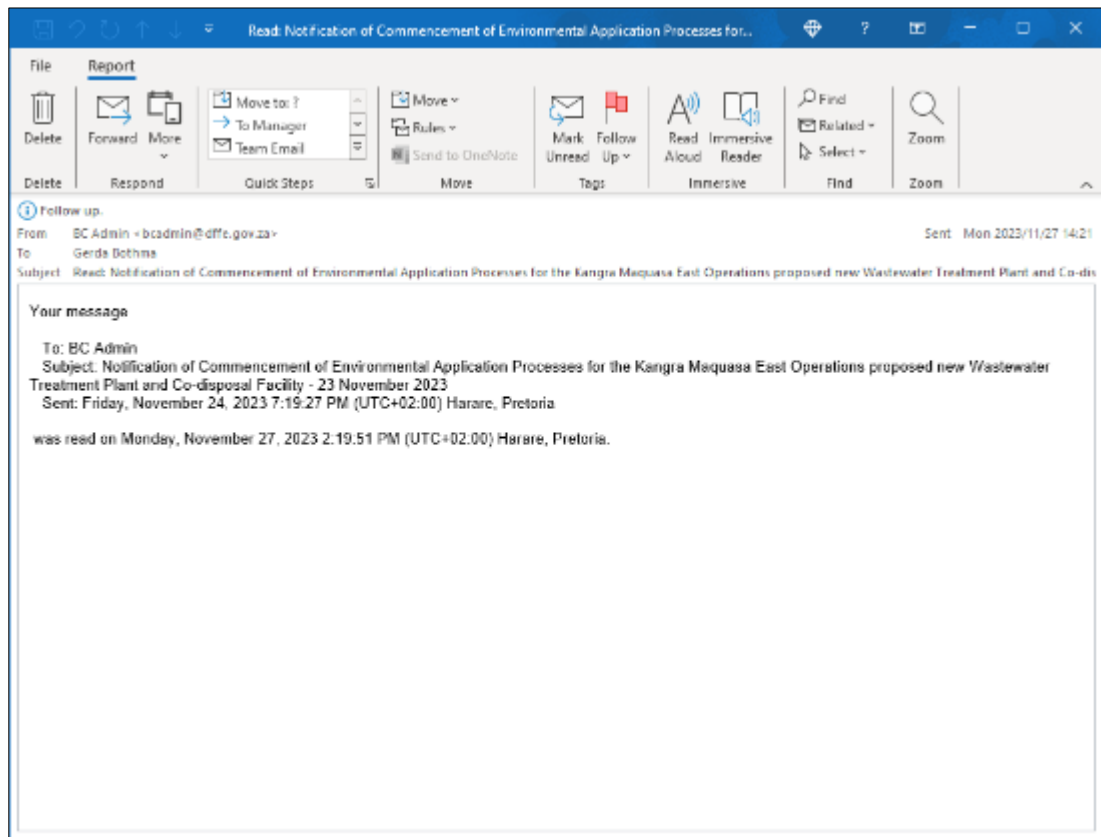
Please advise us if enclosures are not as described.

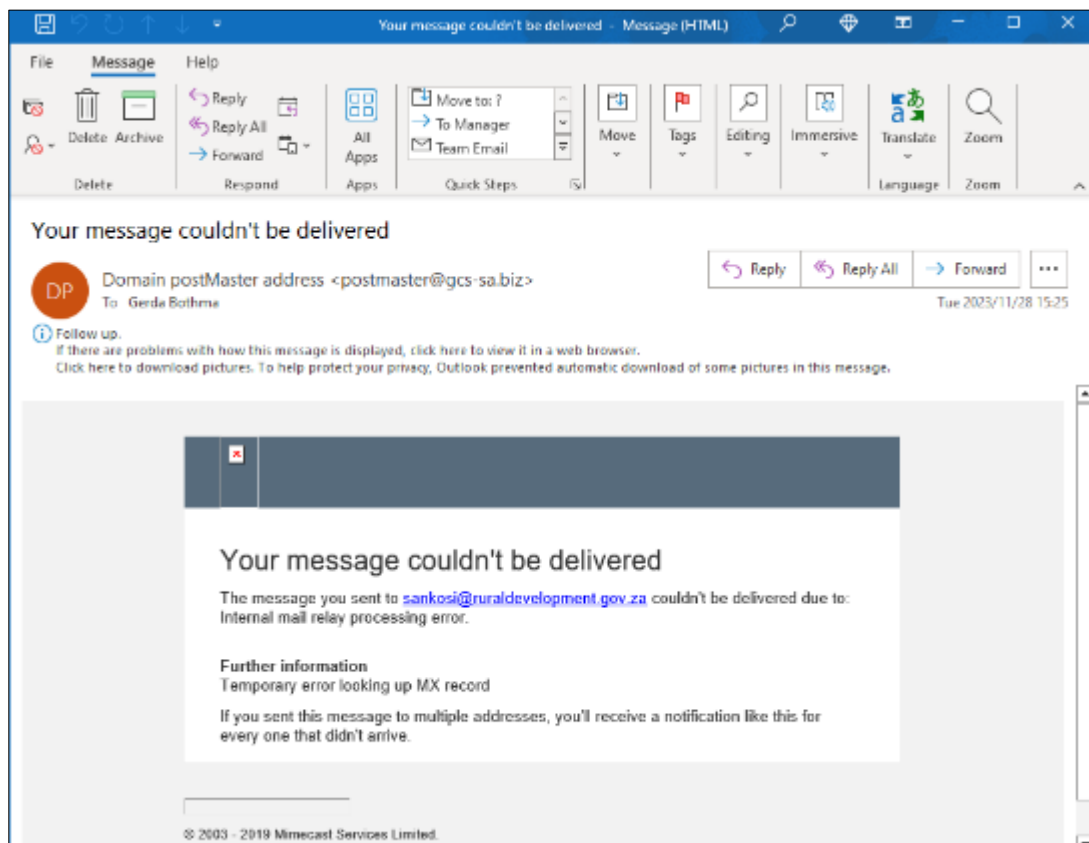
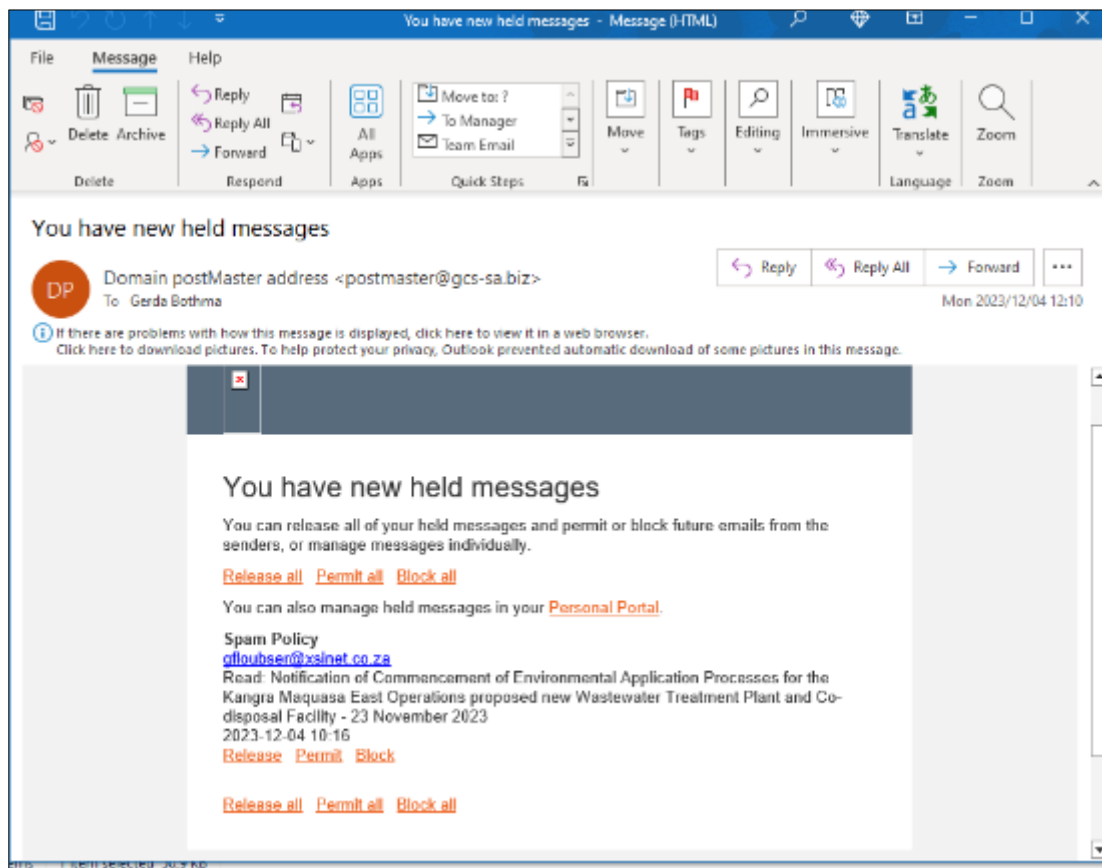
## **APPENDIX F: NOTIFICATIONS AND DELIVERY RECEIPTS**

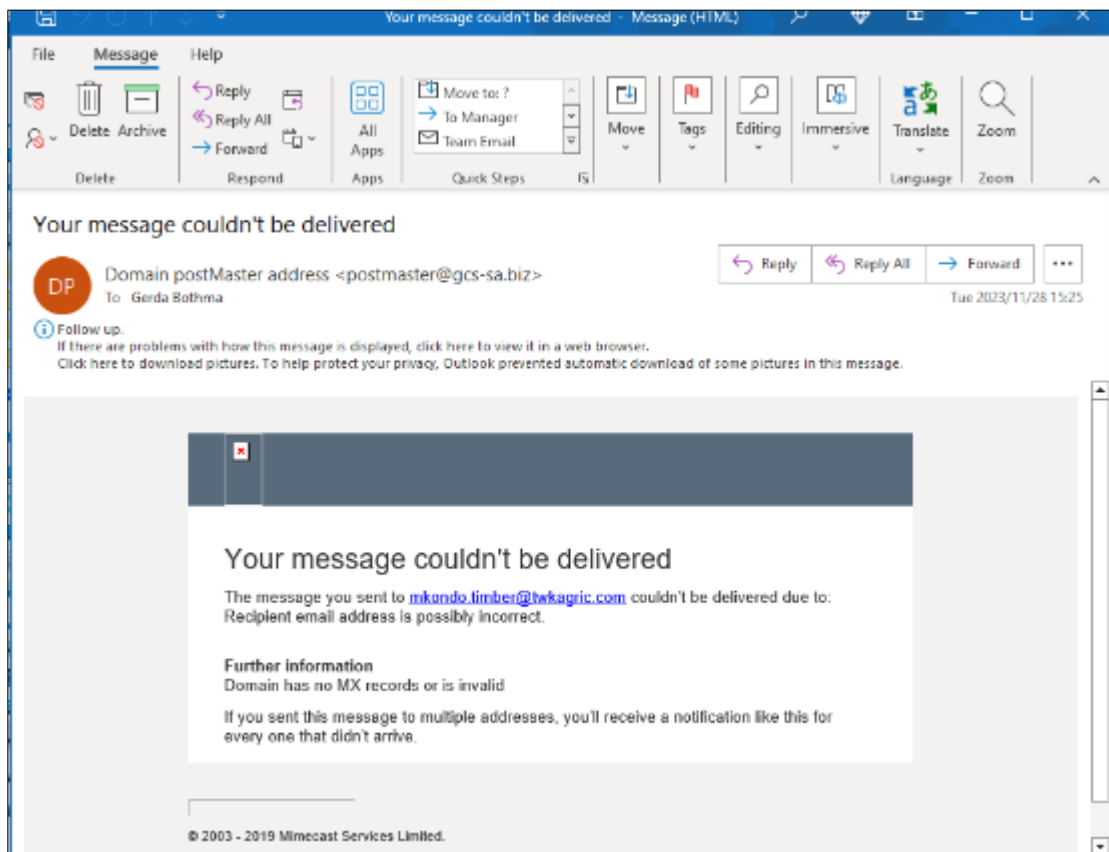
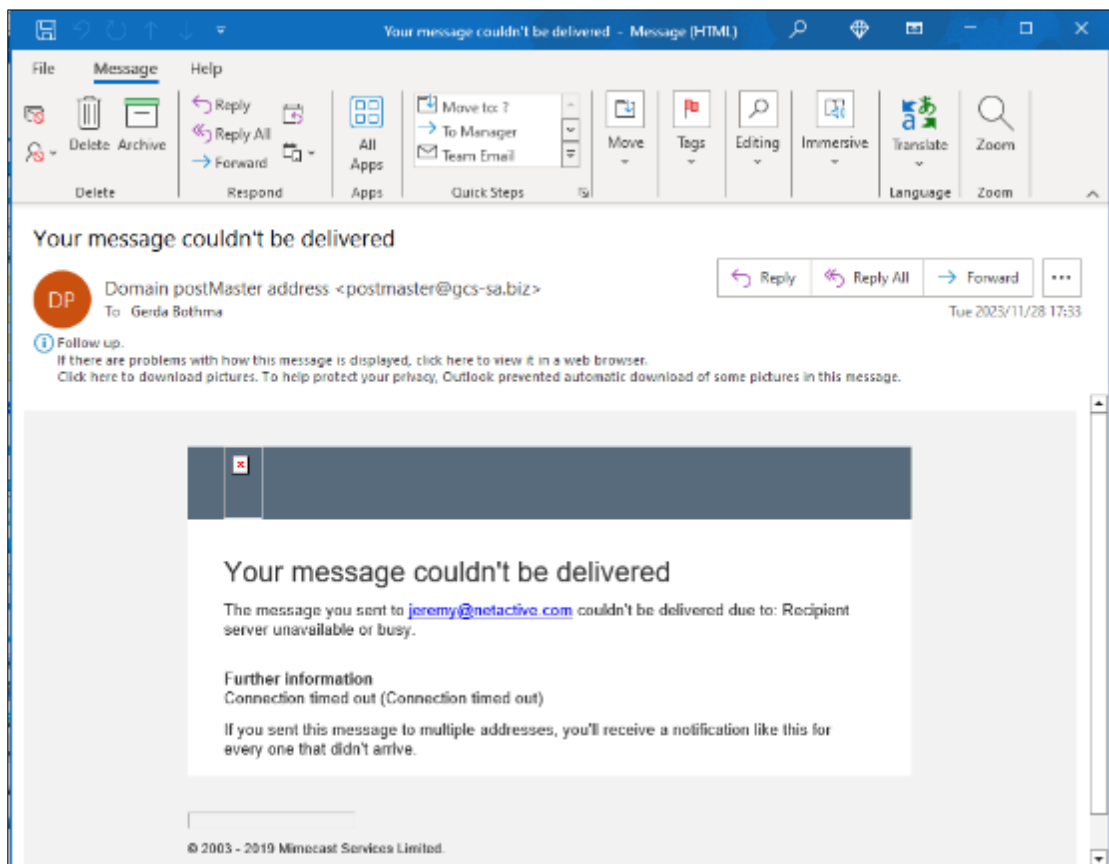














---

## APPENDIX D: IMPACT ASSESSMENT MATRIX

ACTIVITY(S)	POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION												RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION												Confidence	Irreplaceable loss of resources	Degree of reversibility
		Severity	Spatial Scale	Duration	CONSEQUENCE	Freq of Activity	Freq of Impact	Legal Issues	Detection	LIKELIHOOD	Significance	+/-	RISK RATING		Severity	Spatial Scale	Duration	CONSEQUENCE	Freq of Activity	Freq of Impact	Legal Issues	Detection	LIKELIHOOD	Significance	+/-	RISK RATING			
CONSTRUCTION PHASE																													
Air Quality & Climate																													
Vegetation clearing, topsoil stripping and stockpiling, use of unsurfaced roads and transportation of construction materials	Generation of inhalable particle emissions and fugitive dust and dust fallout	4	2	2	8	5	4	1	3	13	104	-	L	<ul style="list-style-type: none"><li>• Reduce speed limit (max 30km/h).</li><li>• Restrict construction vehicle movement to designated construction areas.</li><li>• Wet suppression on exposed surfaces, unpaved roads, and materials handling areas-where feasible.</li><li>• Demarcate and minimise extent of disturbed areas.</li><li>• Reduction of frequency of disturbance.</li><li>• Stabilisation (chemical, rock cladding or vegetative) of disturbed and stockpiled soil.</li><li>• Early/concurrent rehabilitation and re-vegetation, as appropriate on disturbed areas.</li><li>• Implement dust fallout monitoring.</li></ul>	4	1	2	7	5	4	1	3	13	91	-	L	100%	Low	High
Construction activities involving the use to vehicles and equipment (e.g. generators) and fires	GHG emissions during the construction activities	2	2	2	6	3	3	1	2	9	54	-	L	<ul style="list-style-type: none"><li>• Prohibit fires, the burning of waste materials or any debris.</li><li>• Service and maintain of vehicles, plant and machinery in accordance with a maintenance schedule.</li><li>• Use high efficiency generators.</li><li>• Use of low carbon and sulphur fuels.</li><li>• Equipment that is used intermittently must be switched off when not in use.</li></ul>	2	1	2	5	2	2	1	2	7	35	-	L	100%	Low	Medium
Terrestrial Ecology																													
Vegetation clearing	Loss of vegetation within development footprint	8	3	5	16	5	5	5	2	17	272	-	H	<ul style="list-style-type: none"><li>• Limit the impact area and construction activities to the proposed footprint area and the associated infrastructure servitude only.</li><li>• Existing roads/servitudes should be considered first option over the construction of new roads/servitudes and must only be made where necessary.</li><li>• Minimise the extent of vegetation clearing for the infrastructure. Areas to be cleared must be clearly/visibly demarcated to avoid unnecessary clearing.</li><li>• Fire management plan must be in place for the areas surrounding the project area and the road to restrict the impact from fire on the natural flora and fauna communities.</li><li>• Progressive rehabilitation will enable topsoil to be returned more rapidly, thus ensuring more recruitment from the existing seedbank. Surplus rehabilitation material can be applied to other areas in need of stabilisation and vegetation cover.</li></ul>	6	2	4	12	4	3	5	2	14	168	-	M	75%	High	Low
Introduction of alien species, especially plants	Degradation and loss of surrounding natural vegetation	6	2	3	11	5	5	5	2	17	187	-	M	<ul style="list-style-type: none"><li>• Compile and implement an alien vegetation management plan from the onset of construction. The plan must identify areas for action (if any) and prescribe the necessary removal methods and frequencies to be applied. This plan must also prescribe a monitoring plan and be updated as/when new data is collated;</li><li>• Remove organic waste from site weekly to prevent pest species from becoming a problem. A waste management plan must be compiled and implemented from the onset of the construction phase. The plan must designate collection areas, define the separation of waste and also prescribe removal measures and frequencies from the areas. This plan must be also prescribing a monitoring plan and be updated as/when new data is collated.</li></ul>	6	1	2	9	3	3	5	2	13	117	-	L	75%	Medium	High
Displacement of faunal community due to habitat loss, direct mortalities and disturbance	Construction activity will likely lead to direct mortality of fauna due to earthworks, vehicle collisions, accidental hazardous chemical spills and persecution. Disturbance due to dust and noise pollution and vibration may disrupt behaviour.	6	3	5	14	5	5	1	3	14	196	-	M	<ul style="list-style-type: none"><li>• Signs must be put up stating that should any person be found poaching any species they will be fined.</li><li>• Construction must take place in the winter months as much as feasible.</li><li>• The areas to be developed must be specifically demarcated to prevent movement of staff or any individual into the surrounding environments, access to these areas must be controlled. Signs must be put up to enforce this.</li><li>• Speed limits must be implemented on all roads.</li><li>• Areas should be cleared and disturbed on a needs basis only, as opposed to clearing and disturbing a number of sites simultaneously.</li><li>• Any holes/deep excavations must done in a progressive manner on a needs basis only. No holes/excavations may be left open overnight. In the event holes/excavations are required to remain open overnight, these areas must be covered to prevent fauna falling into these areas.</li><li>• Where possible, work should be restricted to one area at a time and be systematic. This is to reduce the number and extent of on-site activities, allowing fauna to move off as the project progresses. This will give the smaller mammals and reptiles a chance to weather the disturbance in an undisturbed zone close to their natural territories.</li><li>• All personnel and contractors to undergo Environmental Awareness Training. A signed register of attendance must be kept for proof. Discussions are required on sensitive environmental receptors within the project area to inform contractors and site staff of the presence of SCC, their identification, conservation status and importance, biology, habitat requirements and management requirements the Environmental Authorisation and within the EMPr;</li><li>• Prior to vegetation clearing activities, the area to be cleared should be walked on foot by 1-2 individuals to create a disturbance in order for fauna to move off. Sites should be disturbed only prior to the area having to be cleared, not more than 1 day in advance.</li><li>• The timing between clearing of an area and subsequent development must be minimized to avoid fauna from re-entering the site to be disturbed.</li></ul>	6	2	2	10	3	3	1	2	9	90	-	L	75%	Medium	Medium
Freshwater Ecology																													
Earthworks & Vegetation clearing	Potential loss of riparian vegetation as a result of the earthworks associated with the construction activities.	6	2	2	10	3	3	5	2	13	130	-	M	The implementation of the proposed 40m buffer around the delineated edges of the wetlands that have been assessed will ensure that no riparian vegetation will be lost during the construction phase. To ensure that the integrity of the buffer is kept the buffer must be clearly demarcated for the duration of the construction phase.	2	1	2	5	1	3	5	2	11	55	-	L	75%	Medium	Medium

The construction will require the clearance of vegetation from the construction site.  Uncontrolled stormwater management of the cleared construction areas could result in increased sedimentation of the wetlands.	Potential increase in sedimentation of the wetland features.	6	2	2	10	3	3	5	2	13	130	-	M	A Stormwater Management Plan for the construction phase of the project must be compiled that makes provision for the following: •All areas that are to be cleared for the construction activities must be clearly demarcated before clearance. This is to ensure that the cleared areas are limited to the construction footprint only. •Provision must be made for the capturing of any silt that may wash of the cleared areas. •No stormwater discharge will be allowed to be made directly in any wetland feature from the construction footprint. •If the construction schedule allows, construction should take place during the dry season to limit the potential impact.	2	1	2	5	2	3	5	2	12	60	-	L	75%	Medium	Medium	
The presence of plant and equipment on the construction site that make use of petrochemical substances for operation pose a risk of contamination of the water quality in the wetlands.	Contamination of the area by petrochemical spillages	6	2	3	11	3	3	5	2	13	143	-	M	The following management and mitigation measures must be included into the Environmental Management Programme for the project: •All plant and equipment that make use of petrochemical substances must be checked leakages on a daily basis before operations commence. •All plant and equipment that are found to be leaking must be removed from the property and only returned once the leakages have been addressed. •If any petrochemical substances are stored on the property, this storage must be done on an impermeable surface in a bunded area that makes provision for 110% of volume of the substances that are stored. •All refuelling of plant and equipment must be conducted over a drip-tray and will not be allowed to take place within the 40m wetland buffer proposed for the construction phase. •If any plant or equipment is to be parked on the site, these must be parked outside of the 40m wetland buffer proposed for the construction phase •If any spillages from plant or equipment occur, the spill must be immediately contained, the contaminated soils must be collected and bagged in impermeable bags and stored on site to be removed and disposed of by a registered service provider.	2	1	6	9	2	3	5	2	12	108	-	L	75%	Medium	Medium	
Spillage or leakage could impact on the water quality that moves through the aquatic features, which could decrease the PES of the features.	Contamination of the aquatic features by the on-site ablation facilities.	6	1	2	9	4	3	5	2	14	126	-	M	The following management measures associated with the ablation facilities must be implemented: •All portable ablation facilities that will be used on site must be located 40m away from the edge of the delineated aquatic feature. If the edge is not clearly defined, this must be done by an aquatic specialist before implementation of the ablutions can take place. •The portable ablation facilities must be provided with sealed wells in which the sewage is collected. •The servicing of these portable ablation facilities must be conducted by a registered service provider who must dispose of the material at a Municipal facility. •A Spill Contingency Plan must be put in place to provide the appropriate management and mitigation measures to be implemented in the event of any spillages from these ablation facilities.	2	1	1	4	2	3	5	2	12	48	-	L	75%	Medium	Medium	
Soils, Land Capability and Land Use																														
Construction of CDF	Loss of land capability	8	2	5	15	5	5	1	2	13	195	-	M	• Make use of existing roads or upgraded tracks before new roads are constructed. The number and width of internal access routes must be kept to a minimum; • A stormwater management plan must be implemented for the development. • The areas to be developed must be specifically demarcated to prevent movement of staff or any individual into the surrounding environments, access to these areas must be controlled. Signs must be put up to enforce this; • Stockpiles should be managed; and stripped soils properly demarcated according to their proper layers, especially the topsoil. Also prevent and minimise erosion (e.g., use of embedded geotextiles controls) and contamination from the stockpile; • Rehabilitation of the area must be initiated from the onset of the project. Soil stripped from infrastructure placement can be used for rehabilitation efforts; and • An alien invasive plant species and control programme must be implemented from the onset of the project.	6	2	5	13	5	5	1	2	13	169	-	M	75%	High	Low	
Site preparation, including placement of contractor laydown areas and storage (i.e. temporary stockpiles, bunded areas etc.) facilities.	Soil interflow processes: • Infilling of wetlands and watercourses inducing alternative flow paths (if infilling occurs). • Alteration to natural hydropedological flow paths. • Impacts on the macro-soil structure. • Impacts on the hydropedological processes supporting the watercourses.  Soil structure & land capability: • Exposure of soils, leading to increased runoff from cleared areas and erosion of the watercourses, thus increasing the potential for sedimentation of the watercourses. • Vegetation loss. • Soil compaction and erosion.  Soil quality: • Natural nutrient content decreases due to soil exposure.	6	2	2	10	5	4	1	3	13	130	-	M	• Only excavate areas applicable to the project area. • Backfill the material in the same order it was excavated to reduce contamination of deeper soils with shallow oxidised soils. • Cover excavated soils with a temporary liner to prevent contamination. • Keep the site clean of all general and domestic wastes. All development footprint areas are to remain as small as possible and vegetation clearing is to be limited to what is essential. • Retain as much indigenous vegetation as possible. • Exposed soils are to be protected using a suitable covering or revegetating. • Existing roads should be used as far as practical to gain access to the site, and crossing watercourses in areas where no existing crossings is apparent should be unnecessary, but if it is essential crossings should be made at right angles. • Have emergency fuel & oil spill kits on site. • Soil quality monitoring & visual assessments - monthly basis. If obvious pollution is noted (visually) then it is advised that soil screening be undertaken.	6	1	2	9	5	3	1	3	12	108	-	L	75%	High	Low	
Disturbing vadose zone during soil excavations/infilling activities.		8	2	2	12	5	5	1	4	15	180	-	M		6	1	2	9	5	3	1	3	12	108	-	L	75%	High	Low	

Vegetation clearing & soil stockpiling.	• Loss or natural bio-organisms essential to soil processes.	8	2	2	12	5	5	1	4	15	180	-	M		6	1	2	9	5	3	1	3	12	108	-	L	75%	High	Low	
Seepage/leakages/overland flow from the co-disposal facility and PCDs and oil & fuel spills from vehicles parked at the site	Soil degradation: Compromised soil quality. Prolonged pollution may migrate to the nearby watercourse and/or percolate into the groundwater table.	6	2	2	10	5	5	1	1	12	120	-	M	• Routine visual inspections of infrastructure and parking areas for signs of soil contamination. • Have emergency fuel & oil spill kits on site. • Implement spill procedure. Remove hydrocarbon contaminated soil and disposed of as contaminated waste.	2	2	2	6	2	2	1	1	6	36	-	L	75%	Low	High	
Temporary dewatering of perched groundwater (only expected during intense storm events and shortly thereafter).	Perched Water Table Dewatering	8	2	2	12	5	5	1	3	14	168	-	M	• Water quality monitoring and routine visual assessment for contamination. • Discharge dewatered / rainwater collected into the nearby stream. If water is contaminated, discharge to the closest greywater system (depending on the extent of contamination).	2	2	2	6	2	2	1	2	7	42	-	L	75%	Low	High	
Geohydrological Aspects																														
Site preparation, earthworks and construction	Disturbing vadose zone during soil excavations/construction activities.	6	1	3	10	5	5	1	2	13	130	-	M	• Only clear and excavate areas applicable to the project area. • Backfill the material in the same order it was excavated to reduce contamination of deeper soils with shallow oxidised soils. • Cover excavated soils with a temporary liner to prevent contamination. • Retain as much indigenous vegetation as possible. • Exposed soils are to be protected using a suitable covering or revegetating.	4	1	3	8	3	3	1	2	9	72	-	L	100%	Medium	Medium	
Site preparation, earthworks and construction	Poor quality seepage from machinery used to excavate soils. Oil, grease and fuel leaks could lead to hydrocarbon contamination of the vadose zone which could percolate into the shallow aquifer.	6	1	3	10	5	4	1	2	12	120	-	M	• Park heavy machinery in lined areas and place drip trays under vehicles at the site. • Visual soil assessments for signs of contamination during • Provide spillkits and implement Spill Management Procedure.	4	1	3	8	3	3	1	2	9	72	-	L	100%	Medium	Medium	
Site preparation, earthworks and construction	Groundwater recharge may increase in some areas and decrease in others	4	2	2	8	3	3	1	3	10	80	-	L	• Appropriate phasing to continue construction soon after clearing activities. • Implement effective stormwater management to prevent ponding. • Continued groundwater monitoring	2	2	2	6	2	2	1	2	7	42	-	L	75%	Low	High	
Temporary dewatering of perched groundwater (only expected during intense storm events and shortly thereafter).	Perched Water Table Dewatering	8	2	2	12	5	5	1	3	14	168	-	M	• Water quality monitoring and routine visual assessment for contamination. • Discharge dewatered / rainwater collected into the nearby stream with appropriate erosion protection measures in place. If water is contaminated, discharge to the closest greywater system (depending on the extent of contamination).	2	2	2	6	2	2	1	2	7	42	-	L	75%	Low	High	
Hydrological Aspects																														
Site preparation, earthworks and construction	Disturbing vadose zone during soil excavations/activities.	8	2	4	14	5	5	5	3	18	252	-	H	• Only excavate areas applicable to the project area. • Keep the site clean of all general and domestic waste. • All development footprint areas to remain as small as possible and vegetation clearing to be limited to what is essential. • Retain as much indigenous vegetation as possible. • Exposed soils to be protected using a suitable covering. • Existing roads should be used as far as practical to gain access to the site, and crossing the streams in areas where no existing crossing is apparent should be unnecessary, but if it is essential crossings should be made at right angles.	4	2	4	10	5	3	1	3	12	120	-	M	100%	Medium	Medium	
Site preparation, earthworks and construction	Surface water contamination and sedimentation from the following activities: • Washing of equipment and vehicles, unattended leaks and spills; • Erosion and sedimentation of watercourses due to unforeseen circumstances (i.e. bad weather); and • Alteration of natural drainage lines which may lead to ponding or increased runoff patterns (i.e. may cause stagnant water levels or increase erosion).	6	2	4	12	3	3	5	2	13	156	-	M	• Install a temporary cut-off trench (if required) to contain poor-quality runoff. • Cover soil stockpiles with a temporary liner to prevent contamination (where required and visually determined). • Access roads should have run-off control features to redirect water flow and dissipate any energy in the water, which may pose an erosion risk. • Washing of vehicles or machinery must be limited to designated areas within the dirty water catchment. • Park vehicles in designated areas. • Park heavy machinery in lined areas and place drip trays under vehicles at the site. • Visual soil assessments for signs of contamination during construction (monthly) • Provide spillkits and implement spill management procedures.	4	2	4	10	2	2	5	2	11	110	-	L	100%	Medium	Medium	
Temporary dewatering of perched groundwater (only expected during intense storm events and shortly thereafter).	Perched Water Table Dewatering	4	1	2	7	5	3	1	2	11	77	-	L	• Water quality monitoring and routine visual assessment for contamination. • Discharge dewatered / rainwater collected into the nearby stream. May require authorisation. If water is contaminated, discharge to the closest greywater system (depending on the extent of contamination)	2	1	2	5	5	3	1	2	11	55	-	L	100%	Low	High	
Visual Impacts																														
Transformation of the landscape by site preparation, earthworks and general construction activities	Negative visual impact on aesthetics	6	2	3	11	4	4	1	2	11	121	-	M	• Limit the construction footprint. • No vegetation clearing must take place beyond the development footprint. • All disturbed areas should be rehabilitated after the construction phase. • Limit construction activities to standard working hours. • Minimize construction duration. • Restrict the movement of personnel and construction vehicles to where they are needed. • Ensure that unwanted construction material is stored in the correct manner and out of sight of surrounding receptors. • Dispose of all unwanted construction material and waste at an appropriately licensed waste facility.	4	2	2	8	2	2	1	2	7	56	-	L	75%	Low	High	

[illegible]



ACTIVITY(S)	POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION												RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION												Confidence	Irreplaceable loss of resources	Degree of reversibility
		Severity	Spatial Scale	Duration	CONSEQUENCE	Freq of Activity	Freq of Impact	Legal Issues	Detection	LIKELIHOOD	Significance	+/-	RISK RATING		Severity	Spatial Scale	Duration	CONSEQUENCE	Freq of Activity	Freq of Impact	Legal Issues	Detection	LIKELIHOOD	Significance	+/-	RISK RATING			
OPERATIONAL PHASE																													
Air Quality & Climate																													
Use of haul roads and generation of wind-borne dust from the CDF	Generation of inhalable particle emissions and fugitive dust	8	2	4	14	5	5	1	3	14	196	-	M	<ul style="list-style-type: none"><li>Concurrent rehabilitation of the CDF(capping, application of topsoil and planting of grass cover).</li><li>Rehabilitate exposed areas and monitor the progress thereof.</li><li>Wet suppression of haul roads.</li><li>Continuation of current dust fallout monitoring to .</li><li>Maintaining and manage a Complaints Register.</li></ul>	4	1	4	9	5	3	1	3	12	108	-	L	100%	Low	High
Terrestrial Ecology																													
Continued fragmentation and degradation of habitats and ecosystems	Disturbance created during the construction phase will leave the project area vulnerable to erosion and Invasive plant encroachment.	6	3	3	12	5	4	5	2	16	192	-	M	<ul style="list-style-type: none"><li>It should be made an offence for any staff to /take bring any plant species into/out of any portion of the project area. No plant species whether indigenous or exotic should be brought into/taken from the project area, to prevent the spread of exotic or invasive species or the illegal collection of plants.</li><li>Implementation of an alien vegetation management plan.</li><li>The area must be demarcated and no disturbance is to be allowed outside the direct development footprint.</li></ul>	6	2	2	10	3	2	5	1	11	110	-	L	75%	Medium	High
Proximity of infrastructure and human activity to the wetlands	This may lead to local disturbance of fauna and flora, through noise, light, trampling, etc. Fauna may move away from the site.	6	3	4	13	5	4	1	2	12	156	-	M	<ul style="list-style-type: none"><li>Lighting should face away from the wetlands.</li><li>Workers should be discouraged from walking on the bed and banks of the wetlands.</li></ul>	6	2	3	11	4	3	1	1	9	99	-	L	75%	Medium	High
Spread of alien and/or invasive species	Ongoing displacement and direct mortalities of faunal community due to disturbance	6	2	2	10	5	4	5	2	16	160	-	M	<ul style="list-style-type: none"><li>Lighting should be kept to a minimum to avoid disturbing crepuscular and nocturnal species. Lighting fixtures should be fitted with baffles, hoods or louvers and directed downward, to minimize light pollution which could attract night migrating species.</li><li>Lighting should be directed towards to footprint area and avoid unnecessary illumination of the adjacent undeveloped areas.</li><li>Where feasible, motion detection lighting must be used to minimise the unnecessary illumination of areas</li><li>Avoid using any road during the night;</li><li>Fences must have 30 x 30 cm holes in at the bottom at every 250m to allow for free movement of fauna.</li></ul>	6	1	1	8	4	3	5	2	14	112	-	L	75%	High	Medium
Freshwater ecology																													
Any leakages of untreated effluent from the WWTW will result in the contamination of the water in the wetland features which will impact on the PES of the features.	Contamination of leakage of untreated effluent from the WWTW	8	2	2	12	3	5	5	3	16	192	-	M	<p>The Operational Management Plan of the WWTW must make provision for regular monitoring of the works to ensure that there are no leakages from the plant.</p> <p>The design of the WWTW must make provision for the discharge of any overflow effluent into the associated PCDs to ensure that the no untreated effluent is released from the works area.</p> <p>No untreated effluent will be allowed to be discharge from the WWTW.</p> <p>The Operational Management Plan should also make provision for the actions that must be taken in the event of an accidental spill form the works area. These should make provision for:</p> <ul style="list-style-type: none"><li>Containment of the leakage;</li><li>Collection of the effluent and possible contaminated soils;</li><li>Storage of the contained material; and</li><li>Removal and disposal from the site by registered service provider.</li></ul>	8	1	2	4	1	3	5	3	12	48	-	L	75%	Medium	Medium
Any leakages of untreated effluent from the pipe networks supplying untreated effluent to the WWTW will result in the contamination of the water in the wetland features which will impact on the PES of the features.	Contamination of leakages of untreated effluent from the pipeline network.	8	2	2	12	3	4	5	3	15	180	-	M	<p>The Operational Management Plan of the WWTW must make provision for regular monitoring of the pipework that deliver effluent to ensure that there are no leakages from the pipelines.</p> <p>The Operational Management Plan should also make provision for the actions that must be taken in the event of an accidental spill form the pipelines. These should make provision for:</p> <ul style="list-style-type: none"><li>Containment of the leakage;</li><li>Collection of the effluent and possible contaminated soils;</li><li>Storage of the contained material; and</li><li>Removal and disposal from the site by registered service provider.</li></ul>	8	1	2	11	2	3	5	3	13	143	-	M	75%	Medium	Medium
Any leakages of treated effluent from the discharge pipeline may result in additional water entering the wetland features associated with the project. This additional water moving into the wetlands may impact the PES of the features.	Changes to the hydrological regime of the wetlands due to leakages from the treated discharge pipeline.	4	2	2	8	3	4	5	3	15	120	-	M	<p>The Operational Management Plan of the WWTW must make provision for regular monitoring of the treated effluent discharge pipeline for any leakages.</p> <p>The Operational Management Plan should also make provision for the actions that must be taken in the event of any leakages from the pipeline. These should make provision for:</p> <ul style="list-style-type: none"><li>Stopping the treated effluent discharge; and</li><li>Immediately addressing the leak from the pipeline.</li></ul>	4	2	2	8	1	3	5	3	12	96	-	L	75%	Medium	Medium
The discharge of treated effluent is directly into the Heyshope Dam. Any changes in the quality of the treated effluent may impact on the water quality in the dam.	Pollution of the Heyshope Dam due to treated effluent discharge limits not being met by the WWTW.	8	2	3	13	3	4	5	3	15	195	-	M	<p>The Operational Management Plan of the WWTW must make provision for regular treated effluent quality monitoring to take place to ensure that the treated effluent remains in the discharge limits that will be stipulated in the Water Use Licence for the discharge.</p> <p>If the discharge limits cannot be met, the discharge should be ceased up until such time as the limits associated with the licence can be produced.</p>	4	2	2	8	1	3	5	3	12	96	-	L	75%	Medium	Medium
Soils, Land Capability and Land Use																													
Disturbing the inner-soil architecture of the original soil profile will disturb natural flow processes (i.e. a result of infilling or cut-and-fill activities).	Soil interflow processes: <ul style="list-style-type: none"><li>Alteration to natural hydrogeological flow paths.</li><li>Impacts on the macro-soil structure.</li><li>Impacts on the hydrogeological processes supporting the watercourses.</li></ul>	6	2	4	12	5	4	1	3	13	156	-	M	<ul style="list-style-type: none"><li>Revegetate areas (with vegetation growing at the site) where heavy machinery movement takes place to prevent erosion.</li></ul>	6	2	4	12	5	4	1	3	13	156	+	M	75%	Low	High
Excavated soil will be placed in other areas (i.e. on top of other soils) and will have an impact on the flow dynamics of the soil it is dumped on top of. This may reduce rainfall infiltration and induce runoff.																													
Impermeable areas will decrease rainfall infiltration into soils, and hence reduce interflow (A/B and A/bedrock) or lateral flow to downstream wetland areas.																													
Seepage/leakages/overland flow from the CDF and oil spills and leaks from vehicles and machinery	Soil contamination	2	2	3	7	5	4	1	3	13	91	-	L	<ul style="list-style-type: none"><li>Have emergency fuel &amp; oil spill kits on site.</li><li>Implement Spill Management Procedure. Remove hydrocarbon contaminated soil and disposed of as contaminated waste.</li><li>Ensure PCDs are operated with the required freeboard stipulated in the Water Use Licence.</li></ul>	2	2	3	7	2	2	1	3	8	56	-	L	75%	Low	High
Geohydrological Aspects																													

Seepage from the PCDs due to liner failure or overflows	Deterioration of groundwater quality	8	3	5	16	4	4	5	3	16	256	-	H	•Regular inspections of the liner. •Continued groundwater monitoring to detect potential seepage •Maintenance of the required freeboard.	2	2	4	8	3	2	5	3	13	104	-	L	100%	Low	High
Seepage from the CDF due to failure of liner or drainage system	Deterioration of groundwater quality	10	3	4	17	4	4	5	3	16	272	-	H	• Routine inspections of all stormwater systems. • Inspect and maintain the liner and drainage system. • Ensure slopes are shaped to prevent erosion. • Undertake concurrent rehabilitation to reduce the infiltration of rainwater.	2	2	4	8	3	2	5	3	13	104	-	L	100%	Low	High
Use liners and compaction of surfaces	Reduction to groundwater recharge over project area	2	2	4	8	4	4	1	2	11	88	-	L	No mitigation is possible. Liners are required to prevent groundwater contamination.	2	2	4	8	4	4	1	2	11	88	-	L	100%	Low	High
Hydrological Aspects																													
Seepage from the CDF, PCDs and Brine PCD • Poor quality seepage and runoff from vehicles parked at the site.	Contamination of vadose zone soils	6	2	4	12	4	3	5	3	15	180	-	M	• Keep the site clean of all general and domestic waste. • Water quality of the streams and sewer line monitoring. • Soil covers in areas where erosion is noted, and dust suppression of the landfill to prevent dust migration onto soils.	4	2	4	10	2	2	1	3	8	80	-	L	100%	Medium	High
Stormwater runoff from WWTP and co-disposal facility • Potential surface water contamination as a result of poor stormwater drainage on-site. • Increased erosion due to vegetation loss. • Contaminated runoff water into nearby streams from parked vehicles or overflow from PCDs. • Sedimentation of watercourses due to altered runoff patterns.	Contamination of surface water	10	2	4	16	5	4	5	2	16	256	-	H	• Implement appropriate approved stormwater management system. • Routine hydraulic monitoring of the stormwater system (monthly). • Rehabilitate exposed surfaces and monitor until vegetation establishment is successful. • Maintain sufficient freeboard in PCDs in accordance with the WUL requirements. • Commission Brine Treatment Plant to reduce the volume of brine in the Brine PCD. • Operate WWTP and Brine Treatment Plant in accordance with Standard Operating Procedures. • Prohibit movement or parking of vehicles outside of dirty water catchment. • Water quality monitoring and visual assessments.	2	2	4	8	4	3	5	2	14	112	-	L	100%	Medium	High
Seepage from the CDF	Poor quality seepage into the subsoils from landfill may impact soil quality, and eventually lead to poor quality seepage into the surroundings.	10	2	4	16	5	4	5	2	16	256	-	H	• Water quality monitoring and visual assessments. • Routine inspections of all stormwater systems. • Ensure the facility is lined. • Ensure slopes are shaped to prevent erosion. • Undertake concurrent rehabilitation to reduce the infiltration of rainwater.	4	2	4	10	5	3	5	2	15	150	-	M	100%	Medium	High
Treatment of decanting water into Heyshope Dam	Reduction of contamination surface water resource	10	2	4	16	5	4	5	2	16	256	+	H	Positive impact. No mitigation required.	10	2	4	16	5	4	5	2	16	256	+	H	100%	Low	High
Visual Impacts																													
Visual impact of the CDF	Increasing size of CDF over the life of the facility	4	2	5	11	5	4	1	2	12	132	-	M	• CDF rise to be undertaken in accordance with design and to be overseen by engineer. • Compile and implement concurrent rehabilitation plan. • Use suitable building finishes/colours that blend in with the surrounding landscape	2	2	5	9	5	4	1	2	12	108	-	L	75%	Low	High
Wind-borne dust from CDF, haul roads and exposed areas.	Poor visibility conditions	2	2	4	8	4	4	1	2	11	88	-	L	•Rehabilitate exposed areas and monitor until vegetation establishment is successful. •Undertake concurrent rehabilitation of the CDF. •Wet suppression of haul roads.	0	1	4	5	2	2	1	1	6	30	-	L	75%	Low	High
Security and night time lighting	Visual intrusion due to glare, light trespass and skyglow	4	2	4	10	4	4	1	2	11	110	-	L	• Choose suitable types of lighting that minimize glare and sky glow • Only focus light sources on where it is needed • Consult a qualified lighting engineer or lighting specialist • No spotlights should be used, if possible	2	1	4	7	2	2	1	1	6	42	-	L	75%	Low	High
Noise Impacts																													
Operational activities	Noise disturbance to sensitive receptors	4	2	4	10	4	4	5	1	14	140	-	M	• Limit activities to standard working hours. • Ensure all equipment and vehicles are regularly serviced. • Equipment and machinery used must comply with manufacturer's specifications and should not exceed regulated limits. • Ensure a complaints register is available on site and that all noise complaints are investigated and addressed. • Implement a noise monitoring programme.	2	2	4	8	3	3	5	1	12	96	-	L	75%	Low	High
Socio-Economic Impacts																													
Maintenance of long term employment	Continued mining facilitated by the provision of a CDF for the disposal of mine wastes.	8	2	5	15	5	5	1	2	13	195	+	M	•Source labour where possible from the surrounding local community in accordance with Kangra's applicable commitments and policies. •Grant skills development opportunities to community members and local job seekers, where needed. •Capture all project relevant skills in the project area with the aim to ensure maximum local employment.	8	2	5	15	5	5	1	2	13	195	+	M	75%	Low	High
• Operational activities	• Traffic volumes are anticipated to remain the same • Dust and noise as a result of general operational activities	6	3	4	13	3	3	5	3	14	182	-	M	• Implement recommended mitigation measures for the reduction of dust generation and the suppression of dust. • Implement recommended mitigation measures for the reduction of noise. • Adhere to work schedule which limits activities to day time as far as possible. • Monitor air quality and noise levels • Maintain complaints register. Investigate complaints and keep a record of the investigation undertaken and results thereof and provide feedback to the complainant.	4	2	4	10	3	3	1	3	10	100	-	L	75%	Low	Medium

ACTIVITY(S)	POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION											RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION											Confidence	Irreplaceable loss of resources	Degree of reversibility		
		Severity	Spatial Scale	Duration	CONSEQUENCE	Freq of Activity	Freq of Impact	Legal Issues	Detection	LIKELIHOOD	Significance	+/-		RISK RATING	Severity	Spatial Scale	Duration	CONSEQUENCE	Freq of Activity	Freq of Impact	Legal Issues	Detection	LIKELIHOOD	Significance				+/-	RISK RATING
DECOMMISSIONING PHASE																													
Air Quality & Climate																													
Transport, demolition activities and ripping of compacted areas	Generation of inhalable particle emissions and fugitive dust and dust fallout	4	2	2	8	5	4	1	3	13	104	-	L	<ul style="list-style-type: none"><li>• Reduce speed limit (max 30km/h).</li><li>• Restrict construction vehicle movement to designated areas.</li><li>• Wet suppression on exposed surfaces, unpaved roads.</li><li>• Limit activities to the designated footprint area.</li><li>• Reduction of frequency of disturbance.</li><li>• Begin rehabilitation and re-vegetation of disturbed areas as soon as possible.</li><li>• Continue dust fallout monitoring.</li></ul>	4	1	2	7	5	4	1	3	13	91	-	L	100%	Low	High
Transport, demolition activities and ripping of compacted areas	GHG emissions during the demolition activities	2	2	2	6	3	3	1	2	9	54	-	L	<ul style="list-style-type: none"><li>• Prohibit fires, the burning of waste materials or any debris.</li><li>• Service and maintain of vehicles, plant and machinery in accordance with a maintenance schedule.</li><li>• Use high efficiency generators.</li><li>• Use of low carbon and sulphur fuels.</li><li>• Equipment that is used intermittently must be switched off when not in use.</li></ul>	2	1	2	5	2	2	1	2	7	35	-	L	100%	Low	Medium
Terrestrial Ecology																													
Movement of vehicles, machinery and personnel and potential damage to vegetation	Potential loss of indigenous vegetation units	4	1	4	9	3	3	5	1	12	108	-	L	<ul style="list-style-type: none"><li>• Demarcate working footprint area clearly.</li><li>• Restrict site clearance to the footprint area only.</li><li>• Edge effects of decommissioning activities need to be actively managed.</li><li>• Vegetation outside of the designated footprint area must be left undisturbed.</li><li>• Restrict the movement of personnel and vehicles to where they are needed within designated areas only.</li><li>• Upon completion of decommissioning activities, it must be ensured that all bare areas are revegetated and that no bare areas remain.</li><li>• Strict adherence to the decommissioning EMP.</li><li>• Constant monitoring through the appointed EC.</li></ul>	2	1	4	7	3	3	5	1	12	84	-	L	75%	Low	Medium
<ul style="list-style-type: none"><li>• Disturbance of vegetation</li><li>• Movement of vehicles, machinery and personnel</li><li>• Dumping of material outside of designated areas</li></ul>	Potential increase in alien vegetation	6	2	3	11	4	3	5	2	14	154	-	M	<ul style="list-style-type: none"><li>• Edge effects of decommissioning activities need to be actively managed.</li><li>• Restrict the movement of personnel and vehicles to where they are needed within designated areas only.</li><li>• Ensure the continued implementation of an Alien Invasive Species Management Plan which must make provision for the following:<ul style="list-style-type: none"><li>- Identification of the alien invasive species that have settled on the site;</li><li>- Clear instructions on how to eradicate these species;</li><li>- A schedule of eradication; and</li><li>- A schedule of regular monitoring of the success of the implementation of the eradication.</li></ul></li><li>• Strict adherence to the decommissioning EMP.</li><li>• Constant monitoring through the appointed EC.</li></ul>	2	1	3	6	4	3	5	1	13	78	-	L	75%	Low	High
• Generation of waste and refuse during the execution of decommissioning activities on the site	Contamination of the area by demolition and domestic waste	4	1	2	7	4	3	5	2	14	98	-	L	<ul style="list-style-type: none"><li>• Skips must be made available on-site for demolition waste disposal.</li><li>• All demolition waste must be cleared from the site on a daily basis and placed in these skips.</li><li>• The capacity of these skips must be monitored daily and skips must be emptied/replaced when required to prevent overflows.</li><li>• The disposal of the content of these skips must be done at an appropriately licensed municipal landfill site.</li><li>• Dumping or burials of demolition waste within the project site or in the surrounding areas will be strictly prohibited.</li><li>• Strict adherence to the decommissioning EMP.</li><li>• Constant monitoring through the appointed ECO.</li><li>• Implement a waste management plan and monitor levels of litter constantly.</li><li>• A designated eating area must be established within the contractor site.</li><li>• Covered domestic waste bins must be present at the eating area to receive all the domestic waste generated.</li><li>• The capacity of these domestic waste bins must be monitored on a daily basis to ensure that they are emptied timeously.</li><li>• The domestic waste from these waste bins must be removed off site and disposed of at an appropriately licensed municipal landfill site on a weekly basis or more regularly if the bins fill up quicker.</li></ul>	2	1	1	4	4	3	5	2	14	56	-	L	75%	Low	High
Movement of vehicles	Direct mortality of fauna Disturbance due to dust and noise pollution and vibration may disrupt behaviour.	6	2	2	10	3	3	1	2	9	90	-	L	<ul style="list-style-type: none"><li>• Signs must be put up stating that should any person be found poaching any species they will be fined.</li><li>• Speed limits must be implemented on all roads.</li><li>• All personnel and contractors to undergo Environmental Awareness Training. A signed register of attendance must be kept for proof. Discussions are required on sensitive environmental receptors within the project area to inform contractors and site staff of the presence of species of conservation concern (SCC), their identification, conservation status and importance, biology, habitat requirements and management requirements the Environmental Authorisation and within the EMP;</li><li>• As far as a reasonably practicable avoid using full beam headlights to minimise light pollution to as it may distract animals and increase the chances of road kill.</li></ul>	2	2	2	6	3	3	1	2	9	54	-	L	75%	Low	High
Freshwater Ecology																													
<ul style="list-style-type: none"><li>• Removal of surface infrastructure</li><li>• Rehabilitation activities</li></ul>	Positive effect on aquatic resources due to removal of surface infrastructure and rehabilitation of the area	6	1	4	11	4	3	5	3	15	165	+	M	<ul style="list-style-type: none"><li>• Ensure adequate stormwater management measures are implemented to prevent potential soil erosion and sedimentation.</li><li>• Ongoing monitoring.</li></ul>	6	1	4	11	4	3	5	3	15	165	+	M	75%	Medium	High

Seepage/leakages/overland flow from the CDF and PCDs	Soil degradation. Compromised soil quality. Prolonged pollution may migrate to the nearby watercourse and/or percolate into the groundwater table	6	2	2	10	5	5	1	1	12	120	-	M	<ul style="list-style-type: none"><li>Final rehabilitation of the CDF and monitoring thereof until vegetation establishment is successful.</li><li>Rehabilitation of disturbed areas monitoring thereof until vegetation establishment is successful.</li><li>Continue drainage and collection of polluted seepage water.</li><li>Implement silt interception such as the placement of silt nets where necessary.</li><li>Continue drainage and collection of polluted seepage water. Rehabilitate PCD during closure if area is considered non-polluting</li></ul>	2	2	2	6	2	2	1	1	6	36	-	L	75%	Low	High
<ul style="list-style-type: none"><li>Damage to vegetation</li><li>Edge effect</li><li>Movement of vehicles, machinery and personnel</li></ul>	Negative effect on aquatic resources due to water quality deterioration as a result of erosion and sedimentation, and/or inadequate stormwater management	6	2	4	12	5	5	5	1	16	192	-	M	<ul style="list-style-type: none"><li>Ensure adequate stormwater management measures are implemented to prevent potential soil erosion and sedimentation.</li><li>Demarcate footprint area clearly &amp; minimise site clearance.</li><li>Edge effects of demolition activities need to be actively managed.</li><li>Vegetation outside of the designated footprint area must be left undisturbed.</li><li>Restrict the movement of personnel and vehicles to where they are needed.</li><li>Upon completion of decommissioning activities, it must be ensured that no bare areas remain.</li><li>Strict adherence to the Decommissioning EMP.</li><li>Ongoing monitoring.</li></ul>	2	1	4	7	5	5	5	1	16	112	-	L	75%	Medium	Medium
<ul style="list-style-type: none"><li>Storage of hazardous waste and substances</li><li>Generation and storage of general waste</li></ul>	Negative effect on aquatic resources due to water quality deterioration as a result of contamination of the area by hydrocarbon/chemical spillages and/or dumping of material outside of designated areas	8	2	2	12	5	4	5	2	16	192	-	M	<ul style="list-style-type: none"><li>Maintain 40m buffer zone around the aquatic systems during decommissioning.</li><li>Surface water monitoring must continue.</li><li>No cleaning of vehicles, machines and equipment on site.</li><li>All hazardous substances to be stored separately in appropriately bunded and demarcated facilities</li><li>Provide spill kits and implement Spill Procedure</li><li>Rehabilitate disturbed areas as soon as possible to prevent erosion</li><li>Implementation of waste management plan.</li><li>Ablution facilities may not be placed within 50 m or the 1:50 year floodline. Whichever is furthest will apply. Appropriate sanitary facilities must be provided and all waste to be removed to an appropriate waste facility</li><li>Suitable waste receptacles must be positioned throughout the site and should be wind and scavenger proof."</li><li>* Restrict movement of construction vehicles to designated areas and roadways.</li><li>All plant and equipment must be checked leakages on a daily basis and removed for repairs if leaking.</li><li>Maintenance to be done in suitably designed areas, preferably off site.</li><li>All refuelling must be conducted over a drip-tray or designated bunded areas.</li><li>Ensure that no material is dumped outside of the designated areas.</li></ul>	4	1	2	7	3	3	5	1	12	84	-	L	75%	Medium	Medium
Soils, Land Capability and Land Use																													
Decommissioning of non-essential infrastructure to rehabilitate and close the co-disposal facilities, and rehabilitate the PCD areas.	Soil interflow processes: <ul style="list-style-type: none"><li>Infilling of wetlands and watercourses inducing alternative flow paths (if infilling occurs).</li><li>Alteration to natural hydropedological flow paths.</li><li>Impacts on the macro-soil structure.</li></ul>	6	2	4	12	5	5	5	3	18	216	+	M	No mitigation is required. Rehabilitation will likely improve the impact of the development on the hydropedology assessment.	6	2	4	12	5	5	5	3	18	216	+	M	75%	Low	High
Re-Disturbing vadose zone during soil excavations/infilling activities.	Soil structure & land capability: <ul style="list-style-type: none"><li>Exposure of soils, leading to increased runoff from cleared areas and erosion of the watercourses, thus increasing the potential for sedimentation of the watercourses.</li></ul>	6	2	4	12	5	5	5	3	18	216	+	M	General risks associated with the construction phase will likely exist during earthworks and rehabilitation activities. <ul style="list-style-type: none"><li>Only excavate areas applicable to the project area.</li><li>Backfill the material in the same order it was excavated to reduce contamination of deeper soils with shallow oxidised soils.</li><li>Keep the site clean of all general and domestic wastes.</li></ul> All development footprint areas are to remain as small as possible and vegetation clearing is to be limited to what is essential.	6	2	4	12	5	5	5	3	18	216	+	M	75%	Low	High
Re-vegetation and rehabilitation.	<ul style="list-style-type: none"><li>Vegetation loss.</li><li>Soil compaction; and Soil erosion.</li></ul> Soil quality: <ul style="list-style-type: none"><li>Natural nutrient content decreases due to soil exposure.</li><li>Loss of natural bio-organisms essential to soil processes.</li></ul>	6	2	4	12	5	5	5	3	18	216	+	M	<ul style="list-style-type: none"><li>Retain as much indigenous vegetation as possible.</li><li>Exposed soils are to be protected using a suitable covering or revegetating.</li><li>Existing roads should be used to gain access to the site. No new roads should be created.</li><li>Have emergency fuel &amp; oil spill kits on site and implement Spill Management Procedure.</li><li>Soil quality monitoring &amp; visual assessments - monthly basis. If obvious pollution is noted (visually) then it is advised that soil screening be undertaken.</li></ul>	6	2	4	12	5	5	5	3	18	216	+	M	75%	Low	High
The presence of the CDF will have long-term implications in terms of altering the natural hydropedological flow drivers of the subsols, on which the facility is situated This applies to the proposed PCDs as well.	Soil interflow processes: <ul style="list-style-type: none"><li>Alteration to natural hydropedological flow paths.</li><li>Impacts on the macro-soil structure.</li><li>Impacts on the hydropedological processes supporting the watercourses.</li></ul>	6	2	4	12	5	4	1	3	13	156	-	M	<ul style="list-style-type: none"><li>Revegetate areas (with vegetation growing at the site) where heavy machinery movement takes place to prevent erosion.</li><li>Ensure that clean stormwater is attenuated back to the natural environment, directly downstream of the development. The release of stormwater will offset the rainfall infiltration reduction impacts on soil interflow and may benefit downstream watercourses and wetland units.</li></ul>	6	2	4	12	5	4	1	3	13	156	+	M	75%	Low	Medium

Operation and maintenance of vehicles and machinery resulting in spills or leaks	Contamination of the area by petrochemical spillages	4	1	2	7	4	4	5	2	15	105	-	L	<ul style="list-style-type: none"><li>• All plant and equipment that make use of petrochemical substances must be checked leakages on a daily basis before operations commence.</li><li>• All plant and equipment that are found to be leaking must be removed from the property and only returned once the leakages have been addressed.</li><li>• If any petrochemical substances are stored on the property, this storage must be done on an impermeable surface in a bunded area that makes provision for 110% of volume of the substances that are stored.</li><li>• All refuelling of plant and equipment must be conducted over a drip-tray or designated bunded areas.</li><li>• If any plant or equipment is to be parked on the site, these must be parked within the demarcated footprint that has been cleared.</li><li>• If any spillages from plant or equipment occur, the spill must be immediately contained, the contaminated soils must be collected and bagged in impermeable bags and stored on site to be removed and disposed of by a registered service provider.</li></ul>	2	1	2	5	4	3	5	2	14	70	-	L	75%	Medium	Medium																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
<ul style="list-style-type: none"><li>• Loss of topsoil due to decommissioning activities</li><li>• Increased stormwater run-off due to increased compacted areas</li><li>• Increased vehicular movement</li></ul>	Soil loss / Soil erosion	6	1	2	9	5	4	5	1	15	135	-	M	<ul style="list-style-type: none"><li>• Ripping and reinstatement of soil should not be done earlier than required.</li><li>• Plan drainage paths and soil conservation measure to prevent soil erosion .</li><li>• Where possible, sandbags (or similar) must be placed at the bases of any stockpiled material to prevent erosion of the material.</li><li>• Appropriate erosion protection measures must be implemented at stockpiles.</li><li>• Stabilise and rehabilitate exposed areas as soon as possible.</li></ul>	4	1	2	7	3	3	5	1	12	84	-	L	75%	Medium	Medium																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													
Geohydrological Aspects																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										



[illegible]

ACTIVITY(S)	POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION												RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION												Confidence	Irreplaceable loss of resources	Degree of reversibility	
		Severity	Spatial Scale	Duration	CONSEQUENCE	Freq of Activity	Freq of Impact	Legal Issues	Detection	LIKELIHOOD	Significance	+/-	RISK RATING		Severity	Spatial Scale	Duration	CONSEQUENCE	Freq of Activity	Freq of Impact	Legal Issues	Detection	LIKELIHOOD	Significance	+/-	RISK RATING				
CUMULATIVE IMPACTS																														
Air Quality & Climate																														
Use of roads, disturbances of surfaces, wind-borne dust from exposed areas and stockpiles	Increased contribution to generation of inhalable particle emissions and fugitive dust	6	2	4	12	4	4	5	2	15	180	-	M	<ul style="list-style-type: none"><li>• Reduction of speed limit (max 30km/h).</li><li>• Restrict vehicle movement to designated work areas.</li><li>• Wet suppression on exposed surfaces, unpaved roads, and materials handling areas-where feasible.</li><li>• Minimise extent of disturbed areas.</li><li>• Reduction of frequency of disturbance.</li><li>• Stabilisation (chemical, rock cladding or vegetative) of disturbed soil.</li><li>• Early/concurrent rehabilitation and re-vegetation, as appropriate on disturbed areas.</li><li>• Implement measures to prevent dust outfall on vegetation.</li></ul>	2	2	2	6	1	2	1	2	6	36	-	L	100%	Low	High	
Terrestrial Ecology																														
The development of the proposed infrastructure will contribute to cumulative habitat loss and thereby impact the ecological processes in the region.	The development of the proposed infrastructure will contribute to cumulative habitat loss and thereby impact the ecological processes in the region.	6	2	2	10	3	3	5	3	14	140	-	M	<ul style="list-style-type: none"><li>• Ensure that a rehabilitation plan and IAP management plan be compiled for each development and are effectively implemented.</li></ul>	6	2	2	10	2	3	5	3	13	130	-	M	75%	High	Low	
Freshwater Ecology																														
Discharge of water which fails to meet discharge standards into the Heyshope Dam.	Pollution of the Heyshope Dam	8	2	3	13	3	4	5	3	15	195	-	M	<p>The Operational Management Plan of the WWTW must make provision for regular treated effluent quality monitoring to take place to ensure that the treated effluent remains in the discharge limits that will be stipulated in the Water Use Licence for the discharge.</p> <p>If the discharge limits cannot be met, the discharge should be ceased up until such time as the limits associated with the licence can be produced.</p>	4	2	2	8	1	3	5	3	12	96	-	L	75%	Medium	Medium	
Continued input of polluted water into wetland systems due to leakages of effluent from pipelines and plant	Contamination of wetland features	8	2	2	12	3	4	5	3	15	180	-	M	<p>The Operational Management Plan of the WWTW must make provision for regular monitoring of the works to ensure that there are no leakages from the plant.</p> <p>The design of the WWTW must make provision for the discharge of any overflow effluent into the associated PCDs to ensure that the no untreated effluent is released from the works area. No untreated effluent will be allowed to be discharge from the WWTW.</p> <p>The Operational Management Plan should also make provision for the actions that must be taken in the event of an accidental spill form the works area. These should make provision for:</p> <ul style="list-style-type: none"><li>•Containment of the leakage;</li><li>•Collection of the effluent and possible contaminated soils;</li><li>•Storage of the contained material; and</li><li>•Removal and disposal from the site by registered service provider.</li></ul>	6	1	2	9	1	3	5	2	11	99	-	L	75%	Medium	Medium	
Soils, Land Capability and Land Use																														
Seepage/leakages/overland flow from the CDF and oil spills and leaks from vehicles and machinery	Soil contamination	6	2	3	11	5	4	1	3	13	143	-	M	<ul style="list-style-type: none"><li>• Have emergency fuel &amp; oil spill kits on site.</li><li>• Implement Spill Management Procedure. Remove hydrocarbon contaminated soil and disposed of as contaminated waste.</li></ul>	4	2	3	9	3	2	1	3	9	81	-	L	75%	Low	High	
Construction of permanent structures and damage to soil structure and quality	Loss of land capability	8	2	5	15	5	5	1	2	13	195	-	M	<ul style="list-style-type: none"><li>• Make use of existing roads or upgraded tracks before new roads are constructed. The number and width of internal access routes must be kept to a minimum;</li><li>• A stormwater management plan must be implemented for the development.</li><li>• The areas to be developed must be specifically demarcated to prevent movement of staff or any individual into the surrounding environments, access to these areas must be controlled. Signs must be put up to enforce this;</li><li>• Stockpiles should be managed; and stripped soils properly demarcated according to their proper layers, especially the topsoil. Also prevent and minimise erosion (e.g., use of embedded geotextiles controls) and contamination from the stockpile;</li><li>• Rehabilitation of the area must be initiated from the onset of the project. Soil stripped from infrastructure placement can be used for rehabilitation efforts; and</li><li>• An alien invasive plant species and control programme must be implemented from the onset of the project.</li></ul>	8	2	5	15	5	5	1	2	13	195	-	M	75%	High	Low	

Construction and operation of CDF and WWTP within an existing mining area	<p>Soil interflow processes:</p> <ul style="list-style-type: none"><li>• Infilling of wetlands and watercourses inducing alternative flow paths (if infilling occurs).</li><li>• Alteration to natural hydropedological flow paths.</li><li>• Impacts on the macro-soil structure.</li><li>• Impacts on the hydropedological processes supporting the watercourses.</li></ul> <p>Soil structure &amp; land capability:</p> <ul style="list-style-type: none"><li>• Exposure of soils, erosion and sedimentation of the watercourses.</li><li>• Vegetation loss.</li><li>• Soil compaction and erosion.</li></ul> <p>Soil quality:</p> <ul style="list-style-type: none"><li>• Natural nutrient content decreases due to soil exposure.</li><li>• Loss of natural bio-organisms essential to soil processes.</li></ul>	8	3	2	13	5	4	1	3	13	169	-	M	<ul style="list-style-type: none"><li>• Only excavate areas applicable to the project area.</li><li>• Backfill the material in the same order it was excavated to reduce contamination of deeper soils with shallow oxidised soils.</li><li>• Cover excavated soils with a temporary liner to prevent contamination.</li><li>• Keep the site clean of all general and domestic wastes.</li></ul> <p>All development footprint areas are to remain as small as possible and vegetation clearing is to be limited to what is essential.</p> <ul style="list-style-type: none"><li>• Retain as much indigenous vegetation as possible.</li><li>• Exposed soils are to be protected using a suitable covering or revegetating.</li><li>• Existing roads should be used as far as practical to gain access to the site, and crossing watercourses in areas where no existing crossing is apparent should be unnecessary, but if it is essential crossings should be made at right angles.</li><li>• Have emergency fuel &amp; oil spill kits on site.</li><li>• Soil quality monitoring &amp; visual assessments - monthly basis. If obvious pollution is noted (visually) then it is advised that soil screening be undertaken.</li></ul>	6	2	2	10	5	3	1	3	12	120	-	M	75%	High	Low
Geohydrological Aspects																													
Seepage from the CDF, PCDs and brine effluent pond • Poor quality seepage and runoff from vehicles parked at the site.	Contamination of vadose zone soils	4	2	4	10	4	3	5	3	15	150	-	M	<ul style="list-style-type: none"><li>• Keep the site clean of all general and domestic waste.</li><li>• Water quality of the streams and sewer line monitoring.</li><li>• Soil covers in areas where erosion is noted, and dust suppression of the landfill to prevent dust migration onto</li></ul>	4	2	4	10	2	2	1	3	8	80	-	L	100%	Medium	High
Seepage from the PCDs due to liner failure or overflows	Deterioration of groundwater quality	8	3	5	16	4	4	5	3	16	256	-	H	<ul style="list-style-type: none"><li>•Regular inspections of the liner.</li><li>•Continued groundwater monitoring to detect potential seepage</li><li>•Maintenance of the required freeboard.</li></ul>	2	2	4	8	3	2	5	3	13	104	-	L	100%	Low	High
Use liners and compaction of surfaces	Reduction to groundwater recharge over project area	2	2	4	8	4	4	1	2	11	88	-	L	No mitigation is possible. Liners are required to prevent groundwater contamination.	2	2	4	8	4	4	1	2	11	88	-	L	100%	Low	High
Hydrological Aspects																													
Seepage from the CDF and PCDs • Poor quality seepage and runoff from vehicles parked at the site.	Contamination of vadose zone soils	6	2	4	12	4	3	5	3	15	180	-	M	<ul style="list-style-type: none"><li>• Keep the site clean of all general and domestic waste.</li><li>• Water quality of the streams and sewer line monitoring.</li><li>• Soil covers in areas where erosion is noted, and dust suppression of the landfill to prevent dust migration onto</li></ul>	4	2	4	10	2	2	1	3	8	80	-	L	100%	Medium	High
Stormwater runoff from WWTP and co-disposal facility • Potential surface water contamination as a result of poor stormwater drainage on-site. • Increased erosion due to vegetation loss. • Contaminated runoff water into nearby streams from parked vehicles or overflow from PCDs. • Sedimentation of watercourses due to altered runoff patterns.	Contamination of surface water	10	2	4	16	5	4	5	2	16	256	-	H	<ul style="list-style-type: none"><li>• Implement appropriate approved stormwater management system.</li><li>• Routine hydraulic monitoring of the stormwater system (monthly)</li><li>• Rehabilitate exposed surfaces and monitor until vegetation establishment is successful.</li><li>• Maintain sufficient freeboard in PCDs in accordance with the WUL requirements.</li><li>• Operate WWTP in accordance with Standard Operating Procedures.</li><li>•Prohibit movement or parking of vehicles outside of dirty water catchment.</li><li>• Water quality monitoring and visual assessments.</li></ul>	2	2	4	8	4	3	5	2	14	112	-	L	100%	Medium	High
Seepage from the CDF	Poor quality seepage into the subsoils from landfill may impact soil quality, and eventually lead to poor quality seepage into the surroundings.	10	2	4	16	5	4	5	2	16	256	-	H	<ul style="list-style-type: none"><li>• Water quality monitoring and visual assessments.</li><li>• Routine inspections of all stormwater systems.</li><li>• Ensure the facility is lined.</li><li>• Ensure slopes are shaped to prevent erosion.</li><li>• Undertake concurrent rehabilitation to reduce the infiltration of rainwater.</li></ul>	4	2	4	10	5	3	5	2	15	150	-	M	100%	Medium	High
Visual Impacts																													
Visual impact of the CDF	Increasing size of CDF over the life of the facility	2	2	5	9	5	4	1	2	12	108	-	L	<ul style="list-style-type: none"><li>• CDF rise to be undertaken in accordance with design and to be overseen by engineer.</li><li>• Compile and implement concurrent rehabilitation plan.</li><li>• Use suitable building finishes/colours that blend in with the surrounding landscape</li></ul>	2	2	5	9	5	4	1	2	12	108	-	L	75%	Low	High
Security and night time lighting	Cumulative impacts regarding visual intrusion due to glare, light trespass and skyglow	2	2	4	8	4	4	1	2	11	88	-	L	<ul style="list-style-type: none"><li>• Choose suitable types of lighting that minimize glare and sky glow</li><li>• Only focus light sources on where it is needed</li><li>• Consult a qualified lighting engineer or lighting specialist</li><li>• No spotlights should be used, if possible</li><li>• Utilize motion sensor lights at security buildings</li></ul>	2	1	4	7	2	2	1	1	6	42	-	L	75%	Low	High
Socio-Economic Impacts																													
Construction activities	Temporary job creation and skills development	6	2	2	10	4	4	1	2	11	110	+	L	<ul style="list-style-type: none"><li>• Ensure that contractors procure local labour, where possible, in accordance with Kangra's applicable policies and commitments.</li><li>• Maintain the open and transparent recruitment procedures that are disclosed to community members</li><li>• Use various mechanisms to advertise employment opportunities before commencement of construction</li><li>• Provide or facilitate training of local people, such as through internships, scholarships, and/or vocational and skills training programmes</li></ul>	6	2	2	10	4	4	1	2	11	110	+	L	75%	Low	High
Construction activities	<p>Increase in nuisance factors:</p> <ul style="list-style-type: none"><li>• Dust &amp; noise could increase as a result of an increase in traffic</li><li>• General construction activities resulting in an increase in fugitive dust emissions</li></ul>	4	3	2	9	2	2	5	3	12	108	-	L	<ul style="list-style-type: none"><li>• Implement recommended mitigation measures for the reduction of dust generation and the suppression of dust.</li><li>• Implement recommended mitigation measures for the reduction of noise.</li><li>• Adhere to work schedule which limits construction to day time as far as possible.</li><li>• Monitor air quality and noise levels</li><li>• Maintain complaints register. Investigate complaints and keep a record of the investigation undertaken and results thereof and provide feedback to the complainant.</li></ul>	4	3	2	9	2	2	5	2	11	99	-	L	75%	Medium	Medium

## **APPENDIX E: SPECIALIST STUDY REPORT**

## **APPENDIX E-1: ECOLOGICAL ASSESSMENT**



# **ECOLOGICAL ASSESSMENT FOR THE KANGRA COAL (PTY) LTD MAQUASA MINE PIPELINE DISPOSAL, WWTWS, DISCARD DUMP NEAR PIET RETIEF, MPUMALANGA PROVINCE**

## **Draft Report**

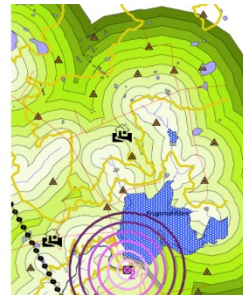
**Version - 1**

**16 September 2024**

**Kangra Coal (Pty) Ltd**

**GCS Project Number: 22-0167**

**Client Reference: GCS Ref - 22-0167**

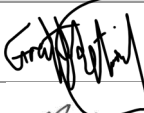



**Report  
Version - 1****16 September 2024**

Kangra Coal (Pty) Ltd

22-0161

**DOCUMENT ISSUE STATUS**

<b>Report Issue</b>	Draft		
<b>GCS Reference Number</b>	22 - 0161		
<b>Client Reference</b>	GCS Ref - 22 - 0161		
<b>Title</b>	Ecological Assessment for the Kangra Coal (PTY) LTD Maquasa Mine Pipeline Disposal, WWTWs, Discard Dump near Piet Retief, Mpumalanga Province		
	<b>Name</b>	<b>Signature</b>	<b>Date</b>
<b>Author</b>	Ronaldo Greeff-Retief		16/09/2024
<b>Document Reviewer</b>	Magnus van Rooyen		16/09/2024

**LEGAL NOTICE**

This report or any proportion thereof and any associated documentation remain the property of GCS until the mandator effects payment of all fees and disbursements due to GCS in terms of the GCS Conditions of Contract and Project Acceptance Form. Notwithstanding the aforesaid, any reproduction, duplication, copying, adaptation, editing, change, disclosure, publication, distribution, incorporation, modification, lending, transfer, sending, delivering, serving or broadcasting must be authorised in writing by GCS.

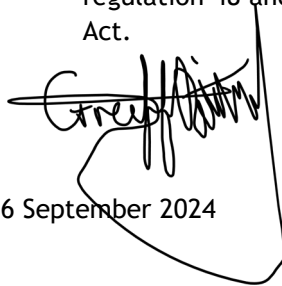
## DECLARATION OF INDEPENDENCE

**Specialist Name** Nico-Ronaldo Greeff-Retief

**Declaration of Independence** I declare, as a specialist appointed in terms of the National Environmental Management Act (Act No 108 of 1998) and the associated 2014 Amended Environmental Impact Assessment (EIA) Regulations, that:

- I act as the independent specialist in this application.
- 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 furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

**Signature**



**Date**

16 September 2024

## EXECUTIVE SUMMARY

In the case of this study site, the grasslands have been altered through anthropogenic activities. The grasslands, however, were not flowering and trees without leaves.

- Anthropogenic impacts identified within the study site included alien vegetation encroachment, gravel roads, natural vegetation removal, hardening of surfaces to establish the mining infrastructure, fencing, grazing of animals and disturbances to the wetland systems around the site.
- The Terrestrial CBA of the site is mixed between transformed areas and ecological support areas (ESA).
- The study site still has a functional role to play in regional ecological functioning and biological functions at the site even though it has been influenced by human-related impacts.
- Ecological connectivity between the grasslands and drainage located towards the Heyshope Dam cannot be excluded in the overall study area.
- An alien invasive species plan must be developed, together with a maintenance management plan that covers termites.
- Monitoring dust at the site should be encouraged.
- Monitoring should be undertaken monthly for the discharge of the treated effluent from the mine into the Heyshope Dam and submitted to DWS>
- A search-and-rescue plan needs to be developed for any medicinal plants onsite. This has to be confirmed by a registered ecologist under SACNASP and during the flowering / summer season.
- Any protected trees must, however, be sampled and recorded and indicated to DAFF.

Concluded from the results presented in this document, the construction activities will impact on the low sensitive terrestrial biota. Mitigation measures should be implemented to mitigate to satisfactory standards if all mitigatory actions are implemented with due care. Alien eradication and rehabilitation must be encouraged through the development of an alien and invasive species plan. . Even though the site has low sensitivity, the mitigation measures provided may reduce the negative risks anticipated with the mining infrastructure construction.

Should all the mitigation measures be implemented and monitored against to ensure compliance and included in the Environmental Management Program the project may be favourably considered

## CONTENTS PAGE

<b>1</b>	<b>INTRODUCTION .....</b>	<b>8</b>
1.1	BACKGROUND .....	8
1.2	PROJECT LOCATION .....	8
1.3	PROJECT OVERVIEW .....	9
1.4	PROJECT LOCATION .....	11
1.5	OVERVIEW OF THE SPECIALIST .....	11
1.6	STRUCTURE OF THE REPORT .....	12
<b>2</b>	<b>SCOPE OF WORK .....</b>	<b>14</b>
2.1	ECOLOGICAL ASSESSMENT .....	14
2.1.1	<i>Biodiversity Assessment</i> .....	14
2.1.2	<i>Specialist Studies</i> .....	14
<b>3</b>	<b>LEGISLATIVE CONTEXT RELATED TO FAUNA AND FLORA .....</b>	<b>16</b>
3.1	NATIONAL LEGISLATION .....	16
3.2	PROVINCIAL AND MUNICIPAL LEVEL .....	18
3.3	INTERNATIONAL LEGISLATION .....	18
<b>4</b>	<b>ENVIROMENTAL CONTEXT OF STUDY AREA (DESKTOP REVIEW).....</b>	<b>20</b>
4.1	LOCATION .....	20
4.2	CLIMATE .....	20
4.3	VEGETATION AND LANDSCAPE .....	21
4.4	LAND COVER & LAND USE OF THE REGION .....	22
4.5	DECLARED AREAS OF CONSERVATION .....	24
4.5.1	<i>Protected Areas:</i> .....	24
4.5.2	<i>National Protected Areas Expansion Strategy (NPAES) Focus Areas:</i> .....	24
4.6	TOPOGRAPHY, RELIEF AND SLOPES .....	25
4.7	GEOLOGY .....	27
4.8	FRESHWATER ECOSYSTEMS .....	28
4.8.1	<i>River FEPA</i> .....	29
<b>5</b>	<b>METHODOLOGY .....</b>	<b>29</b>
5.1	DESKTOP ASSESSMENT .....	29
5.2	BIODIVERSITY ASSESSMENT METHODOLOGY .....	29
5.2.1	<i>Geographic Information Systems (GIS) Mapping</i> .....	29
5.2.2	<i>Botanical Assessment</i> .....	30
5.2.3	<i>Literature Study</i> .....	30
5.2.4	<i>Faunal Assessment (Mammals &amp; Avifauna)</i> .....	31
5.2.5	<i>Herpetology (Reptiles &amp; Amphibians)</i> .....	32
5.3	IMPACT ASSESSMENT .....	32
5.3.1	<i>Extent</i> .....	34
5.3.2	<i>Duration</i> .....	34
5.3.3	<i>Intensity</i> .....	34
5.3.4	<i>Probability</i> .....	34
5.3.5	<i>Confidence</i> .....	34
5.3.6	<i>Reversibility</i> .....	34
5.3.7	<i>Replicability</i> .....	34
5.3.8	<i>Identification of Mitigation Measures</i> .....	35
5.3.9	<i>Ascribing Significance to Cumulative Impacts</i> .....	35
<b>6</b>	<b>ASSUMPTIONS AND LIMITATIONS .....</b>	<b>36</b>
<b>7</b>	<b>FINDINGS AND RESULTS .....</b>	<b>36</b>
7.1	HABITAT AND VEGETATION CHARACTERISTICS .....	36



7.2	ASSESSMENT OF PLANT SPECIES OF CONSERVATION CONCERN .....	37
7.2.1	<i>Protected Trees</i> .....	37
7.3	IDENTIFIED SPECIES LISTS OF OCCURRENCE WITHIN SITES QUARTER DEGREE SQUARE.....	37
7.3.1	<i>Identified Mammal Species for QDS 2730 AB</i> .....	37
7.3.2	<i>Identified Avifaunal Species for QDS 2730AB</i> .....	39
7.3.3	<i>Identified Reptile Species for QDS 2730 AB</i> .....	41
7.3.4	<i>Identified Amphibian Species for QDS 2730AB</i> .....	43
7.3.5	<i>Assessment of Invertebrate Species of Conservation Concern</i> .....	43
7.3.6	<i>Beetles of conservation priority</i> .....	44
7.3.7	<i>Mygalomorph spiders of conservation priority</i> .....	44
7.3.8	<i>Scorpions of conservation priority</i> .....	44
7.4	PHOTOGRAPHIC RECORD .....	45
7.5	SITE SENSITIVITY .....	50
<b>8</b>	<b>IMPACT ASSESSMENT</b> .....	<b>54</b>
8.1	IMPACT ASSESSMENT .....	54
8.1.1	<i>Biodiversity</i> .....	54
8.1.2	<i>Direct habitat destruction</i> .....	54
8.1.3	<i>Increased Erosion risk</i> .....	55
8.1.4	<i>Direct Fauna impacts</i> .....	55
8.1.5	<i>Disruption of broad-scale ecological processes</i> .....	56
8.1.6	<i>Soil and water pollution</i> .....	56
8.1.7	<i>Air pollution</i> .....	56
8.1.8	<i>Spread and establishment of alien invasive species</i> .....	57
8.2	IMPACT ASSESSMENT MATRIX.....	58
<b>9</b>	<b>CONCLUSION AND IMPACT STATEMENT</b> .....	<b>67</b>
9.1	DESIGN AND CONSTRUCTION PHASE FOR BIODIVERSITY: .....	67
9.2	MITIGATION MEASURES FOR IMPACTS ON VEGETATION COMMUNITIES & CBAS .....	68
9.2.1	<i>Recommended mitigation and rehabilitation measures for biodiversity</i> .....	68
9.2.2	<i>Overall Conclusion</i> .....	69
<b>10</b>	<b>REFERENCES</b> .....	<b>71</b>

## LIST OF FIGURES

Figure 1-1: Locality Map .....	8
Figure 4-1: Vegetation Map.....	22
Figure 4-2: Land Cover Map .....	23
Figure 4-3: Terrestrial CBA and ESA surrounding the proposed development. ....	25
Figure 4-4: Topography Map.....	27
Figure 7-1: Plant species sensitivity as per the DFFE Screening Tool .....	51
Figure 7-2: Terrestrial Biodiversity sensitivity as per the DFFE Screening Tool.....	52
Figure 7-3: Terrestrial Sensitivities Map .....	53
Figure 7-4: NFEPA Wetlands .....	53

## LIST OF TABLES

Table 1-1: Property, SG & Ownership details .....	11
Table 1-2: Details of the Specialist.....	11
Table 1-3: Specialist Report Requirements. ....	12

Table 3-1: Legislation in respect to fauna and flora .....	16
<b>Table 7-1: Outline of main landscape and habitat characteristics of the site.....</b>	<b>36</b>
Table 7-2: Mammal species identified to occur in QDS 2730AB .....	38
Table 7-3: Avifauna species identified to occur in QDS 2730AB .....	39
Table 7-4: Reptile species identified to occur in QDS 2730AB.....	41
Table 7-5: Amphibian species identified to occur in QDS 2730AB.....	43
Table 7-6: Butterfly species identified to occur in QDS 2730AB .....	44
Table 7-7: Features identified at the site. ....	45
Table 8-1: Impact assessment Matrix during Construction.....	58
Table 8-2: Impact assessment Matrix during Operation .....	64
Table 8-3: Impact assessment Matrix (Cumulative Impacts).....	66
Table 10-1: List of Least Concern Plant species within QDS 2730AB .....	86
Table 10-2: List of Vulnerable Red Listed Plant Species under QDS 2730AB .....	92
Table 10-3: List of Near Threatened Red Listed Plant Species under QDS 2730AB .....	92

## LIST OF APPENDICES

APPENDIX A -CURRICULUM VITAE OF SPECIALIST.....	77
APPENDIX B – PLANT SPECIES LIST .....	86

## ABBREVIATIONS

DAFF:	Department of Agriculture, Forestry and Fisheries
DFFE:	Department of Forestry, Fisheries, and the Environment
DWS:	Department of Water and Sanitation
EA:	Environmental Authorisation
EAP:	Environmental Assessment Practitioner
EIA:	Environmental Impact Assessment
ER:	Employer's Representative
ECO:	Environmental Control Officer
EMPr:	Environmental Management Program
GA:	General Authorisation
GCS:	Groundwater Consulting Services
NEMA	National Environmental Management Act

## 1 INTRODUCTION

### 1.1 Background

The purpose of the ecological assessment is to determine the state of the flora and fauna being affected by the proposed mining operations and expansions to the Kangra Coal Maquasa Mine and to determine whether sensitive areas are applicable and needs to be avoided.

### 1.2 Project Location

Kangra Coal (Pty) Ltd's (Kangra) Maquasa mining operation is located near Piet Retief within the Mpumalanga Province. The mining area is situated approximately 45km west of Piet Retief and just off the N2 national road on a secondary road leading towards the Heyshope Dam. The Maquasa mining operations is made of the following mining areas:

- Maquasa East
- Maquasa West; and
- Nootgesien.

Refer to Figure 1-1 for a regional locality map.

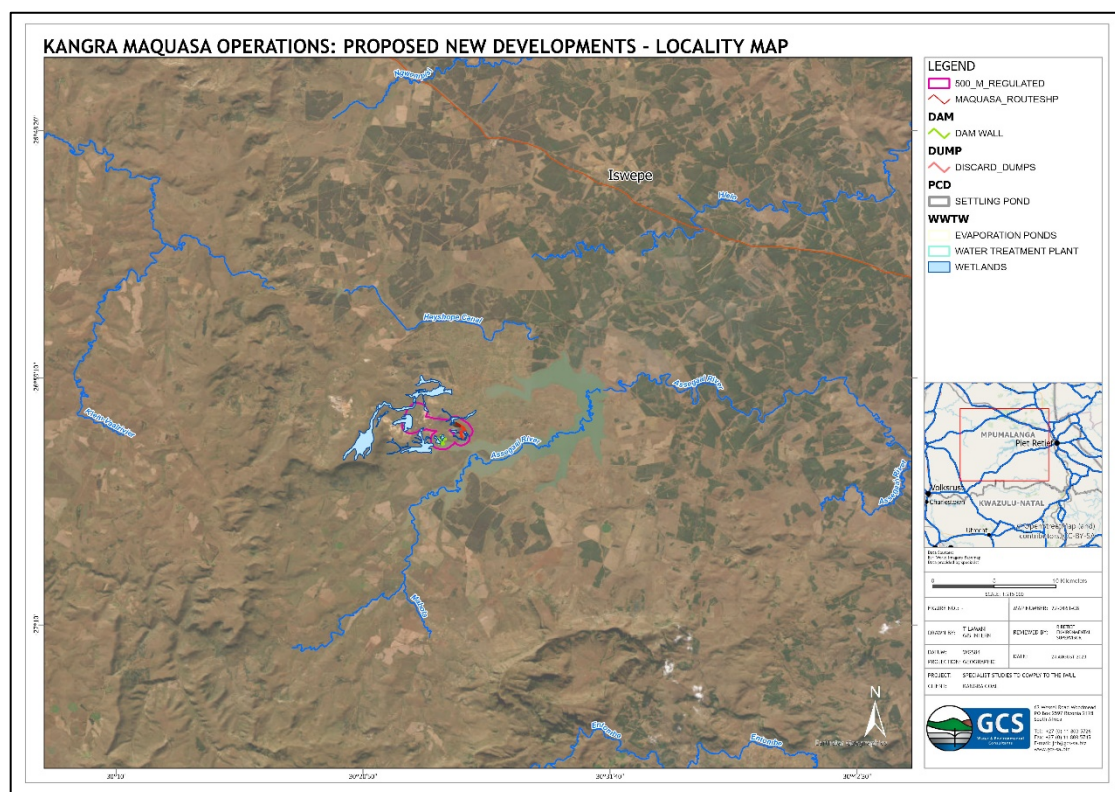


Figure 1-1: Locality Map

All these activities are undertaken and authorised under Mining Right (MR) MP30/5/1/23/2/1/133EM from the Department of Mineral Resources and Energy (DMRE).

All mining and project related infrastructure is located at Maquasa East (MQE) and includes a coal washing plant and associated infrastructure. This plant is used for the processing of all coal mined from Maquasa West and the Nooitgesien opencast mining area. No mining is taking place at Maquasa East as all the coal reserves have already been mined.

The following infrastructure is located at MQE:

- Offices;
- Workshop & ancillary buildings;
- Existing Discard Dump;
- Beneficiation Plant;
- ENPROTEC Plant;
- Diesel Storage Facilities;
- Dirty water containment facilities;
- Maquasa East Adit;
- Haul roads;
- Powerlines;
- Conveyors and associated service roads (transporting mined coal to the Maquasa East processing plant);
- Access Roads;
- Pipeline (transporting water to the Maquasa East underground storage area);
- Crushers;
- Washing and screening plant; and
- Overburden and stockpile (i.e. topsoil, run of mine ore, product) dumps.

Kangra intends to construct a wastewater treatment plant as well as a co-disposal facility, water pipeline for disposal and settling dams at their Maquasa East (MQE) Operations.

To enable the implementation of the proposed projects, Kangra Coal needs to acquire the necessary environmental approvals. GCS Water and Environment (Pty) Ltd (GCS) has been appointed as the independent Environmental Assessment Practitioner (EAP) to compile and submit the required documentation for the Integrated Environmental Application by Kangra Coal (Pty) Ltd.

To enable the implementation of the proposed project, Kangra Coal needs to acquire the necessary environmental approvals. It is in this regard that GCS Water and Environment (Pty) Ltd (GCS) was appointed to undertake the required environmental assessment processes, to determine the biophysical, social and economic impacts associated with undertaking the proposed projects. This wetland assessment forms part of this application.

### **1.3 Project Overview**

An overview of the proposed projects is provided below:

### Wastewater Treatment Plant and PCD

The purpose of the proposed wastewater treatment plant (WWTP) is to treat decant water as well as surplus contaminated water within the mining operations. MQE is currently decanting clear groundwater from old underground workings at an average rate of 1 800m<sup>3</sup>/d. The WWTP will employ 'active' treatment of the wastewater as it was found that passive treatment is not feasible nor possible due to decant point's location, the high flow rates and the discharge quality required. Brine resulting from the WWTP will be piped and stored in a new proposed brine pollution control dam (PCD).

### Co-disposal Facility

The proposed co-disposal facility falls within the exact footprint of the previously authorized (MDARDLE Ref: 17/2/3/GS-240) MQE Discard Dump.

As a result of changing operational requirements, and the lapsing of the previous authorisation, there is now a need to license a new co-disposal facility at MQE.

The co-disposal facility will accommodate discard produces from the beneficiation plant, slurry/filter cake and potentially brine from the WWTP.

The co-disposal facility's design will be similar to the authorized discard dump: a three-compartment side hill-type facility with a footprint of approximately 65ha. A phased development approach, over a period of 20 years, is envisaged: Phase 1 - 7 years; Phase 2 - 7 years and Phase 3 - 6 years capacity.

To enable the implementation of the proposed projects, Kangra needs to acquire the necessary environmental approvals. GCS Water and Environment (Pty) Ltd (GCS) has been appointed as the independent Environmental Assessment Practitioner (EAP) to compile and submit the required documentation for the Integrated Environmental Application by Kangra Coal (Pty) Ltd for:

- An Integrated Environmental Authorisation (IEA) and Waste Management License (WML) through a Scoping and Environmental Impact Reporting (S&EIR) process and the compilation of an Environmental Management Programme (EMPr), in terms of the NEMA, NEMWA, and Environmental Impact Assessment (EIA) Regulations (2014, as amended) (IEA Application); and
- An Integrated Water Use License (IWUL), in terms of the NWA.

### Water Pipeline:

A water pipeline is proposed to be constructed to carry runoff water from the mine operations after treatment and discharge directly into the Heyshope Dam.



## 1.4 Project Location

As mentioned previously, MQE Operations is located within the Mpumalanga Province and operates under one (consolidated) MR, within which the proposed projects are located. The MR area fall within the jurisdiction of the Mkhondo Local Municipality (MLM) and Pixley Ka Seme Local Municipality (PSLM) of the Gert Sibande District Municipality (GSDM).

Table 1-1 provide further information regarding the location of the proposed projects and their affected properties including the Surveyor-general (SG) 21-digit site information for the parent farms.

**Table 1-1: Property, SG & Ownership details**

Project	Property	SG Code	Local Municipality
Wastewater Treatment Plant	Remaining Extent (RE) of the farm Roodekraal 21HT	TOHT00000000002100000	Mkhondo LM
Co-disposal Facility	RE of the farm Rooikop 18HT	TOHT000000000001800000	Pixley Ka Seme LM
	RE of the farm Maquasa 19HT	TOHT000000000001900000	
WWTP Brine PCD	RE of the farm Roodekraal 21HT	TOHT00000000002100000	Mkhondo LM
Water pipeline	Remaining Extent (RE) of the farm Roodekraal 21HT	TOHT00000000002100000	Mkhondo LM

## 1.5 Overview of the Specialist

Mr. Nico-Ronaldo Greeff-Retief is a Registered EAP, water, ecological biodiversity, and visual specialist with emphasis on biodiversity and zoology. He has undertaken numerous mining related, environmental, and ecological assessments, wetland studies and water quality specialist studies as well as visual impact assessments. He is registered with the South African Council for Natural Scientific Professions (SACNASP). For more information, please refer to Table 1-2.

**Table 1-2: Details of the Specialist**

Specialist	Nico-Ronaldo Greeff-Retief
Qualifications:	M.Sc. Zoology (University of Johannesburg)
Experience:	Flora and Fauna Habitat Surveys Water Quality Assessments (Biomonitoring) Wetland Assessments Visual Impact Studies Aquatic Assessments and Biomonitoring Mining and water specialist 19 years' Experience

Affiliation/ Registration	SACNASP Professional Natural Scientist 005636
Address:	63 Wessel Road, Rivonia, Johannesburg, South Africa
Tel:	011 803 5726
Email:	Ronaldo@gcs-sa.biz

## 1.6 STRUCTURE OF THE REPORT

Appendix 6 of GN 706 of 13 July 2018 provides the requirements for specialist reports undertaken as part of the environmental authorisation process. In line with this Table 1-3 provides an overview of Appendix 6 together with information on how these requirements have been met.

**Table 1-3: Specialist Report Requirements.**

Requirement from Appendix 6 of GN 326 of 7 April 2017	Chapter
(a) Details of- (i) the specialist who prepared the report; and (ii) the expertise of that specialist to compile a specialist report including a curriculum vitae	<b>Chapter 1 Appendix A</b>
(b) Declaration that the specialist is independent in a form as may be specified by the competent authority	<b><i>Declaration of Independence</i></b>
(c) Indication of the scope of, and the purpose for which, the report was prepared	<b>Chapter 1</b>
(cA) An indication of the quality and age of base data used for the specialist report	<b>Chapter 3, 4, 5 &amp; 6</b>
(cB) A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change.	<b>Chapter 4, 8 &amp; 9</b>
(d) the Duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	<b>Chapter 5, 8 &amp; 9</b>
(e) Description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used.	<b>Chapter 5</b>
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure inclusive of a site plan identifying site alternatives	<b>Chapter 8 &amp; 9</b>
(g) Identification of any areas to be avoided, including buffers	<b>Chapter 8 &amp; 9</b>

<b>Requirement from Appendix 6 of GN 326 of 7 April 2017</b>	<b>Chapter</b>
(h) Map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers	<b>Chapter 8</b>
(l) Description of any assumptions made and any uncertainties or gaps in knowledge	<b>Chapter 6</b>
(j) Description of the findings and potential implications of such findings on the impact of the proposed activity, or activities	<b>Chapter 7 Chapter 8 Chapter 9</b>
(k) Mitigation measures for inclusion in the EMPr	<b>Chapter 8 &amp; 9</b>
(l) Conditions for inclusion in the environmental authorisation	<b>Chapter 8 &amp; 9</b>
(m) Monitoring requirements for inclusion in the EMPr or environmental authorisation	<b>Chapter 8 &amp; 9</b>
(n) Reasoned opinion- <ul style="list-style-type: none"> <li>(i) whether the proposed activity, activities or portions thereof should be authorised;</li> <li>(iA) regarding the acceptability of the proposed activity or activities; and</li> <li>(ii) if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan</li> </ul>	<b>Chapter 9</b>
(o) Description of any consultation process that was undertaken during the course of preparing the specialist report	<b>Chapter 6</b>
(p) A summary and copies of any comments received during any consultation process and where applicable all responses thereto	<b>Not Applicable</b>
(q) Any other information requested by the competent authority	<b>Not Applicable</b>

## 2 SCOPE OF WORK

### 2.1 Ecological Assessment

#### 2.1.1 *Biodiversity Assessment*

The proposed Scope of Work (SoW) aims to meet the minimum requirements of the Department of Forestry, Fisheries, and the Environment (DFFE) to conduct the relevant specialist assessments in support of a Biodiversity Baseline Assessment (BA). The following documents were considered in determining the SoW:

- Integrated Waste and Water Use License Application
- EIA and EMP; and
- Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in Terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation.

#### 2.1.2 *Specialist Studies*

The selected baseline studies will aim to meet the requirements of DFFE to conduct a biodiversity assessment in the Mpumalanga Province. The following studies will be included in the biodiversity assessment:

- Fauna - Mammals (including bats), birds, reptiles, amphibians & invertebrates.
- Plants and vegetation (including alien vegetation).
- Habitat features - Caves and/or ridges.

Specifically, the Terms of Reference (ToR) included the following:

- Desktop description of the baseline receiving environment specific to the field of expertise (general surrounding area as well as site specific environment)
- Identification and description of any sensitive receptors in terms of relevant specialist disciplines (biodiversity) that occur in the study area, and the manner in which these sensitive receptors may be affected by the activity
- Identify 'significant' ecological, botanical, and faunal features within the proposed development areas
- Site visit to verify desktop information

- Screening to identify any critical issues (potential fatal flaws) that may result in project delays or rejection of the application; and
- Provide a map to identifying sensitive receptors in the study area, based on available maps, database information & site visit verification.



### 3 LEGISLATIVE CONTEXT RELATED TO FAUNA AND FLORA

#### 3.1 National Legislation

Table 3-1: Legislation in respect to fauna and flora

<b>Biodiversity Act (No. 10 of 2004)</b>	To provide for the management and conservation of South Africa's biodiversity within the framework of the National Environmental Management Act 1998; the protection of species and ecosystems that warrant national protection; the sustainable use of indigenous biological resources; the fair and equitable sharing of benefits arising from bioprospecting involving indigenous biological resources; the establishment and functions of a South African National Biodiversity Institute; and for matters connected therewith.
<b>Conservation of Agricultural Resources Act 43 of 1983</b>	The conservation of soil, water resources and vegetation is promoted. Management plans to eradicate weeds and invader plants must be established to benefit the integrity of indigenous life.
<b>Constitution of the Republic of South Africa (Act 108 of 1996)</b>	The Bill of Rights, in the Constitution of South Africa (No. 108 of 1996), states that everyone has a right to a non-threatening environment and requires that reasonable measures be applied to protect the environment. This protection encompasses preventing pollution and promoting conservation and environmentally sustainable development. These principles are embraced in NEMA and given further expression.
<b>Convention on Biological Diversity, 1995</b>	International legally binding treaty with three main goals; conserve biological diversity (or biodiversity); ensure sustainable use of its components and the fair and equitable sharing of benefits arising from genetic resources.
<b>Convention on International Trade in Endangered Species of Wildlife and Fauna</b>	International agreement between governments, drafted because of a resolution adopted in 1963 at a meeting of members of the International Union for Conservation of Nature (IUCN). Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival and it accords varying degrees of protection to more than 33,000 species of animals and plants.

<b>Environment Conservation Act (No. 73 of 1989)</b>	To provide for the effective protection and controlled utilization of the environment and for matters incidental thereto.
<b>Mineral and Petroleum Resources Development Act (Act No.28 of 2002) (MPRDA)</b>	Compilation of Environmental Impact Assessment (EIA) and Environmental Management Programme (Reports) (EMPR).
<b>National Veld &amp; Forest Fire Act (Act No. 101 of 1998)</b>	To prevent and combat veld, forest and mountain fires throughout the Republic, to provide for a variety of institutions, methods and practices for achieving the purpose.
<b>National Environmental Management Act (No. 107 of 1998)</b>	Requires adherence to the principles of Integrated Environmental Management (IEA) in order to ensure sustainable development, which, in turn, aims to ensure that environmental consequences of development proposals be understood and adequately considered during all stages of the project cycle and that negative aspects be resolved or mitigated, and positive aspects enhanced.
<b>National Environmental Management: Biodiversity Act (Act No. 10 of 2004)</b>	To provide for matters relating to threatened or protected species regulations
<b>National Environmental Management Protected Areas Act (No. 57 of 2003)</b>	To provide for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes; for the establishment of a national register of all national, provincial and local protected areas; for the management of those areas in accordance with national norms and standards; for intergovernmental co-operation and public consultation in matters concerning protected areas; and for matters in connection therewith.

<b>White Paper on Conservation and Sustainable Use of South Africa's Biological Diversity (July 1997)</b>	Identifies several strategies to be developed to give effect to the specific policies, including the enhancement of the protected area network, development of specific strategies such as conservation and sustainable use of reptiles and amphibians. Promotes a “Prosperous, environmentally conscious nation, whose people are in harmonious co-existence with the natural environment, and which derives lasting benefits from the conservation and sustainable use of its rich biological diversity”
---	--

### 3.2 Provincial and Municipal Level

The Provincial Department responsible for environmental matters in the **Mpumalanga Province is the Department: Agriculture, Rural Development, Land and Environmental Affairs**. Relevant provincial legislation includes, but is not limited to:

- Town-Planning and Townships Ordinance No.15 of 1986
- Mpumalanga Nature Conservation Act 10 of 1998

### 3.3 International Legislation

- The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). CITES is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival;
- Convention on Biological Diversity (CBD, 1993)
- The United Nations Framework Convention on Climate Change (UNFCCC, 1994)
- The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES 1973)
- The Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention, 1979)
- Nomination file 914, 1999
- Advisory Body Evaluation (IUCN), 1999
- Component Areas of the Nominated Site, 1998; and

- The IUCN (World Conservation Union). The IUCN's mission is to influence, encourage and assist societies throughout the world to conserve the integrity and diversity of nature and to ensure that any use of natural resources is equitable and ecologically sustainable.

## 4 ENVIROMENTAL CONTEXT OF STUDY AREA (DESKTOP REVIEW)

A desktop study was undertaken to gather background information regarding the site and its surrounding areas. This involves:

- Consulting maps, aerial photographs and digital satellite images in order to determine broad habitats and sensitive sites;
- A literature review concerning habitats, vegetation types, faunal and floral species distributions;
- Contacting all the relevant authorities regarding red data listed floral species; and
- Identifying the status of the land as well as conservation requirements and nearby conservation areas.

### 4.1 Location

The proposed Maquasa site is located on rural land approximately 45km due west of the town of Piet Retief in Mpumalanga Province. The site is adjacent to and upstream of Heyshope Dam. The Township of Driefontein is located approximately 5km to the east of the mining area.

### 4.2 Climate

Driefontein normally receives about 738mm of rain per year, with most rainfall occurring during summer. The lowest rainfall is received in June (2mm) and the highest in December (136mm). The average daily maximum temperatures range from 18.8°C in June to 25.9°C in January. The region is the coldest during June with temperatures of 2.4°C on average during the night (saexplorer, 2015).

Strongly seasonal summer rainfall, with very dry winters. Mean annual rainfall is between 690 - 900mm with the overall average of 726mm. There are about 13 - 42 days per year when frost is recorded, this increases with increased altitude.



### 4.3 Vegetation and Landscape

The mining area is located mainly in the Eastern Highveld Grassland (GM12) vegetation unit and is distributed along slightly, to moderately undulating plains, including some low hills and pan depressions, in Mpumalanga and Gauteng Provinces. The vegetation is short dense grassland dominated by the usual Highveld grass composition (*Aristida*, *Digitaria*, *Eragrostis*, *Themeda*, *Tristachya*, etc.) with small, scattered rocky outcrops with wiry, sour grasses and some woody species (*Senegalia caffra*, *Celtis Africana*, *Diospyros lyciodes* subsp. *lycioides*, *Parinari capensis*, *Protea caffra*, *P. welwitschii* and *Rhus magalismontanum*).

The important taxa associated with this vegetation unit are:

**Graminoids:** *Aristida aequiglumis* (d), *A. congesta* (d), *A. junciformis* subsp. *galpinii* (d), *D. tricholaenoides* (d), *Elionurus muticus* (d), *Eragrostis chloromelas* (d), *E. curvula* (d), *E. plana* (d), *E. racemosa* (d), *E. sclerantha* (d), *Heteropogon contortus* (d), *Loudetia simplex* (d), *Setaria sphacelata* (d), *Sporobolus africanus* (d), *S. pectinatus* (d), *Themeda triandra* (d), *Trachypogon spicatus* (d), *Tristachya leucothrix* (d), *T. rehmannii* (d), *Alloteropsis semialata* subsp. *eckloniana*, *Andropogon appendiculatus*, *A. schirensis*, *Bewisia biflora*, *Ctenium concinnum*, *Diheteropogon amplexans*, *Eragrostis capensis*, *E. gummiflua*, *E. patentissima*, *Harpochloa falx*, *Panicum natalense*, *rendlia altera*, *Schizachyrium sanguineum*, *Setaria nigrirostris*, *Urelytrum agropyroides*.

**Herbs:** *Berkheya setifera* (d), *Haplocarpha scaposa* (d), *Justicia anagalloides* (d), *Pelargonium luridum* (d), *Acalypha angustata*, *Chamaecrista mimosoides*, *Dicoma anomala*, *Euryops gilfillanii*, *E. transvaalensis* subsp. *setilobus*, *Helichrysum aureonitens*, *H. caespitum*, *H. callicomum*, *H. oreophilum*, *H. rugulosum*, *Ipomoea crassipes*, *Pentanisia prunelloides* subsp. *latifolia*, *Selago densiflora*, *Sencio coronatus*, *Vernonia oligocephala*, *Wahlenbergia undulate*.

**Geophytic Herbs:** *Gladiolus crassifolius*, *Haemanthus humilis* subsp. *hirsutus*, *Hypoxis rigidula* var. *pilosissima*, *Ledebouria ovatifolia*.

**Succulent Herb:** *Aloe ecklonis*.

**Low Shrubs:** *Anthospermum rigidum* subsp. *pumilum*, *Stoebe plumose*.

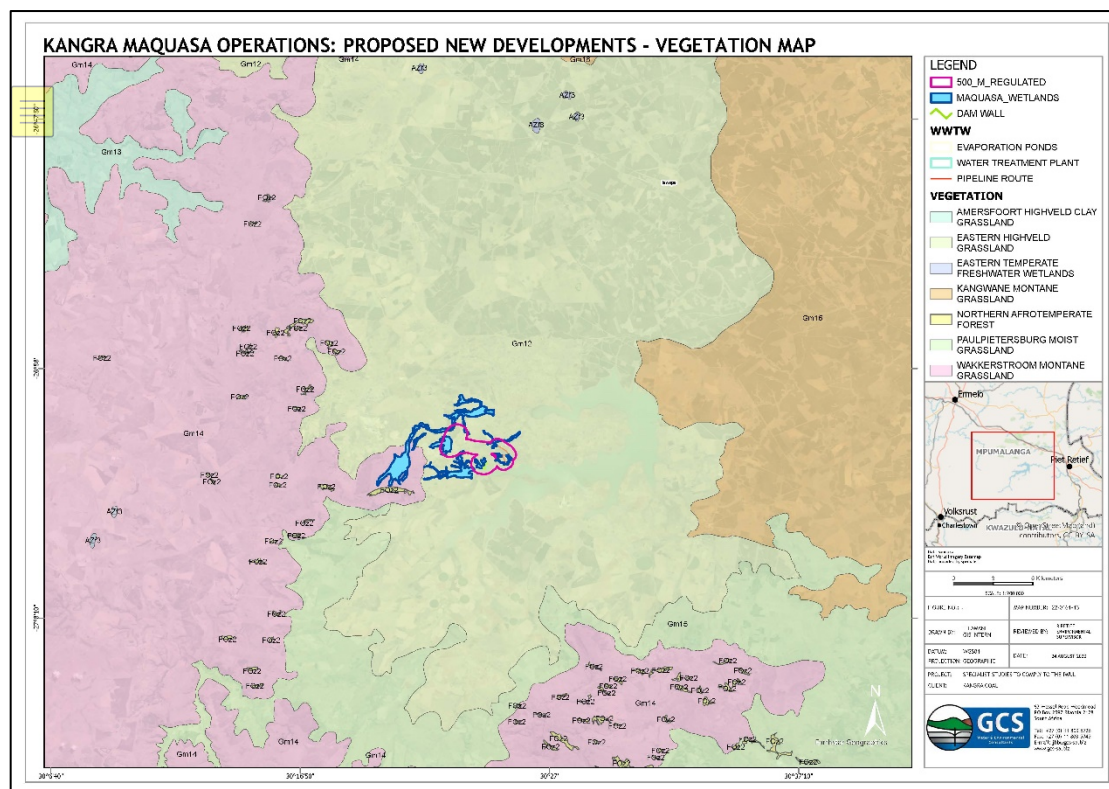


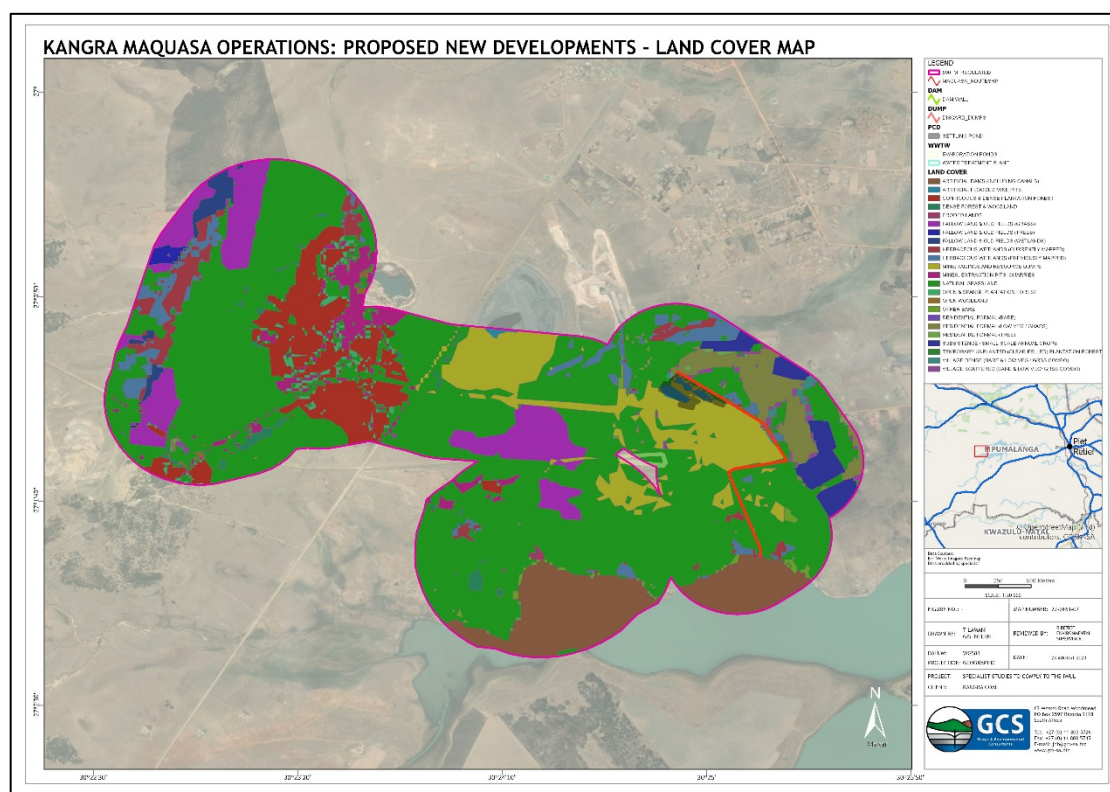
Figure 4-1: Vegetation Map

#### 4.4 Land cover & Land use of the region

To this assessment, land cover is loosely categorised into classes that represent natural habitat and categories that contribute to habitat degradation and transformation on a local or regional scale. In terms of the importance for biodiversity, the assumption is that landscapes exhibiting high transformation levels are normally occupied by plant communities and faunal assemblages that do not necessarily reflect the original or pristine status. This is particularly important in the case of conservation important taxa as these plants and animals generally exhibit extremely low tolerance levels towards disturbances. This is one of the main reasons for the threatened status of these species. Changes in the natural environment available to these species are therefore likely to result in severe impacts on these species and, subsequently, their conservation status.

Three important aspects are associated with habitat changes that accompany certain land uses. Permanent transformation of natural habitat by land uses such as agriculture, mining, and urbanisation results in the permanent decimation of available habitats. These areas will not recover to the original pristine status. A second aspect of habitat transformation or degradation is that it affects species directly, namely changes in species presence / absence and - composition. This result from the exodus of species for which habitat conditions have become unfavourable, the decrease in abundance of certain species because of decreased habitat size, or an influx of species that are better adapted to the altered environment. While some, or most, of the new species that occupy an area might be indigenous, they are not necessarily endemic to the affected area. Lastly, a larger threat to the natural biodiversity of a region is represented by the influx of invasive exotic species that can effectively sterilise large tracts of remaining natural habitat.

The study area is situated within the Seme and neighbouring the Mkhondo Municipalities, which comprise approximately 522 723.6 ha and 488 216.5 ha respectively. The BGIS (2023) assessment indicates that approximately 88.2% and 49% of the municipality are currently considered not transformed. This figure is however regarded an overestimation of the true extent of remaining natural (pristine) habitat.



**Figure 4-2: Land Cover Map**

#### 4.5 Declared areas of conservation

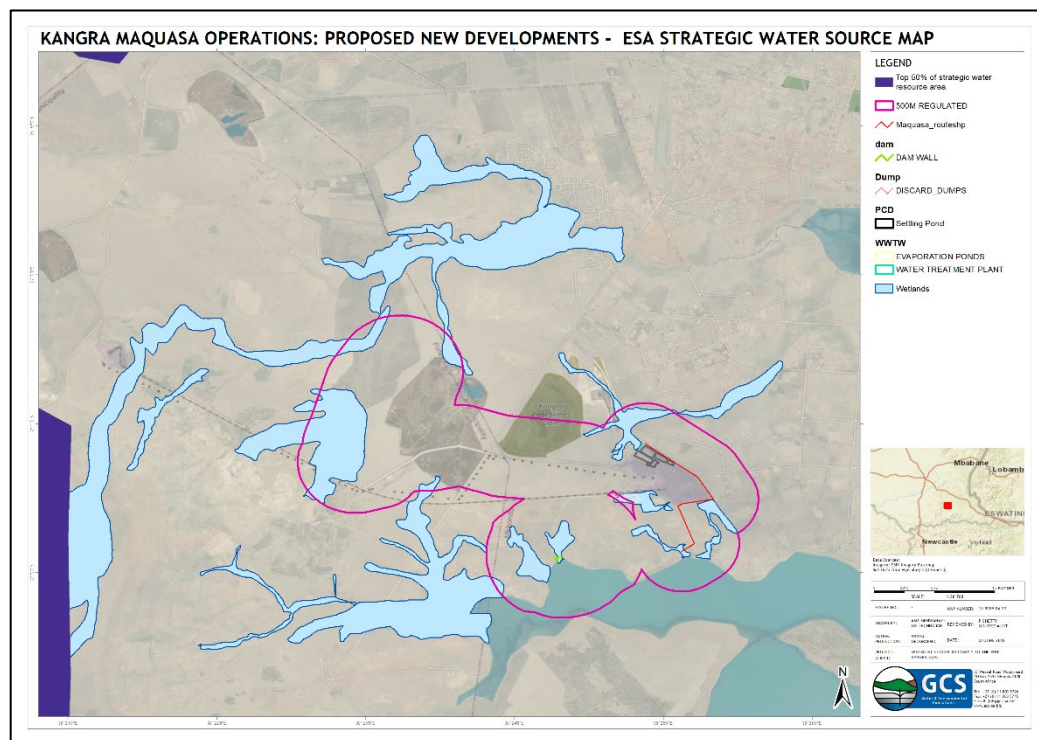
The conservation status of the Eastern Highveld Grassland vegetation is listed as Endangered. This vegetation type has a conservation target of 24%. Currently only a small fraction is conserved in statutory reserves (Nooitgedacht Dam and Jericho Dam Nature Reserves) and in private reserves (Holkransse, Kransbank, Morgenstroom). Some 44% is transformed primarily by clativation, plantations, mines, urbanization and by building dams. The second vegetation unit that is listed as threatened is the Wakkerstroom Montane Grassland. This vegetation is listed as least threatened with a conservation target of 27%. Currently less than 1% is statutorily protected in the Paardeplaats Nature Reserve. There are 10 South African Natural Heritage Sites in this unit, although very little of it is formally protected. Land use pressures from agriculture are low (5% cultivated) owing to the colder climate and shallow soils. The mining area has the following conservation areas within its vicinity:

##### 4.5.1 Protected Areas:

- Paardeplaats Nature Reserve (approximately 6 km to the southeast);
- Pongola Bush Nature Reserve (approximately 8 km to the south); and
- Wakkerstroom Wetland Nature Reserve (approximately 13 km to the southwest).

##### 4.5.2 National Protected Areas Expansion Strategy (NPAES) Focus Areas:

- Moist Escarpment Grasslands (distributed adjacent to mining area running from northwest through to southeast)





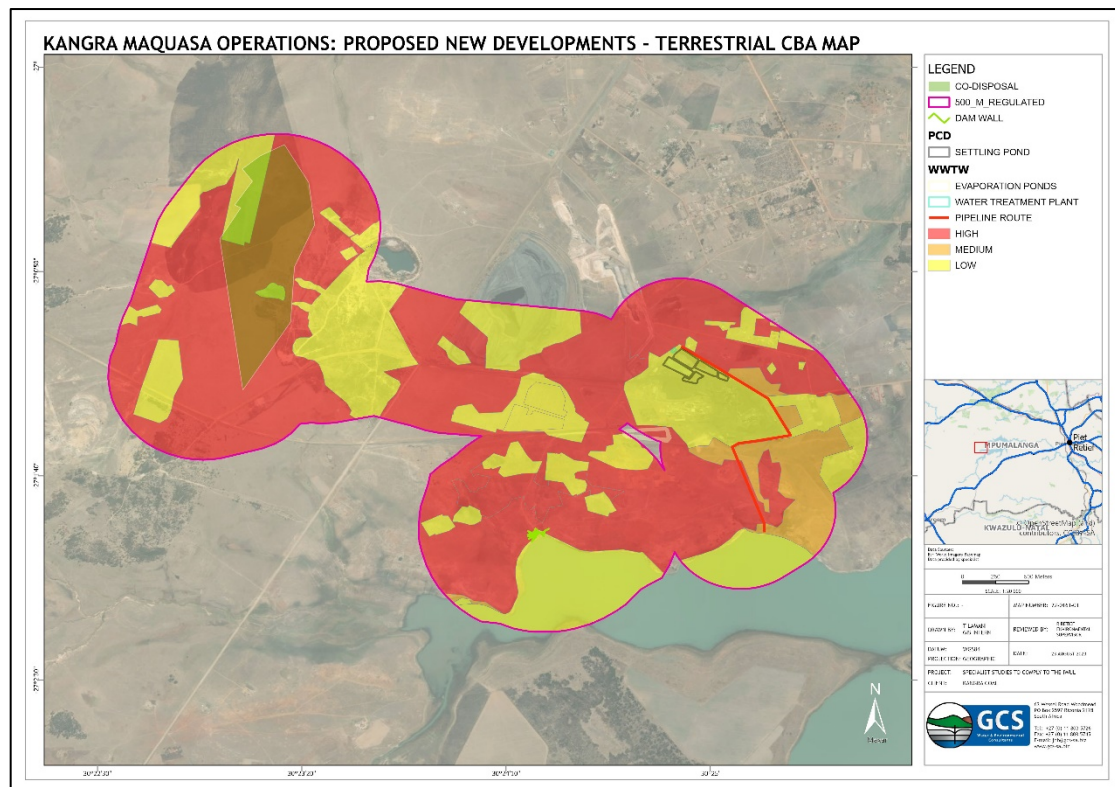


Figure 4-3: Terrestrial CBA and ESA surrounding the proposed development.

#### 4.6 Topography, Relief and Slopes

The topography of the study site comprises mostly, of undulating hills and plains. The altitude ranges from 1300 to 1600 m. Watercourses (perennial and non-perennial) and wetlands were often present in the troughs of the hills. Based on the observed topography one could expect to find wet soils in the troughs and more freely drained soils on the slopes and crests. The site falls within the W51B quaternary catchment.

The topography plays a major role in the depth of the soil found in-situ. Steeper gradients often have soils that are shallow and easily erodible. This higher risk of erosion can cause problems on site. Fortunately, from the site visit most of the area seems to have a gentle gradient and thus limits the potential of erosion. Mitigation measures are also possible for most erosion conditions, although in severe cases it is recommended not to construct near erosion lines.



This area has a relatively high diversity of surface water. The project area lies to the Northwest and adjacent to the Heyshope Dam, this is a very large dam approximately 20km in length and 3km at its widest point. This dam could be seen as a very important water source and therefore extra care should be taken not to affect it. The Heyshope Dam has been built on the Assegaa River which flows to the south of the project area in an easterly direction. There are many non-perennial streams that flow over the project area, discharging into the Assegaa River.

Varied topography is recognised as a powerful influence contributing to the high biodiversity of southern Africa. Landscapes composed of spatially heterogeneous abiotic conditions provide a greater diversity of potential niches for plants and animals than do homogeneous landscapes. The species richness and biodiversity has been found to be significantly higher in areas of geomorphological heterogeneity. Ridges and rocky outcrops are characterised by high spatial variability due to the range of differing aspects, slopes and altitudes all resulting in differing soil (e.g. depth, moisture, temperature, drainage, nutrient content), light and hydrological conditions. Temperature and humidity regimes of microsites vary on both a seasonal and daily basis. Moist cool aspects are more conducive to leaching of nutrients than warmer drier slopes.

Variation in aspect, soil drainage and elevation/altitude has been found to be especially important predictors of biodiversity. It follows that ridges will be characterized by a particularly high biodiversity. Many plant and animal species of conservation importance occupy ridges. Due to their threatened status, Red Data species require priority conservation efforts to ensure their future survival. Ridges may have a direct effect on temperature/radiation, surface airflow/wind, humidity, and soil types. Ridges also influence fire in the landscape, offering protection for those species that can be described as “fire-avoiders”. Because of the influence of topography on rainfall, many streams originate on ridges and control water input into wetlands.

The protection of the ridges in their natural state is therefore a first step in ensuring the normal functioning of ecosystem processes on a larger scale. In contrast, transformation of ridges will alter these major landscape processes. For example, water runoff into streams will increase, causing erosion.

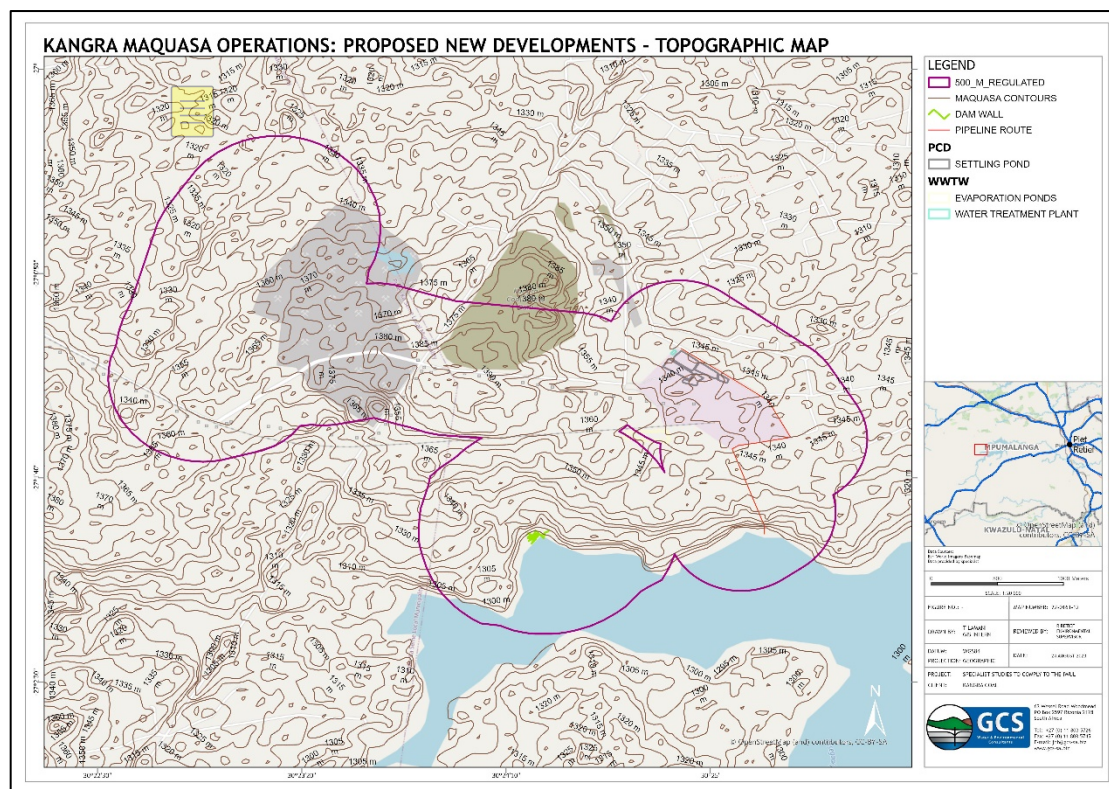


Figure 4-4: Topography Map

## 4.7 Geology

The general geology of the area as characterized by the Eastern Highveld Grassland vegetation unit is made up of red to yellow sandy soils of the Ba and Bb land types found on shale and sandstones of the Madzaringwe Formation (Karoo Supergroup).

The geology underlying the study area and adjacent areas is typical of the highveld and coal fields of Mpumalanga and is dominated by sandstone (Pv) and intrusive dolerites (Jd) of the Vryheid Formation, which forms part of the Eccia Group of the Karoo Sequence. The entire area is underlain by these sandstones, while the higher lying areas to the north and west are underlain by dolerites. Some alluvial deposits occur to the southeast of the proposed mine within the Heyshope Dam footprint. The dolerite rocks are typically harder and more erosion resistant than the surrounding sandstones, resulting in small mountains or hills (e.g. Maquasa Hill) wherever the dolerite sills occur.

The underlying sandstone weathers to form well-drained soils which allow the easy infiltration of rainwater and reduced run-off. An impermeable layer within the soil profile (i.e., ferricrete, sandstone or a soft plinthic layer) prevents deeper infiltration of the water into the soil, resulting in perched water tables within the soil profile. Where these perched water tables extend to within the rooting zone of the overlying vegetation (the top 500mm of the soil profile), the saturation of the soil for extended periods influences the vegetation community and results in the formation of wetlands.

The available published geological map of the area at a scale of 1:250 000 (2730 Vryheid, dated 1988) shows the site to be underlain by carbonaceous shale and sandstone of the Vryheid Formation of the Karoo Supergroup. Dolerite dykes trending northwest to southeast are generally encountered within isolated locations in the region.

#### 4.8 Freshwater Ecosystems

The proposed development is situated in the Usutu to Mhlathuse Management Area, Sub water management area Upper Usutu. The Atlas of Freshwater Ecosystem Priority Areas (FEPA) in South Africa (Nel *et al*, 2011a) (The Atlas) which represents the culmination of the National Freshwater Ecosystem Priority Areas project (NFEPA), a partnership between SANBI, CSIR, WRC, DEA, DWA, WWF, SAIAB and SANParks, provides a series of maps detailing strategic spatial priorities for conserving South Africa's freshwater ecosystems and supporting sustainable use of water resources. Freshwater Ecosystem Priority Areas (FEPA's) were identified through a systematic biodiversity planning approach that incorporated a range of biodiversity aspects such as ecoregion, current condition of habitat, presence of threatened vegetation, fish, frogs and birds, and importance in terms of maintaining downstream habitat. The Atlas incorporates the National Wetland Inventory (SANBI, 2011) to provide information on the distribution and extent of wetland areas. An extract of the NFEPA database is illustrated in below.

The following important observations can be made:

- Flagship Rivers:
  - Hlelo River (11\_P\_L) (approximately 2 km northwest); and
  - Assegai River (11\_P\_L) (approximately 2 km southeast).
- There are numerous natural and artificial wetlands in the surrounding area.

#### 4.8.1 River FEPA

River FEPA's achieve biodiversity targets for river ecosystems and threatened/near threatened fish species and were identified in rivers that are currently in a good condition (A or B ecological category). The FEPA status indicates that they should remain in a good condition in order to contribute to national biodiversity goals and support sustainable use of water resources. Kangra Waste Dump is located in two Sub - Quaternary Catchments. These have been classified as FEPA and FishFSA (W51B).

The goal of NFEPA is to keep further freshwater species from becoming threatened and to prevent those fish species that are already threatened from going extinct. In order to achieve this, there should be no further deterioration in river condition in fish sanctuaries and no new permits should be issued for stocking invasive alien fish in farm dams in the associated sub-quaternary catchment.

## 5 METHODOLOGY

### 5.1 Desktop assessment

The following information sources were considered for the desktop assessment:

- Information as presented by the South African National Biodiversity Institutes (SANBI's) Biodiversity Geographic Information Systems (BGIS) website (<http://bgis.sanbi.org>)
- Aerial imagery (Google Earth Pro)
- Topographical watercourse data sets
- Land Type Data (Land Type Survey Staff, 1972 - 2006)
- The National Freshwater Ecosystem Priority Areas (Nel, *et al.*, 2011)
- Contour data (5 m).

### 5.2 Biodiversity Assessment Methodology

#### 5.2.1 Geographic Information Systems (GIS) Mapping

Existing data layers were incorporated into GIS software. Emphasis was placed on the following spatial datasets:

- Vegetation Map of South Africa, Lesotho, and Swaziland (Mucina *et al.*, 2006)
- Important Bird Areas 2015 - BirdLife South Africa (vector geospatial dataset); and
- Department of Environmental Affairs (DEA) National Land cover 2015.

Field surveys were conducted to confirm (or refute) the presence of species identified in the desktop assessment. The specialist disciplines completed for this study included:

- Botanical
- Fauna (mammals and avifauna); and
- Herpetology (reptiles and amphibians).

Brief descriptions of the standardised methodologies applied in each of the specialist disciplines are provided below.

#### **5.2.2 Botanical Assessment**

The botanical study encompassed an assessment of all the vegetation units and habitat types within the project area. The focus was on an ecological assessment of habitat types as well as identification of any Red Data species within the known distribution of the project area. The methodology included the following survey techniques:

- Sensitivity analysis based on structural and species diversity; and
- Identification of potential floral red-data species.

#### **5.2.3 Literature Study**

A literature review was conducted as part of the desktop study to identify the potential habitats present within the project area. The South African National Biodiversity Institute (SANBI) provides an electronic database system, namely the Botanical Database of Southern Africa (BODATSA), to access distribution records on southern African plants. This is a new database which replaces the old Plants of Southern Africa (POSA) database. The POSA database provided distribution data of flora at the quarter degree square (QDS) resolution.

The Red List of South African Plants website (SANBI, 2021) was utilized to provide the most current account of the national status of flora. Relevant field guides and texts consulted for identification purposes in the field during the surveys included the following:

- Field Guide to the Wildflowers of the Highveld (Van Wyk & Malan, 1997)
- A Field Guide to Wildflowers (Pooley, 1998)
- Guide to Grasses of Southern Africa (Van Oudtshoorn, 1999)
- Orchids of South Africa (Johnson & Bytebier, 2015)
- Guide to the Aloes of South Africa (Van Wyk & Smith, 2014)
- Medicinal Plants of South Africa (Van Wyk *et al.*, 2013)
- Freshwater Life: A field guide to the plants and animals of southern Africa (Griffiths & Day, 2016); and



- Identification Guide to Southern African Grasses. An identification manual with keys, descriptions, and distributions. (Fish *et al.*, 2015).

Additional information regarding ecosystems, vegetation types, and species of conservation concern (SCC) included the following sources:

- The Vegetation of South Africa, Lesotho, and Swaziland (Mucina & Rutherford, 2018)
- Grassland Ecosystem Guidelines: landscape interpretation for planners and managers (SANBI, 2013); and
- Red List of South African Plants (Raimondo *et al.*, 2009; SANBI, 2016).

#### 5.2.4 Faunal Assessment (Mammals & Avifauna)

The faunal desktop assessment included the following:

- Compilation of expected species lists
- Compilation of identified species lists
- Identification of any Red Data or SCC present or potentially occurring in the area; and
- Emphasis was placed on the probability of occurrence of species of provincial, national, and international conservation importance.
- The field survey component of the study utilised a variety of sampling techniques including, but not limited to, the following:
  - Visual observations; and
  - Identification of tracks and signs.
- Habitat types sampled included disturbed and semi-disturbed zones, drainage lines and wetlands.

Mammal distribution data were obtained from the following information sources:

- The Mammals of the Southern African Subregion (Skinner & Chimimba, 2005)
- Bats of Southern and Central Africa (Monadjem *et al.*, 2010)
- The 2016 Red List of Mammals of South Africa, Lesotho, and Swaziland ([www.ewt.org.za](http://www.ewt.org.za)) (EWT, 2016)
- Animal Demography Unit (ADU) - MammalMap Category (MammalMap, 2023) ([mammalmap.adu.org.za](http://mammalmap.adu.org.za)); and
- A Field Guide to the Tracks and Signs of Southern, Central and East African Wildlife (Stuart & Stuart, 2013).

### 5.2.5 Herpetology (Reptiles & Amphibians)

A herpetofauna assessment of the project area was also conducted. The herpetological field survey comprised the following techniques:

- Diurnal hand searches are used for reptile species that shelter in or under particular microhabitats (typically rocks, exfoliating rock outcrops, fallen timber, leaf litter, bark etc.)
- Visual searches - typically undertaken for species whose behaviour involves surface activity or for species that are difficult to detect by hand-searches or pitfall trapping.
- May include walking transects or using binoculars to view the species from a distance without the animal being disturbed
- Amphibians - many of the survey techniques listed above will be able to detect species of amphibians. Over and above these techniques, vocalisation sampling techniques are often the best to detect the presence of amphibians as each species has a distinct call.
- Opportunistic sampling - reptiles, especially snakes, are incredibly elusive and difficult to observe. Consequently, all possible opportunities to observe reptiles are taken in order to augment the standard sampling procedures described above.
- Herpetofauna distributional data was obtained from the following information sources:
  - South African Reptile Conservation Assessment (SARCA) ([sarca.adu.org](http://sarca.adu.org))
  - A Guide to the Reptiles of Southern Africa (Alexander & Marais, 2007)
  - Field guide to Snakes and other Reptiles of Southern Africa (Branch, 1998)
  - Atlas and Red list of Reptiles of South Africa, Lesotho, and Swaziland (Bates *et al.*, 2014)
  - A Complete Guide to the Frogs of Southern Africa (du Preez & Carruthers, 2009)
  - Animal Demography Unit (ADU) - FrogMAP ([frogmap.adu.org.za](http://frogmap.adu.org.za))
  - Atlas and Red Data Book of Frogs of South Africa, Lesotho, and Swaziland (Mintner *et al.*, 2004); and
  - Ensuring a Future for South Africa's frogs (Measey, 2011).

## 5.3 Impact Assessment

The Environmental Impacts associated with the proposed Maquasa Developments were evaluated using Table 5.1.

**Nature of Impact**

+: Positive (A benefit to the receiving environment)

N: Neutral (No cost or benefit to the receiving environment)

-: Negative (A cost to the receiving environment)

<b>Severity / Intensity</b>	<b>Duration</b>
3: High	5: Permanent / Beyond life of the activity
2: Moderate	4: Long-term (more than 5 years)
1: Low	3: Medium-term (18 months - 5 years)
0: None	2: Short-term (6-18 months)
	1: Temporary (0-6 months)
<b>Extent</b>	<b>Loss of Irreplaceable Resources</b>
6: International	1: Yes
5: National	0: No
4: Regional	
3: Local	
2: Site	
1: Footprint	
<b>Reversibility of impacts</b>	<b>Probability of impact</b>
3: Low to non-reversible	2: Definite (75% to 100%)
2: Moderate	1: Probable (50% to 75%)
1: High	0: Improbable (0-less than 50%)
<b>Mitigation Efficiency</b>	<b>Confidence</b>
0: Not Applicable - 0%	0: Not Applicable - 0%
1: Very Low - 20% & below	1: Very Low - 20%
2: Low - 40 % & below	2: Low - 40 %
3: Medium - 60% & below	3: Medium - 60%
4: High - 80% & below	4: High - 80%
5: Very High - 100%	5: Very High

<b>Nature</b>
+
-

The Environmental Effects are rated in the **Table 5.2** below.

The maximum value that can be achieved is 72 Significance Points (SP). Environmental effects were rated as follows:

<b>Risk Rating</b>	<b>Significance</b>	<b>Colour Code</b>
High (positive)	49 to 72	H
Medium (positive)	25 to 48	M
Low (positive)	1 to 24	L
Neutral	0	N
Low (negative)	-1 to - 24	L
Medium (negative)	-25 to -48	M
High (negative)	-49 to -72	H

CONSEQUENCE = (Duration + Extent + Irreplaceable Loss) \* Severity

SIGNIFICANCE = Consequence \* Probability

#### 5.3.1 Extent

The physical and spatial scale of the impact.

#### 5.3.2 Duration

The lifetime of the impact is measured in relation to the lifetime of the proposed operation of the existing project.

#### 5.3.3 Intensity

The assessment of the intensity of the impact is how intense the impact will be on the environment.

#### 5.3.4 Probability

Probability describes the likelihood of the impact(s) occurring for any length of time during the lifecycle of the activity, and not at any given time.

#### 5.3.5 Confidence

The level of knowledge or information that the specialist had in their judgement is rated and not given a numerical value.

#### 5.3.6 Reversibility

Reversibility is the ability of the affected environment to recover from the impact, with or without mitigation. Note that this criterion is not given a numerical value.

#### 5.3.7 Replicability

Replicability is an indication of the scarcity of the specific set of parameters that make up the affected environment. That is, if lost can the affected environment be (a) recreated, or (b) is it a common set of characteristics and thus if lost is not considered a significant loss. Note that this criterion is not given a numerical value.

### ***5.3.8 Identification of Mitigation Measures***

The purpose of mitigation measures is to reduce the significance level of the anticipated negative impact. Therefore, the reduction in the significance level after mitigation is directly related to the scores used in the impact assessment criteria. The effect of potential mitigation measures to reduce the overall significance level is also to be considered in each issues table (i.e., values with and without mitigation are presented).

### ***5.3.9 Ascribing Significance to Cumulative Impacts***

In ascribing significance to cumulative impacts, it should be noted that impacts cannot be assessed in isolation and an integrated approach requires that cumulative impacts will be included in the assessment of individual impacts. The nature of the impact will be described in such a way as to detail the potential cumulative impact of the activity if there is indeed a cumulative impact. For example, dust and air emissions cannot be assessed in isolation of the potential cumulative impact of increased emissions into the atmosphere. Similarly, if water quality is improved within the immediate surroundings of the proposed activities, this will most certainly have a ripple effect/ cumulative impact on the greater water quality in the area.

The impacts were assessed, and significance ratings allocated, after which the project was assessed on a holistic basis to determine the overall project impact on the receiving environment. This is a function of the individual impacts as well as the cumulative nature of combining all those impacts within a single context/ project.



## 6 ASSUMPTIONS AND LIMITATIONS

Consultation as part of the overall environmental authorization process is being undertaken by GCS (Pty) Ltd.

The following limitations with respect to the assessment of the property are applicable to this report:

- Sampling, by nature, implies that not all species in a study site will be recorded due to factors such as plant phenology as affected by seasonality, seasonal climatic conditions, microhabitats and both historical and current management practices.
- The site inspection was a single site visit and no specialist sampling techniques utilised.
- Sampling was undertaken during the autumn period and outside of the flowering period of the summer rainfall region.
- Field assessment notes are supplemented by making use of literature sources and existing data bases (SANBI, Reference books, Articles etc.); and
- The main ecological and floristic observations, forming the basis for recommendations, are, however, based on the field assessment observations.

## 7 FINDINGS AND RESULTS

### 7.1 Habitat and Vegetation Characteristics

An outline of the main landscape and habitat characteristics of the study site is provided in Table 7-1.

**Table 7-1:** Outline of main landscape and habitat characteristics of the site.

HABITAT FEATURE		DESCRIPTION
Topography		The topography of the study site comprises mostly, of undulating hills and plains.
Rockiness		Rockiness was observed near the Heyshope Dam and between Maquasa East and Maquasa West operations.
Presence of wetlands		The altitude ranges from 1300 to 1600 m and watercourses (perennial and non-perennial) and wetlands were often present in the troughs of the hills. Two NFEPA Wetland s
Overview of vegetation		Refer to the vegetation description below.

HABITAT FEATURE	DESCRIPTION
Signs of disturbances	Impacts identified within the sub-quaternary catchment included: transformed grasslands, wetland disturbances, runoff/effluent from urban areas, mining influences, urbanization, alien vegetation encroachment, illegal road crossings, indigenous vegetation removal, erosion, and overgrazing.
Connectivity of natural vegetation at the site and between the site and surrounding areas	Connectivity cannot be excluded. The vegetation and drainage may still fulfil an ecological function by sustaining biodiversity and ecological maintenance of downstream users as well as maintenance of ecological biodiversity drivers.

## 7.2 Assessment of Plant Species of Conservation Concern

No individuals of the endemic or biogeographically important plants were observed during the survey, although it may have previously been found in the larger area and due to the season of assessment.

Six red data species potentially occur in the QDS of the study area according to the SIBIS database. Potential habitat for species does exist, however, the verification for these species and habitat conditions must be reassessed during the summer period.

None of these threatened species were identified during the site inspection in May 2023.

A list of the Species of Concern is in Appendix B - Species lists based on the SANBI POSA site.

### 7.2.1 Protected Trees

In terms of the National Forests Act of 1998, certain tree species can be identified and declared as protected. All trees occurring in natural forests are also protected in terms of the Act. Protective actions take place within the framework of the Act as well as national policy and guidelines. Trees are protected for a variety of reasons, and some species require strict protection while others require control over harvesting and utilization. The protected tree species may not be cut, disturbed, damaged, destroyed and their products may not be possessed, collected, removed, transported, exported, donated, purchased or sold - except under license granted by the Department of Water Affairs and Forestry (or a delegated authority).

The Real Yellowwood (Opregte-geelhout) [*Potocarpus latifolius*] was found in the QDS.

## 7.3 Identified Species Lists of Occurrence Within Sites Quarter Degree Square

### 7.3.1 Identified Mammal Species for QDS 2730 AB

The site has two listed threatened species identified to occur within the sites QDS. The results show there are 8 identified mammal species occurring within the QDS. These species have all been listed as South African endemics (Virtual Museum). Of the identified species there are 5 listed species, these being 3 **Near Threatened** and 2 **Endangered** species. The Endangered species identified are:

- **Oribi:** this species is listed as Least Concern globally, however within South Africa this species is listed as **Endangered**. This species is mainly threatened through habitat destruction (Loss and Fragmentation) due to commercial forestry, commercial farming, grassland degradation and mining. Illegal hunting is the biggest threat to the survival of this species.
- **Swinny's Horseshoe Bat:** this species is listed as Least Concern globally, however within South Africa this species is listed as **Endangered**. This species is threatened by deforestation and general habitat conversion.

Table 7-2: Mammal species identified to occur in QDS 2730AB

Family	Scientific name	Common name	Red list category
Bovidae	<i>Ourebia ourebi</i>	Oribi	Endangered
Felidae	<i>Felis nigripes</i>	Black-footed Cat	Vulnerable (2016)
Felidae	<i>Leptailurus serval</i>	Serval	Near Threatened (2016)
Leporidae	<i>Lepus saxatilis</i>	Scrub Hare	Least Concern
Muridae	<i>Aethomys ineptus</i>	Tete Veld Aethomys	Least Concern (2016)
Muridae	<i>Gerbilliscus leucogaster</i>	Bushveld Gerbil	Least Concern (2016)
Rhinolophidae	<i>Rhinolophus clivosus</i>	Geoffroy's Horseshoe Bat	Least Concern (2016)
Rhinolophidae	<i>Rhinolophus swinnyi</i>	Swinny's Horseshoe Bat	Vulnerable (2016)
Soricidae	<i>Crocidura cyanea</i>	Reddish-gray Musk Shrew	Least Concern (2016)
Soricidae	<i>Crocidura mariquensis</i>	Swamp Musk Shrew	Near Threatened (2016)
Vespertilionidae	<i>Miniopterus natalensis</i>	Natal Long-fingered Bat	Least Concern (2016)
Vespertilionidae	<i>Myotis tricolor</i>	Temminck's Myotis	Least Concern (2016)

None of these species were observed during the site visit, however, habitat for the Swamp Must Shrew, the Swinny Horseshoe Bat and black-footed cat exists around the site.

### 7.3.2 Identified Avifaunal Species for QDS 2730AB

In terms of the migrating and nesting birds in the quarter degree square a total of 107 different species occur in the area. Of these five species of birds were recorded on the Red List for birds in the quarter degree square. Blue Cranes were physically observed within the wetland area of HGM 9. Nesting sites and vulnerable areas should be minimally disturbed.

**Table 7-3: Avifauna species identified to occur in QDS 2730AB**

Ref	Common species	Common group	Genus	Species	RD (Regional, Global)
72	Hamerkop		<i>Scopus</i>	<i>umbretta</i>	
637	Neddicky		<i>Cisticola</i>	<i>fulvicapilla</i>	
844	Quailfinch		<i>Ortygospiza</i>	<i>atricollis</i>	
105	Secretarybird		<i>Sagittarius</i>	<i>serpentarius</i>	VU, EN
431	Black-collared	Barbet	<i>Lybius</i>	<i>torquatus</i>	
439	Crested	Barbet	<i>Trachyphonus</i>	<i>vaillantii</i>	
808	Southern Red	Bishop	<i>Euplectes</i>	<i>orix</i>	
810	Yellow	Bishop	<i>Euplectes</i>	<i>capensis</i>	
709	Southern	Boubou	<i>Laniarius</i>	<i>ferrugineus</i>	
545	Dark-capped	Bulbul	<i>Pycnonotus</i>	<i>tricolor</i>	
874	Golden-breasted	Bunting	<i>Emberiza</i>	<i>flaviventris</i>	
219	Denham's	Bustard	<i>Neotis</i>	<i>denhami</i>	NT, NT
222	White-bellied	Bustard	<i>Eupodotis</i>	<i>senegalensis</i>	
154	Common	Buzzard	<i>Buteo</i>	<i>buteo</i>	
155	Forest	Buzzard	<i>Buteo</i>	<i>trizonatus</i>	
152	Jackal	Buzzard	<i>Buteo</i>	<i>rufofuscus</i>	
860	Black-throated	Canary	<i>Crithagra</i>	<i>atroregularis</i>	
857	Cape	Canary	<i>Serinus</i>	<i>canicollis</i>	
859	Yellow-fronted	Canary	<i>Crithagra</i>	<i>mozambica</i>	
575	Ant-eating	Chat	<i>Myrmecocichla</i>	<i>formicivora</i>	
631	Cloud	Cisticola	<i>Cisticola</i>	<i>textrix</i>	
646	Levaillant's	Cisticola	<i>Cisticola</i>	<i>tinniensi</i>	
634	Wing-snapping	Cisticola	<i>Cisticola</i>	<i>ayresii</i>	
629	Zitting	Cisticola	<i>Cisticola</i>	<i>juncidis</i>	
50	Reed	Cormorant	<i>Microcarbo</i>	<i>africanus</i>	
216	Blue	Crane	<i>Grus</i>	<i>paradisea</i>	NT, VU
214	Grey Crowned	Crane	<i>Balearica</i>	<i>regulorum</i>	EN, EN
523	Cape	Crow	<i>Corvus</i>	<i>capensis</i>	
352	Diederik	Cuckoo	<i>Chrysococcyx</i>	<i>caprius</i>	
316	Cape Turtle	Dove	<i>Streptopelia</i>	<i>capicola</i>	
317	Laughing	Dove	<i>Spilopelia</i>	<i>senegalensis</i>	
318	Namaqua	Dove	<i>Oena</i>	<i>capensis</i>	
314	Red-eyed	Dove	<i>Streptopelia</i>	<i>semitorquata</i>	
96	Yellow-billed	Duck	<i>Anas</i>	<i>undulata</i>	
60	Intermediate	Egret	<i>Ardea</i>	<i>intermedia</i>	
61	Western Cattle	Egret	<i>Bubulcus</i>	<i>ibis</i>	
119	Amur	Falcon	<i>Falco</i>	<i>amurensis</i>	

Ref	Common species	Common group	Genus	Species	RD (Regional, Global)
707	Southern	Fiscal	<i>Lanius</i>	<i>collaris</i>	
655	African Dusky	Flycatcher	<i>Muscicapa</i>	<i>adusta</i>	
682	African Paradise	Flycatcher	<i>Terpsiphone</i>	<i>viridis</i>	
173	Coqui	Francolin	<i>Peliperdix</i>	<i>coqui</i>	
89	Egyptian	Goose	<i>Alopochen</i>	<i>aegyptiaca</i>	
88	Spur-winged	Goose	<i>Plectropterus</i>	<i>gambensis</i>	
618	Cape	Grassbird	<i>Sphenoeacus</i>	<i>afer</i>	
171	African	Harrier-Hawk	<i>Polyboroides</i>	<i>typus</i>	
55	Black-headed	Heron	<i>Ardea</i>	<i>melanocephala</i>	
54	Grey	Heron	<i>Ardea</i>	<i>cinerea</i>	
81	African Sacred	Ibis	<i>Threskiornis</i>	<i>aethiopicus</i>	
83	Glossy	Ibis	<i>Plegadis</i>	<i>falcinellus</i>	
84	Hadada	Ibis	<i>Bostrychia</i>	<i>hagedash</i>	
82	Southern Bald	Ibis	<i>Geronticus</i>	<i>calvus</i>	VU, VU
397	Malachite	Kingfisher	<i>Corythornis</i>	<i>cristatus</i>	
130	Black-winged	Kite	<i>Elanus</i>	<i>caeruleus</i>	
129	Yellow-billed	Kite	<i>Milvus</i>	<i>aegyptius</i>	
247	African Wattled	Lapwing	<i>Vanellus</i>	<i>senegallus</i>	
243	Black-winged	Lapwing	<i>Vanellus</i>	<i>melanopterus</i>	
245	Blacksmith	Lapwing	<i>Vanellus</i>	<i>armatus</i>	
242	Crowned	Lapwing	<i>Vanellus</i>	<i>coronatus</i>	
458	Rufous-naped	Lark	<i>Mirafra</i>	<i>africana</i>	
474	Spike-heeled	Lark	<i>Chersomanes</i>	<i>albofasciata</i>	
703	Cape	Longclaw	<i>Macronyx</i>	<i>capensis</i>	
510	Banded	Martin	<i>Riparia</i>	<i>cincta</i>	
509	Brown-throated	Martin	<i>Riparia</i>	<i>paludicola</i>	
390	Speckled	Mousebird	<i>Colius</i>	<i>striatus</i>	
521	Black-headed	Oriole	<i>Oriolus</i>	<i>larvatus</i>	
311	Speckled	Pigeon	<i>Columba</i>	<i>guinea</i>	
692	African	Pipit	<i>Anthus</i>	<i>cinnamomeus</i>	
238	Three-banded	Plover	<i>Charadrius</i>	<i>tricolor</i>	
649	Tawny-flanked	Prinia	<i>Prinia</i>	<i>subflava</i>	
189	Common	Quail	<i>Coturnix</i>	<i>coturnix</i>	
581	Cape	Robin-Chat	<i>Cossypha</i>	<i>caffra</i>	
511	Black (Southern Africa)	Saw-wing	<i>Psaldoprocne</i>	<i>pristoptera holomelas</i>	
250	African	Snipe	<i>Gallinago</i>	<i>nigripennis</i>	
786	Cape	Sparrow	<i>Passer</i>	<i>melanurus</i>	
784	House	Sparrow	<i>Passer</i>	<i>domesticus</i>	
414 2	Southern Grey-headed	Sparrow	<i>Passer</i>	<i>diffusus</i>	
85	African	Spoonbill	<i>Platalea</i>	<i>alba</i>	
185	Swainson's	Spurfowl	<i>Pternistis</i>	<i>swainsonii</i>	
746	Pied	Starling	<i>Lamprotornis</i>	<i>bicolor</i>	
745	Red-winged	Starling	<i>Onychognathus</i>	<i>morio</i>	
736	Violet-backed	Starling	<i>Cinnyricinclus</i>	<i>leucogaster</i>	



Ref	Common species	Common group	Genus	Species	RD (Regional, Global)
576	African	Stonechat	<i>Saxicola</i>	<i>torquatus</i>	
751	Malachite	Sunbird	<i>Nectarinia</i>	<i>famosa</i>	
493	Barn	Swallow	<i>Hirundo</i>	<i>rustica</i>	
502	Greater Striped	Swallow	<i>Cecropis</i>	<i>cucullata</i>	
503	Lesser Striped	Swallow	<i>Cecropis</i>	<i>abyssinica</i>	
504	South African Cliff	Swallow	<i>Petrochelidon</i>	<i>spilodera</i>	
495	White-throated	Swallow	<i>Hirundo</i>	<i>albigularis</i>	
385	Little	Swift	<i>Apus</i>	<i>affinis</i>	
383	White-rumped	Swift	<i>Apus</i>	<i>caffer</i>	
305	Whiskered	Tern	<i>Chlidonias</i>	<i>hybrida</i>	
275	Spotted	Thick-knee	<i>Burhinus</i>	<i>capensis</i>	
110 5	Olive	Thrush	<i>Turdus</i>	<i>olivaceus</i>	
686	Cape	Wagtail	<i>Motacilla</i>	<i>capensis</i>	
666	African Yellow	Warbler	<i>Iduna</i>	<i>natalensis</i>	
843	Common	Waxbill	<i>Estrilda</i>	<i>astrild</i>	
838	Orange-breasted	Waxbill	<i>Amandava</i>	<i>subflava</i>	
799	Cape	Weaver	<i>Ploceus</i>	<i>capensis</i>	
803	Southern Masked	Weaver	<i>Ploceus</i>	<i>velatus</i>	
564 117 2	Mountain Cape	Wheatear White-eye	<i>Myrmecocichla</i> <i>Zosterops</i>	<i>monticola</i> <i>virens</i>	
846	Pin-tailed	Whydah	<i>Vidua</i>	<i>macroura</i>	
816	Fan-tailed	Widowbird	<i>Euplectes</i>	<i>axillaris</i>	
818	Long-tailed	Widowbird	<i>Euplectes</i>	<i>progne</i>	
814	White-winged	Widowbird	<i>Euplectes</i>	<i>albonotatus</i>	
445	Ground	Woodpecker	<i>Geocolaptes</i>	<i>olivaceus</i>	
452	Olive	Woodpecker	<i>Dendropicops</i>	<i>griseocephalus</i>	

### 7.3.3 Identified Reptile Species for QDS 2730 AB

In terms of the reptile species of concern in the area, a total of 20 species of reptiles was in the area. None of these were, however, on the IUCN red list. Suitable habitat for the least concerned reptile species is located around the mining operations for the species to occur.

Table 7-4: Reptile species identified to occur in QDS 2730AB

#	Family	Scientific name	Common name	Red list category
1	Agamidae	<i>Agama aculeata distanti</i>	Distant's Ground Agama	Least Concern (SARCA 2014)
2	Chamaeleonidae	<i>Chamaeleo dilepis</i>	Common Flap-neck Chameleon	Least Concern (SARCA 2014)
3	Colubridae	<i>Crotaphopeltis hotamboeia</i>	Red-lipped Snake	Least Concern (SARCA 2014)

#	Family	Scientific name	Common name	Red list category
4	Cordylidae	<i>Chamaesaura anguina anguina</i>	Cape Grass Lizard	Least Concern (SARCA 2014)
5	Cordylidae	<i>Cordylus vittifer</i>	Common Girdled Lizard	Least Concern (SARCA 2014)
6	Cordylidae	<i>Pseudocordylus melanotus melanotus</i>	Common Crag Lizard	Least Concern (SARCA 2014)
7	Elapidae	<i>Hemachatus haemachatus</i>	Rinkhals	Least Concern (SARCA 2014)
8	Gekkonidae	<i>Lygodactylus ocellatus</i>	Spotted Dwarf Gecko	Least Concern (SARCA 2014)
9	Gekkonidae	<i>Pachydactylus vansonii</i>	Van Son's Gecko	Least Concern (SARCA 2014)
10	Gerrhosauridae	<i>Gerrhosaurus flavigularis</i>	Yellow-throated Plated Lizard	Least Concern (SARCA 2014)
11	Lacertidae	<i>Pedioplanis burchelli</i>	Burchell's Sand Lizard	Least Concern (SARCA 2014)
12	Lamprophiidae	<i>Duberria lutrix lutrix</i>	South African Slug-eater	Least Concern (IUCN 2021, sp. level)
13	Lamprophiidae	<i>Lamprophis guttatus</i>	Spotted House Snake	Least Concern (SARCA 2014)
14	Lamprophiidae	<i>Lycophidion capense capense</i>	Cape Wolf Snake	Least Concern (SARCA 2014)
15	Lamprophiidae	<i>Psammophis brevirostris</i>	Short-snouted Grass Snake	Least Concern (SARCA 2014)
16	Lamprophiidae	<i>Psammophylax rhombeatus</i>	Spotted Grass Snake	Least Concern (SARCA 2014)
17	Scincidae	<i>Acontias wakkerstroomensis</i>	Wakkerstroom Legless Skink	
18	Scincidae	<i>Trachylepis capensis</i>	Cape Skink	Least Concern (SARCA 2014)
19	Scincidae	<i>Trachylepis punctatissima</i>	Speckled Rock Skink	Least Concern (SARCA 2014)
20	Scincidae	<i>Trachylepis varia sensu lato</i>	Common Variable Skink Complex	Least Concern (SARCA 2014)

### 7.3.4 Identified Amphibian Species for QDS 2730AB

In terms of frog species of concern in the area, a total of 12 species of amphibians occurs in the area, and none are on the IUCN red list.

**Table 7-5: Amphibian species identified to occur in QDS 2730AB**

#	Species code	Family	Scientific name	Common name	Red list category
1	370	Bufonidae	<i>Sclerophrys capensis</i>	Raucous Toad	Least Concern
2	330	Bufonidae	<i>Sclerophrys gutturalis</i>	Guttural Toad	Least Concern (IUCN, 2016)
3	590	Hyperoliidae	<i>Hyperolius marmoratus</i>	Painted Reed Frog	Least Concern (IUCN ver 3.1, 2013)
4	660	Hyperoliidae	<i>Kassina senegalensis</i>	Bubbling Kassina	Least Concern
5	1050	Pipidae	<i>Xenopus laevis</i>	Common Platanna	Least Concern (IUCN 2020)
6	820	Ptychadenidae	<i>Ptychadena porosissima</i>	Striped Grass Frog	Least Concern
7	880	Pyxicephalidae	<i>Amietia delalandii</i>	Delalande's River Frog	Least Concern (2017)
8	890	Pyxicephalidae	<i>Amietia fuscigula</i>	Cape River Frog	Least Concern (2017)
9	400	Pyxicephalidae	<i>Cacosternum boettgeri</i>	Common Caco	Least Concern (2013)
10	940	Pyxicephalidae	<i>Strongylopus fasciatus</i>	Striped Stream Frog	Least Concern
11	950	Pyxicephalidae	<i>Strongylopus grayii</i>	Clicking Stream Frog	Least Concern
12	1030	Pyxicephalidae	<i>Tomopterna natalensis</i>	Natal Sand Frog	Least Concern

### 7.3.5 Assessment of Invertebrate Species of Conservation Concern

In terms of butterfly species of concern in the area, a total of 22 species of butterfly occurs in the area, and one, the Wakkerstroom Widow is listed on the IUCN red list as Near Threatened. Suitable vegetation and habitat for the species was observed and the possibility of the species occurring onsite, cannot be excluded.

**Table 7-6: Butterfly species identified to occur in QDS 2730AB**

#	Family	Scientific name	Common name	Red list category
1	HESPERIIDAE	Afrogegenes sp.		
2	LYCAENIDAE	Actizera lucida	Rayed blue	Least Concern (SABCA 2013)
3	LYCAENIDAE	Aloeides henningi	Hillside russet	Least Concern (SABCA 2013)
4	LYCAENIDAE	Aloeides merces	Wakkerstroom russet	Least Concern (SABCA 2013)
5	LYCAENIDAE	Aloeides oreas	Small mountain russet	Least Concern (SABCA 2013)
6	LYCAENIDAE	Aloeides titei	Mountain russet	Least Concern (SABCA 2013)
7	LYCAENIDAE	Capys alpheus extentus	Orange banded protea	Least Concern (SABCA 2013)
8	LYCAENIDAE	Chrysoritis aethon	Lydenburg opal	Least Concern (SABCA 2013)
9	LYCAENIDAE	Durbania amakosa ayresi	Amakoza rocksitter	Least Concern (SABCA 2013)
10	LYCAENIDAE	Orachrysops lacrimosa	Restless cupid	Least Concern (SABCA 2013)
11	NYMPHALIDAE	Acraea violarum	Speckled red acraea	Least Concern (SABCA 2013)
12	NYMPHALIDAE	Aeropetes tulbaghia	Table Mountain beauty	Least Concern (SABCA 2013)
13	NYMPHALIDAE	Danaus chrysippus orientis	African plain tiger	Least Concern (SABCA 2013)
14	NYMPHALIDAE	Dingana alaedeus	Wakkerstroom widow	Near Threatened (SABCA 2013)
15	NYMPHALIDAE	Junonia hierta cebrene	Yellow pansy	Least Concern (SABCA 2013)
16	NYMPHALIDAE	Pseudonympha magoides	False silver-bottom brown	Least Concern (SABCA 2013)
17	NYMPHALIDAE	Pseudonympha paludis	Marsh brown	Least Concern (SABCA 2013)
18	NYMPHALIDAE	Pseudonympha varii	Mountain marsh brown	Least Concern (SABCA 2013)
19	NYMPHALIDAE	Stygionympha curlei	Marsh hillside brown	Least Concern (SABCA 2013)
20	NYMPHALIDAE	Stygionympha wichgrafi williami	Wichgraf's hillside brown	Least Concern (SABCA 2013)
21	PIERIDAE	Eurema brigitta brigitta	Broad-bordered grass yellow	Least Concern (SABCA 2013)
22	PIERIDAE	Teracolus agoye bowkeri	Speckled sulphur tip	Least Concern (SABCA 2013)

### 7.3.6 Beetles of conservation priority

No beetles of conservation priority were recorded within the quarter degree square 2730AB. The likelihood of these species occurring within the quarter degree square cannot be excluded.

### 7.3.7 Mygalomorph spiders of conservation priority



None of the baboon spiders were recorded within the QSD 2730AB, however suitable habitat for spiders exists in the wetland and grassland areas.

### 7.3.8 Scorpions of conservation priority



None of the red listed scorpions were recorded within the QSD 2730AB. The chance-finding scorpions in the rocky and grassland areas cannot be excluded.

## 7.4 Photographic record

Table 7-7: Features identified at the site.

	
View when looking north towards HGM 3.	View of the mountains and conveyor belt between Maquasa West and East operations.





 A photograph showing a wide, flat landscape under a bright blue sky with scattered white clouds. The foreground is a mix of green grass and reddish-brown soil. In the distance, there are low hills and some industrial structures, likely related to the Maquasa East operations.	 A photograph showing a field of tall, golden-brown grass in the foreground. In the background, there are some trees and a body of water, with mountains visible on the horizon under a blue sky with white clouds.
<p><b>View towards HGM 10 and the Maquasa East operations</b></p>	<p><b>View of HGM 9 looking south.</b></p>

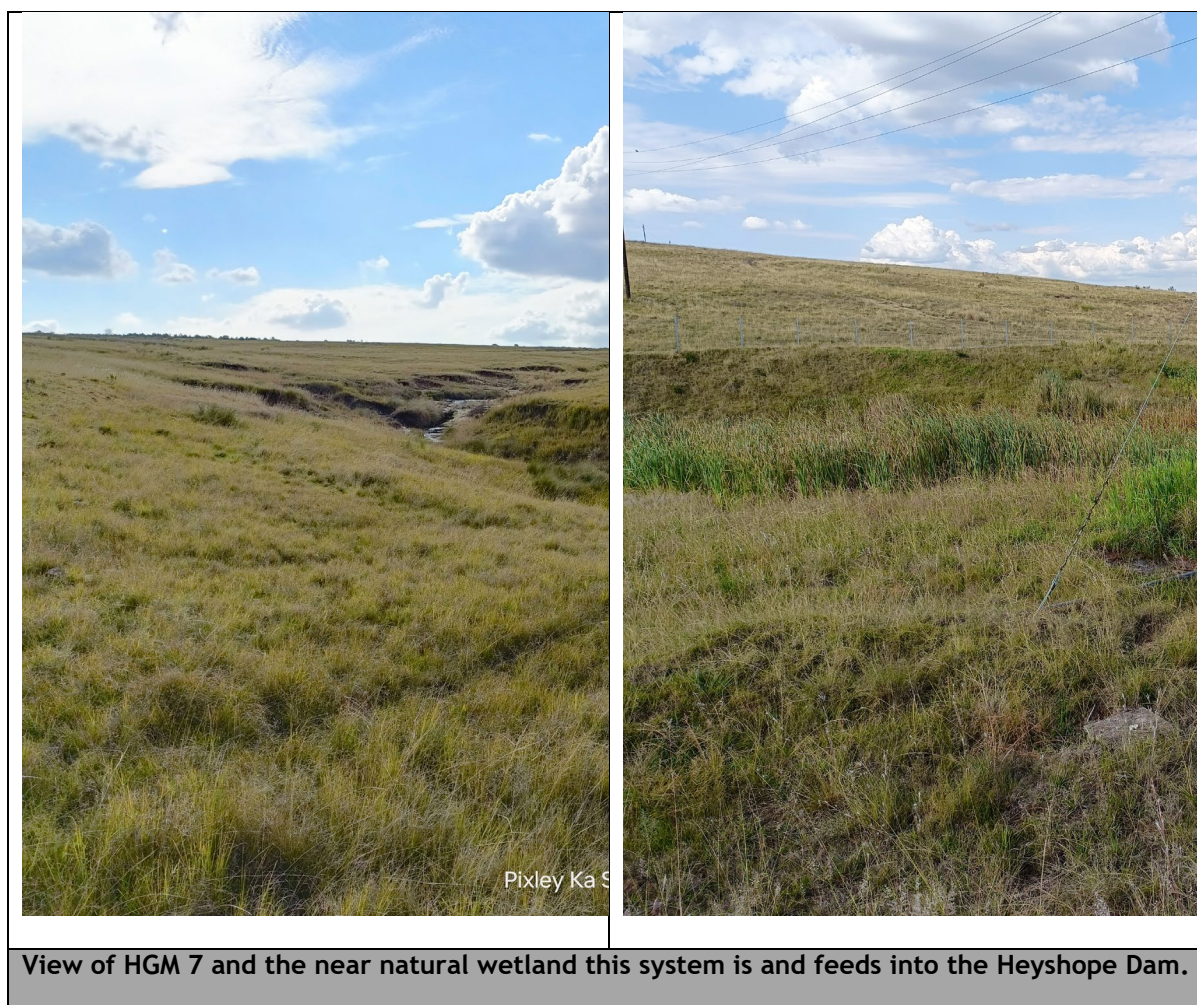
	
<p>The HGM 9 wetland just outside of the Maquasa East operations.</p>	<p>View looking at HGM 1 and HGM 2</p>



	
View of HGM 4 looking west from Maquasa West	View of wetland vegetation and wet soil at HGM 7.

 <p>Pixley Ka S</p>	
<b>HGM 7 and the pump station</b>	<b>View towards HGM 10 and the Maquasa East operations</b>





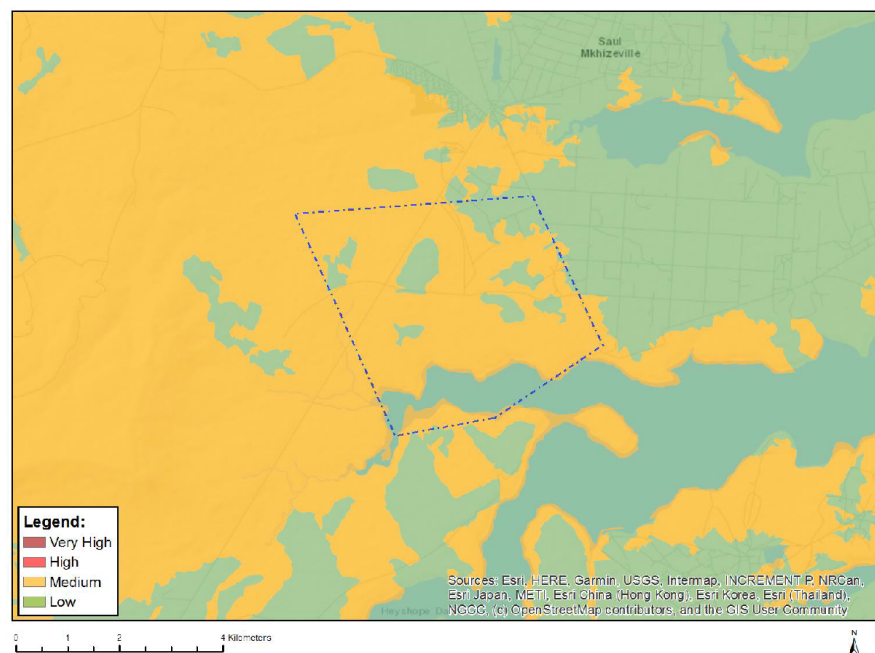
## 7.5 Site Sensitivity

Based on the findings above, the following maps depict the delineation of the study site and the overall ecological sensitivity on the study site. Sensitive features identified at the site are indicated in Figure 7-3.

Anthropogenic impacts identified within the sub-quaternary catchment included: transformed grasslands, wetland disturbances, runoff/effluent from urban areas, mining influences, urbanization, alien vegetation encroachment, illegal road crossings, indigenous vegetation removal, erosion, and overgrazing.



## MAP OF RELATIVE PLANT SPECIES THEME SENSITIVITY



Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at [eiadatarequests@sanbi.org.za](mailto:eiadatarequests@sanbi.org.za) listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

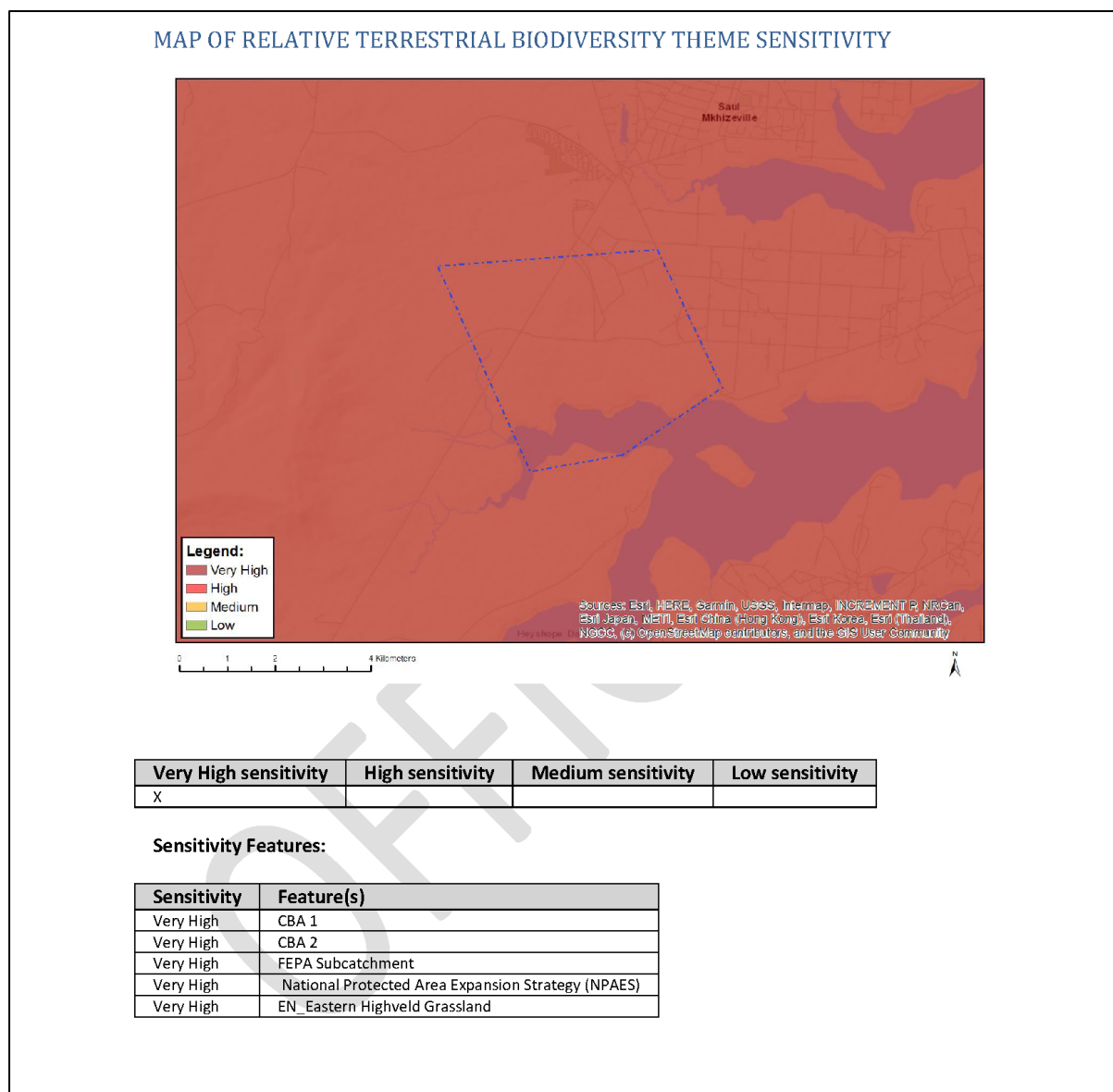
Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

## Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity
Medium	Indigofera hybrida
Medium	Sensitive species 41
Medium	Sensitive species 691

**Figure 7-1: Plant species sensitivity as per the DFFE Screening Tool**

Based on the DFFE Screening Tool and the Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in Terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation the site falls within a medium plant species sensitivity. From the site visit it can be confirmed that the sensitivity of the site is low, however, it was concluded from the one site visit outside of the biodiversity sampling season.



**Figure 7-2: Terrestrial Biodiversity sensitivity as per the DFFE Screening Tool**

Based on the DFFE Screening Tool and the Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in Terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation the site falls within a very high Terrestrial Biodiversity Sensitivity. From the site visit it can be confirmed that the onsite sensitivity of the site is Medium (for certain wetlands within the regulated area), while the grasslands have been disturbed and some remnants of grasslands remain which might have a functional role to play for ecological connectivity. The grasslands have been given a low sensitivity; however, the data is based on a single site visit during autumn, outside of the biodiversity period.

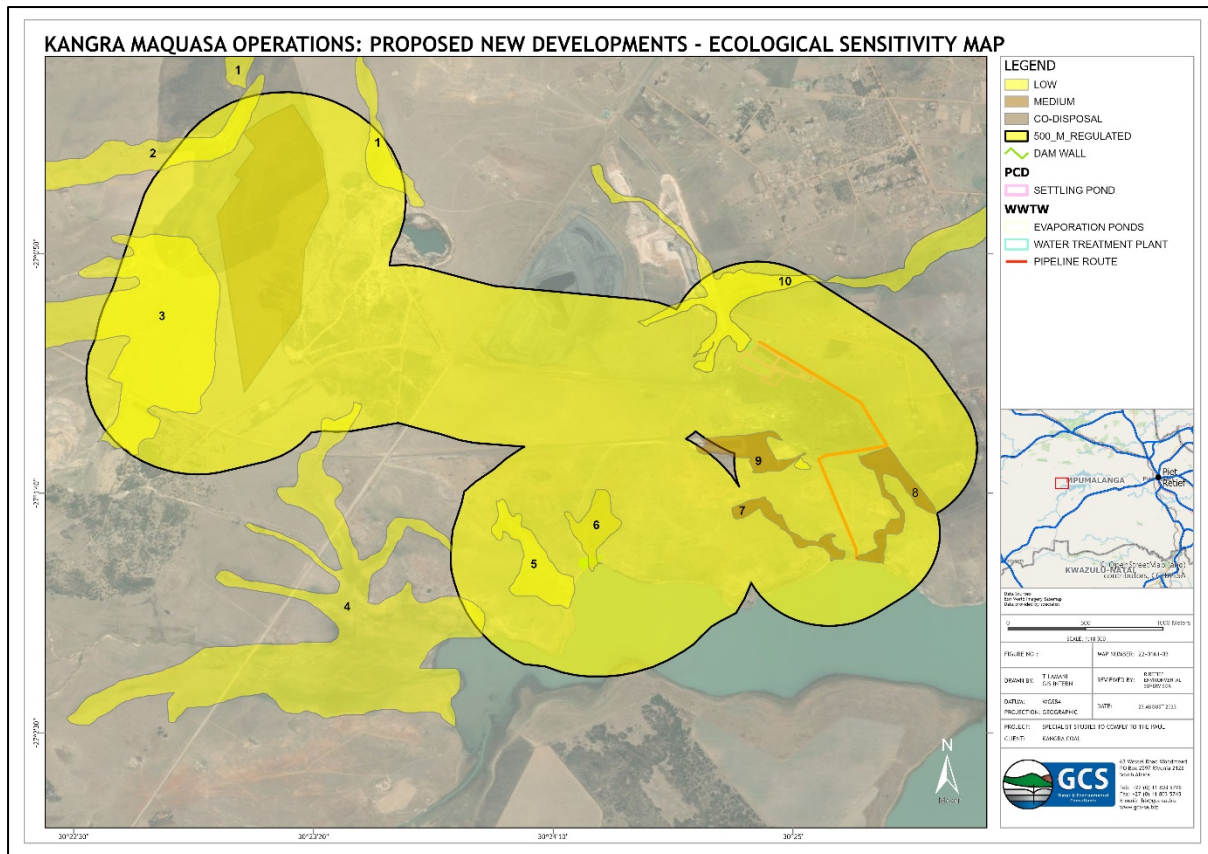


Figure 7-3: Terrestrial Sensitivities Map

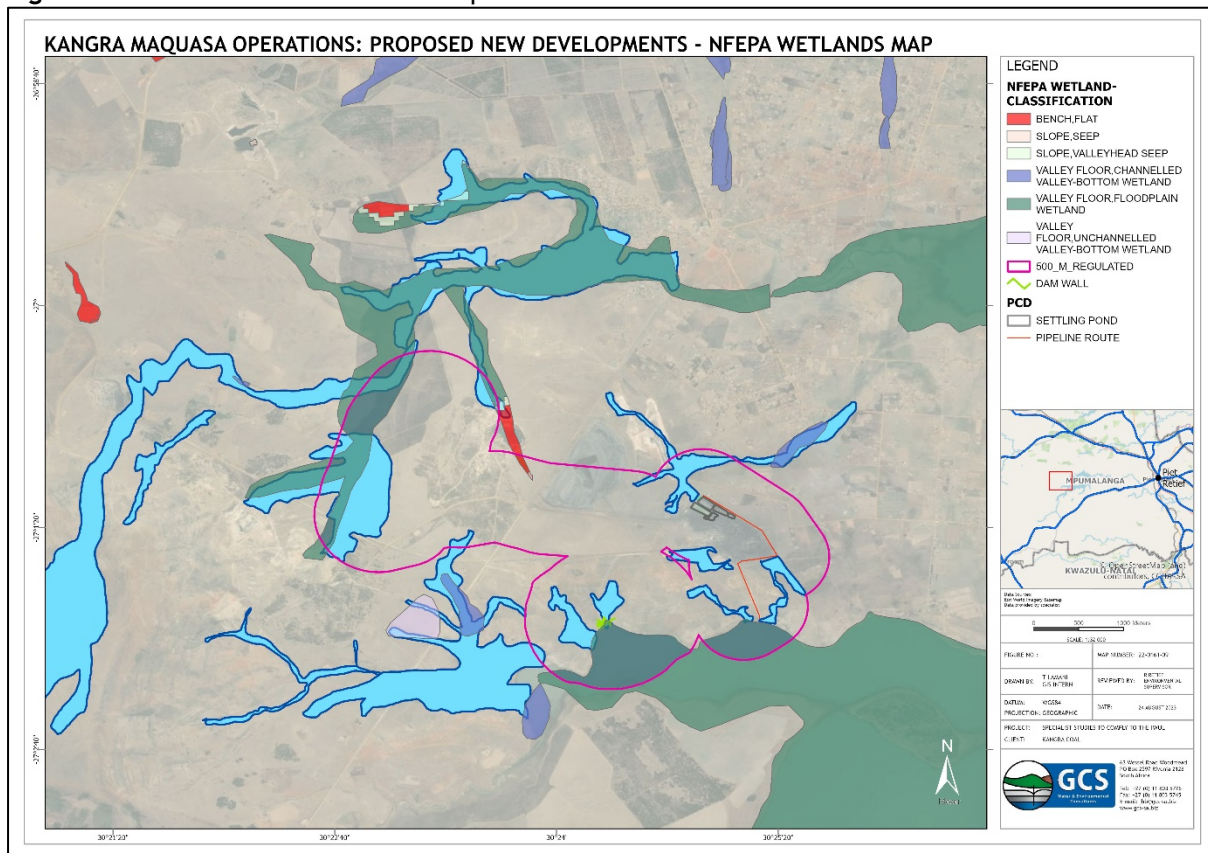


Figure 7-4: NFEPA Wetlands

## 8 IMPACT ASSESSMENT

### 8.1 IMPACT ASSESSMENT

The Mpumalanga Terrestrial Assessment Map has been developed as a tool to assist in identifying the threatened habitats, including the threatened species often associated with these habitat types. The plan also considers other important ecological principles such as connectivity, functioning, corridors / linkages as tools for determining delineations of areas. The aforementioned factors were then used to delineate Critical (CBA) and Ecologically (ESA) sensitive areas, which warrant special attention during impact assessments.

The study site falls within Ecological Support Areas. The study area has been influenced by anthropogenic activities ranging from transformation of the grasslands and alien infestation in the mining area, overgrazing, and hardening of surfaces including roads, structures. A high number medium sensitivity is expected as the area may provide nesting for birds, hiding spots for reptiles and observation points for mammalian species, however, certain wetlands have been rated medium. Potential ecological impacts resulting from the development would stem from a variety of different activities and risk factors associated with the construction and operational phases of the project including the following:

#### 8.1.1 Biodiversity

The potential impacts associated with the various project stages are discussed below.

##### 8.1.1.1 Construction Phase

The following potential impacts were considered on terrestrial vegetation communities:

- Destruction of, and fragmentation of, the remaining vegetation communities.

##### 8.1.1.2 Operational Phase

The following potential impacts were considered on terrestrial vegetation communities:

- Routine maintenance in case of emergency leaks from stormwater infrastructure draining into the Heyshope Dam at HGM 7.
- No illegal dumping in drainages especially near the Heyshope Dam

#### 8.1.2 Direct habitat destruction

##### 8.1.2.1 Impacts on vegetation and protected tree species

Impacts on vegetation would occur due to the construction of the additional infrastructure at the mine.

##### 8.1.2.2 Mitigation measures:

- Vegetation clearing to be kept to a minimum. No unnecessary vegetation to be cleared.

- The final development area should be surveyed for species suitable for search and rescue, which should be translocated prior to the commencement of construction. This must be confirmed by the Ecologist during the biodiversity season.
- Development would be likely to encourage alien plant invasion and measures to prevent and limit alien plant invasion should be implemented as part of the EMPr for the development.
- Any Protected trees should be tagged, and a permit obtained from the DAFF.

### **8.1.3 Increased Erosion risk**

Increased erosion risk because of soil disturbance and loss of vegetation cover.

#### **8.1.3.1 Mitigation measures:**

- Minimise the development footprint so that only areas where infrastructure will be located are cleared.
- Post-construction revegetation of all bare areas with local species.
- Regular monitoring for erosion after construction to ensure that no erosion problems have developed as result of the disturbance.
- All erosion problems observed should be rectified as soon as possible, using the appropriate erosion control structures and revegetation techniques.
- An erosion management plan should be developed as part of the EMPr for the development.

### **8.1.4 Direct Fauna impacts**

#### **8.1.4.1 Description of impact:**

Faunal habitat destruction, alteration, and physical disturbance.

#### **8.1.4.2 Mitigation measures:**

- The site should not be fenced with electric fencing which is near to the ground.
- Any fauna directly threatened by the construction activities should be removed to a safe location by the ECO or other suitably qualified person.
- The collection, hunting or harvesting of any plants or animals at the site should be strictly forbidden. Personnel should not be allowed to wander off the demarcated construction site.
- Fires should only be allowed within fire-safe demarcated areas.
- No fuelwood collection should be allowed on-site.
- No dogs should be allowed on site.
- If the site must be lit at night for security purposes, this should be done with low-UV type lights (such as most LEDs), which do not attract insects.
- All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill.
- Staff present during the operational phase should receive environmental education to ensure that that no hunting, killing, or harvesting of plants and animals occurs.



### **8.1.5 Disruption of broad-scale ecological processes**

#### **8.1.5.1 Description of impact:**

Disruption of the broad-scale ecological processes.

#### **8.1.5.2 Mitigation measures:**

- Areas of natural vegetation within the site should be managed in a manner which promotes or is at least compatible with the maintenance of biodiversity at the site.

### **8.1.6 Soil and water pollution**

#### **8.1.6.1 Description of impact:**

Construction work of the magnitude contemplated for the proposed development will always carry a substantial risk of soil and water pollution, with large construction vehicles contributing substantially due to oil and fuel spillages.

#### **8.1.6.2 Mitigation measures:**

- Water falling on areas polluted with oil/diesel or other hazardous substances must be contained.
- Any excess or waste material or chemicals should be removed from the site and discarded in an environmentally friendly way. The ECO should enforce this rule rigorously.
- Dry chemicals to be stored on an impervious surface protected from rainfall and stormwater run-off.
- Ensure that refuelling stations on site are constructed to prevent spillage of fuel or oil onto the soil and put in place measures to ensure that any accidental spillages can be contained and cleaned up promptly.
- Sewage should either be treated in a suitable plant or removed from the site for treatment elsewhere.
- Spill kits should be on-hand to deal with spills immediately.
- Spillages or leakages must be treated according to an applicable procedure as determined by a plan of action for the specific type of disturbance for instance the maintenance management plan.
- All construction vehicles should be inspected for oil and fuel leaks regularly and frequently.

### **8.1.7 Air pollution**

#### **8.1.7.1 Description of impact:**

The environmental impacts of wind-borne dust, gases and particulates from the construction activities associated with the proposed development are primarily related to human health and ecosystem damage. The proposed development will typically comprise the following sources and associated air quality pollutants:

- Land clearing operations, building, and scraping.
- Stockpiling (particulate matter)

- Materials handling operations (truck loading & unloading, tipping, stockpiling)
- Vehicle entrainment on paved and unpaved roads
- Windblown dust-fugitive emissions (stockpiles).

Dust pollution will impact the most severe during the construction phase. Construction vehicles and equipment are the major contributors to the impact on air quality. Dust is generated during site clearance for the construction of infrastructure.

#### *8.1.7.2 Mitigation measures:*

- Dust suppression must be undertaken in conjunction with a dust monitoring programme that places dust deposition gauges or receiving buckets, directional dust collection receptacles, high volume active air samplers or continuous particle monitors or even personal exposure samplers at generation sites, around the mine and in adjacent areas.
- Implement standard dust control measures, including periodic spraying (frequency will depend on many factors including weather conditions, soil composition and traffic intensity and must thus be adapted on an on-going basis) of construction areas and access roads, and ensure that these are continuously monitored to ensure effective implementation.
- A speed limit (preferably 60 km/hour) should not be exceeded on dirt roads.

### **8.1.8 Spread and establishment of alien invasive species**

#### *8.1.8.1 Description of impact:*

This is probably one of the most significant potential impacts from a terrestrial invertebrate perspective and may have very significant knock-on effects that could impact of virtually every aspect of the surrounding ecosystem. Vehicles often transport many seeds, and some may be of invader species, which may become established along the road, especially where the area is disturbed. Continued movement of personnel and vehicles on and off the site, as well as occasional delivery of materials required for maintenance, will result in a risk of importation of alien species throughout the life of the project.

#### *8.1.8.2 Mitigation measures:*

- Institute strict control over materials brought onto site, which should be inspected for potential invasive invertebrate species and steps taken to eradicate these before transport to the site.
- Rehabilitate disturbed areas as quickly as possible to reduce the area where invasive species would be at a strong advantage and most easily able to establish.
- Institute a monitoring programme to detect alien invasive species early, before they become established and, in the case of weeds, before the release of seeds.
- Institute an eradication/control programme for early intervention if invasive species are detected, so that their spread to surrounding natural ecosystems can be prevented.

## 8.2 IMPACT ASSESSMENT MATRIX

Table 8-1 indicate the impacts described above and specific ratings of significance the impact will potentially have on the ecological components of the study area during construction, while Table 8-2 indicates the operational impacts. Cumulative Impacts are shown in Table 8-3

**Table 8-1: Impact assessment Matrix during Construction**

ACTIVITY(S)	POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION								RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION												
		Duration	Extent	Irreplaceable Loss	Severity	CONSEQUENCE	Probability	SIGNIFICANCE	+/-		Confidence	RISK RATING (C x S)	Mitigation Efficiency	Duration	Extent	Irreplaceable Loss	Severity	CONSEQUENCE	Probability	SIGNIFICANCE	+/-	Confidence	RISK RATING (C x S)
Loss of vegetation within development footprint	Loss of vegetation within development footprint	5	4	1	3	30	2	60	-	4: High - 80%	H	<ul style="list-style-type: none"><li>Limiting the impact area and construction activities to the proposed footprint area and the associated infrastructure servitude only.</li><li>Existing roads/servitudes should be considered first option over the construction of new roads/servitudes and must only be made where necessary.</li><li>Minimise the extent of vegetation clearing for the infrastructure. Areas to be cleared must be clearly/visibly demarcated to avoid unnecessary clearing.</li><li>Fire management plan must be in place for the areas surrounding the project area and the road to restrict the impact from fire on the natural flora and fauna communities.</li><li>Progressive rehabilitation will enable topsoil to be returned more rapidly, thus ensuring more recruitment from the existing seedbank. Surplus rehabilitation</li></ul>	4: High - 80% & below	4	3	1	2	16	2	32	-	4: High - 80%	M

ACTIVITY(S)	POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION										RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION										
		Duration	Extent	Irreplaceable Loss	Severity	CONSEQUENCE	Probability	SIGNIFICANCE	+/-	Confidence	RISK RATING (C x S)		Mitigation Efficiency	Duration	Extent	Irreplaceable Loss	Severity	CONSEQUENCE	Probability	SIGNIFICANCE	+/-	Confidence	RISK RATING (C x S)
												material can be applied to other areas in need of stabilisation and vegetation cover.											
Introduction of alien species, especially plants	Degradation and loss of surrounding natural vegetation	4	3	1	2	16	2	32	-	3: Medium - 60%	M	<ul style="list-style-type: none"><li>• Compile and implement an alien vegetation management plan from the onset of construction. The plan must identify areas for action (if any) and prescribe the necessary removal methods and frequencies to be applied. This plan must also prescribe a monitoring plan and be updated as/when new data is collated;</li><li>• Remove organic waste from site weekly to prevent pest species from becoming a problem. A waste management plan must be compiled and implemented from the onset of the construction phase. The plan must designate collection</li></ul>	4: High - 80% & below	3	2	1	2	12	2	24	-	4: High - 80%	L

ACTIVITY(S)	POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION								RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION												
		Duration	Extent	Irreplaceable Loss	Severity	CONSEQUENCE	Probability	SIGNIFICANCE	+/-		Confidence	RISK RATING (C x S)	Mitigation Efficiency	Duration	Extent	Irreplaceable Loss	Severity	CONSEQUENCE	Probability	SIGNIFICANCE	+/-	Confidence	RISK RATING (C x S)
											areas, define the separation of waste and also prescribe removal measures and frequencies from the areas. This plan must be also prescribing a monitoring plan and be updated as/when new data is collated.												



ACTIVITY(S)	POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION											
		Duration	Extent	Irreplaceable Loss	Severity	CONSEQUENCE	Probability	SIGNIFICANCE	+/-	Confidence		RISK RATING (C x S)	Mitigation Efficiency	Duration	Extent	Irreplaceable Loss	Severity	CONSEQUENCE	Probability	SIGNIFICANCE	+/-	Confidence	RISK RATING (C x S)
Displacement of faunal community due to habitat loss, direct mortalities and disturbance	Construction activity will likely lead to direct mortality of fauna due to earthworks, vehicle collisions, accidental hazardous chemical spills and persecution. Disturbance due to dust and noise pollution and vibration may disrupt behaviour.	5	4	1	2	20	2	40		3: Medium - 60%	M	<ul style="list-style-type: none"><li>• Signs must be put up stating that should any person be found poaching any species they will be fined.</li><li>• Construction must take place in the winter months as much is feasible.</li><li>• The areas to be developed must be specifically demarcated to prevent movement of staff or any individual into the surrounding environments, access to these areas must be controlled.</li><li>• Signs must be put up to enforce this.</li><li>• Speed limits must be implemented on all roads.</li><li>• Areas should be cleared and disturbed on a needs basis only, as opposed to clearing and disturbing a number of sites simultaneously.</li><li>• Any holes/deep excavations must done in a progressive manner on a needs basis only. No holes/excavations may be left open overnight. In the event holes/excavations are required to remain open overnight, these areas must be covered to prevent fauna falling into these areas.</li><li>• Where possible, work should be restricted to one area at a time and be systematic. This is to reduce</li></ul>	3: Medium - 60% & below	3	3	1	2	14	1	14	-	4: High - 80%	L

[illegible]

ACTIVITY(S)	POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION								RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION											
		Duration	Extent	Irreplaceable Loss	Severity	CONSEQUENCE	Probability	SIGNIFICANCE	+/-		Confidence	RISK RATING (C x S)	Mitigation Efficiency	Duration	Extent	Irreplaceable Loss	Severity	CONSEQUENCE	Probability	SIGNIFICANCE	+/-	Confidence
											clearing of an area and subsequent development must be minimized to avoid fauna from re-entering the site to be disturbed.											

Table 8-2: Impact assessment Matrix during Operation

ACTIVITY(S)	POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION								RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION												
		Duration	Extent	Irreplaceable Loss	Severity	CONSEQUENCE	Probability	SIGNIFICANCE	+/-		Confidence	RISK RATING (C x S)	Mitigation Efficiency	Duration	Extent	Irreplaceable Loss	Severity	CONSEQUENCE	Probability	SIGNIFICANCE	+/-	Confidence	RISK RATING (C x S)
Continued fragmentation and degradation of habitats and ecosystems	Disturbance created during the construction phase will leave the project area vulnerable to erosion and IAP encroachment.	3	4	1	2	16	2	32	-	4: High - 80%	M	<ul style="list-style-type: none"><li>It should be made an offence for any staff to /take bring any plant species into/out of any portion of the project area. No plant species whether indigenous or exotic should be brought into/taken from the project area, to prevent the spread of exotic or invasive species or the illegal collection of plants.</li><li>Implementation of an alien vegetation management plan.</li><li>The area must be demarcated and no disturbance is to be allowed outside the direct development footprint.</li></ul>	3: Medium - 60% & below	2	3	1	2	12	2	24	-	4: High - 80%	L
Proximity of infrastructure and human activity to the wetlands	This may lead to local disturbance of fauna and flora, through noise, light, trampling, etc. Fauna may move away from the site.	2	2	1	2	10	2	20	-	5: Very High	L	<ul style="list-style-type: none"><li>Lighting should face away from the wetlands.</li><li>Workers should be discouraged from walking on the bed and banks of the wetlands.</li></ul>	5: Very High - 100%	2	1	1	2	8	2	16	-	4: High - 80%	L

ACTIVITY(S)	POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION											
		Duration	Extent	Irreplaceable Loss	Severity	CONSEQUENCE	Probability	SIGNIFICANCE	+/-	Confidence		RISK RATING (C x S)	Mitigation Efficiency	Duration	Extent	Irreplaceable Loss	Severity	CONSEQUENCE	Probability	SIGNIFICANCE	+/-	Confidence	RISK RATING (C x S)
Spread of alien and/or invasive species	Ongoing displacement and direct mortalities of faunal community due to disturbance	3	3	1	2	14	2	28	-	3: Medium - 60%	M	<ul style="list-style-type: none"><li>• Lighting should be kept to a minimum to avoid disturbing crepuscular and nocturnal species. Lighting fixtures should be fitted with baffles, hoods or louvres and directed downward, to minimize light pollution which could attract night migrating species.</li><li>• Lighting should be directed towards to footprint area and avoid unnecessary illumination of the adjacent undeveloped areas.</li><li>• Where feasible, motion detection lighting must be used to minimise the unnecessary illumination of areas</li><li>• Avoid using any road during the night;</li><li>• Fences must have 30 x 30 cm holes in at the bottom at every 250m to allow for free movement of fauna.</li></ul>	4: High - 80% & below	2	2	1	2	10	2	20	-	4: High - 80%	L



**Table 8-3: Impact assessment Matrix (Cumulative Impacts)**

ACTIVITY(S)	POTENTIAL ENVIRONMENTAL IMPACT	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION											
		Duration	Extent	Irreplaceable Loss	Severity	CONSEQUENCE	Probability	SIGNIFICANCE	+/-	Confidence		RISK RATING (C x S)	Mitigation Efficiency	Duration	Extent	Irreplaceable Loss	Severity	CONSEQUENCE	Probability	SIGNIFICANCE	+/-	Confidence	RISK RATING (C x S)
The development of the proposed infrastructure will contribute to cumulative habitat loss and thereby impact the ecological processes in the region.	The development of the proposed infrastructure will contribute to cumulative habitat loss and thereby impact the ecological processes in the region.	3	3	1	2	14	2	28	-	4: High - 80%	M	• Ensure that a rehabilitation plan and IAP management plan be compiled for each development and are effectively implemented.	3: Medium - 60% & below	3	4	2	2	18	2	36	-	2: Low - 40 %	M
Fragmentation of aquatic ecosystems, and loss of connectivity between aquatic ecosystems and the surrounding landscape	This may impact on the movement of fauna and flora in the area, and may alter the hydrology of this part of the catchment due to loss of infiltration capacity.	3	2	1	2	12	2	24	-	4: High - 80%	L	• Where footprints cannot avoid sensitive aquatic ecosystems, ensure that sub-surface movement of water is unhindered; • Allow for natural corridors to remain for the movement of fauna and flora • Crossings over wetlands and watercourses must be built in a manner that allows for free flow of surface and subsurface water.	3: Medium - 60% & below	3	3	3	2	18	2	36		2: Low - 40 %	M

## 9 CONCLUSION AND IMPACT STATEMENT

Based on the ecological assessment for the Maquasa Project Developments, the following is noted:

### 9.1 Design and Construction Phase for biodiversity:

The following mitigation and management measures should be implemented during the construction phase to minimise potential environmental impacts:

- To preserve these footprints, need to be demarcated and then adhered to.
- Construction activities should be limited to between 07:00 and 17:00 or in conjunction with the ECO. There will be nightworks during the construction period. In such cases, nearby landowners will be informed prior and appropriate lighting will be used.
- A complaints register should be available onsite whereby the public or community in close connection of the proposed development can issue their concerns, if need be.
- Adopt responsible construction practices aimed at containing the construction activities to specifically demarcated areas.
- Any soil must be exposed for the minimum time possible once cleared of vegetation to avoid prolonged exposure to wind and water erosion and to minimise dust generation.
- Use existing ablutions or provide to a max of 10 per ablution.
- Induction awareness training should be undertaken.
- Onsite waste management and removal, waste not to sit longer than 7 days. Bins to have lids.
- Separation of waste should be encouraged.
- Erosion control measures should be in place.
- Any buffers identified should be maintained by the contractor.

#### 9.1.1.1 Operation Phase for biodiversity:

The following mitigation and management measures should be implemented during the operation phase to minimise potential environmental impacts:

- Waste should be managed as not to be aesthetically appealing or attract pests or rodents.
- Control of alien invasive plants is encouraged.
- Rehabilitation and landscaping with indigenous vegetation within the development should be encouraged and made a condition within the Environmental Authorisation.
- Mitigation Measure Objectives for biodiversity impacts on flora and fauna should be encouraged. The EMPr has made further provision for this.

The focus of mitigation measures should be to reduce the significance of potential impacts associated with the proposed water pipeline and thereby to:

- Prevent the destruction of, and fragmentation, of the vegetation community.
- Prevent the loss of the faunal community associated with this vegetation community.

## 9.2 Mitigation Measures for Impacts on Vegetation Communities & CBAs

From an ecological perspective, the development is situated within an area, which has been disturbed. It is recommended that any alien plant species found during construction, be removed according to best practice guidelines and all efforts should be made to prevent further growth of other alien or invasive plant species. It is further recommended that an alien invasive species plan accompany the basic assessment report to the Department of Forestry, Fisheries, and the Environment.

### 9.2.1 *Recommended mitigation and rehabilitation measures for biodiversity:*

- As far as possible, the proposed development should be restricted to areas that have already been disturbed, and limited further loss of secondary vegetation, wetland areas, drainage lines should be permitted.
- It is recommended that areas to be developed be specifically demarcated so that during the construction phase, only the demarcated areas be impacted upon and preventing movement of workers into sensitive surrounding environments.
- Where possible, existing access routes and walking paths must be made use of, and new routes limited.
- All laydown, storage areas etc should be restricted to within the project area, not beyond the sensitive areas.
- All building materials should be mixed off site and no mixing should take place in sensitive areas.
- Prefabricated material must be used (or prioritised) to limit the fabrication and mixing on site; and
- Areas that are denuded during construction need to be re-vegetated with indigenous vegetation to prevent erosion during flood events. This will also reduce the likelihood of encroachment by alien invasive plant species.

#### 9.2.1.1 *Mitigation Measures for Impacts on Faunal Communities*

Recommended mitigation and rehabilitation measures for faunal community's hinge largely on protecting their habitats and ensuring it remains intact.

#### 9.2.1.2 *Specific mitigation measures for birds, mammals, and amphibians*

- Fauna species such as frogs and reptiles that have not moved away should be carefully and safely removed to a suitable location beyond the extent of the development footprint by a suitably qualified ECO trained in the handling and relocation of animals.
- No trapping, killing, or poisoning of any wildlife is to be allowed on site, including snakes, birds, lizards, frogs, insects, or mammals.

- All building materials should be mixed off site and no mixing should take place near the sensitive areas.
- Have action plans onsite, and training for contactors and employees in the event of spills, leaks, and other impacts to the surrounding environment.
- It is worth noting that by applying relevant mitigation measures to the system to ensure that the functionality of the watercourse not be lost will directly ensure that the surrounding system's functionality be retained and that impacts to the water resources be limited.
- Recommended mitigation measures for the project include the following:
  - The footprint area associated with the construction must be minimised, avoiding the wetland and drainage areas where possible. Areas earmarked for development must be marked to ensure a controlled disturbance footprint area to minimise negative impacts.
  - Erosion prevention and sediment control measures are imperative and need to be implemented throughout the entire project footprint area, access roads and temporary laydown / storage sites. Temporary and permanent erosion control methods may include silt fences, interceptor ditches, seeding and sodding, riprap of exposed embankments, erosion mats, and mulching.
  - Further, unstable, and exposed soil embankments should be protected from erosion with a combination of retainer wall bricks / blocks and vegetation.
  - The contractors used for the construction should have spill kits available prior to construction to ensure that any fuel, oil, or hazardous substance spills are cleaned-up and discarded correctly.
  - It is preferable that construction takes place during the dry season (as much as possible) to reduce the erosion potential of the exposed surfaces.
  - During construction activities, all rubble generated must be removed from the site and not dumped in the instream, within the wetland habitat towards the northwest of the site.
  - An alien invasive plant management plan needs to be compiled and implemented post construction to control current invaded areas and prevent the growth of invasive species on cleared areas.
  - A maintenance management plan should accompany the EIA to DFFE on how to prevent and contain the termites in future.

### 9.2.2 Overall Conclusion

- In the case of this study site, the grasslands have been altered through anthropogenic activities. The grasslands, however, were not flowering and trees without leaves.

- Anthropogenic impacts identified within the study site included alien vegetation encroachment, gravel roads, natural vegetation removal, hardening of surfaces to establish the mining infrastructure, fencing, grazing of animals and disturbances to the wetland systems around the site.
- The Terrestrial CBA of the site is mixed between transformed areas and ecological support areas (ESA).
- The study site still has a functional role to play in regional ecological functioning and biological functions at the site even though it has been influenced by human-related impacts.
- Ecological connectivity between the grasslands and drainage located towards the Heyshope Dam cannot be excluded in the overall study area.
- An alien invasive species plan must be developed, together with a maintenance management plan that covers termites.
- Monitoring dust at the site should be encouraged.
- Monitoring should be undertaken monthly for the discharge of the treated effluent from the mine into the Heyshope Dam and submitted to DWS>
- A search-and-rescue plan needs to be developed for any medicinal plants onsite. This has to be confirmed by a registered ecologist under SACNASP and during the flowering / summer season.
- Any protected trees must, however, be sampled and recorded and indicated to DAFF.
- Concluded from the results presented in this document, the construction activities will impact on the low sensitive terrestrial biota. Mitigation measures should be implemented to mitigate to satisfactory standards if all mitigatory actions are implemented with due care. Alien eradication and rehabilitation must be encouraged through the development of an alien and invasive species plan.

Even though the site has low sensitivity, the mitigation measures provided may reduce the negative risks anticipated with the mining infrastructure construction. Should all the mitigation measures be implemented and monitored against to ensure compliance and included in the Environmental Management Program the project may then be favourably considered.



## 10 REFERENCES

- ADU (Animal Demography Unit). (2023). Virtual Museum. (Accessed: June 2023).
- Alexander, G. & Marais, J. (2007). A guide to the Reptiles of Southern Africa. Struik, Cape Town.
- Bates, M.F., Branch, W.R., Bauer, A.M., Burger, M., Marais, J., Alexander, G.J & de Villiers, M.S. (Eds). (2014). Atlas and Red List of Reptiles of South Africa, Lesotho and Swaziland. Suricata 1. South African Biodiversity Institute, Pretoria.
- Barbour, M.T., Gerritsen, J. & White, J.S. 1996. Development of a stream condition index (SCI) for Florida. Prepared for Florida Department of Environmental Protection: Tallahassee, Florida.
- BGIS. (Biodiversity GIS) (2023). <http://bgis.sanbi.org/>. (Accessed: June 2023).
- BirdLife (2023). Important Bird Areas Factsheet. <http://www.birdlife.org> (Accessed: June 2023).
- Bonn Convention (1979). Convention on the Conservation of Migratory Species of Wild Animals. [www.cms.int/sites/default/files/instrument/CMS-text.en\\_.PDF](http://www.cms.int/sites/default/files/instrument/CMS-text.en_.PDF) (Accessed: June 2023).
- BODATSA-POSA (2016). Plants of South Africa - an online checklist. POSA ver. 3.0. <http://newposa.sanbi.org/>. (Accessed: June 2023).
- Branch, W.R. (1998) Field Guide to Snakes and Other Reptiles of Southern Africa. Struik, Cape Town.
- CBD (Convention on Biological Diversity). (1993). <https://www.cbd.int/doc/legal/cbd-en.pdf>. (Accessed: June 2023).
- CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora) (1973). [www.cites.org](http://www.cites.org). (Accessed: June 2023).
- Cyrus, D. P., Wepener, V., Mackay, C. F., Cilliers, P. M., Weerts, S. P., & Viljoen, A. 2000. The effects of Intrabasin Transfer on the Hydrochemistry, Benthic Invertebrates and Ichthyofauna on the Mhlathuze Estuary and Lake Nsezi. Water Research Commission.
- Davies, B., & Day, J. 1998. Vanishing Water. UCT Press.
- Del Hoyo, J., Collar, N.J., Christie, D.A., Elliott, A., Fishpool, L.D.C., Boesman, P. & Kirwan, G.D. (2014): Technical Report for the Gauteng Conservation Plan (Gauteng C-Plan v3.3). Gauteng Department of Agriculture and Rural Development: Nature Conservation Directorate. 60 pages.
- De Frey, W. 2012. Specialist Report: Ecological Assessment with Emphasis on Vegetation - Adams, ESciences Associates
- Department of Environmental Affairs, Forestry and Fisheries (DEFF), 2021. Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in Terms

of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation. 30 October 2021.

Department of Environmental Affairs. 2013. Mining and biodiversity guideline- Mainstreaming biodiversity into the mining sector.

Department of Water Affairs and Forestry (DWAF) 2005. Final draft: A practical field procedure for identification and delineation of wetlands and Riparian areas.

Department of Water and Sanitation (DWS). 1996. South African Water Quality Guidelines. Volume 7: Aquatic Ecosystems. Department of Water Affairs and Forestry, Pretoria.

Department of Water and Sanitation (DWS). 1999. Resource Directed Measures for Protection of Water Resources. Volume 2: Integrated Manual (Version 1). Department of Water Affairs and Forestry, Pretoria.

Department of Water and Sanitation (DWS). 2005. River Ecoclassification: Manual for Ecstatus Determination. First Draft for Training Purposes. Department of Water Affairs and Forestry.

Department of Water and Sanitation (DWS). 2017. A Desktop Assessment of the Present Ecological State, Ecological Importance and Ecological Sensitivity per Sub Quaternary Reaches for Secondary Catchments in South Africa. Draft. Compiled by RQS-RDM.

Dickens, C. W. S. and Graham, P.M. 2002. The South African Scoring System (SASS) Version 5: Rapid bioassessment method for rivers. African Journal of Aquatic Science. 27 (1): 1 -10.

GDARD. Requirements for biodiversity assessments: Version 3. Johannesburg: Gauteng Department of Agriculture and Rural Development; 2014.

Gerber, A. & Gabriel, M.J.M. 2002. Aquatic Invertebrates of South African Rivers Field Guide. Institute for Water Quality Studies. Department of Water Affairs and Forestry. 150pp

G.M. (1996). HBW and BirdLife International Illustrated Checklist of the Birds of the World. Volume 2: Passerines. Lynx Editions and BirdLife International, Barcelona, Spain and Cambridge, UK.

DEA. (2015). National land cover data for SA. [https://egis.environment.gov.za/national\\_land\\_cover\\_data\\_sa](https://egis.environment.gov.za/national_land_cover_data_sa) (Accessed: December 2021).

Driver, A., Nel, J.L., Snaddon, K., Murray, K., Roux, D.J., Hill, L., Swartz, E.R., Manuel, J., Funke, N. (2011). Implementation Manual for Freshwater Ecosystem Priority Areas. Report to the Water Research Commission, Pretoria.

Du Preez, & Carruthers, V. (2009) A Complete Guide to the Frogs of Southern Africa. Struik Nature, Cape Town.

Eskom (2015). Taylor MR, Peacock F, Wanless RM (Eds). The 2015 Eskom Red Data Book of birds of South Africa, Lesotho and Swaziland. BirdLife South Africa, Johannesburg.

EWT. (2016). Mammal Red List 2016. [www.ewt.org.za](http://www.ewt.org.za) (Accessed: January 2022).

- Fish, L., Mashau, A.C., Moeaha, M.J., Nembudani, M.T. (2015). Identification Guide to Southern African Grasses: An Identification Manual with Keys, Descriptions, and Distributions. SANBI, Pretoria.
- FrogMap (2023). The Southern African Frog Atlas Project (SAFAP, now FrogMAP). <http://vmus.adu.org.za> (Accessed in June 2023).
- Griffiths, C., Day, J. & Picker, M. (2016). Freshwater Life: A Field Guide to the Plants and Animals of Southern Africa. Struik Nature, Cape Town.
- Hellawell, J.M. 1977. Biological Surveillance and Water Quality Monitoring. In: JS Alabaster (Ed). Biological monitoring of inland fisheries. Applied Science, London. Pp 69-88.
- Henning, BJ (2012). AN ENVIRONMENTAL REPORT ON THE ECOLOGY (FLORA AND FAUNA) FOR THE FOR THE PROPOSED RENEWABLE ENERGY GENERATION PROJECT ON THE REMAINDER PORTION OF THE FARM KLIPDRIFT 20, FREE STATE PROVINCE. Pulida Energy (Pty) Ltd. Prepared by Ages (Pty) Ltd
- Hockey, P.A.R., Dean, W.R.J. & Ryan, P.G. (Eds). (2005). Roberts - Birds of Southern Africa, VIIth ed. The Trustees of the John Voelcker Bird Book Fund, Cape Town.
- International Union for Conservation of Nature and Natural Resources (IUCN). 2021. Red list of threatened species - 2021.2. [www.iucnredlist.org](http://www.iucnredlist.org). Accessed June 2023.
- IUCN (2021). The IUCN Red List of Threatened Species. [www.iucnredlist.org](http://www.iucnredlist.org) (Accessed: June 2023).
- Johnson, S. & Bytebier, B. (2015). Orchids of South Africa: A Field Guide. Struik publishers, Cape Town.
- Kleynhans, CJ. 1996. A qualitative procedure for the assessment of the habitat integrity status of the Luvuvhu River (Limpopo System, South Africa) Journal of Aquatic Ecosystem Health 5:41-54.
- Kotze, D.C., Marneweck, G.C., Batchelor, A.L., Lindley, D.C., and Collins, N.B. 2009. A Technique for rapidly assessing ecosystem services supplied by wetlands. Mondi Wetland Project.
- Land Type Survey Staff. (1972 - 2006). Land Types of South Africa: Digital Map (1:250 000 Scale) and Soil Inventory Databases. Pretoria: ARC-Institute for Soil, Climate, and Water.
- MammalMap (2023). <http://mammalmap.adu.org.za/> (Accessed: June 2023).
- Macfarlane, D.M., Kotze, D.C., Ellery, W.N., Walters, D., Koopman, V., Goodman, P. and Goge, C. 2008. A technique for rapidly assessing wetland health: WET-Health. WRC Report TT 340/08.
- Macfarlane, D.M., Bredin, I.P., Adams, J.B., Zungu, M.M., Bate, G.C. and Dickens, C.W.S. 2014. Preliminary guideline for the determination of buffer zones for rivers, wetlands, and estuaries. Final Consolidated Report. WRC Report No TT 610/14, Water Research Commission, Pretoria.

- McMillan, P.H. 1998. An Invertebrate Habitat Assessment System (IHASv2), for the Rapid Biological Assessment of Rivers and Streams. A CSIR research project, number ENV - P-I 98132 for the Water Resource Management Program, CSIR. li + 44p.
- Measey, G.J. (2011). Ensuring a Future for South Africa's Frogs: A Strategy for Conservation Research. South African National Biodiversity Institute, Pretoria.
- Minter, L., Burger, M., Harrison, J.A. & Kloepfer, D. (2004). Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland. Smithsonian Institute Avian Demography Unit, Washington; Cape Town.
- Monadjem, A., Taylor, P.J., Cotterill, F.D.P. & Schoeman, C. (2010). Bats of southern and central Africa: a biogeographic and taxonomic synthesis. Wits University Press, Johannesburg.
- Mucina, L. and Rutherford, M.C. (Eds.). (2006). The vegetation of South Africa, Lesotho and Swaziland. Strelizia 19. South African National Biodiversity Institute, Pretoria South African.
- Mucina, L., Rutherford, M.C. & Powrie, L.W. (Eds.). (2007). Vegetation map of South Africa, Lesotho and Swaziland. 1:1 000 000 scale sheet maps. 2nd ed. South African National Biodiversity Institute, Pretoria.
- National Environmental Management Act. 1998. National Environmental Management Act (act no. 107 of 1998)- Environmental management framework regulations.
- NBA. (2011). Terrestrial Formal Protected Areas. <http://bgis.sanbi.org/>. (Accessed: June 2023).
- NBA. (2012). Terrestrial Ecosystem Threat Status 2012. <http://bgis.sanbi.org/>. (Accessed: June 2023)
- NBF (2009). National Biodiversity Framework. [www.environment.gov.za](http://www.environment.gov.za) (Accessed: June 2023).
- Nel JL, Murray KM, Maherry AM, Petersen CP, Roux DJ, Driver A, Hill L, Van Deventer H, Funke N, Swartz ER, Smith-Adao LB, Mbona N, Downsborough L and Nienaber S. 2011. Technical Report for the National Freshwater Ecosystem Priority Areas project. WRC Report No. K5/1801.
- NPAES (2011). National Protected Areas Expansion Strategy. [www.environment.gov.za](http://www.environment.gov.za) (Accessed: June 2023).
- Ollis DJ, Snaddon CD, Job NM, and Mbona N. 2013. Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems. SANBI Biodiversity Series 22. South African Biodiversity Institute, Pretoria.
- Plafkin, J.L., Barbour, M.T., Porter, K.D., Gross S.K., Hughes, R.M., 1989. Rapid Bio-assessment protocols for use in streams and rivers: benthic macroinvertebrates and fish. U.S. Environmental Protection Agency.
- Raimonde, D. (2009). Red list of South African Plants. SANBI, Pretoria.
- RAMSAR. (1971). The RAMSAR convention. [www.ramsar.org](http://www.ramsar.org) (Accessed: December 2021).

- Rautenbach, A., Dickerson, T. & Schoeman, M.C. (2014). Diversity of rodent and shrew assemblages in different vegetation types of the savannah biome in South Africa: no evidence for nested subsets or competition. *African Journal of Ecology*, 52:30-40.
- Rountree MW, Malan H and Weston B (editors). 2012. Manual for the Rapid Ecological Reserve Determination of Inland Wetlands (Version 2.0). Joint Department of Water Affairs/Water Research Commission Study. Report No XXXXXXXXXX. Water Research Commission, Pretoria.
- SABAP2 (Bird Atlas Project). (2018). <http://vmus.adu.org.za/>. Accessed: June 2023
- SANBI. (2010). SANBI Biodiversity Series 14: National Protected Area Expansion Strategy for 2008. [www.sanbi.org/documents/sanbi-biodiversity-series-14-national-protected-area-expansion-strategy-for-2008/](http://www.sanbi.org/documents/sanbi-biodiversity-series-14-national-protected-area-expansion-strategy-for-2008/) (Accessed: June 2023).
- SANBI. (2013). Grassland Ecosystem Guidelines: landscape interpretation for planners and managers. <http://biodiversityadvisor.sanbi.org> (Accessed: June 2023).
- SANBI. (2016). Red List of South African Plants version 2021.2. [Redlist.sanbi.org](http://redlist.sanbi.org) (Accessed: June 2023).
- SANBI. (2017). Technical guidelines for CBA Maps: Guidelines for developing a map of Critical Biodiversity Areas & Ecological Support Areas using systematic biodiversity planning. Driver, A., Holness, S. & Daniels, F. (Eds). 1st Edition. South African National Biodiversity Institute, Pretoria.
- SARCA (2018). South African Reptile Conservation Assessment. <http://sarca.adu.org.za/> (Accessed: June 2023).
- SASA, S. A. (1999). Identification & management of the SOILS of the South African sugar industry. Mount Edgecombe: South African Sugar Association Experiment Station.
- Soil Classification Working Group. (1991). Soil Classification a Taxonomic system for South Africa. Pretoria: The Department of Agricultural Development.
- South African National Biodiversity Institute (SANBI). 2009. Further Development of a Proposed National Wetland Classification System for South Africa. Primary Project Report. Prepared by the Freshwater Consulting Group (FCG) for the South African National Biodiversity Institute (SANBI).
- Skelton, P.H. 2001. A complete guide to the freshwater fishes of southern Africa. Struik Publishers, South Africa.
- Skinner J.D. & Chimimba, C.T. (2005). The Mammals of the Southern African Subregion (New Edition). Cambridge University Press. South Africa.
- Stuart, C. & Stuart, T. (1994). A field guide to the tracks and signs of Southern, Central East African Wildlife. Struik Nature, Cape Town.
- Taylor, P. (1998). The Smaller Mammals of KwaZulu-Natal. University of Natal Press, Durban.
- Taylor, M.R., Peacock, F. & Wanless, R.M. (Eds). (2015). The 2015 Eskom Red Data Book of birds of South Africa, Lesotho and Swaziland. BirdLife South Africa, Johannesburg.



- Thirion, C.A., Mocke, A. & Woest, R. 1995. Biological monitoring of streams and rivers using SASS4. A User's Manual. Internal Report No. N 000/00REQ/1195. Institute for Water Quality Studies. Department of Water Affairs and Forestry. 46
- United States Geological Survey (USGS). 2004. Methods for Sampling Fish Communities as part of the National Water-Quality Assessment Program. <http://water.usgs.gov/nawqa/protocols/OFR-93-104/fishp1.html>.
- United States Environmental Protection Agency (USEPA), 1998. Rapid Bioassessment Protocols for Use in Streams and Rivers. US Environmental Protection Agency, Office of Water. Washington, DC
- Van Oudtshoorn, F. (2004). Gids tot die grasse van Suider-Afrika. Second Edition. Briza Publikasies, Pretoria.
- Van Wyk, B. & Van Wyk, P. (1997). Field guide to trees of Southern Africa. Struik Publishers, Cape Town.
- Van Wyk, B. & Malan, S. (1997). Field Guide to the Wildflowers of the Highveld: Also Useful in Adjacent Grassland and Bushveld, Struik Publishers, Cape Town.
- Van Wyk, B-E., Van Oudtshoorn, B. & Gericke, N. (2013). Medicinal Plants of South Africa. Briza Publications, Pretoria.
- Van Wyk, B-E. & Smith, G.F. (2014). Guide to the Aloes of South Africa. Briza Publishers, Pretoria.
- UNFCC. (1994). The United Nations Framework Convention on Climate Change.

**APPENDIX A -CURRICULUM VITAE OF SPECIALIST**

<b>NAME</b>	Nico-Ronaldo Greeff-Retief
<b>DATE OF BIRTH</b>	07 February 1982
<b>ID Number</b>	8202075093082
<b>Tel</b>	072 666 6348
<b>Email</b>	ronaldoretief@gmail.com
<b>PROFESSION/SPECIALISATION</b>	Ecological specialist studies, Wetland specialist studies, Aquatic specialist studies; Mining specialist studies; Visual Impact specialist studies; Professional Environmental Assessment Practitioner
<b>NATIONALITY</b>	South African
<b>YEARS' EXPERIENCE</b>	19 years
<p><b>KEY QUALIFICATIONS:</b> I have 19 years' experience in the environmental consulting industry. My key interest falls within the water and mining industry. I completed my Masters in Zoology in February 2007 and since August 2010 I have been registered as a Professional Natural Scientist in Zoological Science, Ecological Science &amp; Environmental Science. I have considerable experience in the writing of EIA reports and have managed a variety of small- to large-scale EIA projects ranging from electrical power lines to housing developments. I have completed over 90 EIA projects, more than 50 Water Use License Applications, more than 20 mining related applications and more than 55 specialist input assessments.</p> <p>I have vast experience as an Environmental Assessment Practitioner with expertise in: Water Quality Management, GIS mapping (in particular, PlanetGIS and ArcGIS software packages) and Surface Water Management.</p> <p>I have valuable practical experience in the following EIA fields: bulk service infrastructure, water pipelines, sewage pipelines, road projects and upgrades; residential developments; renewable energy, mining applications and water use license applications. I am also proficient in conducting aquatic, wetland and ecological assessments. I have undertaken a variety of Visual Impact Assessments and utilise GIS and onsite first-hand experience when compiling the reports.</p> <p>I believe that I am a valuable asset in any environmental industry owing to my experience, knowledge and expertise. I have the ability to lead, train and inspire staff to be enthusiastic and goal orientated. I am self-motivated and maintain an organised efficient work habitat.</p> <p>I am registered as an environmental assessment practitioner with EAPASA 2019/181.</p> <p>My Career Specialist skills include:</p> <ul style="list-style-type: none"> <li>• Biomonitoring;</li> <li>• EIA guidance;</li> <li>• Environmental Compliance Monitoring (ECO)</li> <li>• Ecological Assessments and environmental identification and mapping;</li> <li>• Drafting and Preparing Environmental Management Plans (EMPs);</li> <li>• Undertaking Public Participation;</li> <li>• Preparing Strategic guideline documents and training material;</li> <li>• Compiling EIA reports;</li> <li>• EIA guidance and recommendations;</li> <li>• Mentoring junior staff;</li> <li>• Project Procurement;</li> <li>• Project Invoicing and Billing; and</li> <li>• Water Quality Management;</li> <li>• Wetland Delineations;</li> <li>• GIS mapping and map production;</li> <li>• Environmental Impact Assessments;</li> <li>• Water Use License Applications;</li> </ul>	

<ul style="list-style-type: none"> <li>• Mining applications and Guidance;</li> <li>• Water Quality Management;</li> <li>• Petroleum (Filling Stations) Groundwater Monitoring;</li> <li>• Filling Stations Gas Monitoring;</li> <li>• Aquatic Impact Assessments;</li> <li>• Visual Impact Assessments;</li> <li>• SASS5 &amp; Biomonitoring;</li> <li>• Conduct and manage Environmental Impact Assessments (EIAs) and other environmental investigations according to the new EIA legislation.</li> <li>• Providing input for strategic assessment, policy development and reporting.</li> <li>• Interpreting and applying environmental legislation.</li> <li>• Develop, plan, co-ordinate and facilitate Public Participation Processes (PPP).</li> <li>• Client and authority liaison.</li> <li>• Compiling, reviewing and approving project proposals and environmental reports.</li> <li>• Developing and implementing Environmental Management Plans (EMP's).</li> <li>• Conducting environmental monitoring, reviews and audits.</li> <li>• Mentoring of junior staff.</li> <li>• Manage project budget and programme.</li> <li>• Provision of ongoing assistance and support to line managers and rest of the environmental team.</li> </ul>	
<b><u>EMPLOYMENT RECORD:</u></b>	
March 2020 - Currently	NCC Environmental Services - Professional EAP and Ecologist
June 2018-March 2020	Delta Built Environment Consultants - Professional Environmental Assessment Practitioner
December 2017 - June 2018	Bokamoso Landscape Architects and Environmental Consultants
May 2015 - November 2017	PRISM Environmental Management Services, Position
September 2014 - April 2015	DMT-Kai Batla
June 2014 - August 2014	Kantey and Templer
September 2013 - May 2014	GladAfrica Environmental Management
August 2012 - April 2013	African Innovative Solutions and Projects
May 2011 - July 2012	Lidwala Consulting Engineers
March 2010 - April 2011	Strategic Environmental Focus
May 2009 - February 2010	Savannah Environmental
April 2007 - April 2009	Nemai Consulting
<b><u>PROFESSIONAL EXPERIENCE:</u></b>	
<b><u>Environmental Impact Assessments: Electricity</u></b>	
<ul style="list-style-type: none"> <li>• Eskom - Dunnottar 88kV substation and power lines - 2011;</li> <li>• Eskom - Koeberg Integration Project - 2009;</li> <li>• Eskom - Tshwane Strengthening Project. Report - 2009;</li> <li>• Mulilo - Wind Monitoring Masts - 2009;</li> <li>• Mulilo - Siting exercise for a solar energy facility - 2009;</li> <li>• Exxaro - Wind Monitoring Mast near Brand-se-Baai - 2009;</li> <li>• Biotherm - Wind monitoring masts on farms within the Overberg - 2009;</li> <li>• Eskom - Majuba Power Station Ash Dump Expansion project 2012;</li> <li>• Eskom - Tabor-Nzhelele 400kV power line between Polokwane and Musina - 2012;</li> <li>• Zimbabwe Power Company - expansion of the power station, Hwange - 2014</li> <li>• Adams PV Facility BESS, Northern Cape, ENEL Green Power 2022</li> <li>• Pulida PV Facility BESS, Free State, ENEL, 2022</li> <li>• Suikerbekkie PV 1 and PV2, Western Cape, 2022, 23</li> <li>• MCWAP2 Powerline and Substation, Limpopo, Eskom 2022, 23</li> </ul>	
<b><u>Environmental Impact Assessments: Mining</u></b>	
<ul style="list-style-type: none"> <li>• Lonmin - Karee 4 Mine EMPR amendment - 2010;</li> <li>• Frankfort Mineral Resources - Priority East Prospecting Right Application - 2010;</li> <li>• BHP Billiton - Klipspruit Mining Colliery - 2010;</li> </ul>	

<ul style="list-style-type: none"> <li>• Sound Mining Solutions - Proposed Prospecting in the Northern Cape near Kuruman - 2011;</li> <li>• Exarro Resources - Inyanda Coal Mine - 2012;</li> <li>• Sebilong - Sebilong Chrome Retreatment Works - 2013; 3</li> <li>• Kumba Iron Ore - Sishen mine borehole monitoring for the DMR - 2012;</li> <li>• Northam Platinum Limited Production Works Expansion Zondereinde division for Northam Platinum - 2015;</li> <li>• Section 24G Rectification Application for the BP Wiggill Engineering Foundry in Boksburg North - 2016;</li> <li>• Maroeloesfontein AEL monitoring and audit report in Thabazimbi, Limpopo Province 2016;</li> </ul>
<b><u>Environmental Impact Assessments: Residential / Commercial Infrastructure</u></b>
<ul style="list-style-type: none"> <li>• Highlands Estate - Mixed-Use Development - 2010;</li> <li>• Limpopo Department of Health - Limpopo Academic Hospital in Polokwane - 2010;</li> <li>• Mogale City Local Municipality - Munsieville Extension 6 Township Development - 2011; Olivier Construction - Kuruman Development - 2012;</li> <li>• Thaba Ya Batswana - Stone River's Arch Mixed-Use Development Klipriver Drive - 2014; World Bank - ASIDI Schools Development in Mthatha (Development of EMPs and ECO monitoring) - 2014;</li> <li>• Village Green Township Development - 2016;</li> <li>• Roodekrans Ext 26 Township Development - 2015;</li> <li>• Nederburg Mixed-use Development - 2016;</li> <li>• Greengate Ext 70 - 2016, 2017;</li> <li>• Greengate Ext 69 - 2016, 2017;</li> <li>• Greengate Ext 68 Curro School - 2016, 2017;</li> <li>• Olievenpoort Ext 47 Development - 2017;</li> <li>• Portion 96 Lindley Township Development - 2017;</li> <li>• Ptn 71 of Knopjeslaagte housing development, 2017;</li> <li>• Dr. Yusaf Dadoo Hospital Expansion, EIA, Ecological Reporting, 2017</li> <li>• Wesgro Locale &amp; Master Plan Cape Health Technology Park, Wesgro, 2018,</li> <li>• Review of Tubatse Business Plan, Limpopo Economic Development Agency, 2018</li> <li>• JDA Central Fire Station Environmental, JDA, 2018,</li> <li>• West Rand Agro-Processing HUB, GIFA, 2018;</li> <li>• DBSA Town Planning Human Settlement, Wayo Consulting, 2018;</li> <li>• Umzimkhulu LM, Umzimkhulu LM, 2018;</li> <li>• EIA and Township Establishment for Musina Makhado SEZ, Limpopo Economic Development Agency; 2017;</li> <li>• DPW Oshoek Site Clearance; 2017;</li> <li>• Upgrading of Roads in Devon; 2017;</li> <li>• KZN DOHS Serviced Sites Programme - Bellair; 2016;</li> <li>• DPW Site Clearance DOJ Umlazi; 2016;</li> <li>• DPW Site Clearance DOJ Grassy Park; 2016;</li> <li>• EMM Roads and Stormwater Norkem Park;</li> <li>• DPW Site Clearance Sterrewag; 2015;</li> <li>• Lesotho Border Road; 2014;</li> <li>• Oshoek Road Upgrade, DPW, 2020</li> <li>• Louis Fourie Mixed-Use Development, Mossel Bay 2021/2022</li> </ul>
<b><u>Environmental Impact Assessments: Infrastructure</u></b>
<ul style="list-style-type: none"> <li>• Heartland Properties - Marlboro Road Extension (M60) - 2010;</li> <li>• Sanral - Road Upgrades - Hendrina along the N11 to Ermelo (Work Package 2); Amersfoort to Majuba Power Station (Work Package 3) &amp; Bethal to D622 (Work Package 4) - 2012; Sanral - Notwane River Bridge upgrade between South Africa &amp; Botswana - 2009;</li> <li>• City of Tshwane Metropolitan Municipality - Upgrade of Charles Street - 2008;</li> <li>• Gautrans - Upgrade of the R103 between van Dyk &amp; Diana Roads - 2009</li> </ul>

<ul style="list-style-type: none"> <li>• Gautrans - Upgrade of Moore Street - 2009;</li> <li>• Passenger Rail Agency of Southern Africa - Doornfontein Railway Station - 2008;</li> <li>• Sanral - N11 Section 10 Road Rehabilitation and Upgrade between Middelburg and Loskop Dam - 2012;</li> <li>• City of Tshwane Metropolitan Municipality - Rehabilitation of the Apies River between Wonderboom junction and Rosslyn Road - 2014;</li> <li>• Onderstepoort Biological Products - DEC- Development of a vaccination plant at the existing Onderstepoort Veterinary plant - 2015;</li> <li>• Gautrans - Rose Interchange - 2016;</li> <li>• Boukorp (Pty) Ltd - Greengate Electrical Powerline - 2016;</li> <li>• Transnet Freight Rail, Erection of a fence around City Deep Terminal, Kascon Yard and Kaserne Marshall Yard, 2020.</li> </ul>
<b><u>Environmental Impact Assessments: Bulk Services Infrastructure</u></b>
<ul style="list-style-type: none"> <li>• Mogale City Local Municipality - Munsieville Bulk Sewer Pipeline - 2011;</li> <li>• Johannesburg Property Company - Pimville Golf Course - 2007;</li> <li>• Johannesburg City Parks and Zoo - Upgrade of Regional Parks within Soweto - 2008-09;</li> <li>• Rand Water - Zuikerbosch Central Sludge Pipeline - 2007;</li> <li>• Ekurhuleni Metropolitan Municipality - Kempton Park Eastern Outfall Sewer - 2008;</li> <li>• Ekurhuleni Metropolitan Municipality - Signal Hill Reservoir - 2008;</li> <li>• City of Johannesburg Metropolitan Municipality - Bruma Lake Desiltation - 2009;</li> <li>• Moses Kotane Local Municipality - Ledig Water Supply Project - 2008; Sun International - Sun City Recreational Dam - 2008;</li> <li>• Dr Ruth Segomotsi Mompati District Municipality - Pomfret and Bray Wastewater Treatment Works, Waste licenses, environmental licences and Water Use Licenses - 2013;</li> </ul>
<b><u>Environmental Impact Assessments: Water Quality Guidelines</u></b>
<ul style="list-style-type: none"> <li>• National Department of Health - Water Quality Monitoring Training and Training Manual Development for Domestic Use - 2012;</li> <li>• Strategic Environmental Focus - Environmental Opinion for the Mine Waste Solutions Reclamation Project - 2012;</li> <li>• Heartland Properties - Modderfontein Conservation Park - 2012;</li> <li>• Department of Water and Sanitation - Wise use of Wetlands. Compilation of a Wise Use of Wetlands and Best Practise Guideline for the Department of Water Affairs (DWA) - 2008;</li> <li>• Department of Water and Sanitation - Agricultural Research Project for Wineries. Preparation of posters, pamphlets and a T-Shirt for the research project. The topics for the project consisted of wineries, eutrophication, agricultural strategies and a communication framework in agriculture - 2008;</li> <li>• Department of Water and Sanitation - Resource Directed Measures. Preparation of user-friendly material for Resource Directed Measures including the Spatial and Time Series Information Modelling Software (SPATSIM), Groundwater Resources Directed Measures (GRDM) and Teacha (Tool for Ecological Aquatic Chemical Habitat Assessment) software packages. A layman's pocket guide and a poster were also prepared. This material was work-shopped throughout South Africa - 2007-08;</li> <li>• Department of Water and Sanitation - Resource Directed Management of Water Quality: Attended a workshop at the CSIR International Conference Centre where the training material, posters etc. were discussed. Amending the posters and pamphlets with Corel Draw Graphics suite - 2008.</li> <li>• Steyn City Water Quality Monitoring reports for in-situ and monthly water quality reporting, 2017;</li> </ul>
<b><u>Environmental Impact Assessments: Ecological Assessments</u></b>
<ul style="list-style-type: none"> <li>• Umgeni Water - Mhlabatshane Dam: Preparing a specialist study report as well as conducting a site visit on the feasibility of the site for the construction of the</li> </ul>



- Mhlabatshane Dam. The report consisted of the feasibility and general characteristics of the area while also discussing the water quality of the site - 2008;
- City of Tshwane - Capital Park Feasibility study. Compiled a feasibility report for the proposed housing development in Capital Park. This was accomplished with the aid of PlanetGIS map overlays - 2008;
- Kumba Iron Ore - Sishen mine development of a Biodiversity Action plan, Ecological Baseline study and Monitoring protocol for the expansion of the mine towards the west from the current site 2012.
- Honeydew Grove Ext 15 development, Ecological Scan report to identify the sensitivity and importance of the proposed site's development, ongoing.
- Steyn City Water Quality Monitoring reports for in-situ and monthly water quality reporting, 2017;
- Randpark Ridge Water Quality monitoring reporting and assessment of the water quality onsite, 2017;
- Maroeloesfontein Mine, Air Quality monthly reporting and report development 2017;
- Dr Yusuf Dadoo Hospital Ecological Assessment, Phase 1, 2017;
- Olievenpoort Ext 47. Ecological Impact Assessment, 2017;
- Greengate Ext 70, 68 and 69 Ecological Assessments, 2017;
- Temple development along Malibongwe Road in Northgate area, Ecological Assessment, 2017;
- Erand Gardens Ext 15, Ecological Assessment and site inspection, 2017.
- Olympus AH 72 site inspection with search-and-rescue for orange listed and red listed plant species, Bronberg, Tshwane, 2017;
- Glenvista Fauna and Flora amendment assessment, 2017;
- Jukskei View Mixed-Use Development in Midrand Ecological Assessment and Scan (Waterfall Ridge), 2017;
- La Montagne Ecological Assessment, 2018;
- Kameeldrift Voere (Pty) Ltd, Alien Eradication Plan and Plant Species Map, 2018;
- Chamdor X4 Mixed Use Development Ecological Assessment, 2018;
- PWV18 Ecological Assessment, 2018;
- TUT Ga-Rankuwa Sports Precinct Ecological Assessment, 2018;
- Berea Park, City of Tshwane marking and tagging of oak trees, 2018;
- Knopjeslaagte x19 Ecological Assessment, 2018;
- Equestria residential development, ecological scan and wetland delineation, 2018;
- Carnival City Dalpark Ecological Assessment, 2018;
- Cayman Academy ecological assessment, 2018;
- Hazeldean Road ecological assessment, 2018;
- Faerie Glen Ecological Scan, 2018;
- Secunda filling station ecological opinion, 2018;
- Mooibosch development ecological opinion, 2018;
- Peach Tree x25 residential development ecological assessment, 2018
- SA Defence Force ecological opinion, 2018;
- Kudube rising main and pump station ecological assessment, 2018
- Kudube pump station ecological assessment, 2018;
- Tonga Retail ecological weed eradication plan, 2018;
- Welgedacht filling station ecological assessment, 2018;
- DPW Oshoek Site Clearance; 2019;
- Eastleigh Culvert Upgrade, 2019.
- Kliprivier Kleinboere (Pty) Ltd. Romansrivier, Western Cape, 2019
- Transnet Freight Rail City Deep Terminal, Kascon Yard and Kaserne Marshall Yard Fence, 2020.
- Centurion Aerospace Village, Water Pipeline 2020
- Ekurhuleni Metropolitan Municipality, Malvern East Pipelines, 2020,
- Thembaletu Ecological, 2021
- Amaoti Ecological, 2021
- eZulu Game Reserve, 2021
- OR Tambo SEZ Ecological, 2021

<ul style="list-style-type: none"> <li>• Timbavati Road and Deviation, ecological and tree permit applications, Limpopo, 2020/21</li> </ul>
<b><u>Environmental Impact Assessments: Wetland Assessments</u></b>
<ul style="list-style-type: none"> <li>• Eskom - Majuba Power Station Ash Dump Expansion Project - Wetland Delineation and Functional Assessment 2012;</li> <li>• Lekwa-Teemane Municipality - Mamusa Bulk Pipeline Project between Bloemhof and Schweizer-Reneke - Wetland Delineation and Functional Assessment and Water Use License - 2012;</li> <li>• DPW Oshoek Site Clearance; 2019;</li> <li>• Eastleigh Culvert Upgrade Wetland Assessment, 2019</li> <li>• Kliprivier Kleinboere (Pty) Ltd. Romansrivier, Western Cape, 2019</li> <li>• Malvern East Pipelines, Ekurhuleni, 2020</li> <li>• Suikerbosrand Nature Reserve, 2021</li> <li>• OR Tambo SEZ ecological, 2021</li> <li>• Modelkloof Ecological Assessment, KZN near Ladysmith, 2021</li> </ul>
<b><u>Environmental Impact Assessments: Air Quality Assessments</u></b>
<ul style="list-style-type: none"> <li>• Maroeloesfontein Mine, development of a Monitoring Programme based on the Approved Air Emissions License issued by LEDET, 2016, 2017 with dust monitoring reports.</li> </ul>
<b><u>Environmental Impact Assessments: Waste / landfill site</u></b>
<ul style="list-style-type: none"> <li>• Kgatelopele Municipality - Danielskuil Domestic Waste Site EIA - 2011;</li> </ul>
<b><u>Environmental Impact Assessments: Filling Stations, Gas monitoring &amp; Groundwater Monitoring</u></b>
<ul style="list-style-type: none"> <li>• Engen Petroleum - 72 groundwater monitoring boreholes around Gauteng, Free State, North West and Mpumalanga - 2014;</li> <li>• Engen Petroleum - Removal of storage tanks at the Bellavista Service Station - 2014;</li> <li>• Engen Petroleum - Upgrade / removal of the fuel storage tanks at the Rustenburg Depot - 2014;</li> <li>• Engen Petroleum - Proposed installation of 1 x 5 000m<sup>3</sup> aboveground fuel storage tank and associated handling infrastructure at Engen Rustenburg Depot - 2014;</li> <li>• Volkswagen SA - Borehole assessment report for Volkswagen SA, Port Elizabeth plant, Eastern Cape for Volkswagen SA, Port Elizabeth plant, Eastern Cape - 2014;</li> <li>• Volkswagen SA - Borehole assessment report for Volkswagen SA, Uitenhage plant, Eastern Cape for Volkswagen SA, Uitenhage plant, Eastern Cape - 2014;</li> <li>• Engen Petroleum - Tank removal, groundwater monitoring, gas testing, level 1 and 2 assessment and Permit to Work for 72 Engen Filling Stations around Gauteng, Mpumalanga, Free State and Northwest 2014.</li> <li>• Groblersdal filling station EIA and establishment, 2018;</li> <li>• Greenstone filling station EIA, 2018;</li> <li>• Dennehof filling station EIA, 2018;</li> <li>• Selby ext. 19 filling station EIA, 2018;</li> </ul>
<b><u>Environmental Impact Assessments: Visual Impact Assessments:</u></b>
<ul style="list-style-type: none"> <li>• Nkosi City Integrated Human Settlement, Mpumalanga province visual impact assessment, 2018;</li> <li>• Dalpark Ext 32 Mixed-Use Development visual impact assessment, 2018;</li> <li>• La Montage Reservoir and access road visual impact assessment, 2018;</li> <li>• Glenvista Residential Development visual impact assessment, 2018;</li> <li>• DPW Oshoek Site Clearance; 2017;</li> </ul>
<b><u>Environmental Impact Assessments: Water Use License Applications &amp; General Authorisations</u></b>
<ul style="list-style-type: none"> <li>• Heartland Properties - Westlake View WULA. Compilation of this Integrated Water Use License Application for the proposed project - 2009;</li> <li>• Heartland Properties - Marlboro Road Extension (M60). Compilation of this Integrated Water Use License Application for the proposed project - 2009;</li> </ul>

- Heartland Properties - Highlands Estate Ext 5, 6 & 7: Compilation of the Integrated Water Use License Application for this project - 2009;
- Mooiooi Chrome Processing Plant - Compilation of this Integrated Water Use License Application - 2011;
- Sanral - N14 WULA. Compilation of this Integrated Water Use License Application - 2009; Minco Mineral Holdings - Compilation of the Integrated Water Use License Application - 2009;
- Sebilong - Sebilong Chrome Retreatment Plant - 2012;
- Dr Ruth Municipality - Bray and Pomfret Waste Water Treatment Works - 2013;
- Franskraal Bowling Club - Water Use License - 2013;
- Transvaal Gold Mining - Tailings Water Use License - 2013;
- Tamboekiesfontein - Compilation of an Integrated Water Use License Application - 2015;
- Vista Park Extension 10 - Compilation of an Integrated Water Use License Application - 2015;
- SAFDEV SSDC (Pty) Ltd - K6 Road Upgrade - Compilation of an Integrated Water Use License Application - 2015;
- Summerset Ext. 25 - Compilation of an Integrated Water Use License Application - 2015;
- Rose Interchange - Compilation of an Integrated Water Use License Application - 2016;
- Randpark Ridge Extensions - Compilation of an Integrated Water Use License Application - 2015;
- Greengate Electrical line - Compilation of General Authorisation - 2016;
- Willowbrook Integrated Water Use License Application - 2016;
- Wilgeheuwel Ext 60 Water Use License Application - 2016;
- Nederburg Mixed-Use Development Water Use License Application - 2016, 2017;
- The Village X10 Residential Development - Water Use License Application - 2016, 2017;
- P39-1 (N14) Diepsloot Interchange - General Authorisation - 2017;
- Rietvlei Farm Village Sewage Treatment Works - Water Use License Application - 2018;
- Oshoek Land Port of Entry - Water Use License Application, 2019, 2020
- Louis Fourie Mixed-Use Development, Western Cape, 2022
- Suikerbekkie PV 1 and PV 2 WUL 2022

#### **Environmental Impact Assessments: Aquatic Assessments**

- Johannesburg Water - Biomonitoring on numerous urban rivers (including the Jukskei River, Harrington Spruit and Klip River) to obtain baseline data to detect disturbance and non-compliance of various construction activities on aquatic ecosystems. This includes the Northern Wastewater Treatment Works, Goudkoppies Wastewater Treatment Works, Bushkoppie Wastewater Treatment Works and Olifantsvlei Wastewater Treatment Works - 2008;
- Johannesburg Water - Zandspruit Sewage Spill: Investigation for the Northern Wastewater Treatment Works on foot from its effluent discharge point to the City of Johannesburg sampling point (J5). This was done to identify possible causes of higher dissolved oxygen levels at J5 compared to the control site DWJ27 in the Jukskei River - 2008
- Johannesburg Water - Zandspruit Pump Station Sewage Spill. Biomonitoring in the Klein Jukskei River above the pump station and below the pump station. Physical water quality variables were also taken while onsite - 2008;
- City of Johannesburg - Upper Klipspruit Catchment Framework: Determine any sources of pollution and to identify impacts or anthropogenic stresses on the upper Klipspruit system. This was done for improving both river systems for the 2010 Soccer World Cup. A comprehensive report was compiled called the "Sustainable Urban River Management Plan for the Upper Klipspruit Catchment". Co-author for the report and also compiled the water quality data - 2008;

<ul style="list-style-type: none"> <li>City of Johannesburg - Bruma Lake Rehabilitation: Undertaking the biomonitoring of the Jukskei River at the inlet to the Bruma Lake at UJ5 (DWA water sampling point) and below Bruma Lake at the DWA sampling site UJ6. The results were included as a specialist study for an environmental Impact assessment for the Rehabilitation of Bruma Lake - 2009.</li> <li>CASIDRA - Klein Boere - Romansrivier Aquatic Assessment to assist with the basic assessment report for the Kleinboere Vereniging - 2019</li> </ul>	
<b><u>Environmental Impact Assessments: Amendment Applications;</u></b>	
<ul style="list-style-type: none"> <li>Wilgeheuvel Ext 60 Amendment Application Phase 1 and Phase 2, GDARD, 2017;</li> <li>Strubensvallei x10 Amendment Application Phase 1, GDARD, 2017;</li> <li>TASEZ Tshwane SEZ, 2020-22</li> </ul>	
<b><u>Environmental Impact Assessments: International Projects</u></b>	
<ul style="list-style-type: none"> <li>Upgrade of the Notwane river bridge crossing at the Swartkopfontein Border Post between South Africa and Botswana, EIA, 2009.</li> <li>Zimbabwe Power Company, Mining and EIA for the supply of coal to the Hwange Coal fired power station, 2014</li> </ul>	
<b><u>Carbon Footprint / Section 24g</u></b>	
<ul style="list-style-type: none"> <li>Lanseria International Airport, Airport Carbon Accreditation, 2019</li> <li>S24G rectification application for eZulu Game Reserve, Eastern Cape, 2020 to current</li> </ul>	
<b><u>EDUCATION:</u></b>	
Rand Afrikaans University (2001-2003)	B.Sc.
Rand Afrikaans University (2004)	B.Sc. Honours
University of Johannesburg (2005-2007)	M.Sc.
<b><u>CAREER ENHANCING COURSES:</u></b>	
GDARD - 14, 15 April 2008	Basic Wetlands
Lexis Nexis Sandton - 12 October 2009	Lexis Nexis
FET Water - Dept. Water Affairs 08 March 2010	Risk Management of Aquifers
Strategic Environmental Focus- 13 August 2010	NEMA Legislation 2010
Dept. Water Affairs - 08, 09 September 2010	Section 21 c & i
ProjectLink - 20 & 21 June 2011	Microsoft Project Professional
Prowalco 6-8 June 2014	Engen Permit to Work
2014:	Health and Safety (Level 1 & 2 First Aid)
2014:	Firefighting
2004:	Advanced 4 x 4 driving course
2019:	Mine Closure and Case Law Development Workshop 20 June 2019 by Imbewu
<b><u>PROFESSIONAL AFFILIATIONS:</u></b>	

Registration No: 005636	Professional Ecological, Environmental and Zoological Scientist: South African Council for Natural Scientific Professions		
N/A	Member of the Zoological Society of Southern Africa		
N/A	Member of the International Association for Impact Assessment South Africa		
N/A	Member of the Water Institute for Southern Africa (MWISA)		
Registration No: 2019/181	Professional Environmental Assessment Practitioner with Environmental Assessment Practitioners of South Africa (EAPASA)		
<b><u>LANGUAGE:</u></b>			
<b>LANGUAGE</b>	<b>SPEAKING</b>	<b>READING</b>	<b>WRITING</b>
English	Fluent	Fluent	Fluent
Afrikaans	Fluent	Fluent	Fluent
<b><u>PUBLICATIONS:</u></b>			
<ul style="list-style-type: none"><li>• Retief, N.-R., Avenant-Oldewage, A., du Preez, H.H. 2006. The use of cestode parasites from the largemouth yellowfish, <i>Labeobarbus kimberleyensis</i> (Gilchrist and Thompson, 1913) in the Vaal Dam, South Africa as indicators of heavy metal bioaccumulation. <i>Physics and Chemistry of the Earth</i> 31, 840-847.</li><li>• Retief, N.-R., Avenant-Oldewage, A., du Preez, H.H. 2007. Ecological aspects of the occurrence of Asian tapeworm, <i>Bothriocephalus acheilognathi</i> Yamaguti, 1934 infection in the Largemouth yellowfish, <i>Labeobarbus kimberleyensis</i> Gilchrist and Thompson, 1913 in the Vaal Dam, South Africa. <i>Physics and Chemistry of the Earth</i> 32(15-18), 1384-1390.</li><li>• Retief, N.-R., Avenant-Oldewage, A., du Preez, H.H. 2009. Seasonal study on <i>Bothriocephalus</i> as indicator of metal pollution in yellowfish, South Africa. <i>Water SA</i> 35 (3) 315-322.</li></ul>			



## APPENDIX B - PLANT SPECIES LIST

Table 10-1: List of Least Concern Plant species within QDS 2730AB

Family	Taxon
Euphorbiaceae	<i>Acalypha depressinervia</i>
Euphorbiaceae	<i>Acalypha wilmsii</i>
Lamiaceae	<i>Acrotome hispida</i>
Asteraceae	<i>Adenanthellum osmitoides</i>
Asteraceae	<i>Afroaster hispidus</i>
	<i>Afroaster serrulatus</i>
Lamiaceae	<i>Ajuga ophrydis</i>
Asphodelaceae	<i>Aloe ecklonis</i>
Iridaceae	<i>Aristea torulosa</i>
Apocynaceae	<i>Asclepias aurea</i>
Apocynaceae	<i>Asclepias brevicuspis</i>
Apocynaceae	<i>Asclepias cucullata</i> subsp. <i>cucullata</i>
Apocynaceae	<i>Asclepias cultriformis</i>
Apocynaceae	<i>Asclepias eminens</i>
Apocynaceae	<i>Asclepias meyeriana</i>
Apocynaceae	<i>Asclepias multicaulis</i>
Asparagaceae	<i>Asparagus buehneri</i>
Asparagaceae	<i>Asparagus cooperi</i>
Asparagaceae	<i>Asparagus virgatus</i>
Apocynaceae	<i>Aspidoglossum dissimile</i>
Apocynaceae	<i>Aspidoglossum interruptum</i>
Apocynaceae	<i>Aspidoglossum ovalifolium</i>
Apocynaceae	<i>Aspidonepsis diploglossa</i>
Apocynaceae	<i>Aspidonepsis reenensis</i>
Aspleniaceae	<i>Asplenium adiantum-nigrum</i> var. <i>adiantum-nigrum</i>
Aspleniaceae	<i>Asplenium varians</i> subsp. <i>fimbriatum</i>
Asteraceae	<i>Berkheya echinacea</i> subsp. <i>echinacea</i>
Asteraceae	<i>Berkheya insignis</i>
Asteraceae	<i>Berkheya radula</i>
Asteraceae	<i>Berkheya rhapontica</i> subsp. <i>rhapontica</i>
Asteraceae	<i>Berkheya setifera</i>
Asteraceae	<i>Berkheya speciosa</i> subsp. <i>lanceolata</i>
Blechnaceae	<i>Blechnum australe</i> subsp. <i>australe</i>
Stilbaceae	<i>Bowkeria citrina</i>
Poaceae	<i>Brachiaria brizantha</i>
Scrophulariaceae	<i>Buddleja auriculata</i>
Cyperaceae	<i>Bulbostylis hispidula</i> subsp. <i>pyriformis</i>
Cyperaceae	<i>Bulbostylis humilis</i>
Fabaceae	<i>Calpurnia sericea</i>
Rubiaceae	<i>Cephalanthus natalensis</i>
Dipsacaceae	<i>Cephalaria zeyheriana</i>

Family	Taxon
Apocynaceae	<i>Ceropegia meyeri</i>
Pteridaceae	<i>Cheilanthes pentagona</i>
Pteridaceae	<i>Cheilanthes quadripinnata</i>
Pteridaceae	<i>Cheilanthes viridis</i> var. <i>glauca</i>
Pteridaceae	<i>Cheilanthes viridis</i> var. <i>viridis</i>
Agavaceae	<i>Chlorophytum fasciculatum</i>
Vitaceae	<i>Cissus diversilobata</i>
Cleomaceae	<i>Cleome monophylla</i>
Peraceae	<i>Clutia affinis</i>
Peraceae	<i>Clutia hirsuta</i> var. <i>hirsuta</i>
Peraceae	<i>Clutia monticola</i> var. <i>monticola</i>
Colchicaceae	<i>Colchicum melanthioides</i> subsp. <i>transvaalense</i>
Combretaceae	<i>Combretum kraussii</i>
Commelinaceae	<i>Commelina africana</i> var. <i>krebsiana</i>
Burseraceae	<i>Commiphora neglecta</i>
Campanulaceae	<i>Craterocapsa tarsodes</i>
Poaceae	<i>Ctenium concinnum</i>
Poaceae	<i>Ctenium concinnum</i>
Poaceae	<i>Ctenium concinnum</i>
Cucurbitaceae	<i>Cucumis hirsutus</i>
Cucurbitaceae	<i>Cucumis hirsutus</i>
Cucurbitaceae	<i>Cucumis hirsutus</i>
Commelinaceae	<i>Cyanotis lapidosa</i>
Commelinaceae	<i>Cyanotis speciosa</i>
Orobanchaceae	<i>Cycnium tubulosum</i> subsp. <i>tubulosum</i>
Boraginaceae	<i>Cynoglossum lanceolatum</i>
Cyperaceae	<i>Cyperus compressus</i>
Cyperaceae	<i>Cyperus congestus</i>
Cyperaceae	<i>Cyperus congestus</i>
Cyperaceae	<i>Cyperus denudatus</i>
Cyperaceae	<i>Cyperus denudatus</i>
Cyperaceae	<i>Cyperus difformis</i>
Cyperaceae	<i>Cyperus obtusiflorus</i> var. <i>obtusiflorus</i>
Lobeliaceae	<i>Cyphia elata</i>
Lobeliaceae	<i>Cyphia elata</i>
Amaryllidaceae	<i>Cyrtanthus breviflorus</i>
Thymelaeaceae	<i>Dais cotinifolia</i>
Caryophyllaceae	<i>Dianthus transvaalensis</i>
Scrophulariaceae	<i>Diclis rotundifolia</i>
Asteraceae	<i>Dicoma anomala</i> subsp. <i>anomala</i>
Asteraceae	<i>Dicoma anomala</i> subsp. <i>anomala</i>
Iridaceae	<i>Dierama insigne</i>
Iridaceae	<i>Dierama insigne</i>
Iridaceae	<i>Dierama pauciflorum</i>
Iridaceae	<i>Dietes iridioides</i>
Ebenaceae	<i>Diospyros austroafricana</i> var. <i>rubriflora</i>

Family	Taxon
Ebenaceae	<i>Diospyros lycioides</i> subsp. <i>guerkei</i>
Hyacinthaceae	<i>Dipcadi brevifolium</i>
Hyacinthaceae	<i>Dipcadi viride</i>
Fabaceae	<i>Dolichos linearis</i>
Dryopteridaceae	<i>Dryopteris athamantica</i>
Dryopteridaceae	<i>Dryopteris pentheri</i>
Cyperaceae	<i>Eleocharis limosa</i>
Gentianaceae	<i>Enicostema axillare</i> subsp. <i>axillare</i>
Equisetaceae	<i>Equisetum ramosissimum</i> subsp. <i>ramosissimum</i>
Poaceae	<i>Eragrostis capensis</i>
Poaceae	<i>Eragrostis curvula</i>
Poaceae	<i>Eragrostis racemosa</i>
Ericaceae	<i>Erica caffrorum</i> var. <i>caffrorum</i>
Ericaceae	<i>Erica reenensis</i>
Eriocaulaceae	<i>Eriocaulon sonderianum</i>
Fabaceae	<i>Eriosema distinctum</i>
Fabaceae	<i>Eriosema kraussianum</i>
Poaceae	<i>Eulalia villosa</i>
Orchidaceae	<i>Eulophia hians</i> var. <i>nutans</i>
Euphorbiaceae	<i>Euphorbia clavarioides</i>
Euphorbiaceae	<i>Euphorbia natalensis</i>
Asteraceae	<i>Euryops gilfillanii</i>
Asteraceae	<i>Euryops transvaalensis</i> subsp. <i>setilobus</i>
Asteraceae	<i>Euryops transvaalensis</i> subsp. <i>transvaalensis</i>
Poaceae	<i>Festuca scabra</i>
Cyperaceae	<i>Fimbristylis complanata</i>
Iridaceae	<i>Freesia laxa</i> subsp. <i>laxa</i>
Asteraceae	<i>Garuleum woodii</i>
Asteraceae	<i>Gerbera viridifolia</i>
Iridaceae	<i>Gladiolus appendiculatus</i>
Iridaceae	<i>Gladiolus crassifolius</i>
Colchicaceae	<i>Gloriosa modesta</i>
Melanthaceae	<i>Greyia radlkoferi</i>
Melanthaceae	<i>Greyia sutherlandii</i>
Asteraceae	<i>Gymnanthemum corymbosum</i>
Celastraceae	<i>Gymnosporia buxifolia</i>
Orchidaceae	<i>Habenaria dregeana</i>
Orchidaceae	<i>Habenaria epipactidea</i>
Asteraceae	<i>Helichrysum adenocarpum</i> subsp. <i>adenocarpum</i>
Asteraceae	<i>Helichrysum athrixiifolium</i>
Asteraceae	<i>Helichrysum auronitens</i>
Asteraceae	<i>Helichrysum callicomum</i>
Asteraceae	<i>Helichrysum dregeanum</i>
Asteraceae	<i>Helichrysum herbaceum</i>
Asteraceae	<i>Helichrysum melanacme</i>
Asteraceae	<i>Helichrysum monticola</i>

Family	Taxon
Asteraceae	<i>Helichrysum nudifolium</i> var. <i>nudifolium</i>
Asteraceae	<i>Helichrysum opacum</i>
Malvaceae	<i>Hermannia cristata</i>
Malvaceae	<i>Hermannia depressa</i>
Malvaceae	<i>Hermannia oblongifolia</i>
Iridaceae	<i>Hesperantha coccinea</i>
Asteraceae	<i>Heteromma krookii</i>
Malvaceae	<i>Hibiscus aethiopicus</i> var. <i>ovatus</i>
Malvaceae	<i>Hibiscus microcarpus</i>
Asteraceae	<i>Hilliardiella aristata</i>
Asteraceae	<i>Hilliardiella hirsuta</i>
Asteraceae	<i>Hilliardiella nudicaulis</i>
Poaceae	<i>Hyparrhenia anamesa</i>
Poaceae	<i>Hyparrhenia filipendula</i> var. <i>filipendula</i>
Hypericaceae	<i>Hypericum aethiopicum</i> subsp. <i>aethiopicum</i>
Hypericaceae	<i>Hypericum aethiopicum</i> subsp. <i>sonderi</i>
Acanthaceae	<i>Hypoestes aristata</i> var. <i>alba</i>
Acanthaceae	<i>Hypoestes forskaolii</i>
Hypoxidaceae	<i>Hypoxis acuminata</i>
Hypoxidaceae	<i>Hypoxis filiformis</i>
Hypoxidaceae	<i>Hypoxis rigidula</i> var. <i>rigidula</i>
Convolvulaceae	<i>Ipomoea crassipes</i> var. <i>crassipes</i>
Convolvulaceae	<i>Ipomoea oblongata</i>
Cyperaceae	<i>Isolepis sepulcralis</i>
Scrophulariaceae	<i>Jamesbrittenia silenoides</i>
Juncaceae	<i>Juncus dregeanus</i> subsp. <i>dregeanus</i>
Juncaceae	<i>Juncus oxycarpus</i>
Acanthaceae	<i>Justicia anagalloides</i>
Asphodelaceae	<i>Kniphofia albescens</i>
Asphodelaceae	<i>Kniphofia laxiflora</i>
Asphodelaceae	<i>Kniphofia linearifolia</i>
Poaceae	<i>Koeleria capensis</i>
Cyperaceae	<i>Kyllinga erecta</i> var. <i>erecta</i>
Thymelaeaceae	<i>Lasiosiphon burchellii</i>
Thymelaeaceae	<i>Lasiosiphon capitatus</i>
Hyacinthaceae	<i>Ledebouria cooperi</i>
Hyacinthaceae	<i>Ledebouria marginata</i>
Hyacinthaceae	<i>Ledebouria monophylla</i>
Hyacinthaceae	<i>Ledebouria revoluta</i>
Hyacinthaceae	<i>Ledebouria sandersonii</i>
Cyperaceae	<i>Lipocarpha nana</i>
Boraginaceae	<i>Lithospermum cinereum</i>
Poaceae	<i>Lophacme digitata</i>
Asteraceae	<i>Lopholaena segmentata</i>
Asteraceae	<i>Macledium zeyheri</i> subsp. <i>zeyheri</i>
Celastraceae	<i>Maytenus acuminata</i> var. <i>acuminata</i>

Family	Taxon
Celastraceae	<i>Maytenus undata</i>
Melanthaceae	<i>Melianthus dregeanus</i> subsp. <i>insignis</i>
Fabaceae	<i>Melolobium aethiopicum</i>
Fabaceae	<i>Melolobium obcordatum</i>
Apocynaceae	<i>Miraglossum pulchellum</i>
Poaceae	<i>Miscanthus junceus</i>
Anemiaceae	<i>Mohria vestita</i>
Geraniaceae	<i>Monsonia angustifolia</i>
Iridaceae	<i>Moraea moggii</i> subsp. <i>albescens</i>
Polygalaceae	<i>Muraltia saxicola</i>
Scrophulariaceae	<i>Nemesia caerulea</i>
Asteraceae	<i>Nidorella anomala</i>
Asteraceae	<i>Nolletia rarifolia</i>
Stilbaceae	<i>Nuxia congesta</i>
Ochnaceae	<i>Ochna serrulata</i>
Hyacinthaceae	<i>Ornithogalum paludosum</i>
Orchidaceae	<i>Orthochilus welwitschii</i>
Fabaceae	<i>Otholobium nigricans</i>
Oxalidaceae	<i>Oxalis obliquifolia</i>
Apocynaceae	<i>Pachycarpus campanulatus</i> var. <i>campanulatus</i>
Apocynaceae	<i>Pachycarpus scaber</i>
Poaceae	<i>Panicum aequinerve</i>
Poaceae	<i>Panicum ecklonii</i>
Poaceae	<i>Paspalum distichum</i>
Rubiaceae	<i>Pavetta gardeniifolia</i> var. <i>gardeniifolia</i>
Malvaceae	<i>Pavonia columella</i>
Fabaceae	<i>Pearsonia grandifolia</i> subsp. <i>grandifolia</i>
Fabaceae	<i>Pearsonia sessilifolia</i> subsp. <i>sessilifolia</i>
Geraniaceae	<i>Pelargonium luridum</i>
Pteridaceae	<i>Pellaea calomelanos</i> var. <i>calomelanos</i>
Phyllanthaceae	<i>Phyllanthus glaucophyllus</i>
Phyllanthaceae	<i>Phyllanthus maderaspatensis</i>
Apiaceae	<i>Pimpinella caffra</i>
Podocarpaceae	<i>Podocarpus latifolius</i>
Poaceae	<i>Pogonarthria squarrosa</i>
Caryophyllaceae	<i>Pollichia campestris</i>
Asteraceae	<i>Polydora angustifolia</i>
Polygalaceae	<i>Polygala gracilentia</i>
Polygalaceae	<i>Polygala hottentotta</i>
Proteaceae	<i>Protea subvestita</i>
Rubiaceae	<i>Psydrax obovata</i> subsp. <i>obovata</i>
Pteridaceae	<i>Pteris cretica</i>
Celastraceae	<i>Pterocelastrus echinatus</i>
Orchidaceae	<i>Pterygodium dracomontanum</i>
Lamiaceae	<i>Pycnostachys reticulata</i>
Cyperaceae	<i>Pycnus flavescens</i>



Family	Taxon
Cyperaceae	<i>Pycnus nitidus</i>
Ranunculaceae	<i>Ranunculus multifidus</i>
Apocynaceae	<i>Raphionacme galpinii</i>
Poaceae	<i>Rendlia altera</i>
Hypoxidaceae	<i>Rhodohypoxis baurii</i> var. <i>baurii</i>
Fabaceae	<i>Rhynchosia monophylla</i>
Cyperaceae	<i>Rhynchospora brownii</i>
Poaceae	<i>Rottboellia cochinchinensis</i>
Rosaceae	<i>Rubus rigidus</i>
Polygonaceae	<i>Rumex sagittatus</i>
Polygonaceae	<i>Rumex woodii</i>
Lamiaceae	<i>Salvia runcinata</i>
Colchicaceae	<i>Sandersonia aurantiaca</i>
Orchidaceae	<i>Satyrium cristatum</i> var. <i>longilabiatum</i>
Orchidaceae	<i>Satyrium hallackii</i> subsp. <i>ocellatum</i>
Orchidaceae	<i>Satyrium neglectum</i> subsp. <i>neglectum</i> var. <i>neglectum</i>
Dipsacaceae	<i>Scabiosa columbaria</i>
Apocynaceae	<i>Schizoglossum atropurpureum</i> subsp. <i>atropurpureum</i>
Cyperaceae	<i>Schoenoplectus brachyceras</i>
Cyperaceae	<i>Schoenoplectus decipiens</i>
Cyperaceae	<i>Schoenoplectus paludicola</i>
Anacardiaceae	<i>Searsia dentata</i>
Anacardiaceae	<i>Searsia discolor</i>
Anacardiaceae	<i>Searsia pyroides</i> var. <i>pyroides</i>
Anacardiaceae	<i>Searsia tomentosa</i>
Anacardiaceae	<i>Searsia transvaalensis</i>
Gentianaceae	<i>Sebaea leiostyla</i>
Gentianaceae	<i>Sebaea natalensis</i>
Selaginellaceae	<i>Selaginella mittenii</i>
Asteraceae	<i>Senecio achilleifolius</i>
Asteraceae	<i>Senecio affinis</i>
Asteraceae	<i>Senecio barbatus</i>
Asteraceae	<i>Senecio deltoideus</i>
Asteraceae	<i>Senecio glaberrimus</i>
Asteraceae	<i>Senecio glanduloso-pilosus</i>
Asteraceae	<i>Senecio inaequidens</i>
Asteraceae	<i>Senecio lydenburgensis</i>
Asteraceae	<i>Senecio madagascariensis</i>
Asteraceae	<i>Senecio oxyriifolius</i> subsp. <i>oxyriifolius</i>
Asteraceae	<i>Senecio polyodon</i> var. <i>polyodon</i>
Asteraceae	<i>Senecio scitus</i>
Malvaceae	<i>Sida alba</i>
Malvaceae	<i>Sida dregei</i>
Caryophyllaceae	<i>Silene undulata</i> subsp. <i>undulata</i>
Apocynaceae	<i>Sisyranthus huttoniae</i>
Apocynaceae	<i>Sisyranthus imberbis</i>

Family	Taxon
Solanaceae	<i>Solanum lichtensteinii</i>
Asteraceae	<i>Sonchus nanus</i>
Lamiaceae	<i>Stachys natalensis</i> var. <i>natalensis</i>
Lamiaceae	<i>Stachys sessilis</i>
Gesneriaceae	<i>Streptocarpus pentherianus</i>
Lamiaceae	<i>Syncolostemon concinnus</i>
Lamiaceae	<i>Syncolostemon parviflorus</i> var. <i>parviflorus</i>
Lamiaceae	<i>Syncolostemon pretoriae</i>
Fabaceae	<i>Tephrosia multijuga</i>
Fabaceae	<i>Tephrosia natalensis</i> subsp. <i>natalensis</i>
Santalaceae	<i>Thesium costatum</i> var. <i>costatum</i>
Santalaceae	<i>Thesium racemosum</i>
Acanthaceae	<i>Thunbergia atriplicifolia</i>
Asphodelaceae	<i>Trachyandra saltii</i> var. <i>saltii</i>
Juncaginaceae	<i>Triglochin milnei</i>
Iridaceae	<i>Tritonia disticha</i> subsp. <i>rubrolucens</i>
Asteraceae	<i>Ursinia alpina</i>
Fabaceae	<i>Vachellia karroo</i>
Valerianaceae	<i>Valeriana capensis</i> var. <i>capensis</i>
Rubiaceae	<i>Vangueria macrocalyx</i>
Rubiaceae	<i>Vangueria thamnus</i>
Fabaceae	<i>Vigna oblongifolia</i> var. <i>oblongifolia</i>
Campanulaceae	<i>Wahlenbergia huttonii</i>
Iridaceae	<i>Watsonia pulchra</i>
Iridaceae	<i>Watsonia watsonioides</i>
Woodsiaceae	<i>Woodsia angolensis</i>
Woodsiaceae	<i>Woodsia burgessiana</i>
Xyridaceae	<i>Xyris obscura</i>
Apocynaceae	<i>Xysmalobium involucreatum</i>
Apocynaceae	<i>Xysmalobium parviflorum</i>
Scrophulariaceae	<i>Zaluzianskya elongata</i>
Rhamnaceae	<i>Ziziphus zeyheriana</i>
Fabaceae	<i>Zornia milneana</i>

Table 10-2: List of Vulnerable Red Listed Plant Species under QDS 2730AB

Family	Taxon
Asphodelaceae	<i>Aloe kniphofioides</i>
Araceae	<i>Zantedeschia pentlandii</i>
Fabaceae	<i>Indigofera hybrida</i>

Table 10-3: List of Near Threatened Red Listed Plant Species under QDS 2730AB

Family	Taxon
Proteaceae	<i>Protea parvula</i>
Hyacinthaceae	<i>Merwillia plumbea</i>

## **APPENDIX E-2: WETLAND ASSESSMENT**



2 Impunzi Place  
Kloof  
KwaZulu-Natal  
3640

Tel: +27 83 556 4087  
Email: [info@ecolinksa.co.za](mailto:info@ecolinksa.co.za)

**WETLAND AND AQUATIC ASSESSMENT FOR  
THE WASTEWATER TREATMENT WORKS AND  
DISCHARGE PIPELINE ASSOCIATED WITH THE  
KANGRA COAL (PTY) LTD MAQUASA MINE  
NEAR PIET RETIEF, MPUMALANGA PROVINCE**

**Version – final**

**September 2024**

**Project Number: 24-0020**

**Client Reference:**



---

**WETLAND AND AQUATIC ASSESSMENT FOR THE WASTEWATER TREATMENT  
WORKS AND DISCHARGE PIPELINE ASSOCIATED WITH THE KANGRA COAL (PTY)  
LTD MAQUASA MINE NEAR PIET RETIEF, MPUMALANGA PROVINCE**

**Version – final**

**September 2024**

**DOCUMENT ISSUE STATUS**

<b>Report Issue</b>	Final		
<b>Ecolink Reference Number</b>	24-0020		
<b>Client Reference</b>			
<b>Title</b>	<b>WETLAND AND AQUATIC ASSESSMENT FOR THE WASTEWATER TREATMENT WORKS AND DISCHARGE PIPELINE ASSOCIATED WITH THE KANGRA COAL (PTY) LTD MAQUASA MINE NEAR PIET RETIEF, MPUMALANGA PROVINCE</b>		
	<b>Name</b>	<b>Signature</b>	<b>Date</b>
<b>Author</b>	Magnus van Rooyen		September 2024
<b>Director</b>	Magnus van Rooyen		September 2024



## CONTENTS PAGE

<b>1</b>	<b>INTRODUCTION .....</b>	<b>5</b>
<b>2</b>	<b>PROJECT BACKGROUND .....</b>	<b>5</b>
2.1	PROJECT LOCATION AND EXTENT .....	5
2.2	PROJECT DESCRIPTION .....	7
<b>3</b>	<b>APPLICABLE SOUTH AFRICAN LEGISLATION .....</b>	<b>9</b>
3.1	APPLICABLE NATIONAL LEGISLATION .....	9
<b>4</b>	<b>TERMS OF REFERENCE.....</b>	<b>11</b>
<b>5</b>	<b>ASSUMPTIONS AND KNOWLEDGE GAPS .....</b>	<b>12</b>
<b>6</b>	<b>REPORTING CONDITIONS .....</b>	<b>13</b>
<b>7</b>	<b>EXPERTISE OF THE SPECIALIST .....</b>	<b>14</b>
<b>8</b>	<b>METHODOLOGY .....</b>	<b>14</b>
<b>9</b>	<b>DESCRIPTION OF THE STUDY SITE .....</b>	<b>21</b>
9.1	CLIMATE .....	21
9.3	TOPOGRAPHY.....	23
9.4	LAND COVER AND LAND USE .....	24
<b>10</b>	<b>DESKTOP ASSESSMENT FINDINGS .....</b>	<b>25</b>
10.1	STUDY SITE DEFINITION.....	25
<b>11</b>	<b>FIELD ASSESSMENT FINDINGS .....</b>	<b>31</b>
11.1	IDENTIFICATION, DELINEATION AND MAPPING OF AQUATIC FEATURES .....	32
11.2	AQUATIC FEATURES FUNCTIONAL ASSESSMENT .....	34
11.3	DETERMINING THE PRESENT ECOLOGICAL STATE OF AN AQUATIC FEATURE.....	37
<b>12</b>	<b>IMPACT ASSESSMENT .....</b>	<b>40</b>
<b>13</b>	<b>MANAGEMENT AND MITIGATION MEASURES.....</b>	<b>47</b>
<b>14</b>	<b>MONITORING REQUIREMENTS .....</b>	<b>47</b>
<b>15</b>	<b>CONCLUSION AND SPECIALIST REASONED OPINION .....</b>	<b>47</b>

## LIST OF FIGURES

Figure 2-1:	Location of the Maquasa Mine (map provided by GCS) .....	6
Figure 2-2:	Layout and extent of the WWTW and associated pipelines .....	8
Figure 2-3:	Layout of the WWTW (note that PCD 1, 2 and 3 are existing and approved) .....	9
Figure 8-1:	Cross section through a typical drainage basin (www.pngegg.com).....	15
Figure 9-1:	Average climatic conditions of the town of Piet Retief (source www.meteoblue.com) .....	21
Figure 9-2:	Extent of the Eastern Highveld Grassland (Gm12).....	22
Figure 10-1:	Extent of the study site, shown in yellow around the project site .....	26
Figure 10-2:	Results for the Aquatic Theme as per the DFFE Screening Tool.....	27
Figure 10-3:	Location of the NFEPA Rivers identified in the NFEPA Database for Quaternary Catchment W51B.....	28
Figure 10-4:	Location of the wetland features identified in the NFEPA Dataset (shown in green) in relation to a 500m radius (shown in yellow) of the project site .....	29
Figure 10-5:	Location of the wetland feature identified in the SAIIAE Dataset (shown in blue) in relation to a 500m radius (shown in yellow) of the project site .....	30
Figure 10-6:	Location of the wetland feature identified in the MPHG Wetland Dataset (2015), shown in orange, in relation to a 500m radius (shown in yellow) of the project site .....	31
Figure 11-1:	Wetland classification as per SANBI guideline (Ollis <i>et al.</i> 2013).....	32
Figure 11-2:	Location of the wetland features identified during the field assessment (in blue) within a 500m radius (in yellow) of the project site .....	33
Figure 11-3:	Conceptual illustration of a Seep wetland, showing the typical landscape setting and the dominant inputs, throughputs and outputs of water (Ollis <i>et al.</i> 2013) .....	34

Figure 11-4: Conceptual illustration of a Unchannelled Valley Bottom wetland showing the typical landscape setting and the dominant inputs, throughputs and outputs of water (Ollis <i>et al.</i> 2013).....	35
Figure 11-5: Conceptual illustration of a Channelled Valley Bottom wetland showing the typical landscape setting and the dominant inputs, throughputs and outputs of water (Ollis <i>et al.</i> 2013) .....	36
Figure 11-6: Location and extent of the applicable 40m construction buffer (in red) around the wetland within the study site .....	39
Figure 11-7: Location and extent of the applicable 20m operational buffer (in purple) around the wetland features within the study site .....	40

## LIST OF TABLES

Table 3-1: Applicable National Legislation .....	9
Table 8-1: Wetland hydrogeomorphic (HGM) types typically supporting inland wetlands in South Africa (Ollis <i>et al.</i> , 2013).....	15
Table 8-2: Ecoservices rating of the probable extent to which a benefit is being supplied ....	19
Table 8-3: The magnitude of impacts on wetland functionality (Macfarlane <i>et al.</i> , 2008) .....	20
Table 8-4: Definitions of the PES categories (Macfarlane <i>et al.</i> , 2008) .....	20
Table 10-1: Desktop hydrological characteristics of the study site .....	27
Table 11-1: Ecosystem service provision by the Channelled Valley Bottom Wetlands associated with the project site.....	36
Table 11-2: Present Ecological State (PES) of the system .....	37
Table 11-3: Ecological importance and sensitivity of the aquatic system .....	38
Table 12-1: Construction phase impacts associated with the Maquasa Mine project .....	41
Table 12-2: Operational phase impacts associated with the Maquasa Mine project .....	44

## LIST OF PLATES

Plate 9-1: View of the vegetation, on and surrounding the project site .....	23
Plate 9-2: View of the topography of the surrounding areas, looking in a southerly direction towards the Heyshope Dam .....	24
Plate 9-3: View of the mine access road and conveyor system associated with the mining operations .....	25

## Declaration

I, Magnus van Rooyen, in my capacity as a specialist consultant, hereby declare that I:

- Act as an independent consultant;
- Do not have any financial interest in the undertaking of the activity, other than remuneration for the work performed in terms of the National Environmental Management Act (Act No. 107 of 1998);
- Have and will not have vested interest in the proposed activity proceeding;
- Have no, and will not engage in, conflicting interests in the undertaking of the activity;
- Undertake to disclose, to the competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the National Environmental Management Act (Act No. 107 of 1998);
- As a registered member of the South African Council for Natural Scientific Professions, will undertake my profession in accordance with the Code of Conduct of the Council, as well as any other societies to which I am a member;
- Based on information provided to me by the project proponent and in addition to information obtained during the course of this study, have presented the results and conclusion within the associated document to the best of my professional ability; and
- Reserve the right to modify aspects pertaining to the present investigation should additional information become available through ongoing research and/or further work in this field.



Magnus van Rooyen (Pr.Sci.Nat)  
SACNASP reg. no. 400335/11

September 2024  
Date

# **WETLAND AND AQUATIC ASSESSMENT FOR THE WASTEWATER TREATMENT WORKS AND DISCHARGE PIPELINE ASSOCIATED WITH THE KANGRA COAL (PTY) LTD MAQUASA MINE NEAR PIET RETIEF, MPUMALANGA PROVINCE**

## **1 INTRODUCTION**

Ecolink Consulting has been appointed by the GCS (Pty) Ltd to conduct a Wetland and Aquatic Assessment associated with the proposed Wastewater Treatment Works (WWTW) and discharge pipeline associated with the Kangra Coal (Pty) Ltd Maquasa Mine near the town of Piet Retief in the Mpumalanga Province.

The assessment will be submitted in support of the Waste Management Licence Application in accordance with the National Environmental Management: Waste Act (Act No. 59 of 2008), the Application for Environmental Authorisation in accordance with the National Environmental Management Act (Act No. 107 of 1998): Environmental Impact Assessment Regulations (2014), as amended and the Water Use Licence Application in accordance with the National Water Act (Act No. 36 of 1998).

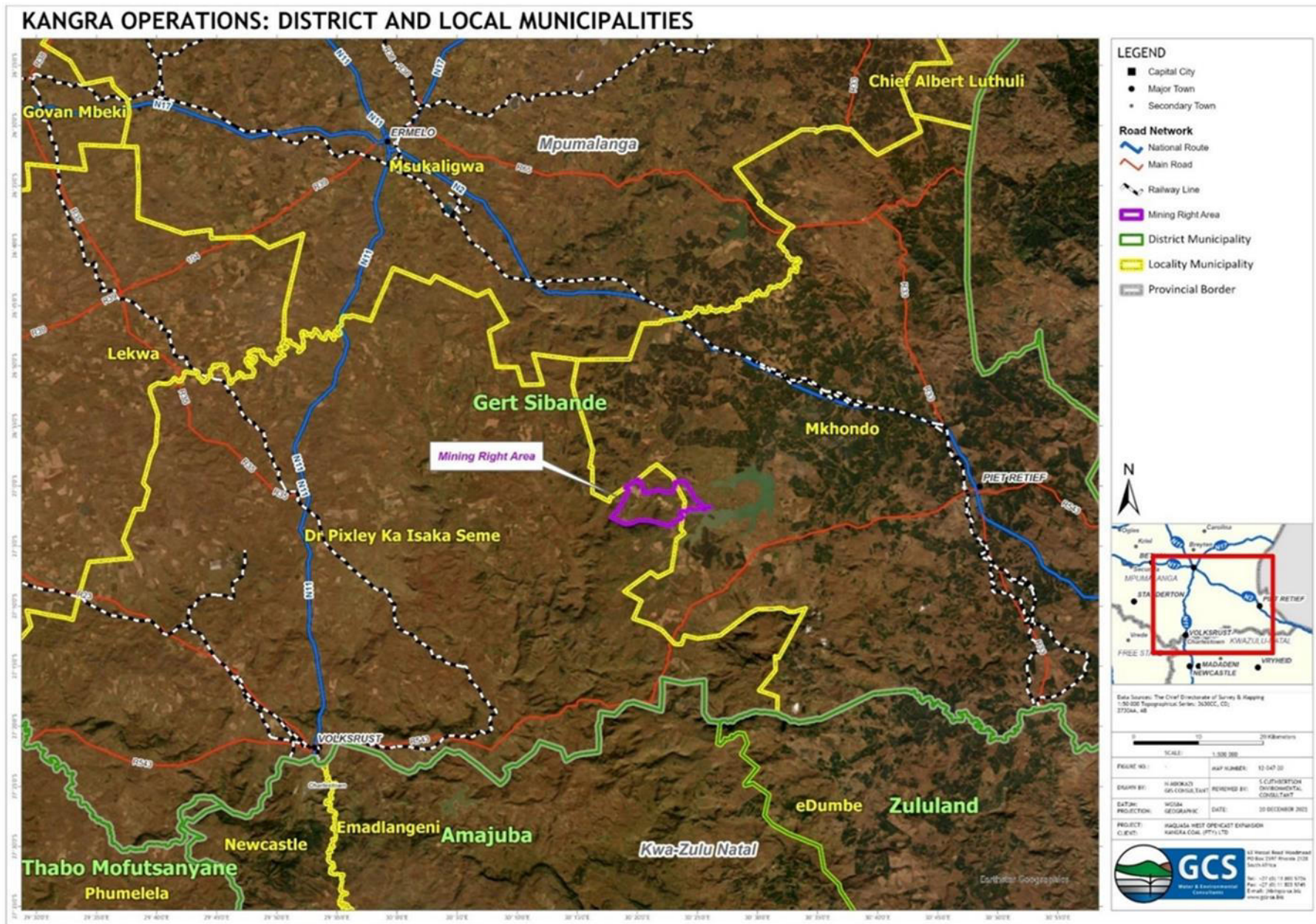
## **2 PROJECT BACKGROUND**

### **2.1 Project location and extent**

Kangra Coal (Pty) Ltd's Maquasa mining operation is located near Piet Retief within the Mpumalanga Province. The mining area is situated approximately 45km west of Piet Retief and just off the N2 national road on a secondary road leading towards the Heyshope Dam. The Maquasa mining operations is made of the following mining areas:

- Maquasa East;
- Maquasa West; and
- Nooitgesien.

The location of the Maquasa Mine is provided in Figure 2-1.





## 2.2 Project description

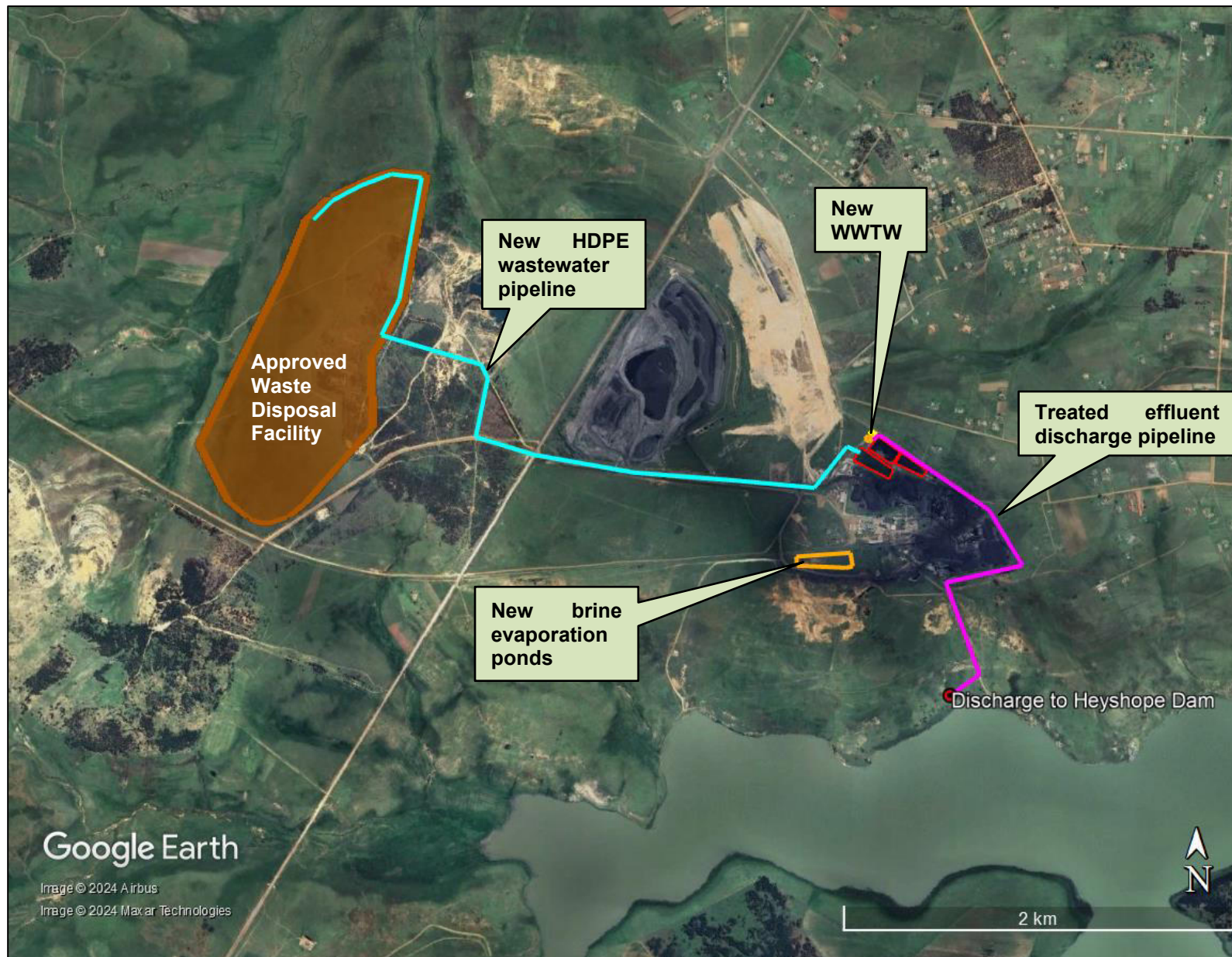
All the mining activities are undertaken and authorised under Mining Right (MR) MP30/5/1/23/2/1/133EM from the Department of Mineral Resources and Energy (DMRE).

All mining and project related infrastructure is located at Maquasa East and includes a coal washing plant and associated infrastructure. This plant is used for the processing of all coal mined from Maquasa West and the Nooitgesien opencast mining area. No mining is taking place at Maquasa East as all the coal reserves have already been mined.

The following existing infrastructure is located at Maquasa East:

- Offices;
- Workshop and ancillary buildings;
- Existing discard dump;
- Beneficiation plant;
- ENPROTEC plant;
- Diesel storage facilities;
- Dirty water containment facilities;
- Maquasa East Adit;
- Haul roads;
- Powerlines;
- Conveyors and associated service roads (transporting mined coal to the Maquasa East processing plant);
- Access roads;
- Pipeline (transporting water to the Maquasa East underground storage area);
- Crushers;
- Washing and screening plant; and
- Overburden and stockpile (i.e. topsoil, run of mine ore, product) dumps.

Kangra intends to construct a wastewater treatment works (see Figure 2-3), a HDPE pipeline transporting waste water from the approved Waste Disposal Facility, a treated effluent discharge pipeline, treated effluent discharge point on the Heyshope Dam and brine evaporation ponds at their Maquasa East operations. This new infrastructure forms the infrastructure focus of this assessment. The location and extent of the infrastructure is provided in Figure 2-2. Please note that the Waste Disposal Facility is authorised in accordance with an existing approval and not subject to this assessment.



**Figure 2-2: Layout and extent of the WWTW and associated pipelines**

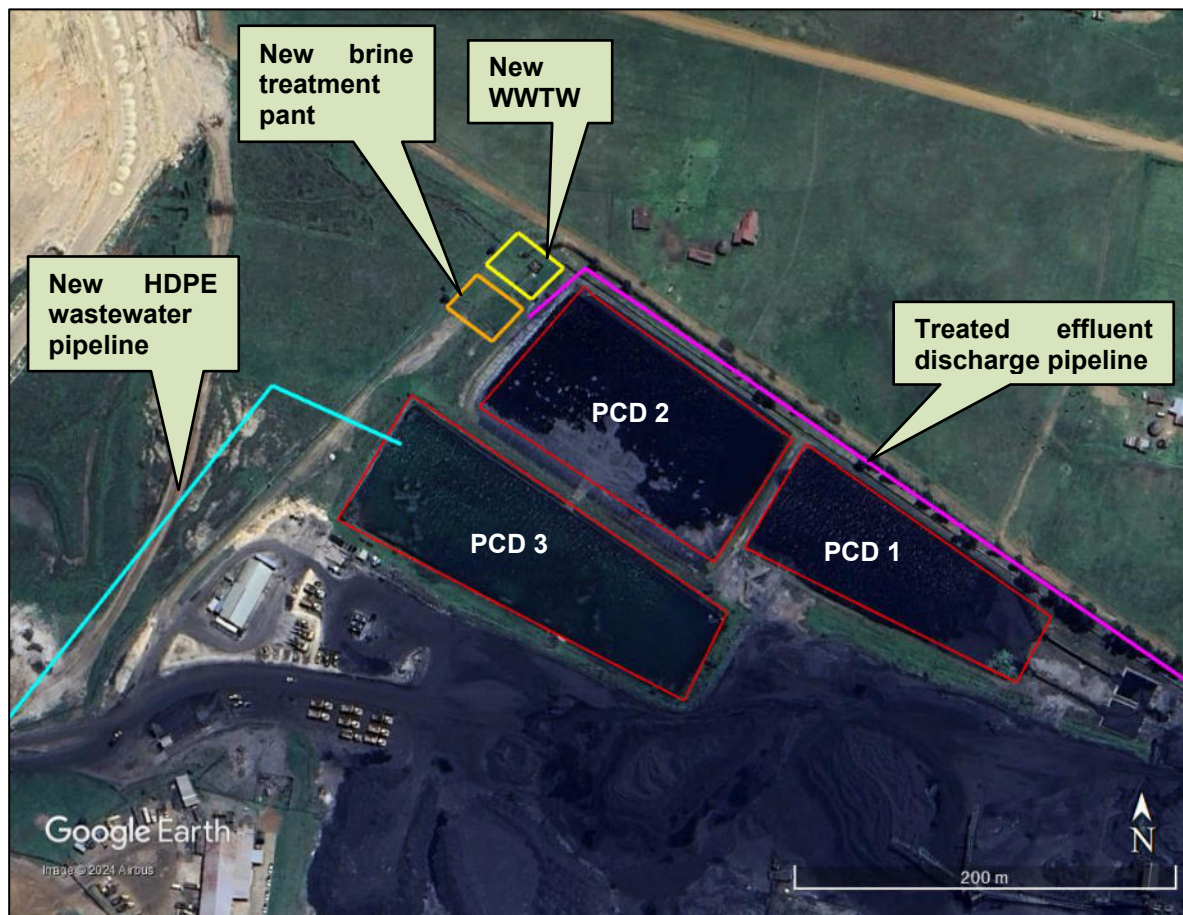


Figure 2-3: Layout of the WWTW (note that PCD 1, 2 and 3 are existing and approved)

### 3 APPLICABLE SOUTH AFRICAN LEGISLATION

The national and provincial legislation briefly described in this section relates directly with the legal aspects associated with the biodiversity associated with the project.

#### 3.1 Applicable National Legislation

The project applicable environmental related National Legislation is provided in Table 3-1.

Table 3-1: Applicable National Legislation

Legislation	Description
<b>Constitution of the Republic of South Africa (Act No. 108 of 1996)</b>	According to the South African Constitution, South African citizens have the right to have the environment protected for the benefit of the present and future generations.
<b>Conservation of Agricultural Resources Act (Act No. 43 of 1983)</b>	This Act includes the use and protection of land, soil, wetlands and vegetation and the control of weeds and invader plants. In the regulations published in 1984 under the Act, which declared approximately 50 plant species as “weeds” or “invader plants”. This list was further expanded on 30 March 2001 to now contain a comprehensive list of declared weed and invader plant species.
<b>White Paper on Environmental Management Policy for South Africa (1998)</b>	Through this Policy, the government of South Africa commits to give effect to the many rights in the Constitution that relate to the environment.



Legislation	Description
<b>National Veld and Forest Fire Act (Act No. 101 of 1998)</b>	The purpose of the Act is to prevent and combat veld fires in the country. The Act was amended by the National Forest and Fire Laws Amendment Act (Act No. 12 of 2001).
<b>National Water Act (Act No. 36 of 1998)</b>	This Act recognises that water is a scarce and unevenly distributed natural resource that should be equitably utilised in a sustainable manner. The Act ensures that water resources are protected, used, developed, conserved and controlled in ways that take into account a range of needs and obligations, including the need to “protect aquatic and associated ecosystems and their biological diversity”. The Act further specifies the water uses that must be authorised and it details the authorisation procedures as well as the minimum requirements for evaluation and decision-making by the relevant authority.
<b>National Forests Act (Act No. 84 of 1998)</b>	An objective of the Act is to provide special measures for the protection of certain forest and tree species, and to promote the sustainable use of forests for environmental, economic, educational, recreational, cultural, health and spiritual purposes. In terms of Section 15(1) of the Act, forest trees or Protected Tree Species may not be cut, disturbed, damaged, destroyed and their products may not be possessed, collected, removed, transported, exported, donated, purchased or sold – except under license granted by the relevant authority. Government Notice 35648 of 2012 provides the latest List of Protected Tree Species within the borders of South Africa.
<b>National Environmental Management Act (Act No. 107 of 1998)</b>	<p>The Act is an umbrella act covering broad principles of environmental management which makes provision for three main areas, namely Land Planning and Development, Natural and Cultural Resources Use and Conservation and Pollution Control and Waste Management. In accordance with the Act, sustainable development requires the consideration of all relevant factors, including:</p> <ul style="list-style-type: none"> <li>• That the disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied;</li> <li>• That the use and exploitation of non-renewable natural resources are conducted in a responsible and equitable manner and takes into account the consequences of the depletion of the resource; and</li> <li>• That the development, use and exploitation of renewable resources and the ecosystems of which they are part of do not exceed the level beyond which their integrity is jeopardised.</li> </ul> <p>According to Section 2(r) of the Act, sensitive, vulnerable, highly dynamic or stressed ecosystems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure.</p>
<b>National Environmental Management: Protected Areas Act (Act No. 57 of 2003)</b>	<p>The Act focuses on the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural land-and seascapes. The Act addresses inter alia:</p> <ul style="list-style-type: none"> <li>• The protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural land- and seascapes;</li> <li>• The establishment of a national register of all national, provincial and local protected areas;</li> <li>• The management of those areas in accordance with national standards; and</li> <li>• Inter-governmental co-operation and public consultation in matters concerning protected areas.</li> </ul>

Legislation	Description
<b>National Environmental Management: Waste Act (Act No. 59 of 2008)</b>	<p>The Act serves to reform the law regulating waste management in order to protect health and the environment by providing reasonable measures for:</p> <ul style="list-style-type: none"> <li>the prevention of pollution and ecological degradation and for securing ecologically sustainable development;</li> <li>to provide for institutional arrangements and planning matters; to provide for national norms and standards for regulating the management of waste by all spheres of government; to provide for specific waste management measures;</li> <li>to provide for the licensing and control of waste management activities;</li> <li>to provide for the remediation of contaminated land; to provide for the national waste information system;</li> <li>to provide for compliance and enforcement; and</li> <li>to provide for matter connected therewith.</li> </ul>
<b>National Environmental Management: Biodiversity Act (Act No. 10 of 2004)</b>	<p>The main objective of the act is to provide for the management and conservation of South Africa's biodiversity and to ensure the sustainable use of indigenous biological resources. In addition to regulations on Threatened, Protected, Alien and Invasive Species in South Africa, the Act also identifies Terrestrial and Aquatic Priority Areas and Threatened Ecosystems for biodiversity conservation.</p>

#### 4 TERMS OF REFERENCE

It is understood that the assessment will be submitted as part of the Application for Environmental Authorisation in accordance with the National Environmental Management Act (Act No. 107 of 1998): Environmental Impact Assessment (EIA) Regulations (2014) and an Application for a Waste Management Licence in accordance with the National Environmental Management: Waste Act (Act No. 59 of 2008). In addition, the assessment will be submitted in support of a Water Use Licence Application in accordance with the National Water Act (Act No. 36 of 1998).

As such, the assessment will be completed in accordance with the requirements of the abovementioned Acts and will focus on the potential impacts that the project may have on the identified aquatic features within the study site. The assessment will make provision for the following regulated requirements:

- Location of the activity within the “regulated area of a watercourse” as defined by the Act;
- An identification of all the aquatic features within the determined “regulated area of a watercourse”;
- A delineation of all these identified aquatic features to determine their extent, the delineation will be conducted in accordance with the Department of Water Affairs and Sanitation’s guideline on the delineation of these features;



- An assessment of the identified aquatic features to determine their hydrogeomorphic classification, their present ecological state (PES), the ecosystem services they provide as well as their ecological importance and sensitivity (EIS);
- Identification of the potential impacts of the proposed activity on the identified aquatic features;
- An impact assessment with the provision of management and mitigation measures; and
- A Risk Assessment Matrix that follows the Department of Water and Sanitation protocols.

In brief, these requirements have as an outcome to achieve the following:

- A methodology of the site visit and techniques used to assess the specific aspects of the site;
- Details of the assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of site plan identifying site alternatives (where applicable);
- An indication of any areas that are to be avoided, including provision of buffers (where applicable);
- A description of any assumptions made and any uncertainties or gaps in knowledge;
- A description of the findings and potential implications of such findings on the impact of the proposed activities;
- Any mitigation measures for inclusion in the Environmental Management Programme Report (EMPr);
- Any conditions for inclusion in the Environmental Authorisation, Waste Management Licence and the Water Use Licence;
- Any monitoring requirements for inclusion into the EMPr or Water Use Licence; and
- A reasoned opinion whether the activity should be authorised based on the findings of the assessment.

## **5 ASSUMPTIONS AND KNOWLEDGE GAPS**

The following are assumptions made in the completion of the report:

- The assessment of the potential impacts of the proposed development on the aquatic features on the development site is based on the development layout that has been provided. If the development layout is amended, the impact identification and assessment contained in this report may also change.
- The findings of the report are limited to a two-day long site visit conducted on 18 May 2023 which is considered to be autumn to early winter. No provision has been made for seasonal visits to the site and is not considered a shortcoming of the report.
- The identification and delineation of the aquatic features that have been assessed within the study area was conducted in terms of the procedures as specified by the Department of Water and Sanitation.
- The classification of any identified aquatic features has been conducted in accordance with the classification system of inland aquatic ecosystem as prescribed by Ollis *et al.*, 2013.
- The following desktop information was used to augment the finding of the assessment:
  - Electronic biodiversity databases managed by the South African National Biodiversity Institute (SANBI);
  - Available provincial electronic biodiversity databases;
  - Wetland and Riparian Habitat Delineation Document (Department of Water and Sanitation report); and
  - Classification system for wetlands and other aquatic ecosystems in South Africa (Inland Systems) (Ollis *et al.*, 2013 – SANBI Biodiversity Series 22).

## 6 REPORTING CONDITIONS

The following conditions apply to the report in part or as a whole:

- The findings and conclusion of this report are based on the author's scientific and professional knowledge as well as available information at the time of the assessment. In addition, the recommendations made are considered to be the best, implementable actions that can be taken to alleviate the identified impacts.
- As such, the author accepts no liability for any actions, claims, demands, losses, liabilities, costs, damages, and expenses that may arise from or in connection with the services rendered, and by any use of the information contained in this document.
- No part of this report may be amended without written consent from the author.

## 7 EXPERTISE OF THE SPECIALIST

Mr Magnus van Rooyen is a registered natural scientist with the South African Council of Natural Scientific Professions (SACNASP) and holds a Master's degree in Environmental Management, a BSc Honours degree in Botany and a BSc degree in Botany and Zoology from the University of Stellenbosch. Mr van Rooyen has in excess of 25 years' experience in the field of wetland and terrestrial ecological studies in Southern and Western Africa. The *curriculum vitae* of the specialist, Mr Magnus van Rooyen is attached in Appendix A.

## 8 METHODOLOGY

The methodology that was followed in completing this study is in line with the requirements and specifications of the Department of Water and Sanitation and includes the following aspects. In addition, provision is made to conduct an assessment to meet the extended aspects included in the Scope of Works.

### 8.1 Identification of aquatic features and mapping

The initial identification process for aquatic features was conducted at a desktop level during which available GIS databases were interrogated to determine the presence of any wetland and watercourse areas that have been determined in the past. The key database that was interrogated was the National Freshwater Ecosystem Priority Area (NFEPA) as managed and updated by the South African National Biodiversity Institute (SANBI) as well as the updated version of this dataset, the Wetland MAP5 (2018).

In addition to the database interrogation, the most recent Google Earth and Zoom Earth Imagery of the site was considered to see if any wetland areas or “anomalies” within the site are visible.

Following the desktop assessment of the site, a site visit was conducted on 18 May 2023. During the site visit, the potential aquatic features identified through the desktop assessment were verified and any other aquatic features were identified and their boundaries accurately delineated.

### 8.2 Aquatic feature delineation

The delineation of these wetlands areas was conducted in accordance with the Department of Water and Sanitation, “*A practical field procedure for identification and delineation of wetlands and riparian areas*” (2005).

This field guide makes use of several specific indicators which show the presence and the boundaries of wetlands. The presence of the following indicators was used during the identification and delineation of the site:

- **Terrain Unit Indicator** – Identification of the part of the landscape where wetlands are more likely to occur;
- **Soil Form Indicator** – Identification of the soil types which are associated with prolonged and frequent saturation;
- **Soil Wetness Indicator** – Identification of the morphological signatures that develop in soil profiles as a result of prolonged and frequent saturation; and
- **Vegetation Indicator** – Identification of the hydrophilic vegetation associated with frequently saturated soil.

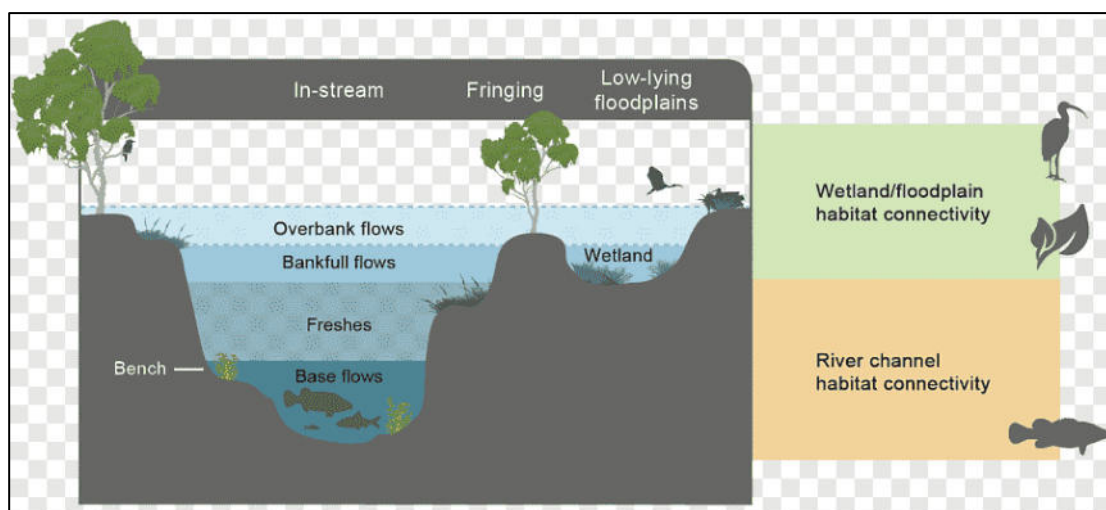
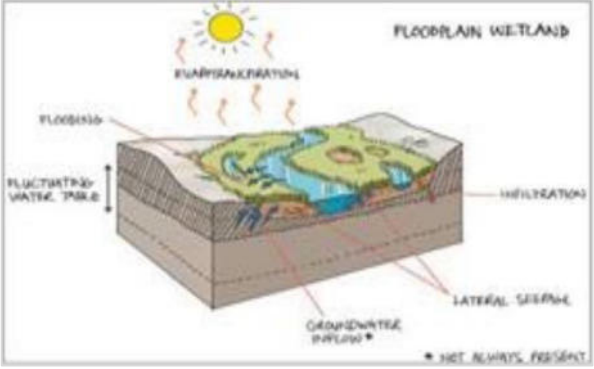
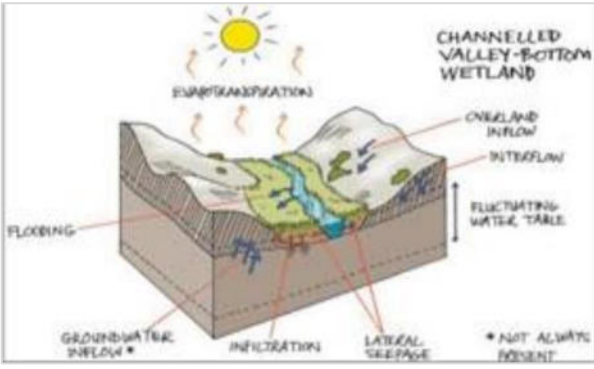
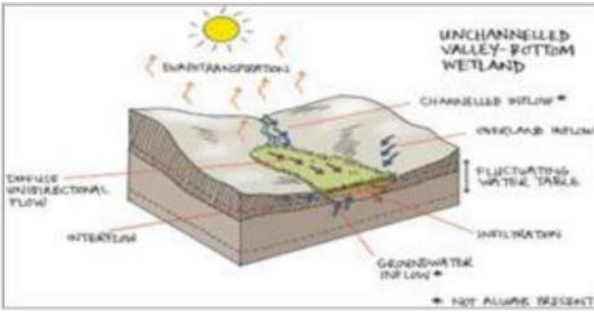
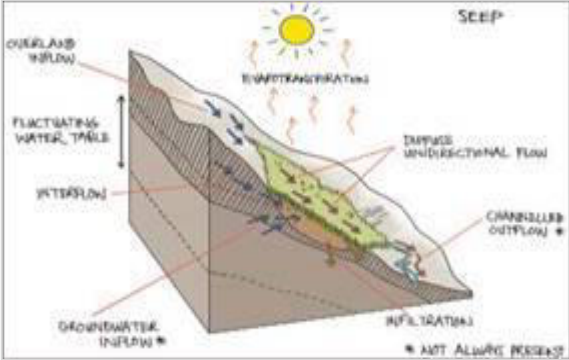


Figure 8-1: Cross section through a typical drainage basin ([www.pngegg.com](http://www.pngegg.com))

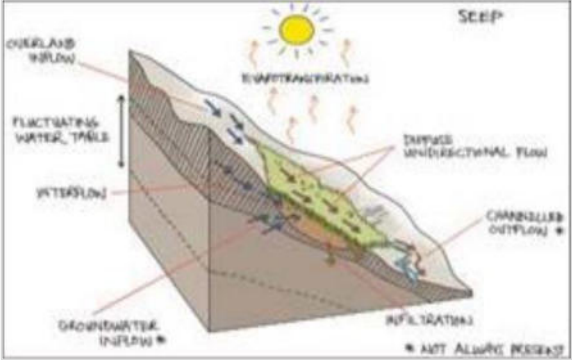
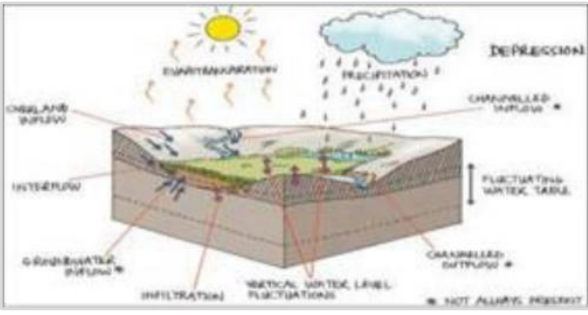
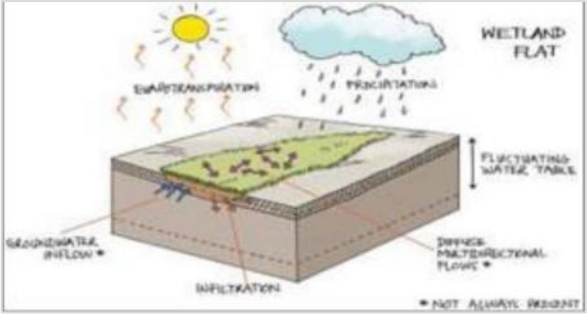
Following the identification of the aquatic features on the study site, these are then classified into specific hydrogeomorphic (HGM) units according to the Classification System for Wetlands and other Aquatic Ecosystems in South Africa (inland systems) (Ollis et al., 2013).

Table 8-1: Wetland hydrogeomorphic (HGM) types typically supporting inland wetlands in South Africa (Ollis et al., 2013)

Hydrogeomorphic types		Description
River		<p>Rivers are linear landforms with clearly discernible banks and a channel, which permanently or periodically, carries a contained and defined flow of water. A river is taken to include both the active channel and the riparian zone.</p>

Hydrogeomorphic types	Description
<b>Floodplain</b> 	Valley bottom areas with a well-defined stream channel, gently sloped and characterised by floodplain features such as oxbow depressions and natural levees and the alluvial (by water) transport and deposition of sediment, usually leading to a net accumulation of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.
<b>Valley bottom with channel</b> 	Valley bottom areas with a well-defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterised by the net accumulation of alluvial deposits or may have steeper slopes and be characterised by the net loss of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.
<b>Valley bottom without a channel</b> 	Valley bottom areas with no clearly defined stream channel, usually gently sloped and characterised by alluvial sediment deposition generally leading to a net accumulation of sediment. Water inputs mainly from channel entering the wetland and also from adjacent slopes.
<b>Hillslope seepage linked to a stream channel</b> 	Slopes on hillsides, which are characterised by the colluvial (transported by gravity) movement of materials. Water inputs are mainly sub-surface flow and outflow is usually via a well-defined stream channel connecting the area directly to a stream channel.



Hydrogeomorphic types	Description
<p><b>Isolated Hillslope seepage</b></p> 	<p>Similar to other hillslope seeps but with no direct surface water connection to a stream channel. Slopes on hillsides, which are characterised by the colluvial (transported by gravity) movement of materials. Water inputs mainly from sub-surface flow and outflow primarily by diffuse sub-surface and/or limited surface flow.</p>
<p><b>Depression (includes Pans)</b></p> 	<p>A basin shaped area with a closed elevation contour that allows for the accumulation of surface water (i.e. it is inward draining). It may also receive sub-surface water. An outlet is usually absent, and therefore this type is usually isolated from the stream channel network.</p>
<p><b>Wetland Flat</b></p> 	<p>A flat wetland with no apparent inlet or outlet points. Water is obtained from surface or near surface flows and is lost either by downward percolation or evapotranspiration. May be only seasonal in terms of its wetness and hydromorphic soils may be only weakly developed or else be absent. Vegetation may be the strongest indicator.</p>

### 8.3 Riparian Delineation

The delineation of the riparian areas was conducted in accordance with the Department of Water and Sanitation document, “A practical field procedure for identification and delineation of wetlands and riparian areas” (2005).

Like wetlands, riparian areas have their own unique set of indicators. It is possible to delineate riparian areas by checking for the presence of these indicators. The riparian delineation process takes the following physical aspects into consideration:

- **Topography associated with the watercourse** – The topography is a good rough indicator of the outer edge of the riparian area as the riparian edge is the same as the edge of the macro channel bank.

- **Vegetation** – The delineation of riparian areas relies primarily on the vegetative indicators. Using vegetation, the outer boundary of a riparian area must be adjacent to a watercourse and can be defined as the zone where a distinctive change occurs:
  - In species composition relative to the adjacent terrestrial area; and
  - In the physical structure, such as vigour or robustness of growth forms of species similar to that of adjacent terrestrial areas. Growth form refers to the health, compactness, crowding, size, structure and/or numbers of individual plants.
- **Alluvial soils and deposited material** – Alluvial soils can be defined as relatively recent deposits of sand, mud, etc. set down by flowing water, especially in the valleys of large rivers. Riparian areas often, but not always, have alluvial soils.

#### 8.4 Aquatic features functional Assessment

Once the aquatic features have been identified and their boundaries determined, the assessment of the ecosystem services these features provide to the hydraulic system that they contribute to, as well as the immediate natural and social environment, was undertaken. An understanding of this functionality of these features contributes directly to the level of importance that is attributed to the specific feature that is developed. The assessment was conducted by using a modelling tool that forms part of the WET-Management Series (issued by the Water Research Commission), WET-EcoServices (Kotze *et al.* 2008).

The WET-EcoServices tool makes provision for the rapid assessment of the ecosystem services provided by an aquatic feature. The process of applying the tool is based on the characterisation of hydrogeomorphic aquatic feature types based on desktop and field assessment and observations of identified and delineated aquatic features. This model, furthermore, considers the biophysical and social conditions around a feature and converts these considerations into a fixed score for a series of defined ecosystem services that the wetland delivers.

- |                                      |                                    |
|--------------------------------------|------------------------------------|
| • Flood Attenuation                  | • Streamflow regulation            |
| • Sediment trapping                  | • Phosphate assimilation           |
| • Nitrate Assimilation               | • Toxicant Assimilation            |
| • Erosion control                    | • Carbon storage (sequestration)   |
| • Maintenance of biodiversity        | • Provision of water for human use |
| • Provision of harvestable resources | • Provision of cultivated food     |

- Cultural significance
- Tourism and recreation
- Education and research

The maximum score for any service is a value of 4 and the rating of the probable extent of the service is shown in the table below.

**Table 8-2: Ecoservices rating of the probable extent to which a benefit is being supplied**

Score	Rating of likely extent to which a benefit is being supplied
< 0.5	Low
0.6 - 1.2	Moderately Low
1.3 - 2.0	Intermediate
2.1 - 3.0	Moderately High
> 3.0	High

## 8.5 Determining the Present Ecological State of a water resource

The determination of the present ecological state (PES) of a water resource was conducted by using a tool from the WET-Management Series (issued by the Water Research Commission), the WET-Health (Macfarlane et al. 2008).

This tool is designed to assess the health or integrity of an aquatic feature. The health of the aquatic feature is defined as a measure of the deviation of feature in structure and function from the it's natural reference condition. The tool therefore attempts to assess the hydrological, geomorphological and vegetation impacts that has been imparted on the wetland at the time of assessment.

The overall approach is to quantify the impacts of human activity or clearly visible impacts on the health of the aquatic feature, and then to convert the impact scores to a PES score. This takes the form of assessing the spatial extent of impact of individual activities/occurrences and then separately assessing the intensity of impact of each activity in the affected area. The extent and intensity are then combined to determine an overall magnitude of impact. The impact scores and Present State categories are provided in the tables below.

**Table 8-3: The magnitude of impacts on wetland functionality (Macfarlane et al, 2008)**

Impact Category	Description	Score
None	No Discernible modification or the modification is such that it has no impacts on the wetland integrity	0 to 0.9
Small	Although identifiable, the impact of this modification on the wetland integrity is small.	1.0 to 1.9
Moderate	The impact of this modification on the wetland integrity is clearly identifiable, but limited.	2.0 to 3.9
Large	The modification has a clearly detrimental impact on the wetland integrity. Approximately 50% of wetland integrity has been lost.	4.0 to 5.9
Serious	The modification has a highly detrimental effect on the wetland integrity. More than 50% of the wetland integrity has been lost.	6.0 to 7.9
Critical	The modification is so great that the ecosystem process of the wetland integrity is almost totally destroyed, and 80% or more of the integrity has been lost.	8.0 to 10

The level of impacts on these three parameters is a direct indication of the PES of the aquatic feature as well as its functionality. An aquatic feature that has undergone severe impacts on its hydrology, geomorphology or vegetation or a combination of all three will reflect a low present ecological state while the converse is also true for pristine features. Since hydrology, geomorphology and vegetation are interlinked in the model, their scores are aggregated to obtain the overall PES health score using the formula:

$$\text{Health} = ((\text{Hydrology value} \times 3) + (\text{Geomorphology value} \times 2) + (\text{Vegetation value} \times 2))/7$$

**Table 8-4: Definitions of the PES categories (Macfarlane et al, 2008)**

Impact Category	Description	Impact Score Range	Present State Category
None	Unmodified, natural	0 to 0.9	A
Small	Largely Natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1.0 to 1.9	B
Moderate	Moderately Modified. A moderate change in ecosystem processes and loss of natural habitats has taken place, but the natural habitat remains predominantly intact.	2.0 to 3.9	C
Large	Largely Modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	4.0 to 5.9	D
Serious	Seriously Modified. The change in ecosystem processes and loss of natural habitat and biota is great, but some remaining natural habitat features are still recognizable.	6.0 to 7.9	E
Critical	Critical Modification. The modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8.0 to 10	F

## 8.6 Determining the Ecological Importance and Sensitivity of aquatic features

The outcomes of the implementation of the WET-EcoServices tool discussed above, is key in the determination of the ecological importance and sensitivity of aquatic features as the results is a direct indication of the contribution that the feature is making to the hydraulic system with which it is linked. This contribution is linked to the sensitivity of this feature to any possible change and how this will impact on the hydraulic system it is linked to.

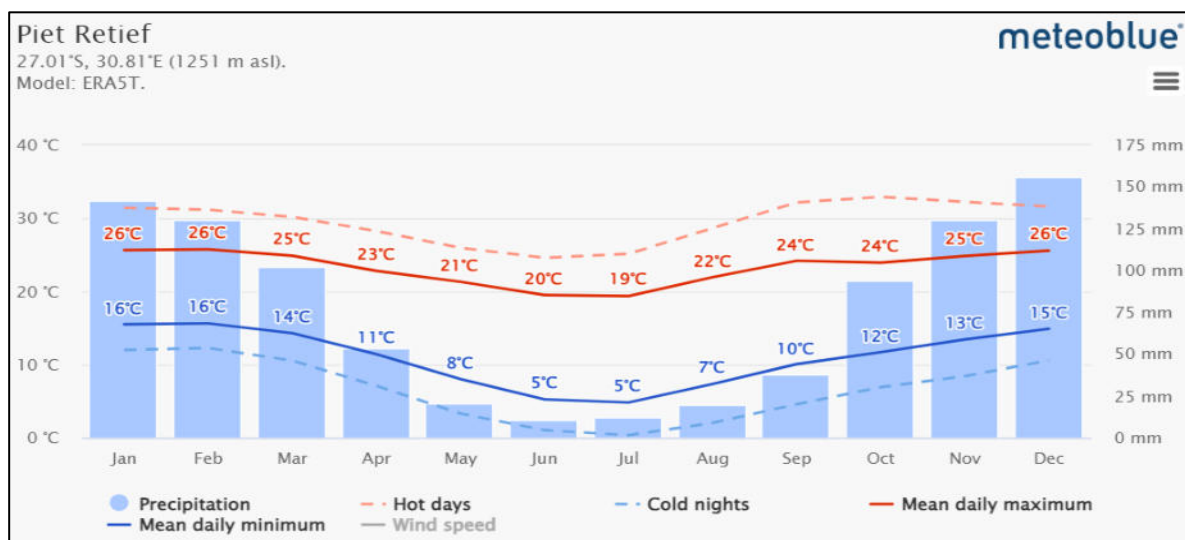
## 8.7 Ecological Classification and Description

The ecological classification and description are direct results of the implementation of the methodology and tools described above as the results of these determinations contribute to the understanding of the ecology of the aquatic feature. The description of the aquatic feature will therefore make provision for a description of the physical attributes of the feature (location, size, etc.), the ecosystem services that it provides, the current ecological state of the feature and the importance of the feature and its sensitivity.

# 9 DESCRIPTION OF THE STUDY SITE

## 9.1 Climate

Driefontein normally receives about 738mm of rain per year, with most rainfall occurring during summer. The lowest rainfall is received in June (2mm) and the highest in December (136mm). The average daily maximum temperatures range from 18.8°C in June to 25.9°C in January. The region is the coldest during June with temperatures of 2.4°C on average during the night (www.meteoblue.com).



**Figure 9-1: Average climatic conditions of the town of Piet Retief (source [www.meteoblue.com](http://www.meteoblue.com))**



## 9.2 Vegetation

The project site is located in the Eastern Highveld Grassland (Gm12) vegetation unit and is distributed along slightly, to moderately undulating plains, including some low hills and pan depressions, in Mpumalanga and Gauteng Provinces. The vegetation is short dense grassland dominated by the usual Highveld grass composition (*Aristida*, *Digitaria*, *Erigerotis*, *Themeda*, *Tristachya*, etc.) with small, scattered rocky outcrops with wiry, sour grasses and some woody species (*Senegalia caffra*, *Celtis Africana*, *Diospyros lyciodes* subsp *lycioides*, *Parinari capensis*, *Protea caffra*, *P. welwitschii* and *Rhus magalismontanum*).

The location of the project site in the southern limb of the vegetation type is provided in Figure 9-2.

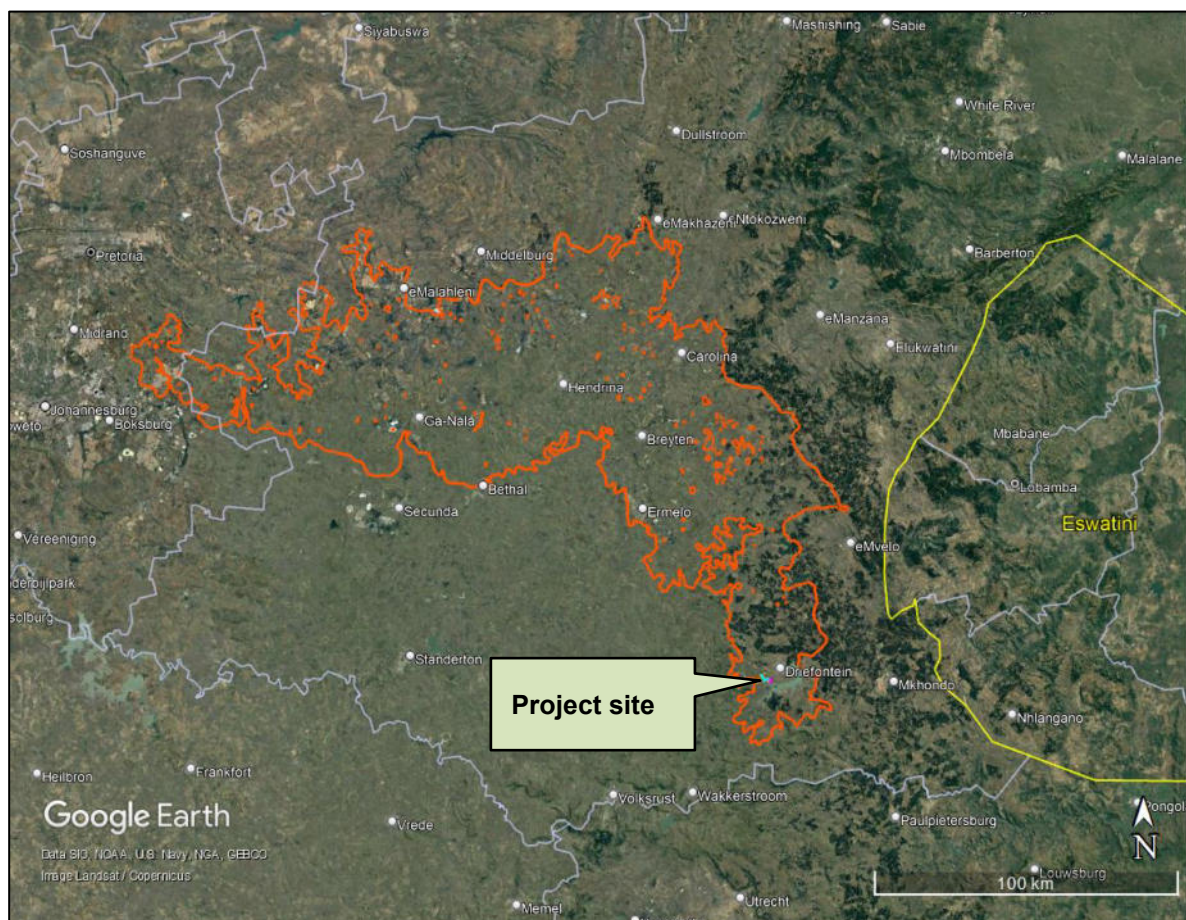


Figure 9-2: Extent of the Eastern Highveld Grassland (Gm12)



**Plate 9-1: View of the vegetation, on and surrounding the project site**

### **9.3 Topography**

The topography of the study site comprises mostly, of undulating hills and plains. The altitude ranges from 1 300m to 1 600m and watercourses (perennial and non-perennial) and wetlands were often present in the troughs of the hills. Based on the observed topography one could expect to find wet soils in the troughs and more freely drained soils on the slopes and crests. The site falls within the W51B quaternary catchment.

The topography plays a major role in the depth of the soil found *in-situ*. Steeper gradients often have soils that are shallow and easily erodible. This higher risk of erosion can cause problems on site. Fortunately, from the site visit the majority of the area seems to have a gentle gradient and thus limits the potential of erosion.

This area has a relatively high diversity of surface water. The project area lies to the northwest and adjacent of the Heyshope Dam, this is a very large dam approximately 20km in length and 3km at its widest point. This dam could be seen as a very important water source and therefore extra care should be taken not to affect it. The Heyshope Dam has been built on the Assegai River which flows to the south of the project area in an easterly direction.





**Plate 9-2: View of the topography of the surrounding areas, looking in a southerly direction towards the Heyshope Dam**

#### **9.4 Land cover and land use**

The current land use in the area consists of infrastructure associated with the operations of the coal mine as well as open areas consisting of indigenous grasses typical to transformed areas.



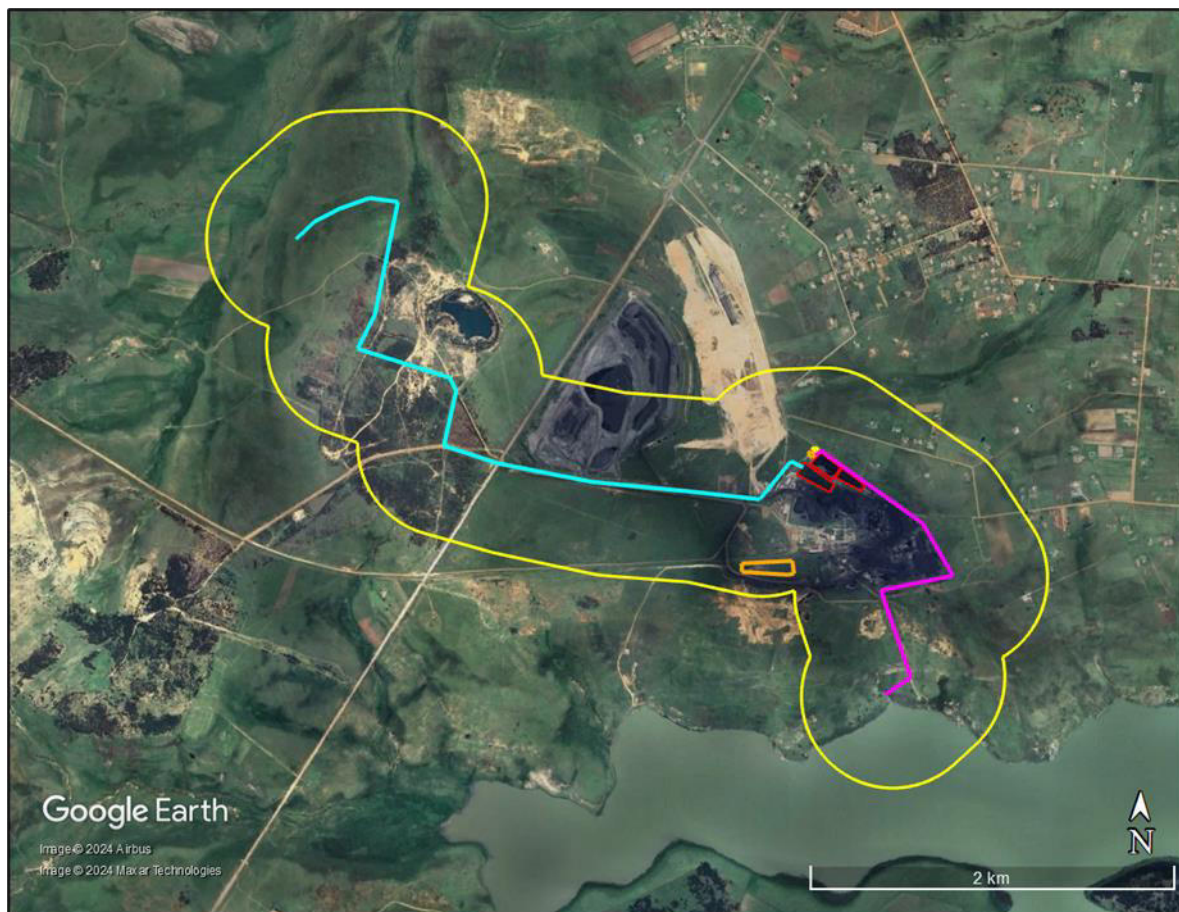
**Plate 9-3: View of the mine access road and conveyor system associated with the mining operations**

## **10 DESKTOP ASSESSMENT FINDINGS**

The findings relating to the aquatic ecology is based on the desktop assessment of available databases as well as site investigations.

### **10.1 Study site definition**

The definition of the assessment area is based on the requirements of the Department of Water and Sanitation that relates to the determination of the “regulated area of a watercourse” as it relates to a 500m radius from any delineation wetland features. The extent of the study site is provided in Figure 10-1.



**Figure 10-1: Extent of the study site, shown in yellow around the project site**

## **10.2 Department of Forestry, Fisheries and Environment (DFFE) Online Screening Tool**

The results generated by the DFFE Online Screening Tool has classified the Aquatic Theme sensitivity to be “VERY HGH” due to the presence of the project site within the following strategic environmental plans:

- Aquatic Critical Biodiversity Area in accordance with the Mpumalanga Biodiversity Sector Plan (2014);
- Strategic Water Resource Area in accordance with the Mpumalanga Biodiversity Sector Plan (2014);
- Freshwater Ecosystem Priority Area quinary Catchment in accordance with the NFEPA dataset (2014); and
- The presence of wetlands within project site.



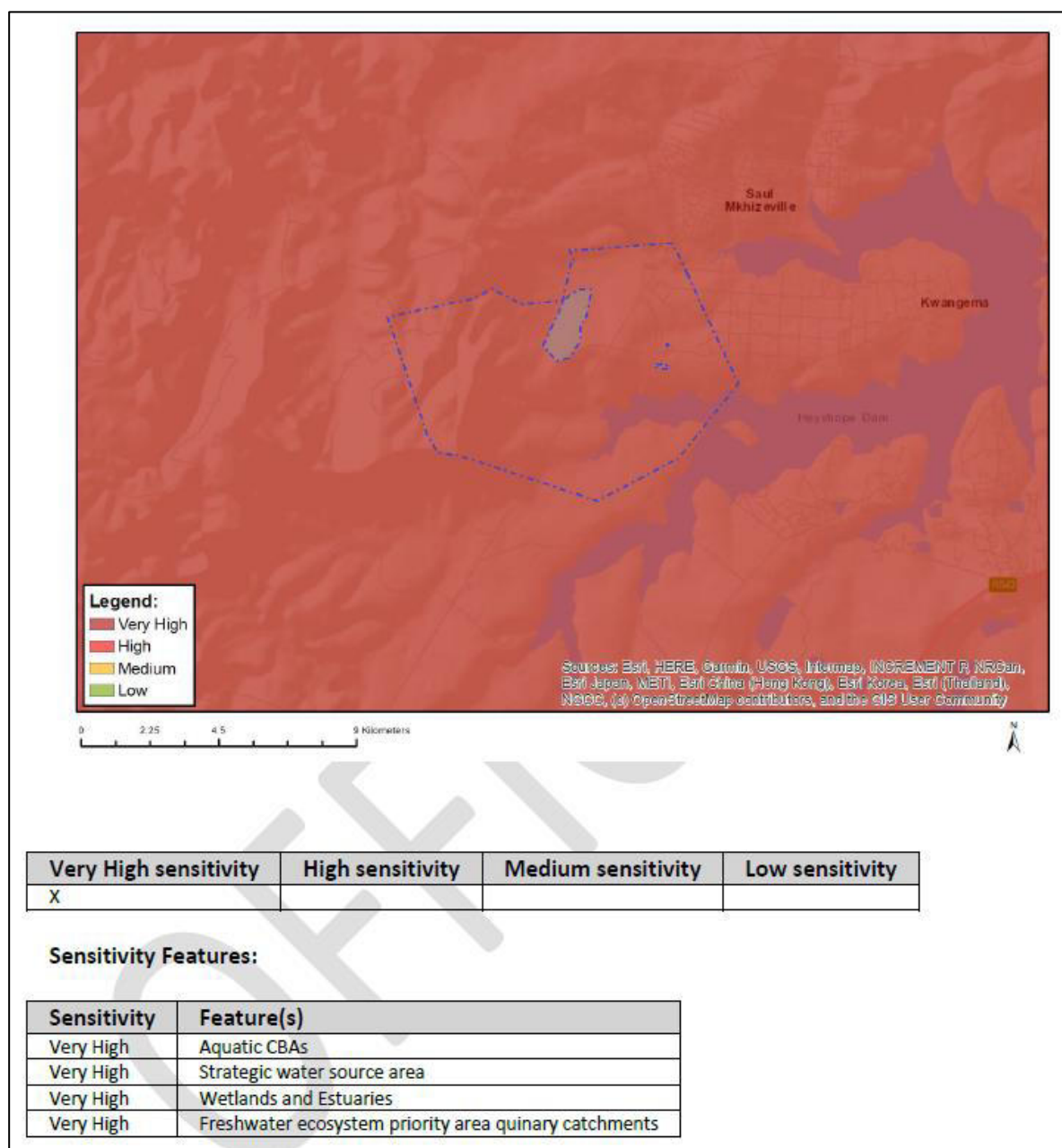


Figure 10-2: Results for the Aquatic Theme as per the DFFE Screening Tool

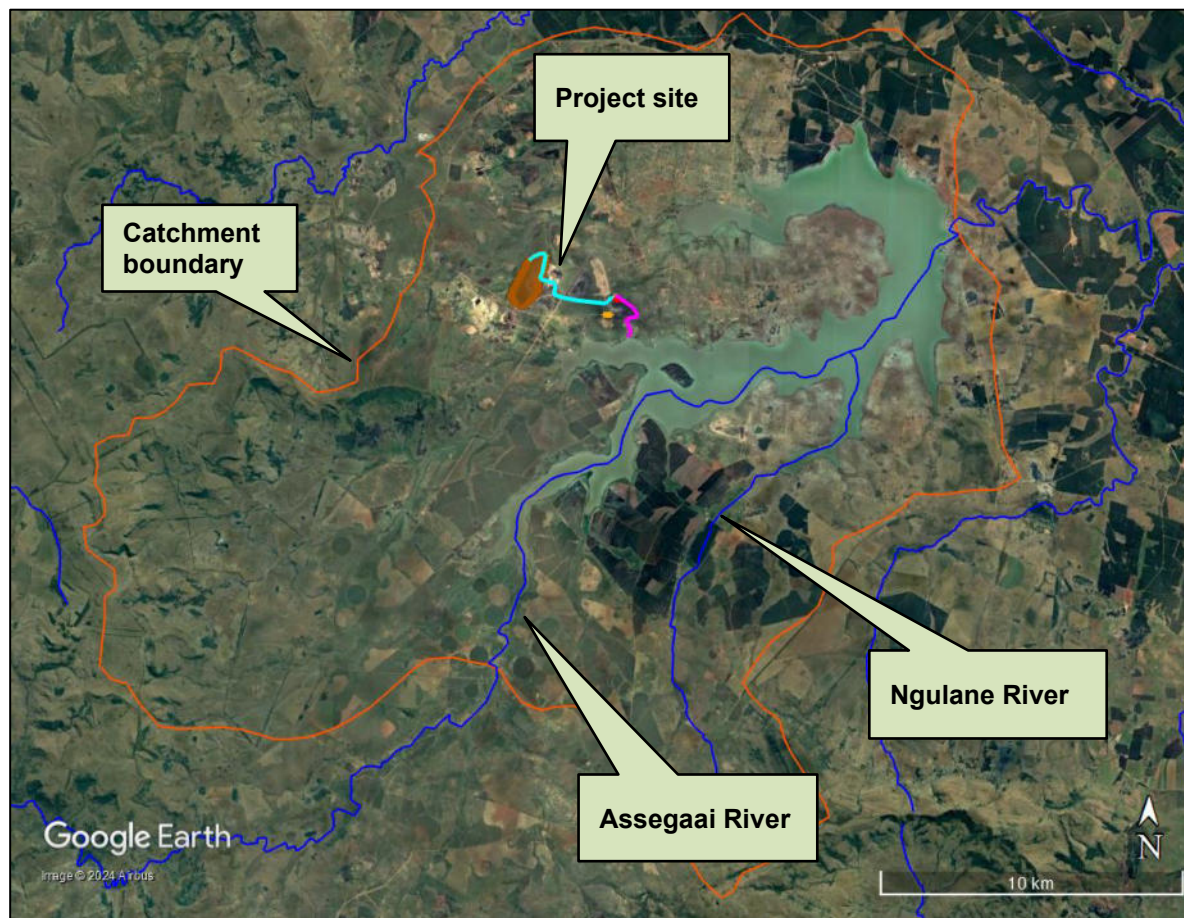
### 10.3 Hydrological setting

The results of the desktop assessment of the hydrological characteristics of the study site are provided in the table below.

Table 10-1: Desktop hydrological characteristics of the study site

Hydrological characteristic	Result	Comment
Water Management Area	Inkomati - Usuthu	
Primary Catchment	Primary region W	
Tertiary Catchment	W51	
Quaternary Catchment	W51B	The dominant rivers in the Quaternary Catchment are the Assegai and Ngulane Rivers that drains the catchment in an easterly direction (see Figure 10-3). Both these rivers are classified as NFEPA Rivers and has been classified as Class C features

Hydrological characteristic	Result	Comment
		which means that they are Moderately Modified.



**Figure 10-3: Location of the NFEPA Rivers identified in the NFEPA Database for Quaternary Catchment W51B**

No NFEPA Rivers were identified to be within the boundaries of the project site.

#### **10.4 National Freshwater Ecosystem Priority Areas (NFEPA)(2014):**

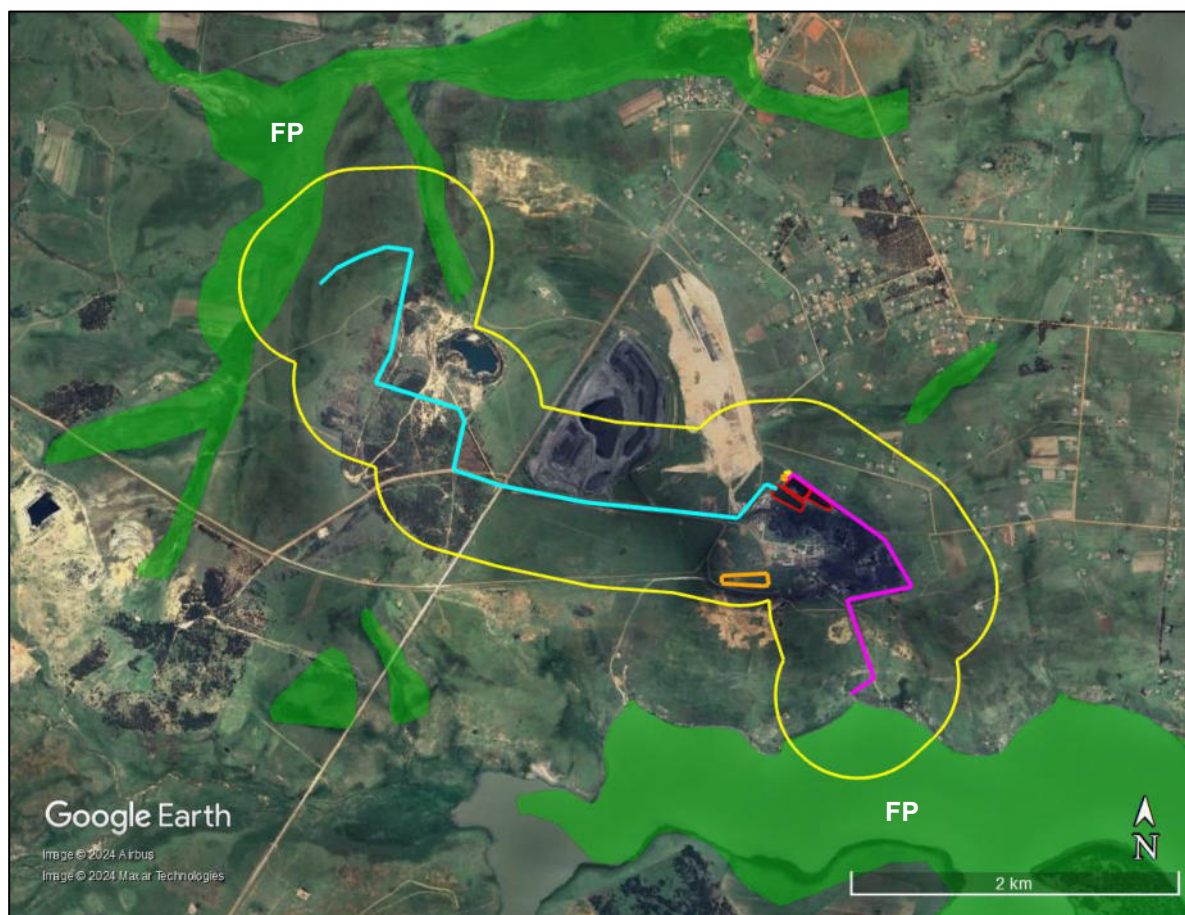
The National Freshwater Ecosystem Priority Areas (NFEPA) project provides strategic spatial priorities for conserving South Africa's freshwater ecosystems and supports sustainable use of water resources. The priority areas are called Freshwater Ecosystem Priority Areas, or "FEPAs". The FEPAs were identified based on:

- Representation of ecosystem types and flagship free-flowing rivers;
- Maintenance of water supply areas in areas with high water yield;
- Identification of connected ecosystems;
- Representation of threatened and near-threatened fish species associated with migration corridors;



- Preferential identification of FEPAs that overlapped with:
  - Any free-flowing river;
  - Priority estuaries identified in the National Biodiversity Assessment (2011); and
  - Existing protected area and focus area for protected area expansion identified in the National Protected Area Expansion Strategy.

Based on the above criteria, the database has identified two wetland features within a 500m radius of the project site. The location of these wetland features is project site is provided in Figure 10-4. The database identifies both the wetland features as Floodplain wetlands. The Floodplain wetland located to the south of the study site is artificial in nature and consists of the Heyshope Dam.



FP = Floodplain

**Figure 10-4: Location of the wetland features identified in the NFEPA Dataset (shown in green) in relation to a 500m radius (shown in yellow) of the project site**

## 10.5 South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (2018)

A South African Inventory of Inland Aquatic Ecosystems (SAIIAE) was established during the National Biodiversity Assessment of 2018 (NBA 2018). The SAIIAE offers a collection of data layers pertaining to ecosystem types and pressures for both rivers and inland wetlands.

The SAIIAE builds on previous efforts while also introducing improvements and several new elements. An inventory of inland aquatic ecosystems responds to a multi-stakeholder need for the planning, conservation and management of these systems, as mandated by a number of Legislative Acts, including the South African National Water Act (NWA) and the National Environmental Management: Biodiversity Act (NEMBA), 2004 (Act 10 of 2004) as amended.

The dataset has indicated the presence of one Channelled Valley Bottom wetland within a 500m radius of the project site. The location of the feature in relation to the project site is shown in Figure 10-5. It is important to note that no wetland features have been identified within the boundaries of the project site.



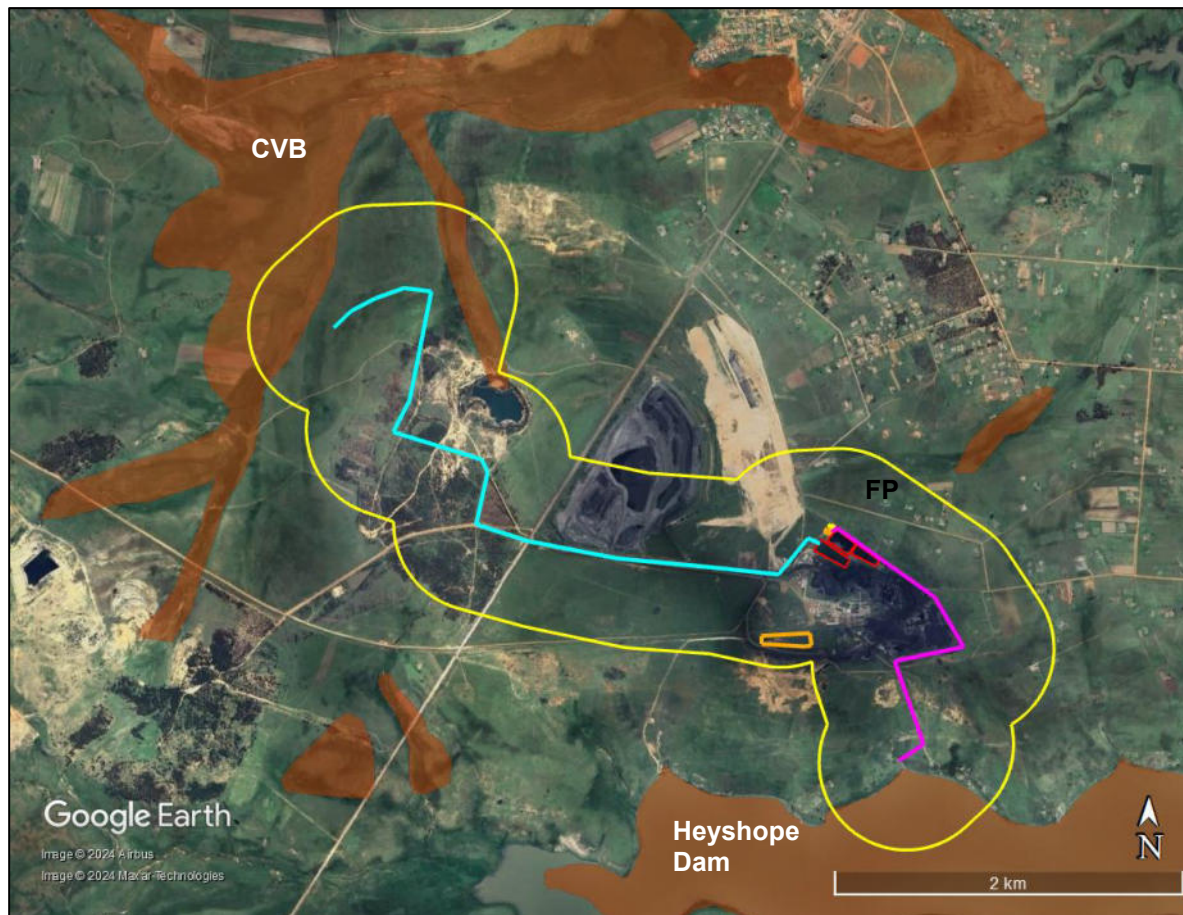
CVB = Channelled Valley Bottom

**Figure 10-5: Location of the wetland feature identified in the SAIIAE Dataset (shown in blue) in relation to a 500m radius (shown in yellow) of the project site**



## 10.6 Mpumalanga Highveld Wetland Study (2015)

The Mpumalanga Highveld Wetland (MPHG) Wetland map provides that spatial extent of the delineated wetland features in the Mpumalanga Province. This dataset has identified the presence of a single Channelled Valley Bottom wetland within a 500m radius of the project site. In addition, the dataset identifies the Heyshope Dam as an artificial wetland within the study site. The location of these features are shown in Figure 10-6.



CVB = Channelled Valley Bottom

**Figure 10-6: Location of the wetland feature identified in the MPHG Wetland Dataset (2015), shown in orange, in relation to a 500m radius (shown in yellow) of the project site**

## 11 FIELD ASSESSMENT FINDINGS

The findings presented in this section are based on the desktop assessment of the proposed project site.

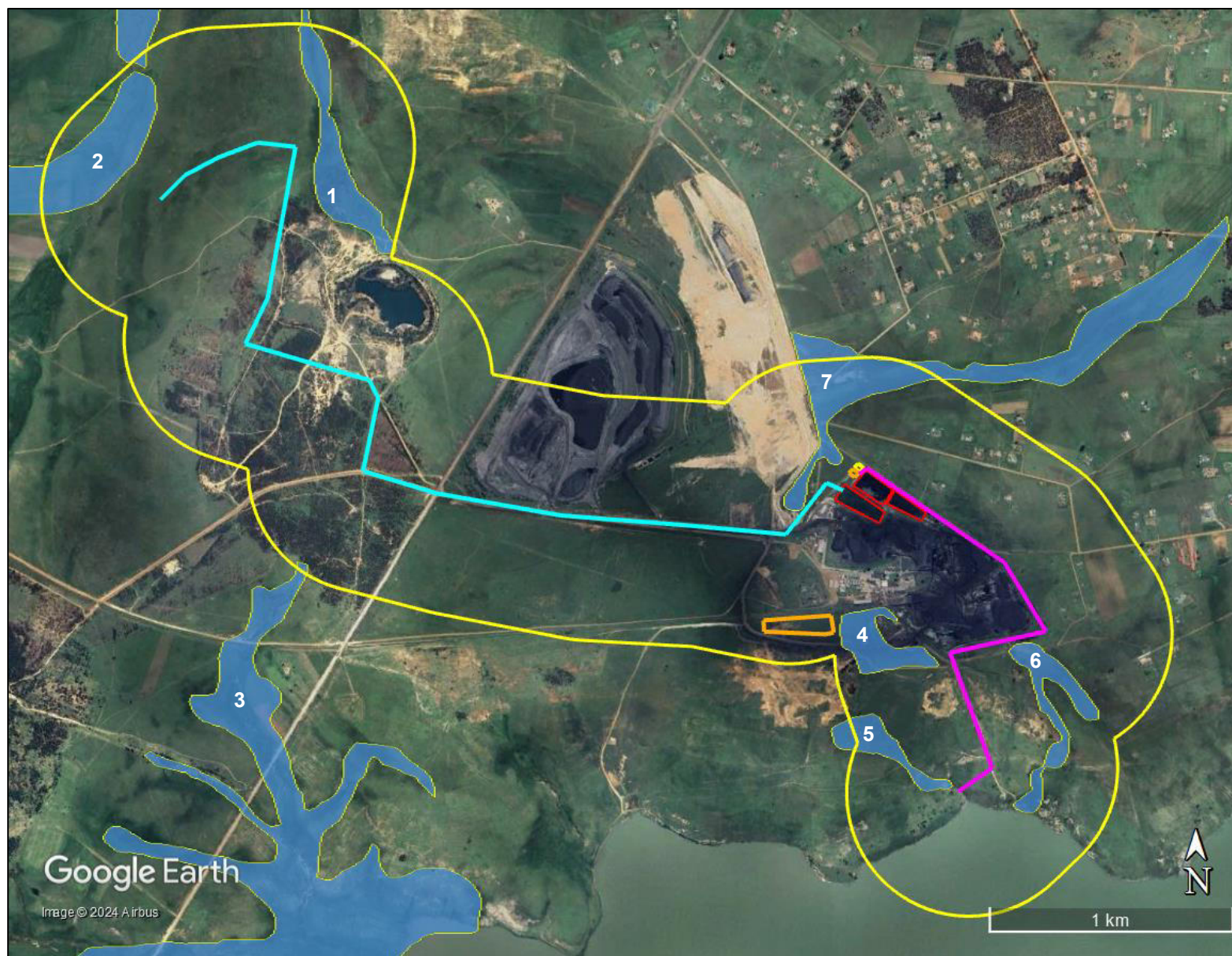


### 11.1 Identification, delineation and mapping of aquatic features

The site assessment confirmed the absence of any natural wetland features within the boundaries of the project site. Furthermore, it identified three wetland features, one a Floodplain wetland (FP) associated with the Kwaggalaagte River, one a Channelled Valley Bottom wetland (CVB) associated with the Heilvleispruit and a Seep wetland (SP) within a 500m radius of the project site. The location of these features is indicated in Figure 11-1 and the identification of the wetland features is provided in Table 11-1.

**Figure 11-1: Wetland classification as per SANBI guideline (Ollis *et al.* 2013)**

Wetland System	Level 1	Level 2	Level 3	Level 4
	System	NFEPA Wet Veg Group/s	Landscape Unit	4A (HGM)
HGM 1	Inland	Mesic Highveld Grassland Group 4	Slope	Channelled Valley Bottom wetland
HGM 2	Inland	Mesic Highveld Grassland Group 4	Slope	Channelled Valley Bottom wetland
HGM 3	Inland	Mesic Highveld Grassland Group 4	Slope	Channelled Valley Bottom wetland
HMG 4	Inland	Mesic Highveld Grassland Group 4	Gentle slope	Seep wetland
HGM 5	Inland	Mesic Highveld Grassland Group 4	Valley floor	Unchannelled valley bottom wetland
HMG 6	Inland	Mesic Highveld Grassland Group 4	Valley floor	Unchannelled valley bottom wetland
HMG 7	Inland	Mesic Highveld Grassland Group 4	Valley floor	Channelled Valley bottom

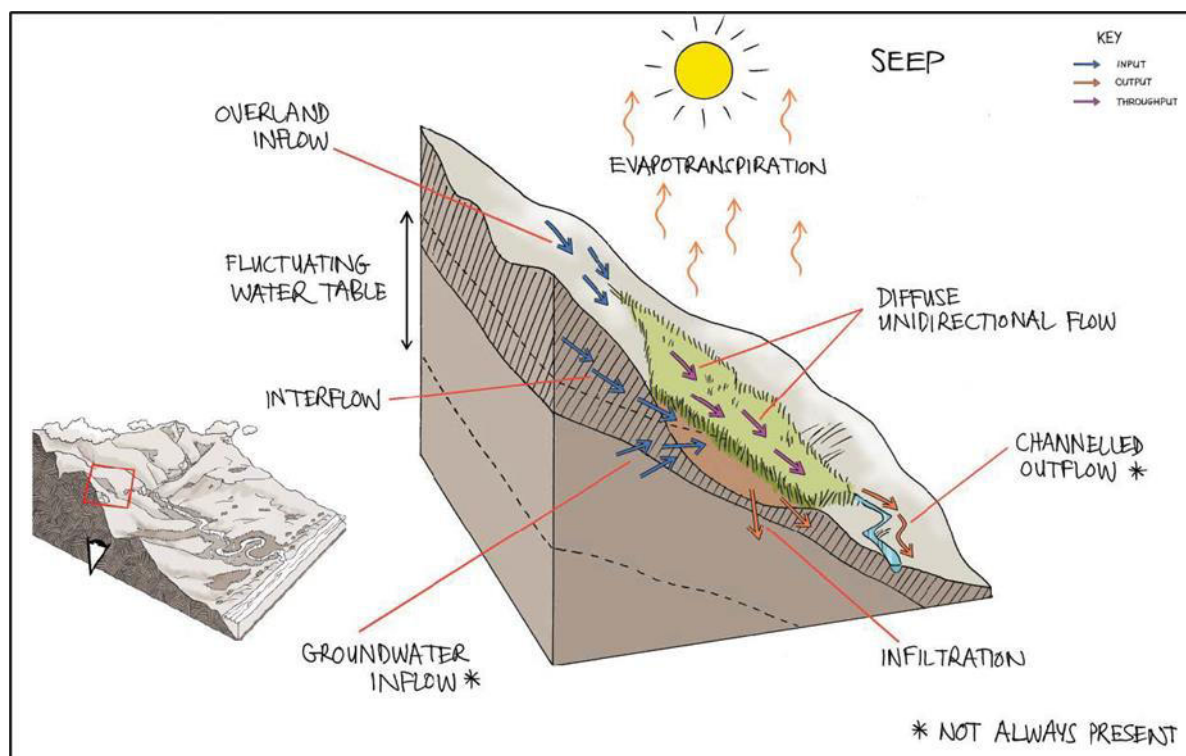


**Figure 11-2: Location of the wetland features identified during the field assessment (in blue) within a 500m radius (in yellow) of the project site**

## 11.2 Aquatic features functional assessment

The functional assessment of the wetland features all relates to the HGM Unit classification of the wetlands.

**Seep** wetlands are typically located on gentle slopes and contain no water inflow channels. Water will typically collect in these Seep areas and due to the dense vegetation within the footprint will have a relatively high roughness coefficient that slows the movement of water to a point that infiltration into the soils is a prominent feature of these wetlands. The key water inputs into these Seeps are the interflow from the near surface groundwater that moves down the slopes as well as overland surface flow down the slopes. Evaporation and channelled outflow are key water releases from the features.



**Figure 11-3: Conceptual illustration of a Seep wetland, showing the typical landscape setting and the dominant inputs, throughputs and outputs of water (Ollis et al. 2013)**

**Unchannelled Valley Bottom** wetlands are characterised by their location on valley floors, an absence of a distinct channel and the presence of the diffuse flow of water through the feature. Water inputs are typically from an upstream channel that becomes dominated by diffuse (surface and subsurface) flow as it enters the wetland and seepage from adjacent slopes. There may also be groundwater input into the wetland. Water characteristically moves through the wetland in the form of diffuse surface or subsurface flow, but the outflow may be in the form of either diffuse or concentrated surface flow. As such, these wetland types provide services associated with the erosion control, storage of toxicants, phosphates and nitrates and certain level of flood retention.



Infiltration and evapotranspiration from unchanneled valley-bottom wetlands can be significant, but horizontal, unidirectional, diffuse surface flow tends to dominate these wetland systems.

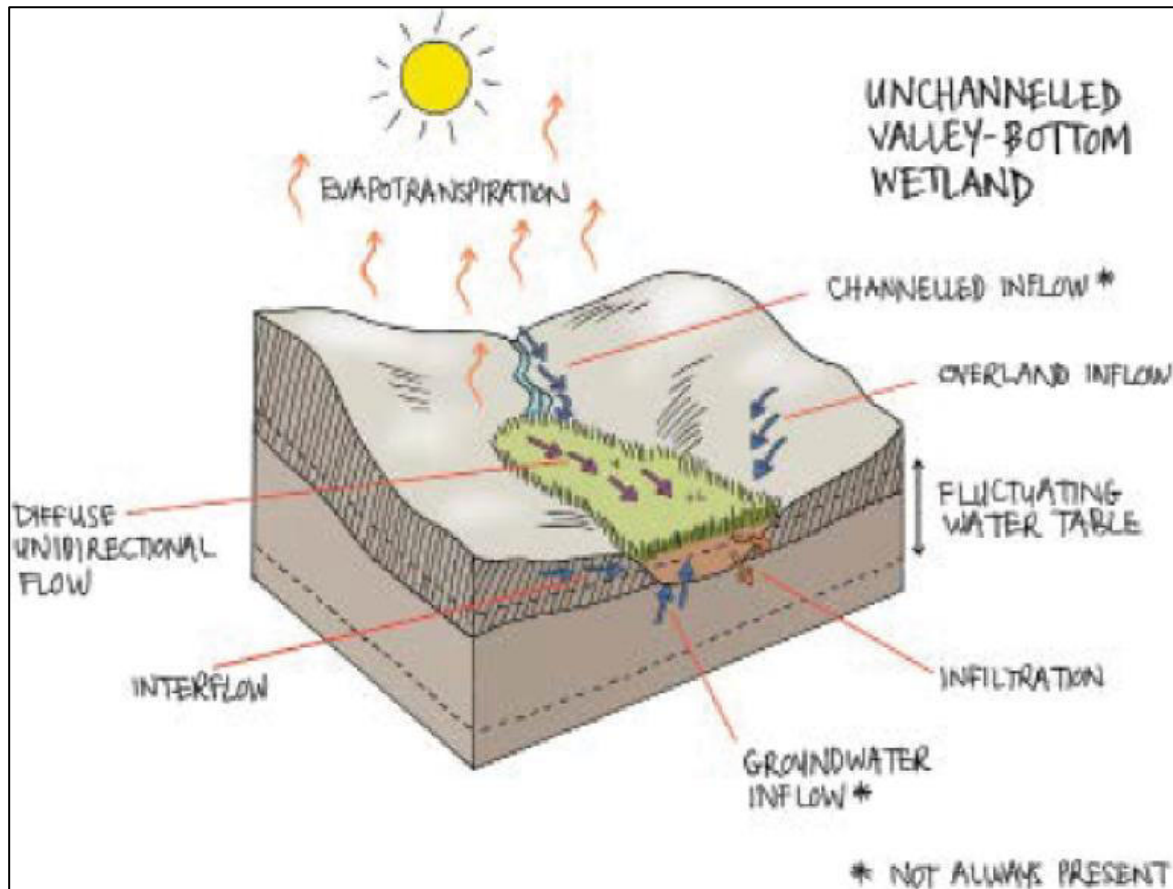
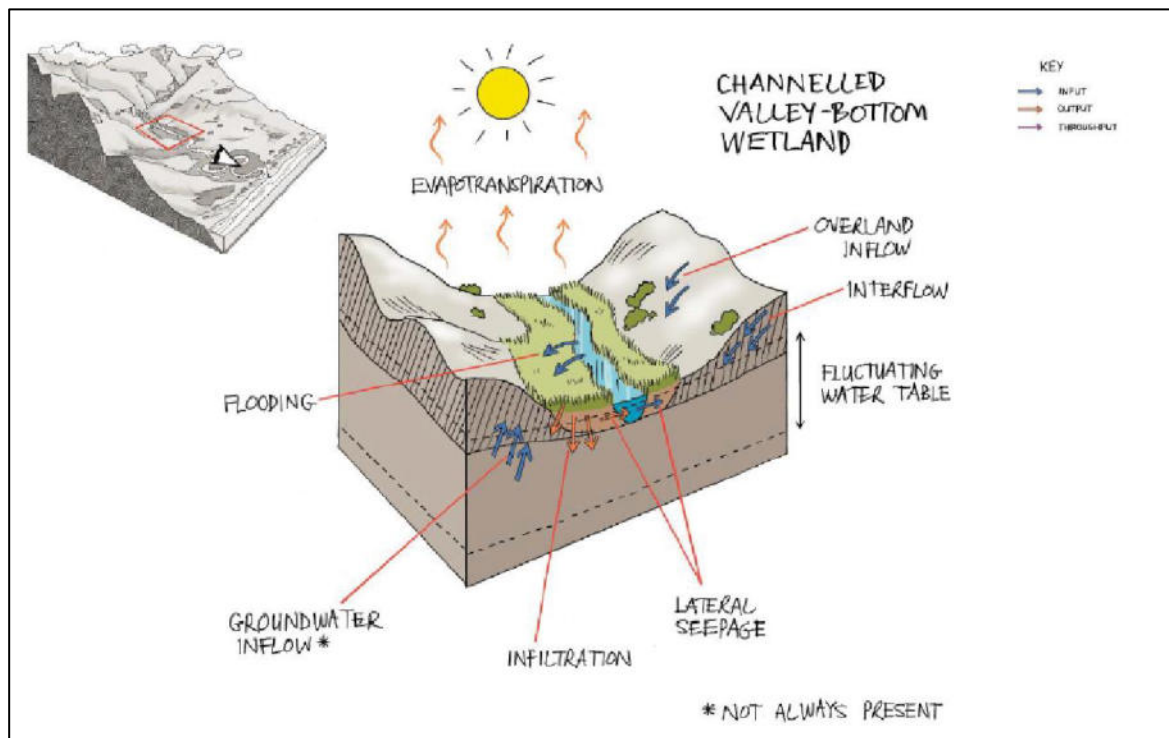


Figure 11-4: Conceptual illustration of a Unchannelled Valley Bottom wetland showing the typical landscape setting and the dominant inputs, throughputs and outputs of water (Ollis *et al.* 2013)

**Channelled Valley Bottom** wetlands must be considered as wetland ecosystems that are distinct from, but sometimes associated with, the adjacent river channel itself, which must be classified as a 'river'. These wetlands are characterised by their location on valley floors, the absence of characteristic floodplain features and the presence of a river channel flowing through the wetland.

Figure 11-5 is a conceptual diagram of a Channelled Valley Bottom wetland, showing the dominant inputs and outputs of water. Dominant water inputs to these wetlands are from the river channel flowing through the wetland, either as surface flow resulting from flooding or as sub- surface flow, and/or from adjacent valley-side slopes (as overland flow or interflow). Water generally moves through the wetland as diffuse surface flow, although occasional, short-lived concentrated flows are possible during flooding events



**Figure 11-5: Conceptual illustration of a Channelled Valley Bottom wetland showing the typical landscape setting and the dominant inputs, throughputs and outputs of water (Ollis *et al.* 2013)**

Water generally exits a Channelled Valley Bottom wetland in the form of diffuse surface or subsurface flow into the adjacent river, with infiltration into the ground and evapotranspiration of water from these wetlands also being potentially significant. Based on the hydrological characteristics of these wetlands they provide sediment, toxicant and nutrient storage functions as well as water supply particularly during the dry seasons.

The ecosystem services provided by the wetlands identified on site were assessed and rated using the WET-EcoServices method (Kotze *et al.* 2008). The summarised results for HGM 1 to HGM 7 are provided in Table 11-1. The average ecosystem services score has been determined to be “Moderately high”.

**Table 11-1: Ecosystem service provision by the Channelled Valley Bottom Wetlands associated with the project site**

Wetland Unit				HGM						
				1	2	3	4	5	6	7
Ecosystem Services Supplied by Wetlands	Indirect Benefits	Regulating and supporting benefits	Flood attenuation	2.1	2.0	2.0	2.2	2.3	2.3	2.3
				2.0	2.0	2.3	2.2	2.3	2.3	2.3
			Water Quality enhancement benefits	2.8	2.8	2.8	2.9	2.8	2.8	2.8
				2.4	2.2	1.9	2.2	2.4	2.2	1.9
				1.9	1.9	1.5	2.4	2.2	2.2	2.2
				2.4	2.4	1.9	2.6	2.4	2.4	2.4
				2.3	2.0	1.7	1.8	1.8	1.8	1.7



	Direct Benefits		Carbon storage	1.7	1.7	1.3	1.3	2.0	2.0	1.7
			<b>Biodiversity maintenance</b>	1.4	1.4	1.8	1.6	1.8	1.6	1.6
		Provisioning benefits	Provisioning of water for human use	2.2	1.7	1.7	1.7	1.7	1.7	1.7
			Provisioning of harvestable resources	2.8	2.2	2.2	2.2	2.2	2.2	2.2
			Provisioning of cultivated foods	1.8	1.8	1.8	1.8	1.8	1.8	1.8
		Cultural benefits	Cultural heritage	1.3	1.3	1.3	1.3	1.3	1.3	1.3
			Tourism and recreation	1.7	1.7	1.7	1.7	1.9	1.7	1.7
			Education and research	1.0	1.0	1.0	0.8	1.8	0.8	1.0
		<b>Average Eco Services Score</b>		2.0	3.0	2.0	2.0	2.0	2.0	2.0

The key ecosystem services provided by the wetland features relate directly their ability to assimilate various substances that move through the catchment. These include nitrates, phosphates and toxicants while the wetlands trap sediment from the catchment which allows for the establishment of dense wetland vegetation that in turn limits the erosion in the features.

### 11.3 Determining the Present Ecological State of an aquatic feature

The PES of an aquatic feature is a function of the impacts that are present within the footprint of the feature as well as the catchments associated with each of these features and how these impacts affect the drivers of the wetland and watercourse.

The impacts identified in the table above were used in the Level 1 WET-Health assessment to determine the PES of the wetland system. The results of the Level 1 assessment are provided in the table below.

**Table 11-2: Present Ecological State (PES) of the system**

HGM Unit	Driver			Combined score
	Hydrology	Geomorphology	Vegetation	
1	4.1	6.2	4.6	<b>4.8 = Class D Largely modified</b>
2	4.5	6.8	4.8	<b>5.2 = Class D Largely modified</b>
3	4.7	7.3	5.3	<b>5.6 = Class D Largely modified</b>
4	2.3	1.2	2.6	<b>2.0 = Class C Moderately modified</b>
5	2.2	1.1	1.7	<b>1.7 = Class B Small modification</b>
6	2.6	1.4	2.6	<b>2.3 = Class C Moderately modified</b>
7	4.4	4.6	5.2	<b>4.7 = Class D Largely modified</b>

The wetland classification provided above makes provision for the following:

- The Class B wetland is considered to be largely natural with limited impacts on the wetland drivers resulting in very little impact on the wetland biodiversity and function.
- The Class C wetlands are considered to have moderate modifications of its wetland drivers resulting in limited impact to the wetland biodiversity and function.
- The Class D wetlands are considered to have undergone large modifications due to severe impacts resulting in large changes to the wetland drivers which consequently results in significant impacts on the wetland biodiversity and function.

#### 11.4 Determining the Ecological Importance and Sensitivity of aquatic features

The Ecological Importance of any aquatic feature is an expression of its importance to the maintenance of the ecological diversity and functioning within itself, as well as hydrologically downstream. The Ecological Sensitivity is a function of the system's ability to resist disturbances on its drivers and its capability to recover from these disturbances once they have occurred.

The wetland EIS assessment was applied to the HGM units described in the previous section to assess the levels of sensitivity and ecological importance of the wetlands. The result of the assessment is shown in Table 11-3.

**Table 11-3: Ecological importance and sensitivity of the aquatic system**

HGM Unit	Criteria	Importance	EIS Class	Overall importance and sensitivity
1	Ecological importance and sensitivity	2.7	M	Medium
	Hydrological/functional importance	2.8	M	
	Direct human benefits	1.3	L	
2	Ecological importance and sensitivity	2.7	M	Medium
	Hydrological/functional importance	2.8	M	
	Direct human benefit	1.3	L	
3	Ecological importance and sensitivity	2.4	M	Medium
	Hydrological/functional importance	2.7	M	
	Direct human benefits	1.9	L	
4	Ecological importance and sensitivity	3.7	H	Medium
	Hydrological/functional importance	2.8	M	
	Direct human benefits	1.0	L	
5	Ecological importance and sensitivity	3.3	H	High
	Hydrological/functional importance	3.0	H	
	Direct human benefits	1.7	L	
6	Ecological importance and sensitivity	2.2	M	Medium
	Hydrological/functional importance	2.2	M	
	Direct human benefits	1.7	L	
7	Ecological importance and sensitivity	2.2	M	Medium
	Hydrological/functional importance	2.2	M	
	Direct human benefits	1.7	L	

### 11.5 Buffer determination

The modelled wetland characteristics was used to determine the appropriate buffer for these wetlands by using the wetland buffer determination model developed by the Water Research Commission.

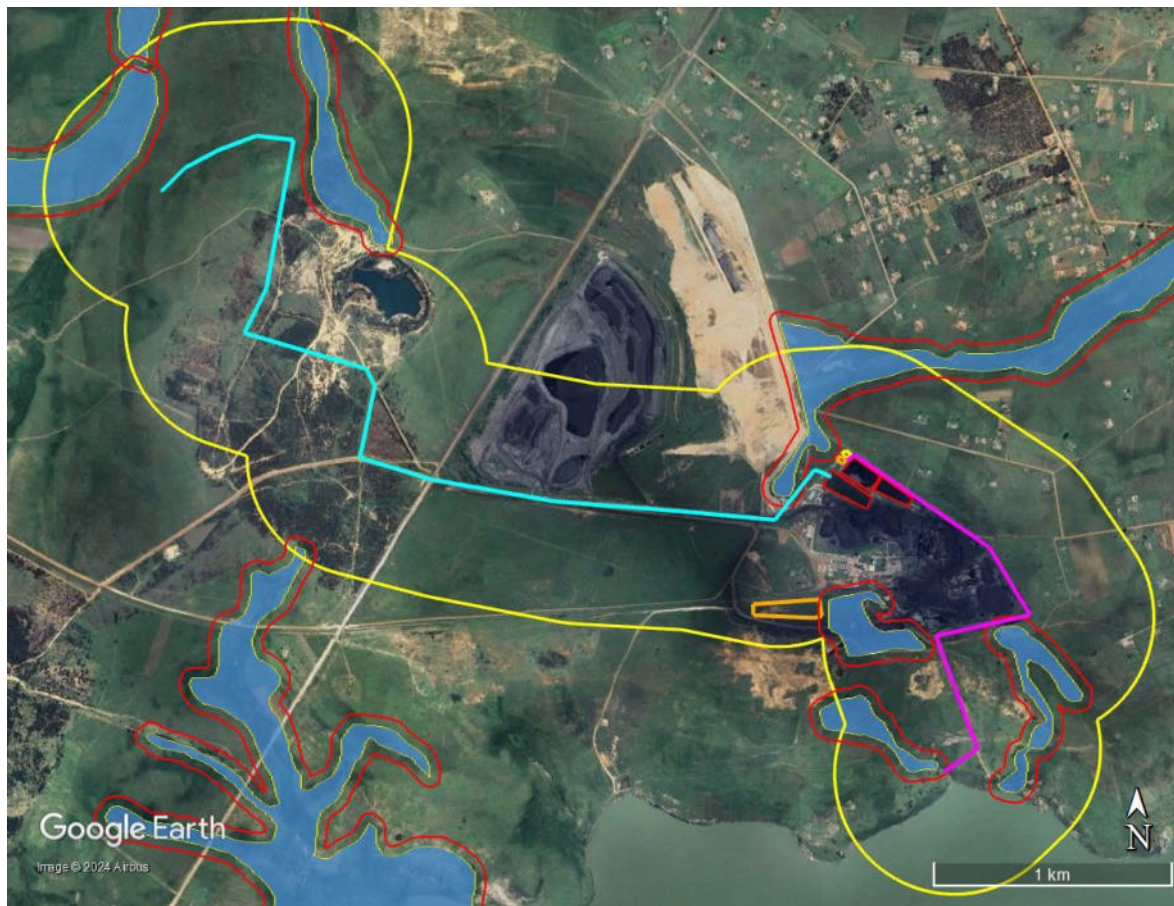
Based on the findings of the assessment, the location and extent of the aquatic features, the PES of the aquatic features, the ecosystem services provided by the system and the EIS of the aquatic features, the following buffers have been determined:

#### **Construction Phase:**

- No plant and equipment must be allowed to be parked within a 40m distance of the delineated edge of any delineated wetland;
- No portable ablution facilities must be allowed to be placed within a 40m distance of the delineated edge of any wetland; and
- No petrochemical storage facilities must be allowed to be placed within a 40m distance of the delineated edge of any wetland.

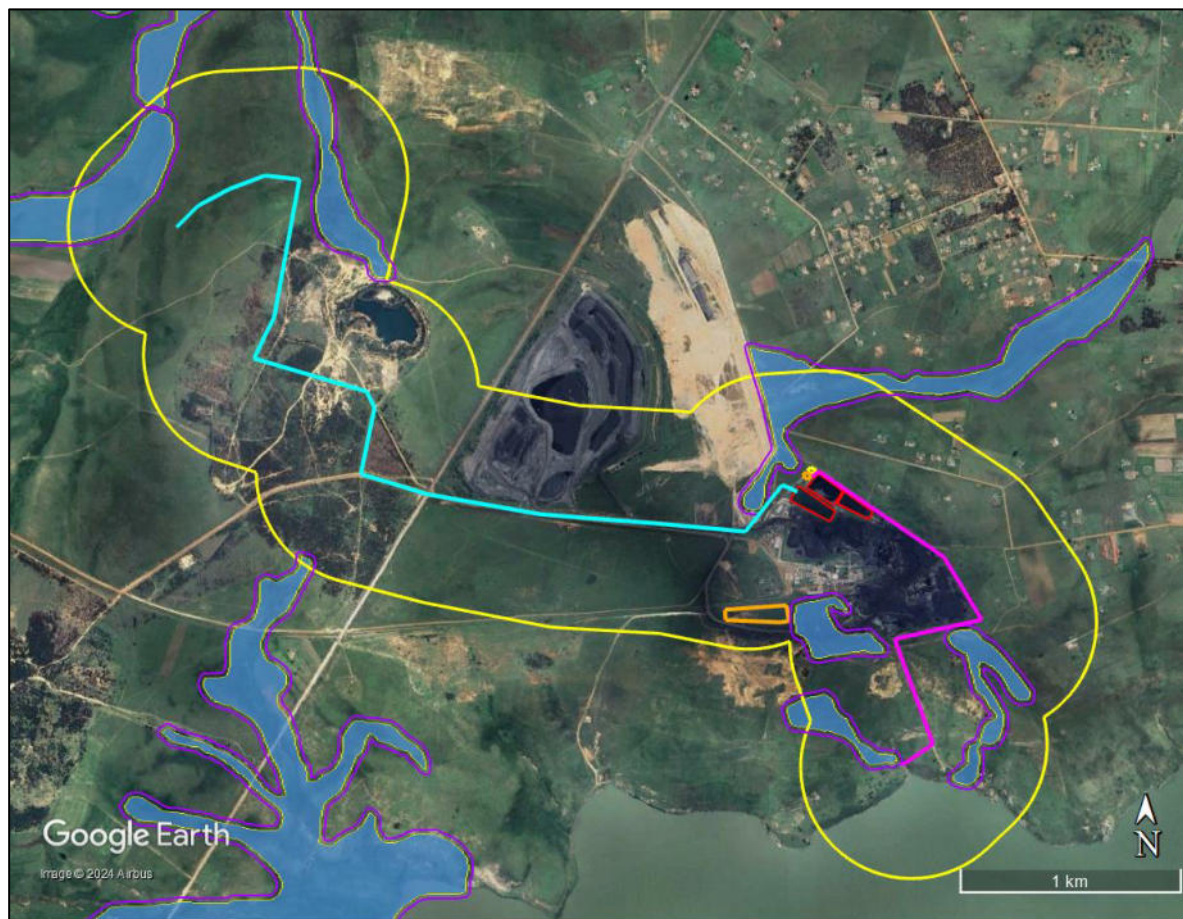
#### **Operational Phase:**

- No part of the infrastructure associated with the project must be allowed to be within a 20m distance from the delineated edge of any wetland.



**Figure 11-6: Location and extent of the applicable 40m construction buffer (in red) around the wetland within the study site**





**Figure 11-7: Location and extent of the applicable 20m operational buffer (in purple) around the wetland features within the study site**

## 12 IMPACT ASSESSMENT

Likely impacts associated with the proposed establishment and operation of the project infrastructure on the project site on the identified aquatic features have been identified through the undertaking of site visits, consultation of published information and independent assessment by the Environmental Project Team. Impacts have also been identified by the specialist assessments undertaken. The impact assessment methodology is provided in Appendix B.

The impacts assessed for the construction and operational phases of the project are provided in Table 12-1 and Table 12-2. Please note that no provision is made for the decommissioning phase of the project as it will not be decommissioned within the next 10 years and as such the determined aquatic baseline might change over time.

**Table 12-1: Construction phase impacts associated with the Maquasa Mine project**

Table 12-1: Construction phase impacts associated with the Maquasa mine project														
Nature of impact	Impact summary	Without mitigation					Significance rating (pre-mitigation)	Proposed mitigation and management measures	With mitigation					Significance rating (post-mitigation)
		S = Status; E = Spatial extent; D = Duration; M = Magnitude P = Probability							S = Status; E = Spatial extent; D = Duration; M = Magnitude P = Probability					
		S*	E	D	M	P			S	E	D	M	P	
Loss of riparian vegetation	Potential loss of riparian vegetation as a result of the earthworks associated with the construction activities.	-	2	2	6	3	Score: 30 Medium Negative	The implementation of the proposed 40m buffer around the delineated edges of the wetlands that have been assessed will ensure that no riparian vegetation will be lost during the construction phase. To ensure that the integrity of the buffer is kept the buffer must be clearly demarcated for the duration of the construction phase.	-	1	2	2	1	Score: 5 Low Negative
Potential increase in sedimentation of the wetland features.	<p>The construction will require the clearance of vegetation from the construction site.</p> <p>Uncontrolled stormwater management of the cleared construction areas could result in increased sedimentation of the wetlands.</p>	-	2	2	6	3	Score: 30 Medium Negative	<p>A Stormwater Management Plan for the construction phase of the project must be compiled that makes provision for the following:</p> <ul style="list-style-type: none"><li>All areas that are to be cleared for the construction activities must be clearly demarcated before clearance. This is to ensure that the cleared areas are limited to the construction footprint only.</li><li>Provision must be made for the capturing of any silt that may wash of the cleared areas.</li><li>No stormwater discharge will be allowed to be made directly in any wetland feature from the construction footprint.</li><li>If the construction schedule allows, construction should take</li></ul>	-	1	2	2	2	Score: 10 Low Negative



Nature of impact	Impact summary	Without mitigation					Significance rating (pre-mitigation)	Proposed mitigation and management measures	With mitigation					Significance rating (post-mitigation)
		S = Status; E = Spatial extent; D = Duration; M = Magnitude P = Probability							S = Status; E = Spatial extent; D = Duration; M = Magnitude P = Probability					
		S*	E	D	M	P			S	E	D	M	P	
								place during the dry season to limit the potential impact.						
Contamination of the area by petrochemical spillages	The presence of plant and equipment on the construction site that make use of petrochemical substances for operation pose a risk of contamination of the water quality in the wetlands.	-	2	3	6	3	Score: 33 Medium Negative	The following management and mitigation measures must be included into the Environmental Management Programme for the project: <ul style="list-style-type: none"><li>All plant and equipment that make use of petrochemical substances must be checked leakages on a daily basis before operations commence.</li><li>All plant and equipment that are found to be leaking must be removed from the property and only returned once the leakages have been addressed.</li><li>If any petrochemical substances are stored on the property, this storage must be done on an impermeable surface in a bunded area that makes provision for 110% of volume of the substances that are stored.</li><li>All refuelling of plant and equipment must be conducted over a drip-tray and will not be allowed to take place within the</li></ul>	-	1	1	6	2	Score: 18 Low Negative

Nature of impact	Impact summary	Without mitigation					Significance rating (pre-mitigation)	Proposed mitigation and management measures	With mitigation					Significance rating (post-mitigation)
		S = Status; E = Spatial extent; D = Duration; M = Magnitude P = Probability							S = Status; E = Spatial extent; D = Duration; M = Magnitude P = Probability					
		S*	E	D	M	P			S	E	D	M	P	
								40m wetland buffer proposed for the construction phase. <ul style="list-style-type: none"><li>If any plant or equipment is to be parked on the site, these must be parked outside of the 40m wetland buffer proposed for the construction phase</li><li>If any spillages from plant or equipment occur, the spill must be immediately contained, the contaminated soils must be collected and bagged in impermeable bags and stored on site to be removed and disposed of by a registered service provider.</li></ul>						
Contamination of the aquatic features by the on-site ablution facilities.	Spillage or leakage could impact on the water quality that moves through the aquatic features, which could decrease the PES of the features.	-	1	1	6	4	Score: 32 Medium Negative	The following management measures associated with the ablution facilities must be implemented: <ul style="list-style-type: none"><li>All portable ablution facilities that will be used on site must be located 40m away from the edge of the delineated aquatic feature. If the edge is not clearly defined, this must be done by an aquatic specialist before implementation of the ablutions can take place.</li><li>The portable ablution facilities must be provided with sealed wells in which the sewage is collected.</li></ul>	-	1	1	2	2	Score: 8 Low Negative

Nature of impact	Impact summary	Without mitigation					Significance rating (pre-mitigation)	Proposed mitigation and management measures	With mitigation					Significance rating (post-mitigation)
		S = Status; E = Spatial extent; D = Duration; M = Magnitude P = Probability							S = Status; E = Spatial extent; D = Duration; M = Magnitude P = Probability					
		S*	E	D	M	P			S	E	D	M	P	
								<ul style="list-style-type: none"><li>The servicing of these portable ablation facilities must be conducted by a registered service provider who must dispose of the material at a Municipal facility.</li><li>A Spill Contingency Plan must be put in place to provide the appropriate management and mitigation measures to be implemented in the event of any spillages from these ablation facilities.</li></ul>						

Table 12-2: Operational phase impacts associated with the Maquasa Mine project

Nature of impact	Impact summary	Without mitigation					Significance rating (pre-mitigation)	Proposed mitigation and management measures	With mitigation					Significance rating (post-mitigation)
		S*	E	D	M	P			S	E	D	M	P	
		S = Status; E = Spatial extent; D = Duration; M = Magnitude P = Probability							S = Status; E = Spatial extent; D = Duration; M = Magnitude P = Probability					
Contamination of leakage of untreated effluent from the WWTW	Any leakages of untreated effluent from the WWTW will result in the contamination of the water in the wetland features which will impact on the PES of the features.	-	2	2	8	3	Score: 36 Medium Negative	The Operational Management Plan of the WWTW must make provision for regular monitoring of the works to ensure that there are no leakages from the plant.  The design of the WWTW must make provision for the discharge of any overflow effluent into the associated PCDs to ensure that the no untreated effluent is released from the works area.	-	1	2	8	1	Score: 11 Low Negative

Nature of impact	Impact summary	Without mitigation					Significance rating (pre-mitigation)	Proposed mitigation and management measures	With mitigation					Significance rating (post-mitigation)
		S*	E	D	M	P			S	E	D	M	P	
		S = Status; E = Spatial extent; D = Duration; M = Magnitude P = Probability							S = Status; E = Spatial extent; D = Duration; M = Magnitude P = Probability					
								No untreated effluent will be allowed to be discharge from the WWTW.  The Operational Management Plan should also make provision for the actions that must be taken in the event of an accidental spill form the works area. These should make provision for: <ul style="list-style-type: none"><li>Containment of the leakage;</li><li>Collection of the effluent and possible contaminated soils;</li><li>Storage of the contained material; and</li><li>Removal and disposal from the site by registered service provider.</li></ul>						
Contamination of leakages of untreated effluent from the pipeline network.	Any leakages of untreated effluent from the pipe networks supplying untreated effluent to the WWTW will result in the contamination of the water in the wetland features which will impact on the PES of the features.	-	2	2	8	3	Score: 36 Medium Negative	The Operational Management Plan of the WWTW must make provision for regular monitoring of the pipework that deliver effluent to ensure that there are no leakages from the pipelines.  The Operational Management Plan should also make provision for the actions that must be taken in the event of an accidental spill form the pipelines. These should make provision for: <ul style="list-style-type: none"><li>Containment of the leakage;</li><li>Collection of the effluent and possible contaminated soils;</li><li>Storage of the contained material; and</li><li>Removal and disposal from the site by registered service provider.</li></ul>	-	1	2	8	2	Score: 11 Low Negative

Nature of impact	Impact summary	Without mitigation					Significance rating (pre-mitigation)	Proposed mitigation and management measures	With mitigation					Significance rating (post-mitigation)
		S*	E	D	M	P			S	E	D	M	P	
		S = Status; E = Spatial extent; D = Duration; M = Magnitude P = Probability							S = Status; E = Spatial extent; D = Duration; M = Magnitude P = Probability					
Changes to the hydrological regime of the wetlands due to leakages from the treated discharge pipeline.	Any leakages of treated effluent from the discharge pipeline may result in additional water entering the wetland features associated with the project. This additional water moving into the wetlands may impact the PES of the features.	-	2	2	4	3	Score: 24 Medium Negative	The Operational Management Plan of the WWTW must make provision for regular monitoring of the treated effluent discharge pipeline for any leakages.  The Operational Management Plan should also make provision for the actions that must be taken in the event of any leakages from the pipeline. These should make provision for: <ul style="list-style-type: none"><li>Stopping the treated effluent discharge; and</li><li>Immediately addressing the leak from the pipeline.</li></ul>	-	2	2	4	1	Score: 8 Low Negative
Pollution of the Heyshope Dam due to treated effluent discharge limits not being met by the WWTW.	The discharge of treated effluent is directly into the Heyshope Dam. Any changes in the quality of the treated effluent may impact on the water quality in the dam.	-	2	3	8	3	Score: 39 Medium Negative	The Operational Management Plan of the WWTW must make provision for regular treated effluent quality monitoring to take place to ensure that the treated effluent remains in the discharge limits that will be stipulated in the Water Use Licence for the discharge.  If the discharge limits cannot be met, the discharge should be ceased up until such time as the limits associated with the licence can be produced.	-	2	2	4	1	Score: 8 Low Negative



### **13 MANAGEMENT AND MITIGATION MEASURES**

The management and mitigation measures as they relate to the impacts associated with the aquatic features are provided in Table 12-1 and Table 12-2. These measures must be included in the Environmental Management Programme Report and Operational Management Plan for the construction and operational phases of the project.

### **14 MONITORING REQUIREMENTS**

It is recommended that an Environmental Control Officer, who meets the requirements of the NEMA: EIA Regulations (2014) as amended, be appointed to conduct monthly audits of the construction phase of the project. An audit report must be completed for each monthly audit and be submitted to the relevant authority.

In addition, it is suggested that provision be made for a biannual biomonitoring be conducted of the identified wetland features and that monthly water quality monitoring be done on the treated effluent discharge at the point of discharge into the Heyshope Dam. This will ensure early detection of any exceedances of the discharged limits.

### **15 CONCLUSION AND SPECIALIST REASONED OPINION**

Appendix 6 of the National Environmental Management Act (Act 107 of 1998): Environmental Impact Assessment Regulations (2014), as amended requires that the specialist conducting a specialist study for submission with an Application for Environmental Authorisation provide a reasoned opinion on whether an authorisation should be granted. In this regard, the following key findings were considered:

- Wetland systems were identified within the study area.
- A total of seven wetland systems were identified within the “regulated area of a watercourse” as defined by the National Water Act (Act No. 36 of 1998).
- The PES of these wetlands ranged from Class B (one wetland), Class C (two wetlands and Class D (four wetlands) with the EIS of the features being classified as low to medium.
- The impacts that were identified and assessed can all be sufficiently managed and mitigated by the implementation of the measures detailed in this assessment.

Based on this, it is the opinion of the specialist that there are no fatal flaws that will prevent the development from being authorized subject to the implementation of the mitigation measures provided in this report.

It is also suggested by the specialist that a rehabilitation plan must be implemented during the rehabilitation of the mine. The rehabilitation plan must focus on the following aspects:

- Rehabilitation of head-cuts where they occur within the identified wetland features.
- Rehabilitation of overgrazed riparian and surrounding areas.

## 16 REFERENCES

Department of Water and Sanitation Report – Wetland and riparian habitat delineation document;

Department of Water and Sanitation Report – Risk Assessment Protocol and associated Matrix;

MUCINA, L. and RUTHERFORD, M.C. (eds.), 2006. The Vegetation of South Africa, Lesotho and Swaziland. Strelitzia Publishers.

South African National Biodiversity Institute – Wetland buffer guideline document;

South African National Biodiversity Institute – Classification System for Wetlands and other Aquatic Ecosystems in South Africa (Ollis. et al.)

Water Research Commission Report TT659/16 – High Risk Wetland Atlas;

Water Research Commission Report TT339/08 – WET-EcoServices a technique for rapidly assessing ecosystem services supplied by wetlands; and

Water Research Commission Report TT340/08 – WET-Health a technique for rapidly assessing wetland health.

**APPENDIX A**  
**SPECIALIST CURRICULUM VITAE**

### CORE SKILLS

- Environmental Impact Assessment
- Specialist Ecological (Terrestrial and Aquatic) Assessment
- Environmental Screening Assessment
- Due Diligence Assessment and Feasibility Studies
- Mining Applications
- Environmental Management Programmes and Plans
- Strategic Environmental Assessments
- Wildlife Management Plans

### DETAILS

#### Qualifications

- MPil. Environmental Management
- BSc (Hon) Botany
- BSc (Botany and Zoology)
- Post Graduate Certificate in Education (Science and Biology)

#### Memberships

- South African Council for Natural Scientific Professions (Pr. Sci. Nat. 400335/11)
- International Association of Impact Assessors (Ref No. 1839)

#### Languages

- Afrikaans - fluent
- English - fluent
- German - fair
- Zulu - communication

#### Countries worked in:

South Africa, Namibia, Lesotho, Mozambique, Botswana, Guinea, Liberia, United States, United Kingdom

### PROFILE

Mr van Rooyen is currently a Technical Director – Environment and the Branch Manager of the KwaZulu-Natal Office of GCS in Durban.

In addition to holding a Masters degree in Environmental Management, he also holds a BSc degree in Botany and Zoology, an Honors degree in Botany and a Post Graduate Certificate in Education. He has in excess of 18 years' experience in the environmental consulting field through conducting and managing Environmental Impact Assessments, Specialist Terrestrial and Aquatic Ecology Assessments and Strategic Environmental Management inputs into various project feasibility studies.

Through these services, he has been exposed to projects in a range of sectors which include the general public infrastructure sector (national and provincial roads, harbour and rail developments, water (dams and supply) and wastewater (treatment works and reticulation), private infrastructure sector (small and large scale housing developments, lodges, private dams, etc.), agricultural sector (dams, establishment of orchards, plantations and feedlots), mining sector (coal mines, gold mine, manganese mines, aggregates and associated mining infrastructure) and the industrial sector (light and heavy industrial infrastructure development).

In addition, Mr van Rooyen has extensive experience in conducting specialist terrestrial and aquatic ecological assessments for various infrastructure (roads, dams, ports) and industrial (smelters, power plants) development projects in a number of diverse ecosystems across Africa. He has experience in the compilation of Resettlement Policy Framework Plans, Due Diligence Assessments and Feasibility Studies associated with infrastructure development projects. Mr van Rooyen has experience in working on various private and public sectors as well as rural and urban environments in various countries

Client	Project Description	Role/ Responsibility
Private client	<b>Wetland Assessment for the farm dam on the Farm Compentation near Matatiele</b> Undertaking of the wetland assessment for the development of an irrigation dam on the Farm Compensation near Matatiele in KwaZulu-Natal.	Wetland Specialist
Senekal Boerdery	<b>Wetland and Biodiversity Assessment for the Mkuze Township Establishment</b> Undertaking of the wetland and biodiversity assessment associated with the township establishment in the town of Mkuze, KwaZulu-Natal.	Wetland and Biodiversity Specialist
WSP Consulting	<b>Wetland Assessment associated with the establishment of a flood protection berm at the SAPPI Saiccor Mill</b> Undertaking of the wetland assessment for the construcion of a flood protection berm between the uMkomaas River and the SAPPI Saiccor Mill in KwaZulu-Natal.	Wetland Specialist
Transnet National Ports Authority	<b>Forest mapping within the Port of Richards Bay</b> Undertaking of the mapping and classification of all the indigenous forest areas within the Port of Richards Bay, KwaZulu-Natal.	Biodiverstiy Specialist
RHDHV	<b>KwaMathanya Water Supply Scheme Wetland Assessment</b> Undertaking of the wetland assessment of the KwaMathanya water supply scheme near town of Ixopo in KwaZulu-Natal.	Wetland Specialist
Private client	<b>Brownsdrift Hydropedological Assessment</b> Undertaking of the wetland and hydropedological assessment associated with the proposed residential developmnet on the site in Brownsdrift, eThekwin Municipality, KwaZulu-Natal.	Wetland Specialist
GreenScene Environmental	<b>Wetland and Biodiversity Assessment for a residential property in Pumula</b> Undertaking of the wetland and biodiversity assessment for the residential development on Lot 967 Pumula, KwaZulu-Natal.	Wetland and Biodiversity Specialist
GreenScene Environmental	<b>Wetland and Biodiversity Assessment for Lot 962 and 965 Port Edward</b> Undertaking of the wetland and biodiversity assessment for the residential development on Lot 962 and 965 Port Edward, KwaZulu-Natal.	Wetland and Biodiversity Specialist
Msunduzi Municipality	<b>Wetland and Biodiversity Assessment for various Military Veterans Housing sites within the Msuduzi Municipality</b> Undertaking of the wetland and biodiversity assessment for the various sites earmarked for the establishment of residential houses for the Military Veterans in the Msunduzi Municipality, KwaZulu-Natal.	Wetland and Biodiversity Specialist
Private client	<b>Forest delineation of a private property in Munster</b> Undertaking of the delineation of the forest margins on the residential property in Munster, KwaZulu-Natal.	Biodiverstiy Specialist



## Previous Experience

Client	Project Description	Role/ Responsibility
JG Afrika (Pty) Ltd	<b>Gunyana Water Supply Scheme Wetland and Biodiversity Assessment</b> Undertaking of the wetland and biodiversity assessment of the Gunyana community water supply scheme near town of Pomeroy in KwaZulu-Natal.	Wetland and Biodiversity Specialist
GreenScene Environmental	<b>Wetland and Vegetation Assessment associated with the construction of the Ingwebaba Pedestrian Bridge near Shelly Beach</b> Undertaking of the wetland and vegetation assessment for the construction of the Ingwebaba Pedestrian Bridge near Shelly Beach in KwaZulu-Natal.	Wetland and Biodiversity Specialist
Terratest (Pty) Ltd	<b>Wetland and Vegetation Assessment associated with the construction of the KwaHlokoheko Rural Water Supply Scheme near Eshowe</b> Undertaking of the wetland and biodiversity assessment of the KwaHlokoheko community water supply scheme near town of Eshowe in KwaZulu-Natal.	Wetland and Biodiversity Specialist
Coastal Macadamias	<b>Wetland Assessment associated with the development of an irrigation dam for Coastal Macadamias near Ramsgate</b> Undertaking of the wetland assessment for the development of an irrigation dam for the Coastal Macadamias property near Ramsgate, KwaZulu-Natal.	Wetland Specialist
South African National Roads Agency Limited	<b>Ballito to Tinley Manor Wetland and Biodiversity Assessment</b> Undertaking of the wetland and biodiversity study to support the preliminary design for the upgrade of the N3 between Ballito and Tinley Manor.	Wetland and Biodiversity Specialist
Vale Limitada	<b>Biodiversity Assessment for the alternative water supply pipeline</b> Undertaking of the biodiversity assessment to support the preliminary design of the proposed alternative water supply pipeline at the Moatize Mine in Tete, Mozambique.	Biodiversity Specialist
GIB Consulting Engineers	<b>Aquadene Wetland Assessment</b> Undertaking of the wetland assessment for the Aquadene housing development in Richards Bay.	Wetland Specialist
JG Afrika (Pty) Ltd	<b>Wetland Assessment for the pipeline route for the drought relief pipeline in Laingsburg</b> Undertaking of the wetland assessment associated with the 25km pipeline route from the water source to the town of Laingsburg in the Western Cape.	Wetland Specialist
Seche International	<b>Wetland and Biodiversity Assessment for the proposed new uMgungundlovu Landfill Site</b> Preliminary wetland and biodiversity assessment for the proposed new uMgungundlovu Landfill site outside of Pietermaritzburg.	Wetland and Biodiversity Specialist
South African National Roads Agency Limited	<b>Wetland and Vegetation Assessment associated with the upgrading of the N1 between Heuningspruit and Koppies</b> Undertaking of the wetland and biodiversity assessment for the upgrading of the N1 between Heuningspruit and Koppies in the Free State Province.	Wetland and Biodiversity Specialist

## Previous Experience

Client	Project Description	Role/ Responsibility
Terratest (Pty) Ltd	<b>Wetland and Vegetation Assessment associated with the upgrading of the Nelson Mandela Museum at Qunu</b> Undertaking of the wetland and vegetation assessment associated with the upgrading of the Nelson Mandela Museum in Qunu in the Eastern Cape Province.	Wetland and Biodiversity Specialist
GreenScene Environmental	<b>Wetland and Vegetation Assessment associated with the construction of the Ulundi Water Supply Scheme</b> Undertaking of the wetland and biodiversity assessment of the Ulundi water supply scheme near town of Eshowe in KwaZulu-Natal.	Wetland and Biodiversity Specialist
MOZAL	<b>Biodiversity Assessment for the raw water supply pipeline for the Mozal Aluminium Smelter in Mozambique</b> Undertaking of the biodiversity assessment for the raw water supply pipeline from the desalination plant in the Port of Matola to the MOZAL smelter in Boane, Maputo, Mozambique.	Biodiversity Specialist
JG Afrika (Pty) Ltd	<b>Wetland and Biodiversity Assessment for various water supply schemes in the Cedarberg Municipality</b> Undertaking of the wetland and biodiversity assessments for the water supply schemes for the town of Whupperthal, Clanwilliam and Citrusdal in the Western Cape.	Biodiversity Specialist
uKhozi Environmentalists	<b>Phalanndwa Coal Mine Biodiversity and Wetland Assessment</b> Undertaking the wetland and biodiversity specialist study in support of the Application for Environmental Authorisation for the Phalanndwa Coal Mine Expansion near Delmas.	Wetland and Biodiversity Specialist
Kongiwe Environmental Consultants	<b>Lephalale Coal Mine Biodiversity and Wetland Assessment</b> Undertaking the wetland and biodiversity specialist study in support of the Application for Environmental Authorisation for the Lephalale Coal Mine near Lephalale.	Wetland and Biodiversity Specialist
Nzingwe Consultancy	<b>Riversdale Coal Mine Wetland Assessment</b> Undertaking the wetland specialist study in support of the Application for Environmental Authorisation and the Water Use Licence Application for the Riversdale Coal Mine near Vryheid.	Wetland Specialist
WSP Environmental	<b>SAPPI Saiccor Wetland Assessment</b> Undertaking the wetland specialist study in support of the Application for Environmental Authorisation for the construction of flood protection	Wetland Specialist

Client	Project Description	Role/ Responsibility
	measures associated with the SAPPI Saiccor Mill, uMkomaas.	
WSP Environmental	<b>11th Avenue Interchange Wetland Assessment</b> Undertaking the wetland specialist study in support of the Application for Environmental Authorisation for the construction of the 11 <sup>th</sup> Avenue Interchange, Durban	Wetland Specialist
WSP Environmental	<b>SAPPI Saiccor Alien Invasive Plant – Risk Assessment</b> Undertaking of the risk assessment of the presence of various listed category I and II alien invasive plant species on the SAPPI Saiccor Mill site, uMkomaas.	Vegetation Specialist
Environmental Resources Management	<b>Bhangazi Community Tented Camp Wetland and Biodiversity Assessment</b> Undertaking of the wetland and biodiversity specialist study in support of the Application for Environmental Authorisation for the establishment of the Bhangazi Community Tented Camp in the isiMangoliso Wetland Park, St. Lucia.	Wetland and Biodiversity Specialist
South African National Roads Agency Limited	<b>N3 – Market Road Interchange Wetland and Biodiversity Assessment</b> Undertaking of the wetland and biodiversity specialist study in support of the Application for Environmental Authorisation for the upgrading of the N3 – Market Road Interchange, Pietermaritzburg.	Wetland and Biodiversity Specialist
ESKOM SOC	<b>ESKOM 22 kVA Lines Vegetation Assessments</b> Undertaking of vegetation assessments for the establishment of various 22kVA electrification lines in KwaZulu-Natal.	Vegetation Specialist
ESKOM SOC	<b>Tombo to Mafini 300kVA Line Vegetation Assessments</b> Undertaking of vegetation assessment for the route alignment of the 300kVA high voltage electricity line from the Tombo Substation to Mafini, Port St. Johns.	Vegetation Specialist
Element Consulting Engineers	<b>Port St. Johns Water Treatment Works Wetland and Biodiversity Assessment</b> Undertaking of the wetland and biodiversity specialist study in support of the Application for Environmental Authorisation for the establishment of the Port St. Johns Water Treatment Works, Port St. Johns.	Wetland and Biodiversity Specialist
South African National Roads Agency Limited	<b>N2 – uMgeni Road Interchange Wetland and Biodiversity Assessment</b> Undertaking of the wetland and biodiversity specialist study in support of the Application for Environmental Authorisation for the upgrading of the	Wetland and Biodiversity Specialist

Client	Project Description	Role/ Responsibility
	N2 – uMgeni Road Interchange, Durban.	
South African National Roads Agency Limited	<b>N2 – Mt Edgecombe Interchange Wetland and Biodiversity Assessment</b> Undertaking of the wetland and biodiversity specialist study in support of the Application for Environmental Authorisation for the upgrading of the N2 – Mt Edgecombe Interchange, Durban.	Wetland and Biodiversity Specialist
Afrimat	<b>Ladysmith Quarry Wetland and Biodiversity Assessment</b> Undertaking the wetland and biodiversity specialist study in support of the Mining Right Application for the establishment of the Afrimat Quarry, Ladysmith.	Wetland and Biodiversity Specialist
South African National Roads Agency Limited	<b>N3 – Epworth Road Interchange Wetland and Biodiversity Assessment</b> Undertaking of the wetland and biodiversity specialist study in support of the Application for Environmental Authorisation for the upgrading of the N3 – Epworth Road Interchange, Pietermaritzburg	Wetland and Biodiversity Specialist
Millennium Challenge Account - Mozambique	<b>Nacala Dam rehabilitation Biodiversity Assessment</b> Undertaking of the biodiversity specialist study in support of the Application for an Environmental Permit for the rehabilitation and raising of the Nacala Dam, Mozambique.	Biodiversity Specialist
WSP Environmental	<b>SAPPI Ngodwana Mill Expansion Wetland and Biodiversity Assessment</b> Undertaking of the wetland and biodiversity specialist study in support of the Application for Environmental Authorisation for the expansion of the Ngodwana Mill, Waterval Boven.	Wetland and Biodiversity Specialist
South African National Roads Agency Limited	<b>N3 – Chota Motala Road Interchange Wetland and Biodiversity Assessment</b> Undertaking of the wetland and biodiversity specialist study in support of the Application for Environmental Authorisation for the upgrading of the N3 – Chota Motala Road Interchange, Pietermaritzburg.	Wetland and Biodiversity Specialist
South African National Roads Agency Limited	<b>R30 Glen Lyon to Brandfort Wetland and Biodiversity Assessment</b> Undertaking of the wetland and biodiversity specialist study in support of the Application for Environmental Authorisation for the upgrading of the R30 between Glen Lyon and Brandfort.	Wetland and Biodiversity Specialist
South African National Roads Agency Limited	<b>R30 Virginia to Beatrix Mine Wetland and Biodiversity Assessment</b> Undertaking of the wetland and biodiversity specialist study in support of the Application for Environmental Authorisation for the upgrading of the R30 between Virginia and Beatrix Mine.	Wetland and Biodiversity Specialist

Client	Project Description	Role/ Responsibility
Miranda Minerals	<b>Sesikhona Colliery Wetland and Biodiversity Assessment</b> Undertaking the wetland and biodiversity specialist study in support of the Mining Right Application for the establishment of the Sesikhona Colliery, Dannhauser.	Wetland and Biodiversity Specialist
Miranda Minerals	<b>Uithoek Colliery Wetland and Biodiversity Assessment</b> Undertaking the wetland and biodiversity specialist study in support of the Mining Right Application for the establishment of the Uithoek Colliery, Dundee.	Wetland and Biodiversity Specialist
Miranda Minerals	<b>Burnside Colliery Wetland and Biodiversity Assessment</b> Undertaking the wetland and biodiversity specialist study in support of the Mining Right Application for the establishment of the Burnside Colliery, Dundee.	Wetland and Biodiversity Specialist
Ultimate Goal	<b>Ultimate Goal Colliery Biodiversity Assessment</b> Undertaking the wetland and biodiversity specialist study in support of the Mining Right Application for the establishment of the Ultimate Goal Colliery, Dundee.	Biodiversity Specialist
Canton Trading	<b>Taylors Halt Quarry Wetland and Biodiversity Assessment</b> Undertaking the wetland and biodiversity specialist study in support of the Mining Right Application for the establishment of the Taylor Halt Quarry, Pietermaritzburg.	Wetland and Biodiversity Specialist
South African National Roads Agency Limited	<b>uMtamvuna Quarry Biodiversity Assessment</b> Undertaking the biodiversity specialist study in support of the Mining Right Application for the establishment of the SANRAL Quarry, Kokstad.	Biodiversity Specialist



## **APPENDIX B**

### **IMPACT ASSESSMENT METHODOLOGY**

## IMPACT ASSESSMENT METHODOLOGY

Likely impacts associated with the proposed development on the identified aquatic and terrestrial biodiversity baseline have been identified through the undertaking of site visits, consultation of published information, comments from Interested and Affected Parties, comments from the relevant authority and independent assessment by the Environmental Project Team. Impacts have also been identified by the specialist assessments undertaken.

The impact assessment will make provision for the assessment of the following impacts:

- No-go impacts;
- Planning and design phase impacts;
- Construction phase impacts;
- Operational phase impacts;
- Decommissioning phase impacts; and
- Cumulative impacts.

Impacts identified were assessed according to the criteria outlined below. Each impact was ranked according to extent, duration, magnitude and probability. These criteria are based on the Department of Environmental Affairs and Tourism (DEAT) (now the Department of Environmental Affairs, Forestry and Fisheries) Guideline Document to the EIA Regulations(1998). A significance rating was calculated as per the methodology outlined below. Where possible, mitigatory measures were recommended for the impacts identified.

### ***Status of the Impact***

The impacts were assessed as having either of the following:

**Table 1: Impact status classification**

Classification	Definition
Negative effect	at a cost to the environment
Positive effect	a benefit to the environment
Neutral	Neutral effect on the environment

### ***Extent of the Impact***

The extent of each impact was rated as being one of the following:

**Table 2: Impact extent classification**

Classification	Definition
1	Site - within the boundaries of the development site
2	Local - the area within 5 km of the site
3	Municipal - the Local Municipality
4	Regional - The Province
5	National – South Africa
6	International – Southern Africa

### ***Duration of the Impact***

The duration of each impact was rated as being one of the following:

**Table 3: Impact duration classification**

Classification	Definition
1	Immediate - > 1 year
2	Short term – 1 to 5 years
3	Medium term – 6 to 15 years
4	Long Term – the impact will cease when the operation stops
5	Permanent – no mitigation measure will reduce the impact after construction

***Magnitude of the Impact***

The intensity or severity of each impact was rated as being one of the following:

**Table 4: Impact severity classification**

Classification	Definition
0	None – where the aspect will have no impact on the environment
2	Minor – where the impact affects the environment in such a way that natural, cultural and social functions / processes are not affected
4	Low – where the impact affects the environment in such a way that the natural, cultural and social functions / processes are slightly affected
6	Moderate – where the affected environment is altered but natural, cultural and social functions / processes continue, albeit in a modified way
8	High – natural, cultural or social functions / processes are altered to the extent that they will temporarily cease
10	Very high / unknown – natural, cultural or social functions / processes are altered to the extent that they will permanently cease

***Probability of Occurrence***

The likelihood of the impact actually occurring is indicated as either:

**Table 5: Impact probability classification**

Classification	Definition
0	None – the impact will not occur
1	Improbable – the possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate corrective actions
2	Low – there is a probability that the impact will occur
3	Medium – the impact may occur
4	High – it is most likely that the impact will occur
5	Definite / unknown – the impact will occur regardless of the implementation of any prevention or corrective actions, or it is not known what the probability will be, based on a lack of published information

***Significance of the Impact***

Based on the information contained in the points above, the potential impacts have been assigned a significance weighting (S). This weighting is formulated by adding the sum of the numbers assigned to extent (E), duration (D) and magnitude (M) and multiplying this sum by the probability (P) of the impact.

$$S = (E+D+M)*P$$

The significance weightings are ranked as:

**Table 6: Impact significance rating**

<b>Impact rating</b>	<b>Definition</b>
< 30	Low – the impact would not have a direct influence on the decision to develop in the area;
30 – 60	Medium – the impact could influence the decision to develop in the area unless it is effectively managed / mitigated;
> 60	High - the impact must have an influence on the decision-making process for development in the area.

## **APPENDIX E-3: HYDROLOGICAL ASSESSMENT**



# Hydrology Assessment for the Proposed Co-Disposal Facility & Water Treatment Plant at Kangra Maquasa East Operations

## Report

Version - Final 1

17 November 2023

Kangra Coal

GCS Project Number: 22-0161

Client Reference: 111862



## Hydrology Assessment for the Proposed Co-Disposal Facility & Water Treatment Plant at Kangra Maquasa East Operations

Report  
Version - Final 1

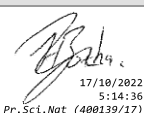

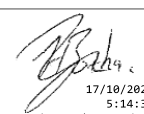


17 November 2023

Kangra Coal

22-0161

### DOCUMENT ISSUE STATUS

Report Issue	Final 1		
GCS Reference Number	GCS Ref - 22-0161		
Client Reference	111862		
Title	Hydrology Assessment for the Proposed Co-Disposal Facility & Water Treatment Plant at Kangra Maquasa East Operations		
	Name	Signature	Date
Author	Hendrik Botha (MSc, PriSciNat)	 17/10/2022 5:14:36 Pr.Sci.Nat (400139/17)	17 November 2023
Proof-reader	Lisa Botha (BSc. Hons)		17 November 2023
Director	Hendrik Botha (MSc, PriSciNat)	 17/10/2022 5:14:36 Pr.Sci.Nat (400139/17)	17 November 2023

### LEGAL NOTICE

This report or any proportion thereof and any associated documentation remain the property of GCS until the mandator effects payment of all fees and disbursements due to GCS in terms of the GCS Conditions of Contract and Project Acceptance Form. Notwithstanding the aforesaid, any reproduction, duplication, copying, adaptation, editing, change, disclosure, publication, distribution, incorporation, modification, lending, transfer, sending, delivering, serving or broadcasting must be authorised in writing by GCS.

## **DECLARATION OF INDEPENDENCE**

GCS (Pty) Ltd was appointed to conduct this specialist surface water study and to act as the independent hydrological specialist. GCS objectively performed the work, even if this results in views and findings that are not favourable. GCS has the expertise in conducting the specialist investigation and does not have a conflict of interest in the undertaking of this study. This report presents the findings of the investigations which include the activities set out in the scope of work.

## APPENDIX 6 OF THE EIA REGULATION - CHECKLIST AND REFERENCE FOR THIS REPORT

**Table 1 - Requirements from Appendix 6 of GN 326 EIA Regulation 2017**

Requirements from Appendix 6 of GN 326 EIA Regulation 2017	Chapter
(a) Details of: (i) The specialist who prepare the reports; and (ii) the expertise of that specialist to compile a specialist report including a curriculum vitae	Document pg ii. Appendix C.
(b) Declaration that the specialist is independent in a form as may be specialities by the competent authority	Document pg iii. Appendix C.
(c) Indication of the scope of, and purpose for which, the report was prepared	Section 1.
(cA) Indication of the quality and age of base data used for the specialist report	Sections 1, 2 and 3.
(cB) A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 7.
(d) Duration, Date and seasons of the site investigation and the relevance of the season to the outcome of the assessment	Section 1.4.
(e) Description of the methodology adopted in preparing the report or carrying out the specialised process include of equipment and modelling used	Section 2.
(f) Details of an assessment of the specifically identified sensitivity of the site related to the proposed activity or activities and its associate's structures and infrastructure, inclusive of a site plan identifying alternative	Sections 1, 4 and 6.
(g) Identification of any areas to be avoided, including buffers	Section 9.1.
(h) Map superimposing the activity and associated structures and infrastructure on environmental sensitivities of the site including areas to be avoided, including buffers	Section 1, 3.
(i) Description of any assumptions made and uncertainties or gaps in knowledge	Sections 2, 4, and 5.
(j) A description of the findings and potential implications of such findings on the impact of the proposed activity including identified alternatives on the environment or activities	Section 9.
(k) Mitigation measures for inclusion in the EMPr	Section 9.2
(l) Conditions for inclusion in the environmental authorisation	Refer to Section 9.
(m) Monitoring requirements for inclusion in the EMPr or environmental authorisation	Refer to Section 9.
(n) Reasoned opinion - (i) as to whether the proposed activity, activities or portions thereof should be authorised. (iA) regarding the acceptability of the proposed activity or activities; and (ii) if the opinion is that the proposed activity, activities or portions thereof should be authorised, and avoidance, management, and mitigation measures should be included in the EMPr, and where applicable, the closure plan	Section 9.3.
(o) Description of any consultation process that was undertaken during preparing the specialist report	None required.
(p) A summary and copies of any comments received during any consultation process and where applicable all responses thereto	None required.
(q) Any other information requested by the competent authority	None required.

## CONTENTS PAGE

DECLARATION of Independence .....	3
Appendix 6 of the EIA Regulation - CHECKLIST and Reference for this Report .....	4
CONTENTS PAGE.....	v
List of Figures.....	vi
List of Tables.....	vii
List of Appendices .....	vii
List of acronyms.....	viii
<b>1 Introduction .....</b>	<b>1</b>
1.1 Project background .....	1
1.1.1 Water Treatment Plant:.....	1
1.1.2 Co-Disposal Facility.....	2
1.2 Objectives .....	3
1.3 Scope of Work .....	4
1.4 Study relevance to the season in which it was undertaken .....	5
<b>2 Methodology .....</b>	<b>7</b>
2.1 Legal considerations .....	7
2.2 Hydrological assessment .....	9
2.2.1 Catchment description and delineation.....	9
2.2.2 Design rainfall and peak flow .....	10
2.3 Flood line modelling .....	11
2.4 Conceptual stormwater management plan (CSWMP).....	11
2.5 Hydrological risk assessment .....	11
2.6 Surface water monitoring plan .....	14
<b>3 Site overview and hydrology .....</b>	<b>15</b>
3.1 Sub-catchments / hydrological response units (HRUs).....	15
3.2 Land cover & slope rise .....	15
3.3 Local geology & soils.....	16
3.4 Climate .....	20
3.4.1 Temperature .....	20
3.4.2 Wind speed and direction .....	21
3.4.3 Rainfall and evaporation .....	21
3.4.4 Runoff.....	23
3.5 Surface water and groundwater users in the study area .....	23
3.6 Depth to groundwater .....	24
3.7 Wetland areas .....	25
3.8 Present ecological state (PES) and environmental sensitivity and ecological importance (EIS) - quaternary scale .....	25
3.9 Overview of site hydrological cycle .....	26
<b>4 Water quality .....</b>	<b>27</b>
4.1 Groundwater Quality .....	28
4.2 Surface Water Quality .....	30
4.3 Concluding remarks on water quality .....	32
<b>5 Flood line assessment.....</b>	<b>33</b>
5.1 Estimated floods return periods.....	34
5.2 Flood line modelling .....	34
5.2.1 Software.....	34
5.2.2 Topography profile data .....	34
5.2.3 Manning's roughness coefficients .....	35
5.2.4 Inflow and boundary conditions .....	35
5.2.5 Hydraulic structures.....	35



5.2.6	Model assumptions.....	35
5.3	Model results.....	36
5.4	Site-specific sensitivity & buffers (avoidance areas).....	36
5.5	Limitations .....	36
<b>6</b>	<b>Conceptual stormwater management plan .....</b>	<b>38</b>
6.1	Aim of the stormwater management plan .....	38
6.2	Existing stormwater infrastructure & proposed on-site stormwater management as per the design report .....	38
6.3	Delineation of clean and dirty water areas.....	40
6.4	Assumptions & limitations .....	40
6.5	Stormwater peak flows.....	40
6.6	Proposed stormwater management measures .....	41
6.6.1	Construction phase .....	41
6.6.2	Operational phase .....	41
6.7	Other stormwater considerations .....	42
6.8	Proposed stormwater monitoring requirements .....	42
<b>7</b>	<b>Risk assessment &amp; mitigation.....</b>	<b>45</b>
7.1	Pre-mining / development phase .....	45
7.2	Operational phase.....	46
7.3	Closure and decommissioning phases .....	48
7.4	Cumulative impacts and impacts on the hydrological cycle .....	48
<b>8</b>	<b>Surface water monitoring .....</b>	<b>52</b>
<b>9</b>	<b>Conclusions .....</b>	<b>54</b>
9.1	Avoidance areas .....	55
9.2	Mitigation measures for inclusion in the EMPr .....	55
9.3	Reasoned opinion on whether the activity should be authorized .....	57

## LIST OF FIGURES

Figure 1-1:	Proposed WTP and possible brine evaporation pond.....	2
Figure 1-2:	Proposed Co-Disposal Facility (Phase 1 already approved, Phase 2 & 3 will be co-disposal) .....	3
Figure 1-3:	Site locality and drainage .....	6
Figure 2-1:	Monitoring Process.....	14
Figure 3-3-1:	Sub-catchments and land cover types.....	17
Figure 3-2:	Sub-catchments and surface slope rise %.....	18
Figure 3-3:	Local geology.....	19
Figure 3-4:	Average yearly temperatures (Meteoblue, 2022) .....	20
Figure 3-5:	Wind rose (Meteoblue, 2022).....	21
Figure 3-6:	Average rainfall for Station 0407639W & WR2012 evaporation .....	22
Figure 3-7:	Simulated natural (unmodified) runoff for W51B .....	23
Figure 3-8:	Groundwater elevation vs topography elevation - correlation (Kangra Monitoring Holes) .....	24
Figure 3-9:	Groundwater baseflow concept (DWS, 2011) .....	25
Figure 3-10:	Simplified overview of the hydrological cycle at the site .....	26
Figure 4-1:	Maquasa East logarithmic groundwater sulphate graph .....	29
Figure 4-2:	Maquasa East logarithmic surface water TDS graph .....	31
Figure 4-3:	Maquasa East logarithmic surface water sulphate graph.....	32
Figure 5-1:	Simulated 1:50 and 1:100 year flood lines .....	37
Figure 6-1:	Draft layout of co-disposal (GFK, 2022).....	39
Figure 6-2:	Discard dump Phase 1 (GFK, 2022) .....	39
Figure 6-3:	Dirty and clean water stormwater catchments.....	43
Figure 6-4:	Conceptual stormwater management system.....	44
Figure 8-1:	Proposed additional surface water monitoring points .....	53

## LIST OF TABLES

Table 2-1: Summary of peak flow methods .....	10
Table 2-2: Proposed Criteria and Rating Scales to be used in the Assessment of the Potential Impacts .....	12
Table 2-3: Explanation of Assessment Criteria .....	13
Table 3-1: Summary of sub-catchments characteristics.....	16
Table 3-2: MAP of nearest rainfall stations .....	21
Table 3-3: Groundwater users within a 2.5 km radius of the site.....	23
Table 3-4: Summary of PES and EIS for the Quaternary Catchment .....	25
Table 4-1: MQE surface water sampling sites .....	27
Table 4-2: MQE groundwater sampling sites .....	28
Table 5-1: Summary of design rainfall data used for peak flow estimates .....	33
Table 5-2: Summary of design peak flows for the delineated sub-catchments (m <sup>3</sup> /s)....	34
Table 6-1: Summary of design rainfall data used for peak flow estimates .....	41
Table 6-2: Stormwater return period estimates for sub-catchments and the development areas .....	41
Table 7-1: Risk rating scale.....	45
Table 7-2: Construction (preparation and development) phase hydrological risk .....	49
Table 7-3: Operational phase hydrological risk.....	50
Table 7-4: Closure Phase Hydrological Risks .....	51
Table 8-1: Proposed monitoring points .....	52

## LIST OF APPENDICES

Appendix A: Peak flow estimates .....	58
Appendix B: Water quality Certificates .....	79
Appendix C: Disclaimer and deceleration of independence .....	80
Details of the specialist, declaration of interest and undertaking under oath .....	81
CV of Specialist .....	83

## LIST OF ACRONYMS

Acronym	Description
BA	Basic Assessment
BOD	Biological oxygen demand
COD	Chemical oxygen demand
CSWMP	The conceptual stormwater management plan
DEM	Digital Elevation Model
DWS	Department of Water and Sanitation
GCS	GCS Water and Environment (Pty) Ltd.
SW	Surface Water
GN704	General Notice 704
ha	Hectare
HRU	Hydrological Response Unit
IWULA	Integrated Water Use Licence Application
m <sup>3</sup>	Cubic Metres
MAE	Mean annual evaporation
MAR	Mean Annual Runoff
MIPI	Midgley and Pitman
NEMA	National Environmental Management Agency
n-Value	Manning's Roughness Coefficients
NWA	National Water Act, 1998 (Act No. 36 of 1998)
PCD	Pollution Control Dam
PFD	Process flow diagram
SDF	Standard design flood
SPP	Sewage Package Plant
TDS	Total dissolved solids
TIN	Triangulated Irregular Network
WMA	Water Management Area
WR2012	Water Resources of South Africa 2012
MQE	Maquasa East

## 1 INTRODUCTION

GCS Water and Environment (Pty) Ltd (GCS) was appointed by Kangra Coal (Pty) Ltd to undertake a hydrological assessment for the proposed development of a Co-Disposal Facility and Water Treatment Plant (WTP) in the Maquasa East, near Driefontein, Mpumalanga Province (refer to Figure 1-3). The project falls in quaternary catchment W51B of the Pongola to Mtamvuna Water Management Area (WMA) (DWS, 2016).

### 1.1 Project background

Kangra Coal is an existing coal mine located in Driefontein, near Piet Retief, in the Mkhondo Local Municipality within the Gert Sibande District Municipality. The Maquasa East (MQE) operations include the historical opencast and underground operations. Kangra is proposing to construct a water treatment plant as well as a co-disposal facility at their Maquasa East operations. The treatment plant will be used to treat water from the existing decant point as well as any surplus water within the mining operations.

#### 1.1.1 Water Treatment Plant:

Decant is currently observed in the form of clear groundwater discharge emanating from the old underground workings at MQE close to the Heyshope Dam. This decant is observed at an elevation range of approx. 1303 to 1306 mamsl and is contained in an unlined contamination dam. This excess decant is currently pumped from the unlined dam back to the MQE PCDs. Based on available data from previous studies undertaken at the mine decant observed emanating from the old workings occurs at a rate ranging from 1 220 to 2 700 m<sup>3</sup>/d (average 1 800 m<sup>3</sup>/d), depending on the rainfall season.

Kangra intends to upgrade the current contamination dam with a correctly lined dam as approved by the Department of Water and Sanitation to prevent any seepages onto the Heyshope Dam. The decant will be pumped into the proposed wastewater treatment plant that will be situated close to the Maquasa East PCDs. Construction and operation of the discussed infrastructure will trigger listed activities that will require authorisation.

The master layout plan associated with the proposed water treatment plant and brine storage facilities proposed (and existing PCDs) is shown in Figure 1-1.

It should also be noted that Kangra is investigating the possibility of storing brine on the discard dump/co-disposal that will come from the water treatment plant. This is one of the two options, with the other being dedicated brine evaporation ponds. GCS has not yet received confirmation as to which option Kangra are opting for, thus impacts relating to both are considered in this assessment.

Treated water will be discharged into the Heyshope dam at the existing decant rate at pristine water quality (in line with GA limits for treated effluent discharge), and therefore will likely not have a negative impact on water quantity or quality. Compared to the active decant water quality, the proposed activity is predicted to improve the Heyshope water quality. Proposed discharge will take place at an existing abstraction point west of Driefontein, that is no longer in use.

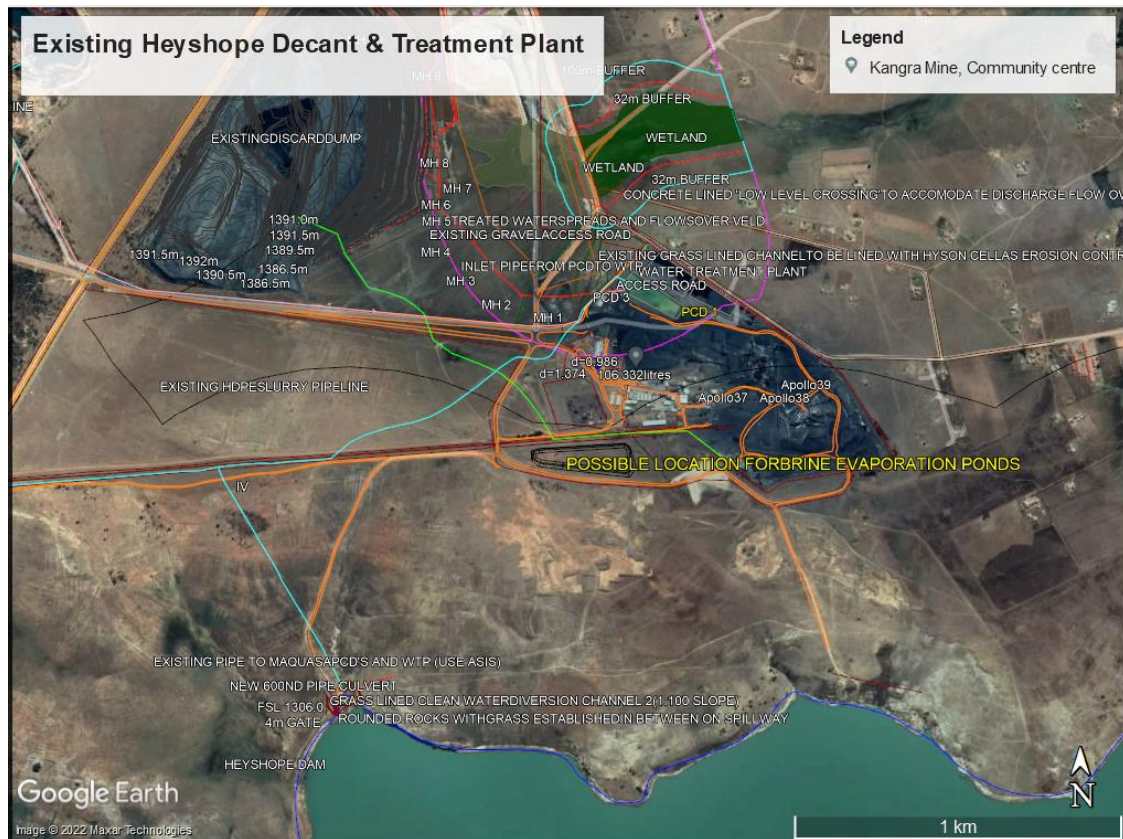


Figure 1-1: Proposed WTP and possible brine evaporation pond

### 1.1.2 Co-Disposal Facility

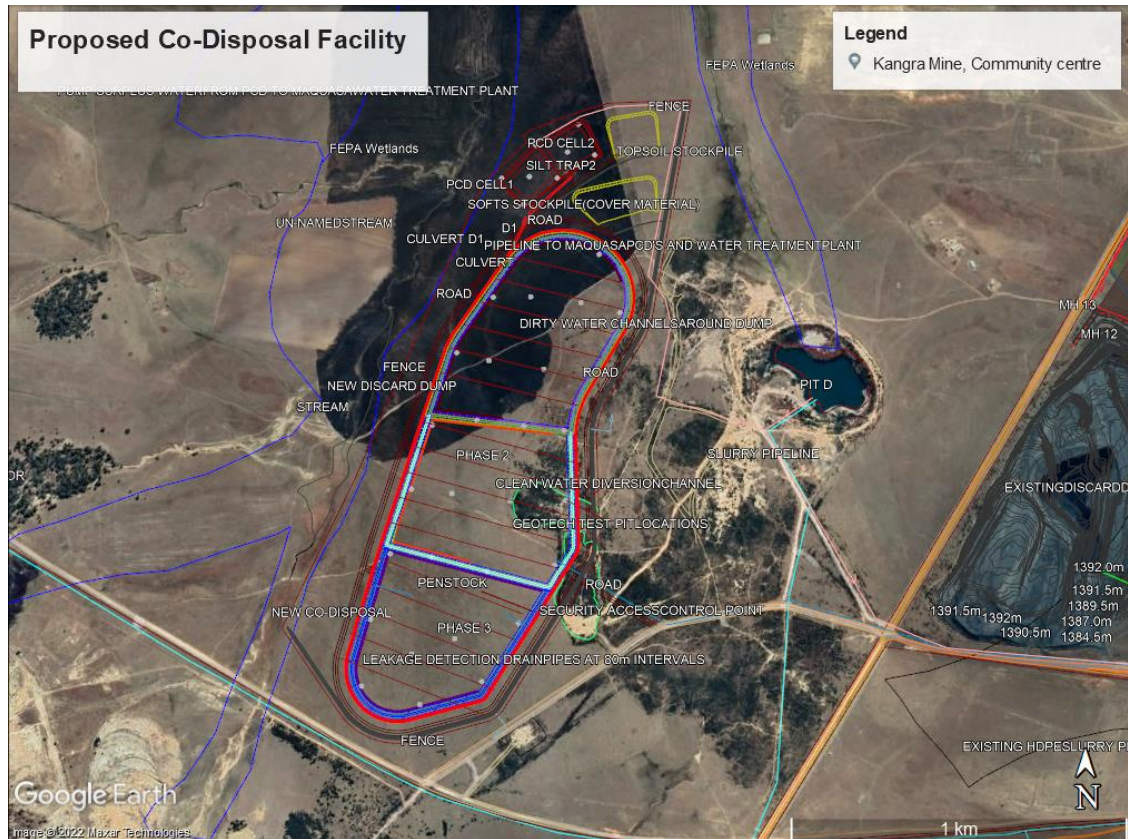
The discard dump at MQE has an approved environmental authorisation and a water use license. As a result of changing operational requirements, there is now a need for a co-disposal facility at MQE, this co-disposal facility is not authorised.

- The co-disposal facility will be located within the MQE operation on the remaining (RE) portion of the farm Rooikop 18 HT. The co-disposal facility will accommodate discarded produced from the beneficiation plant located at Maquasa East, which currently washes and processes coal from the surrounding Kangra Coal operations and will receive coal from future expansion areas.
- This discard dump was originally designed as a three-compartment side hill-type dump with a footprint of approximately 65ha. The three-compartment layout allows for a modular implementation approach with the benefit of delaying capital expenditure. The implementation of this project will be done in two phases:



- Phase 1 will entail the use of the approved discard dump, and
- Phases 2 and 3 will entail the use of a co-disposal facility that requires authorisations.

In the phases, the plan is to build the full waste dump over 20 years. Phase 1 (7 years capacity), Phase 2 (7 years capacity), and Phase 3 (6 years capacity). GFK are undertaking detailed designs of the dump, as well as stormwater sizing. The facility will be lined with an impermeable barrier. The layout plan for the co-disposal facility is shown in Figure 1-2.



**Figure 1-2: Proposed Co-Disposal Facility (Phase 1 already approved, Phase 2 & 3 will be co-disposal)**

## 1.2 Objectives

The objectives of this study, were as follows:

- Undertake a site walkover assessment to identify natural and manmade drainage lines and establish baseline surface water quality.
- Evaluate the site's hydrological setting (i.e., climate, rainfall, drainage, etc.).
- Determine the 1:10, 1:20, 1:50, and 1:100-year peak flows for the non-perennial/perennial streams associated with the site.

- Develop a conceptual stormwater management plan (CSWMP) to provide an overview of stormwater drainage, and formulate mitigative steps to circumvent erosion and control stormwater runoff (detailed designs are being done by the project engineer, GFK).
- Undertake a hydrological risk assessment and compile mitigation measures; and
- Compile a surface water monitoring plan to monitor the impact on the receiving environment.

### 1.3 Scope of Work

The scope of work completed, was as follows:

#### 1. Baseline Hydrology Review:

- a. Hydro-meteorological data collection and analysis.
- b. Catchment delineation and drainage characteristics.
- c. Determination of catchment hydraulic and geometric parameters.

#### 2. Peak Flows & Flood Line Modelling:

- a. Peak flood volume calculation for the 1:10, 1:20, 1:50, and 1:100-year recurring events.
- b. Flood line modelling using HEC-RAS hydraulic software - 1:50 and 1:100-year flood lines were presented; and
- c. Analysis of the modelling results.

#### 3. Conceptual Storm Water Management Plan and Stormwater Monitoring:

- a. Identification of stormwater sub-catchments (i.e., clean and dirty areas)
- b. Determination of stormwater flows and volumes (1:10, 1:20, 1:50 and 1:100- yr return periods) were undertaken.
- c. Indications and explanations of the placement of stormwater attenuation infrastructure were offered.
- d. A stormwater monitoring system plan was drafted, to ensure that the stormwater discharge impact on the environment is managed and controlled.

#### 4. Risk assessment:

- a. A hydrological risk assessment was undertaken, to contextualise the potential surface water risk of the project.

#### 5. Surface Water Monitoring Plan:

- a. A surface water monitoring plan was developed.

**6. Reporting:**

- a. This report was compiled, composing the components above.

**1.4 Study relevance to the season in which it was undertaken**

This study was undertaken as a once-off study and relies on historical hydrological and climate data for the site, as well as recognised hydrological and water resource databases for South Africa. Data generated during the time of this study is not seasonally bound as average yearly data was applied where required and as scientifically acceptable.



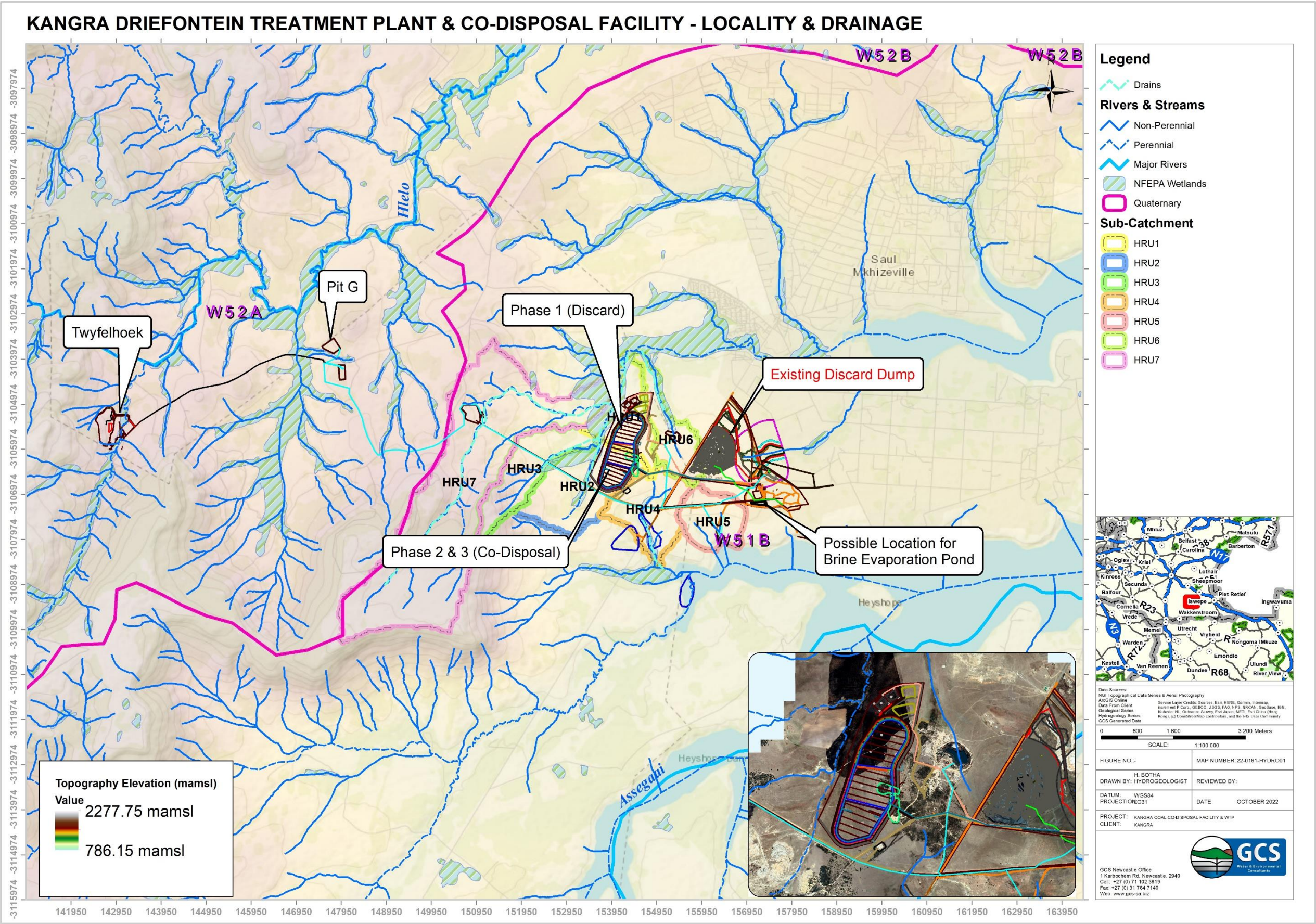


Figure 1-3: Site locality and drainage



---

## 2 METHODOLOGY

The methodological approach for the study is described in the sub-sections below.

### 2.1 Legal considerations

The National Water Act, (Act 36 of 1998) (NWA) governs the use of water and protection of water resources in South Africa. There are two sets of regulations on water use thus far:

- Government Notice No. 704, 4 June 1999, National Water Act, 1998 (No. 36 of 1998): Regulations on the use of water for mining and related activities aimed at the protection of water resources (GN704).
- Government Notice No. 1352, 12 November 1999, National Water Act, 1998 (No. 36 of 1998): Regulations requiring that water use be registered.

In terms of Section 144 of the National Water Act of 1998 (Act 36 of 1998), a flood line, representing the highest elevation that would probably be reached during a storm with a return interval of 100 years, must be indicated on all plans for the establishment of townships. The term, “establishment of townships” includes the subdivision of stands or farm portions in existing townships/development, if the 100-year flood lines are not already indicated on these plans, or when the land-use category of a particular portion of land is changed.

The National Environmental Management Act (Act 107 of 1998) (NEMA) stipulates that all relevant factors be considered for proposed developments to ensure that water pollution and environmental degradation are avoided. Section 2 of the Act establishes a set of principles that apply to the activities of all organs of the state that may significantly affect the environment. These include the following:

- Development must be sustainable
- Pollution must be avoided or minimized and remedied
- Waste must be avoided or minimized, reused or recycled
- Negative impacts must be minimized.

The requirements laid down by the National Building Regulations and Building Standards Act (Act 103 of 1977) in terms of development within the 1:50-year flood line area are based only on safety considerations without proper consideration and understanding of the underlying natural streamflow processes. The Town Planning and Townships Ordinance (Ordinance 15 of 1986) also makes provision in Regulation 44(3) for the extension of flood line areas up to 32 m from the centre of a stream in instances where the 1:50-year flood line is less than 62 m wide in total (CSIR, 2005).

Appendix 6 of GN 326 EIA Regulation 2017 regulations further govern hydrology assessments for EIAs. This hydrology report conforms to Appendix 6 of the EIA regulations, which include the following aspects (where applicable to this study) to be addressed:



---

(a) Details of:

- (i) The specialist who prepare the reports; and
  - (ii) the expertise of that specialist to compile a specialist report including a curriculum vitae.
- (b) Declaration that the specialist is independent in a form as may be specialities by the competent authority.
- (c) Indication of the scope of, and purpose for which, the report was prepared:
  - (cA) Indication of the quality and age of base data used for the specialist report
  - (cB) A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change
- (d) Duration, Date and season of the site investigation and the relevance of the season to the outcome of the assessment.
- (e) Description of the methodology adopted in preparing the report or carrying out the specialised process including equipment and modelling used.
- (f) Details of an assessment of the specifically identified sensitivity of the site related to the proposed activity or activities and its associate's structures and infrastructure, inclusive of a site plan identifying alternatives.
- (g) Identification of any areas to be avoided, including buffers.
- (h) Map superimposing the activity and associated structures and infrastructure on environmental sensitivities of the site including areas to be avoided, including buffers.
- (i) Description of any assumptions made and uncertainties or gaps in knowledge.
- (j) A description of the findings and potential implications of such findings on the impact of the proposed activity including identified alternatives to the environment or activities.
- (k) Mitigation measures for inclusion in the EMPr.
- (l) Conditions for inclusion in the environmental authorisation.
- (m) Monitoring requirements for inclusion in the EMPr or environmental authorisation.
- (n) Reasoned opinion -
  - (i) as to whether the proposed activity, activities or portions thereof should be authorised.
  - (iA) regarding the acceptability of the proposed activity or activities; and
  - (ii) if the opinion is that the proposed activity, activities or portions thereof should be authorised, and avoidance, management, and mitigation measures should be included in the EMPr, and where applicable, the closure plan

- (o) Description of any consultation process that was undertaken during preparing the specialist report.
- (p) A summary and copies of any comments received during any consultation process and where applicable all responses thereto.
- (q) Any other information requested by the competent authority.

## 2.2 Hydrological assessment

Hydrometeorological data for the study area were obtained from various sources including the South African Water Resources Study WR2012 database (Bailey & Pitman, 2015), South African Atlas of Agrohydrology, and Climatology (Schulze, 1997), and the Daily Rainfall Data Extraction Utility (Lynch, 2004). Moreover, sources such as the Köppen Climate Classification (Kottek, et al., 2006), World Climate Data CMIP6 V2.1 (Eyring, 2016), and Meteoblue (Meteoblue, 2022) were used to refine hydrological data.

These sources provided methods of determining the Mean Annual Precipitation (MAP), Mean Annual Runoff (MAR), and Mean Annual Evaporation (MAE) of the study site as well as the design rainfall data. Data was applied to the site water balance calculations, runoff peak flow estimates for flood line modelling and stormwater runoff peak flow estimates for stormwater system sizing (where applicable to this study).

### 2.2.1 *Catchment description and delineation*

A 30 m Digital Terrain Model (DTM) data from the Advanced Land Observing Satellite (ALOS) (JAXA, 2022) were used to delineate the area draining to the streams relevant to this study, sub-catchment flow path as well as to derive river geometry characteristics. These characteristics (area, slopes, and hydraulic parameters) are used to parameterise the site hydraulic model for flood line modelling, water balance modelling or stormwater modelling.

2019 South African (SA) National Land Cover Data (DEA, 2019) was used to characterise the sub-catchment vegetation and derive Manning surface roughness (n-values) coefficients.

### 2.2.2 Design rainfall and peak flow

The Design Rainfall Estimation Software (Smithers & Schulze, 2002) data from the rainfall stations surrounding the study site were used to calculate the 24-hour design rainfall depths for various return periods. Critical storm durations for Rational Methods Alternative 3 were calculated using the Modified Hershfield Equation (Adamson, 1981).

The streams/drainage sections that were modelled applying the three widely used methods were used to calculate 1:10, 1:20, 1:50, and 1:100-year peak flows. These are the Rational Method, Midgley and Pitman (MIPI), and the Standard Design Flood (SDF) methods. A brief description of each of the peak flow methods can be seen in Table 2-1, below.

Methodologies for using the applied peak flow models are explained broadly in the South African Drainage Manual (SANRAL, 2013). Calibration of the runoff coefficients for the drainage areas was guided by the manual, the understanding of the runoff-generating processes as well as land cover attributes. The resulting peak flows calculated using the selected methods were evaluated and conservative values provided inputs into the 1D HEC-RAS flood line model.

**Table 2-1: Summary of peak flow methods**

#### Rational Method

The rational method was developed in the mid-19th century and is one of the most widely used methods for the calculation of peak flows for small catchments (< 15 km<sup>2</sup>). The formula indicates that  $Q = CIA$ , where  $I$  is the rainfall intensity,  $A$  is the upstream runoff area and  $C$  is the runoff coefficient.  $Q$  is the peak flow. There are 3 alternatives to the Rational Method which differ in the methodology used to calculate rainfall intensities. The first alternative (RM1) uses the depth-duration frequency relationships approach, the second uses the modified Hershfield equation and the third alternative uses the Design Rainfall software for South Africa (SANRAL, 2013).

#### Midgley and Pitman

The Midgley and Pitman (MIPI) method is an empirical method that relates peak discharge to catchment size, slope, and distance from the drainage point to the centroid of the catchment (Campbell, 1986). The MIPI method uses 10-unit hydrographs for 10 zones in South Africa. The method does not consider overland flow as a component separate from streamflow but considers only the total longest flow path (Campbell, 1986).

#### Standard Design Flood Method

The Standard Design Flood (SDF) method was developed specifically to address the uncertainty in flood prediction under South African conditions (Alexander, 2002). The runoff coefficient ( $C$ ) is replaced by a calibrated value based on the subdivision of the country into 26 regions or Water Management Areas (WMAs). The design methodology is slightly different and looks at the probability of a peak flood event occurring at any one of a series of similarly sized catchments in a wider region, while other methods focus on point probabilities (SANRAL, 2013).

### 2.3 Flood line modelling

A 30 m ALOS digital terrain model (DTM) (JAXA, 2022) was used to derive the hydraulic and river geometry parameters. River/stream cross-sections and flow paths were prepared using RAS Mapper software and provided input into a 1D HEC-RAS (US Army Corps of Engineers, 2016) flood model. Visual assessment of riverbanks from the Google Earth Imagery and land cover types (DEA, 2019) was used to estimate Manning's 'n' coefficients along the river/streamlines. The 1:50 and 1:100-year flood lines were generated and mapped in Global Mapper and ArcGIS (ESRI, 2018).

### 2.4 Conceptual stormwater management plan (CSWMP)

The CSWMP was designed in conjunction with the provided infrastructure layout plans and available topographical data. The Rational Method was applied to determine stormwater peak flows (sub-catchments < 15 km<sup>2</sup>) within each stormwater sub-catchment, and further considers SCS soil types and land impervious percentages.

The conceptual SWMP was designed to consider relevant South African legislation - the National Water Act (1998) (NWA, 1998) and the Council for Scientific and Industrial Research (CSIR) Human Settlement Planning and Design guidelines (CSIR, 2005).

### 2.5 Hydrological risk assessment

As per GNR 982 of the EIA Regulations (2014), the significance of potential hydrological impacts was assessed. Due to the assessment forming part of a larger risk assessment for the study area, the potential impacts and the determination of impact significance were assessed. The process of assessing the potential impacts of the project includes the following four activities:

1. Identification and assessment of potential impacts.
2. Prediction of the nature, magnitude, extent, and duration of potentially significant impacts.
3. Identification of mitigation measures that could be implemented to reduce the severity or significance of the impacts of the activity; and
4. Evaluation of the significance of the impact after the mitigation measures have been implemented i.e., the significance of the residual impact.

Per GNR 982 of the EIA Regulations (2014), the significance of potential impacts was assessed in terms of the following criteria:

- I. Cumulative impacts.
- II. Nature of the impact.
- III. The extent of the impact.
- IV. Probability of the impact occurring.
- V. The degree to which the impact can be reversed.
- VI. The degree to which the impact may cause irreplaceable loss of resources; and
- VII. The degree to which the impact can be mitigated.

Table 2-2 provides a summary of the criteria used to assess the significance of the potential impacts identified. An explanation of these impact criteria is provided in

Table 2-3.

$$\text{Consequence} = (\text{Duration} + \text{Extent} + \text{Irreplaceability of resource}) \times \text{Severity}$$

And the environmental significance of an impact was determined by multiplying consequence by probability.

**Table 2-2: Proposed Criteria and Rating Scales to be used in the Assessment of the Potential Impacts**

Criteria	Rating Scales	Notes
Nature	Positive (+)	An evaluation of the effect of the impact related to the proposed development.
	Negative (-)	
Extent	Footprint (1)	The impact only affects the area in which the proposed activity will occur.
	Site (2)	The impact will affect only the development area.
	Local (3)	The impact affects the development area and adjacent properties.
	Regional (4)	The effect of the impact extends beyond municipal boundaries.
	National (5)	The effect of the impact extends beyond more than 2 regional/ provincial boundaries.
	International (6)	The effect of the impact extends beyond country borders.
Duration	Temporary (1)	The duration of the activity associated with the impact will last 0-6 months.
	Short-term (2)	The duration of the activity associated with the impact will last 6-18 months.
	Medium-term (3)	The duration of the activity associated with the impact will last 18 months - 5 years.
	Long-term (4)	The duration of the activity associated with the impact will last more than 5 years.
Severity	Low (1)	Where the impact affects the environment in such a way that natural, cultural and social functions and processes are minimally affected.
	Moderate (2)	Where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way; and valued, important, sensitive, or vulnerable systems or communities are negatively affected.
	High (3)	Where natural, cultural, or social functions and processes are altered to the extent that the natural process will temporarily or permanently cease; and valued, important, sensitive, or vulnerable systems or communities are substantially affected.
Potential for impact on irreplaceable resources	No (0)	No irreplaceable resources will be impacted.
	Yes (1)	Irreplaceable resources will be impacted.
Consequence	Extremely detrimental (-25 to -33)	A combination of extent, duration, intensity, and the potential for impact on irreplaceable resources.
	Highly detrimental (-19 to -24)	
	Moderately detrimental (-13 to -18)	
	Slightly detrimental (-7 to -12)	
	Negligible (-6 to 0)	
	Slightly beneficial (0 to 6)	
	Moderately beneficial (13 to 18)	
	Highly beneficial (19 to 24)	
Probability (the likelihood of the impact occurring)	Extremely beneficial (25 to 33)	A function of Consequence and Probability.
	Improbable (0)	
	Probable (1)	
	Definite (2)	
Significance	Very high - negative (-49 to -66)	



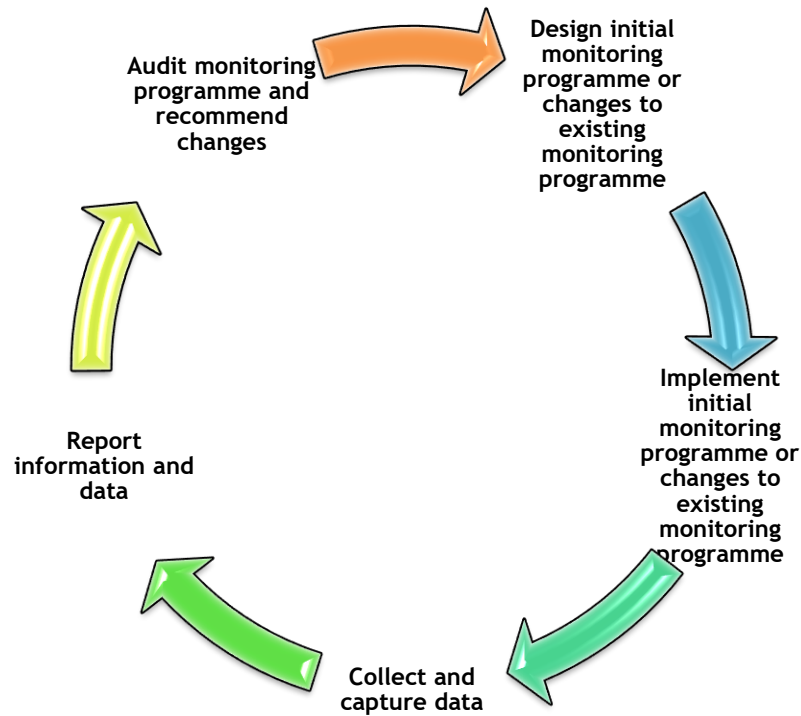
Criteria	Rating Scales	Notes
	High - negative (-37 to -48)	
	Moderate - negative (-25 to -36)	
	Low - negative (-13 to -24)	
	Neutral - Very low (0 to -12)	
	Low-positive (0 to 12)	
	Moderate-positive (13 to 24)	
	High-positive (37 to 48)	
	Very high - positive (49 to 66)	

Table 2-3: Explanation of Assessment Criteria

Criteria	Explanation
Nature	This is an evaluation of the type of effect the construction, operation, and management of the proposed development would have on the affected environment. Will the impact of change on the environment be positive, negative, or neutral?
Extent or Scale	This refers to the spatial scale at which the impact will occur. The extent of the impact is described as footprint (affecting only the footprint of the development), site (limited to the site), and regional (limited to the immediate surroundings and closest towns to the site). The extent of scale refers to the actual physical footprint of the impact, not to the spatial significance. It is acknowledged that some impacts, even though they may be of a small extent, are of very high importance, e.g., impacts on species of very restricted range. To avoid "double counting, specialists have been requested to indicate spatial significance under "intensity" or "impact on irreplaceable resources" but not under "extent" as well.
Duration	The lifespan of the impact is indicated as temporary, short, medium, and long-term.
Severity	This is a relative evaluation within the context of all the activities and the other impacts within the framework of the project. Does the activity destroy the impacted environment, alter its functioning, or render it slightly altered?
Impact on irreplaceable resources	This refers to the potential for an environmental resource to be replaced, should it be impacted. A resource could be replaced by natural processes (e.g., by natural colonisation from surrounding areas), through artificial means (e.g., by reseeding disturbed areas or replanting rescued species) or by providing a substitute resource, in certain cases. In natural systems, providing substitute resources is usually not possible, but in social systems, substitutes are often possible (e.g., by constructing new social facilities for those that are lost). Should it not be possible to replace a resource, the resource is essentially irreplaceable e.g., red data species that are restricted to a particular site or habitat to a very limited extent.
Consequence	The consequence of the potential impacts is a summation of the above criteria, namely the extent, duration, intensity, and impact on irreplaceable resources.
Probability of occurrence	The probability of the impact occurring is based on the professional experience of the specialist with environments of a similar nature to the site and/or with similar projects. It is important to distinguish between the probability of the impact occurring and the probability that the activity causing a potential impact will occur. Probability is defined as the probability of the impact occurring, not as the probability of the activities that may result in the impact.
Significance	Impact significance is defined to be a combination of the consequence (as described below) and the probability of the impact occurring. The relationship between consequence and probability highlights that the risk (or impact significance) must be evaluated in terms of the seriousness (consequence) of the impact, weighted by the probability of the impact occurring. In simple terms, if the consequence and probability of an impact are high, then the impact will have a high significance. The significance defines the level to which the impact will influence the proposed development and/or environment. It determines whether mitigation measures need to be identified and implemented and whether the impact is important for decision-making.
Degree of confidence in predictions	Specialists and the EIR team were required to indicate the degree of confidence (low, medium, or high) that there is in the predictions made for each impact, based on the available information and their level of knowledge and expertise. The degree of confidence is not taken into account in the determination of consequence or probability.
Mitigation measures	Mitigation measures are designed to reduce the consequence or probability of an impact or to reduce both consequence and probability. The significance of impacts has been assessed both with mitigation and without mitigation.

## 2.6 Surface water monitoring plan

The monitoring network is based on the principles of a monitoring network design as described by the DWAF Best Practice Guidelines: G3 Monitoring (DWAF, 2007). The methodological approach that the monitoring plan follows is represented in Figure 2-1, below.



**Figure 2-1: Monitoring Process**

A surface water monitoring program that presents water quality constituencies to be analysed, the frequency of sampling, and the locality of sampling points were drafted. This plan included the construction and operational phase monitoring.

### 3 SITE OVERVIEW AND HYDROLOGY

As mentioned previously, the project falls in quaternary catchment W51B of the Pongola to Mtamvuna Water Management Area (WMA) (DWS, 2016). Elevations on the site typically range from 1 300 to 1 600 meters above mean sea level (mamsl).

#### 3.1 Sub-catchments/hydrological response units (HRUs)

Seven (7) hydrological response unit (HRUs) describes the natural drainage for the study area (using a 1:1 000 stream count and 30 m DTM fill) - refer to Figure 1-3 and Figure 3-3-1. The sub-catchment relates well to desktop-delineated drainage lines for the project area, as well as verified streams associated with the project area.

Primary drainage from the position of the proposed co-disposal site, and much of the MQE area is towards the northeast, to the perennial Egude River, which makes up the bottom inflow of the Heyshope Dam. Drainage from the southern portions of the MQE area, and Maquassa West (MQW) is towards the south, via several perennial and non-perennial drainage lines, towards the southern inflow of the Heyshope Dam. The Heyshope Dam is therefore the end received of any surface water-related pollution that may take place at the MQE operations. The sub-catchments that are associated with the proposed co-disposal facility are HRU1 to 3, and HRU6. The sub-catchment associated with the proposed treatment area is HRU5.

#### 3.2 Land cover & slope rise

The dominant land types associated with the sub-catchment are shown in Figure 3-3-1 (DEA, 2019), and is observed to be natural grasslands. The site is predominantly characterised by natural grassland. The land cover was simplified into 4 categories and is summarised in Table 3-1. Slope % rise for the general area is shown in Figure 3-2. Slope rise % was used to characterise the sub-catchment slope and runoff generation.

In the modelling process of the flood lines or stormwater runoff (whichever applies to this study), Manning's coefficient (n-values) was set to represent natural stream systems and was supplemented by Google Earth Imagery and field observations. These "n" values were further derived from the available vegetation and land cover data for the site.

**Table 3-1: Summary of sub-catchment characteristics**

Sub-Catchment		HRU1	HRU2	HRU3	HRU4	HRU5	HRU6	HRU7
Area (km <sup>2</sup> )		1.549	2.609	1.890	1.84	1.24	1.36	9.92
Longest Drainage Line (km)		1.99	1.08	1.148	1.18	0.57	1.33	7.26
Average Slope (%)		0.56%	1.23%	3.08%	2.01%	9.14%	1.70%	4.30%
Slope (%)	<3	35.66%	15.25%	8.46%	12.24%	4.19%	26.40%	20.00%
	3-10	63.80%	73.48%	42.12%	72.04%	66.11%	73.10%	10.00%
	10-30	0.53%	11.27%	39.28%	14.94%	29.70%	0.50%	20.00%
	>30	0.00%	0.00%	10.14%	0.78%	0.00%	0.00%	50.00%
Land Cover	Thick bush & plantation	18%	11%	8%	17%	2%	12%	5.91%
	Light bush & farm-lands	29%	11%	4%	4%	16%	2%	2.60%
	Grasslands	51.5%	61.3%	77.4%	75.6%	75.0%	63.1%	89.4%
	No Vegetation	1%	17%	10%	3%	7%	23%	2.08%

### 3.3 Local geology & soils

According to the 1:250 000 geological series (2730 Vryheid), the local surface geology is characterised by occurrences of dolerite, and sediments associated with the Vryheid Formation, of the Ecca Group, of the Karoo Sequence (DMEA, 1998g) - refer to Figure 3-3.

According to the Land types of South Africa databases (Land Type Survey Staff, 1972 - 2006c), the soils in the area typically conform to land types of the Bb36 group, which typically entail red and yellow, dystrophic/mesotrophic, apedal soils with plinthic subsoils (plinthic soils comprise > 10% of land type, red soils comprise < 33% of land type). According to WR2012 soil data for the area, the erodibility of the soils for the area can be considered medium (WRC, 2015).

In terms of Hydrological Soil Types, the soils in the project area are classified as Type C, with an erosion factor of 7 and runoff factor of about 0.39.



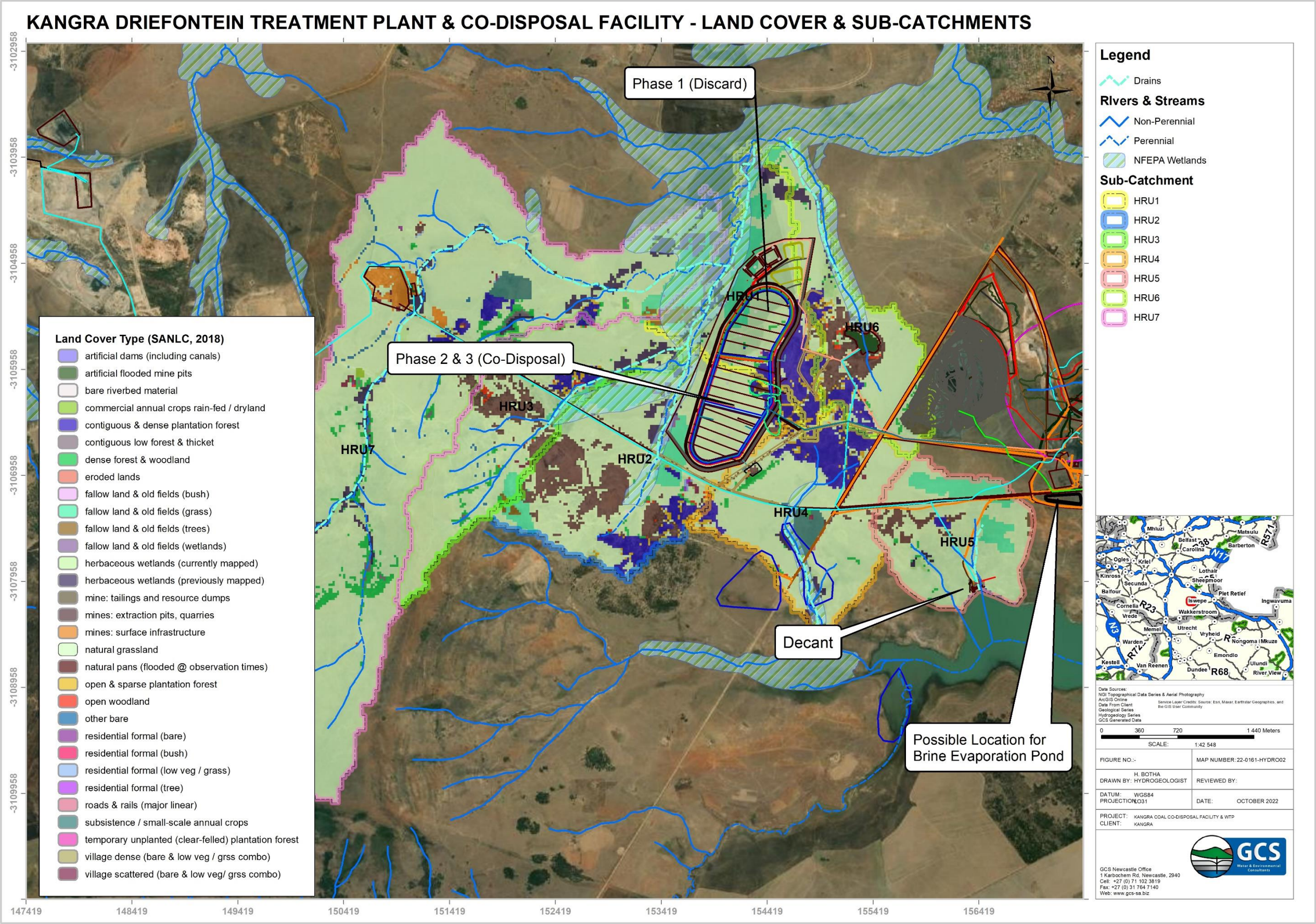


Figure 3-3-1: Sub-catchments and land cover types



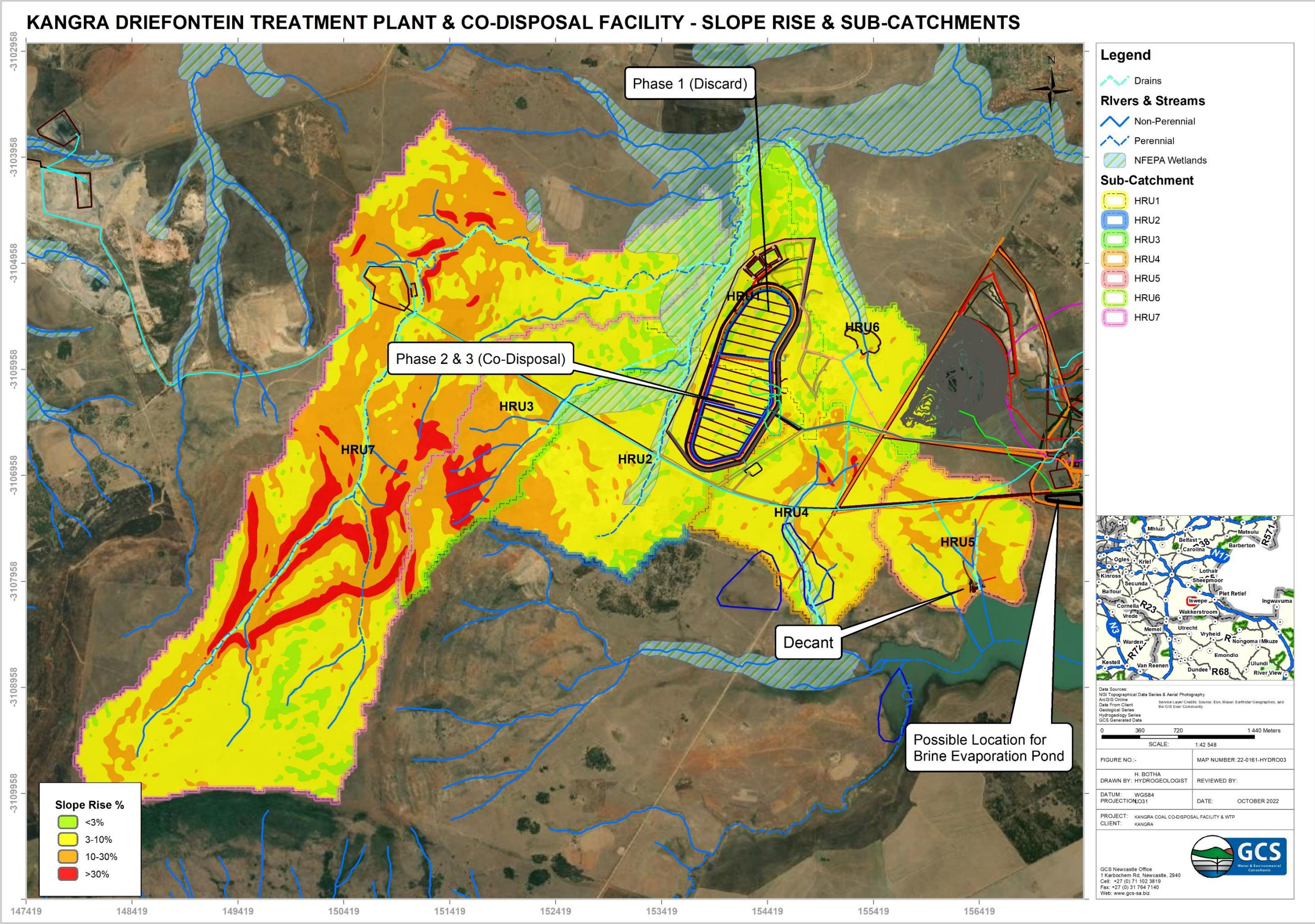


Figure 3-2: Sub-catchments and surface slope rise %



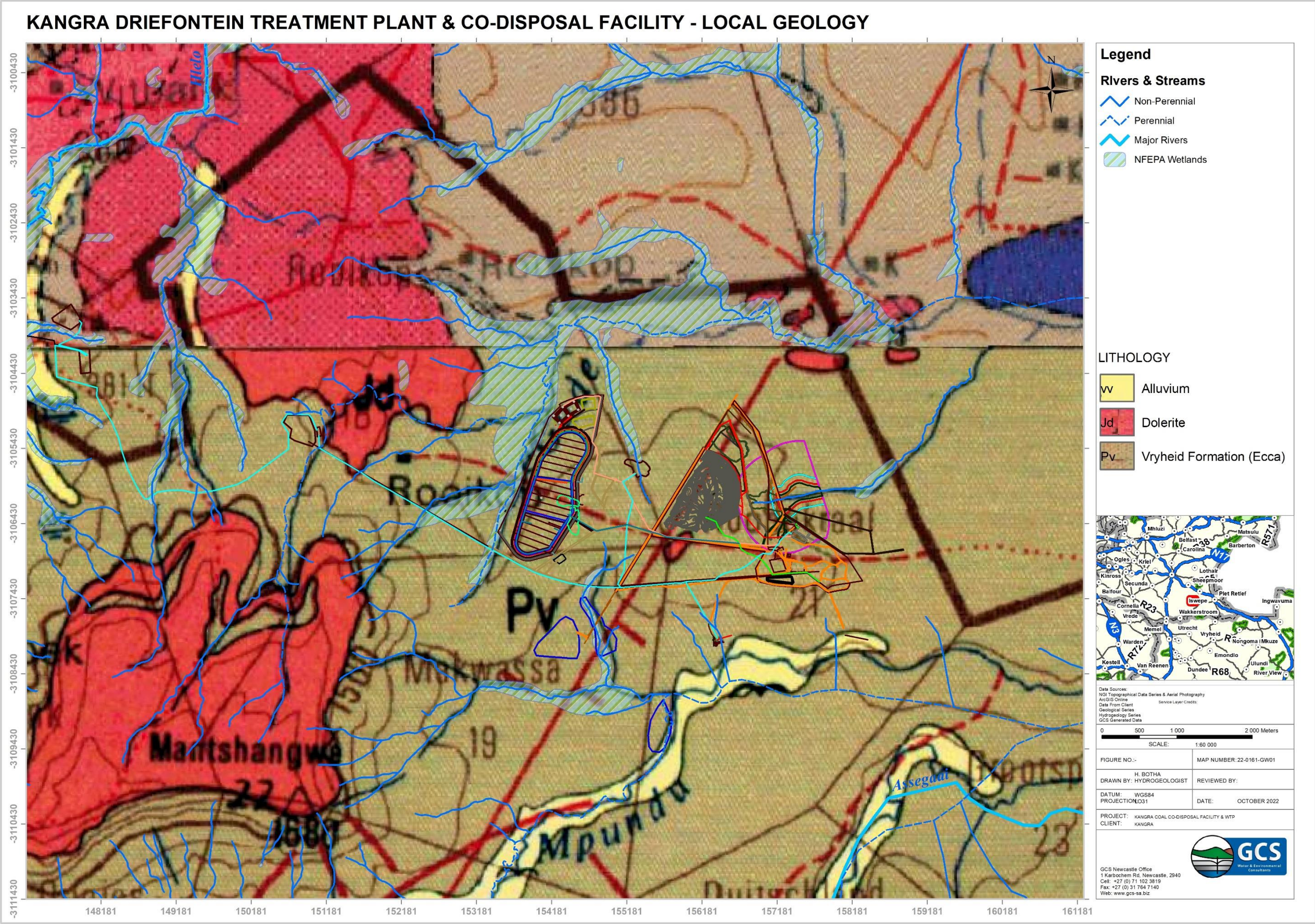


Figure 3-3: Local geology



### 3.4 Climate

Climate, amongst other factors, influences soil-water processes. The most influential climatic parameter is rainfall. Rainfall intensity, duration, evaporative demand and runoff were considered in this study to indicate rainfall partitioning within the project area.

#### 3.4.1 Temperature

The average yearly temperature (refer to Figure 3-4) for the project area ranges from 25 to 33°C (high) and -4 to -2°C (Low). The study area is situated in a subtropical highland climate or temperate oceanic climate with dry winters (Cwb) area, as per the Köppen Climate Classification (Kottek, et al., 2006). The project area receives summer rainfall.

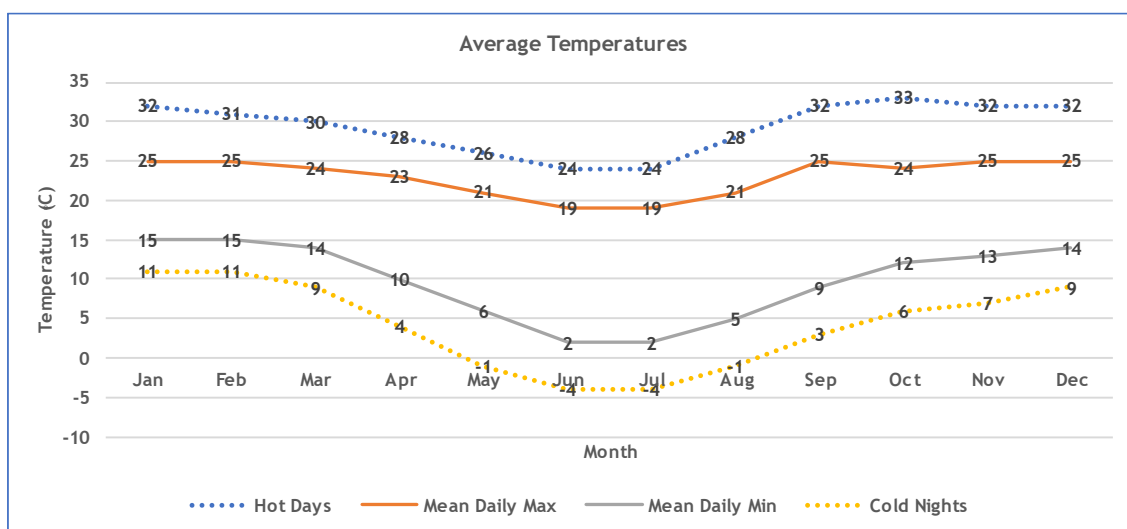


Figure 3-4: Average yearly temperatures (Meteoblue, 2022)

### 3.4.2 Wind speed and direction

Figure 3-5 shows the wind rose for the project area (Vryheid used as reference) and presents the number of hours per year the wind blows from the indicated direction. The wind blows from WW, ENE and E more often, at velocities ranging from 1 km/hr to 28 km/hr; and from other directions but less frequently and at lower velocities (< 19 km/hr).



Figure 3-5: Wind rose (Meteoblue, 2022)

### 3.4.3 Rainfall and evaporation

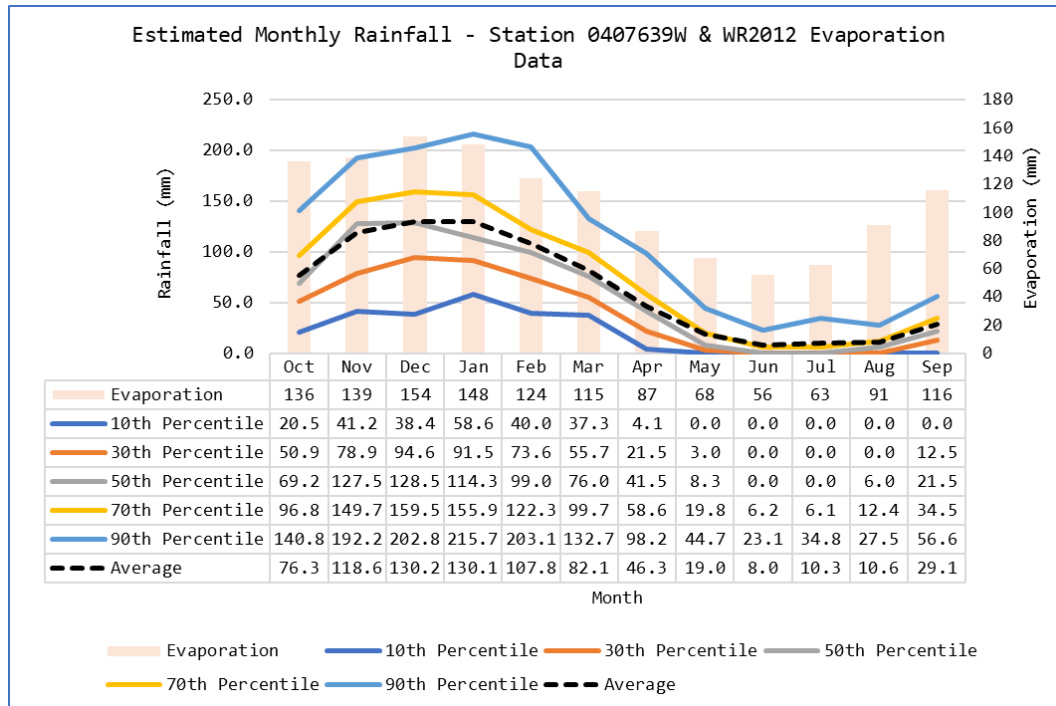
The project area is situated in rainfall zone W5A. The mean annual precipitation (MAP) measured at several rainfall stations that fall close to the site is summarised in Table 3-2, below.

Table 3-2: MAP of nearest rainfall stations

Station Name	ID	MAP (mm/yr)
GROOT RIETVLEI	0407639_W	770
DIRKIESDORP (POL)	0407730_W	681
SPITSKOP	0407397_W	800
BRERETON PARK	0443807_W	900
Average		787.75

The monthly rainfall data used to calculate MAP was obtained from rainfall station 0407639W (Grootvlei). The rainfall record is for the period 1929 to 2003 (74 years). Monthly rainfall for the site is likely to be distributed as shown in Figure 3-6, below.

Available rainfall data suggest a MAP ranging from 482 (30<sup>th</sup> percentile) to 1372 (90<sup>th</sup> percentile) mm/yr. The average rainfall is in the order of 768 mm/yr. The project area falls within evaporation zone 13A, of which Mean Annual Evaporation (MAE) ranges from 1 200 to 1 300 mm/yr. The MAE far exceeds the MAP for the site, which implies greater evaporative losses when compared to incident rainfall. Monthly evapotranspiration for the site is likely to be distributed as shown in Figure 3-6, below.



**Figure 3-6: Average rainfall for Station 0407639W & WR2012 evaporation**



### 3.4.4 Runoff

Runoff from natural (unmodified) catchments for quaternary catchment W51B is simulated in WR2012 (WRC, 2015) as being equivalent to 103.5 mm/yr (or 13% of the MAP). This is approximately 51.369 Mm<sup>3</sup>/yr NMAR for the surface area of W51B.

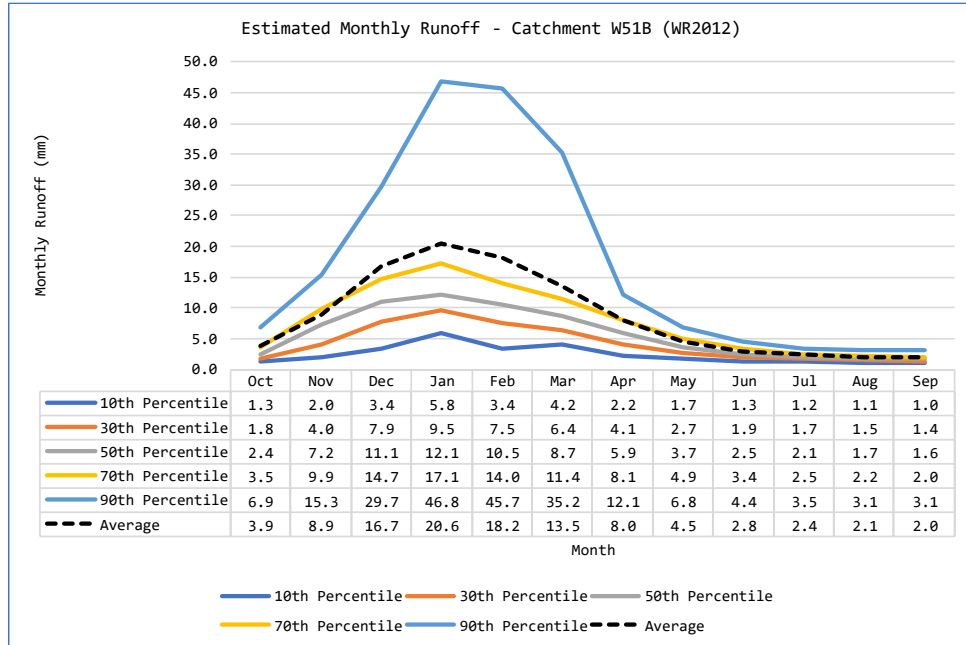


Figure 3-7: Simulated natural (unmodified) runoff for W51B

### 3.5 Surface water and groundwater users in the study area

According to Water Allocation Registration Management System (WARMS, 2019), there are no WARMS water users within a 5 km radius of the proposed activity. According to SADAC GIP and National Groundwater Activities (NGA) data, there are at least 3 registered boreholes within a 5 km radius of the proposed activities (refer to Figure 1-3 and Table 3-3).

Table 3-3: Groundwater users within a 2.5 km radius of the site

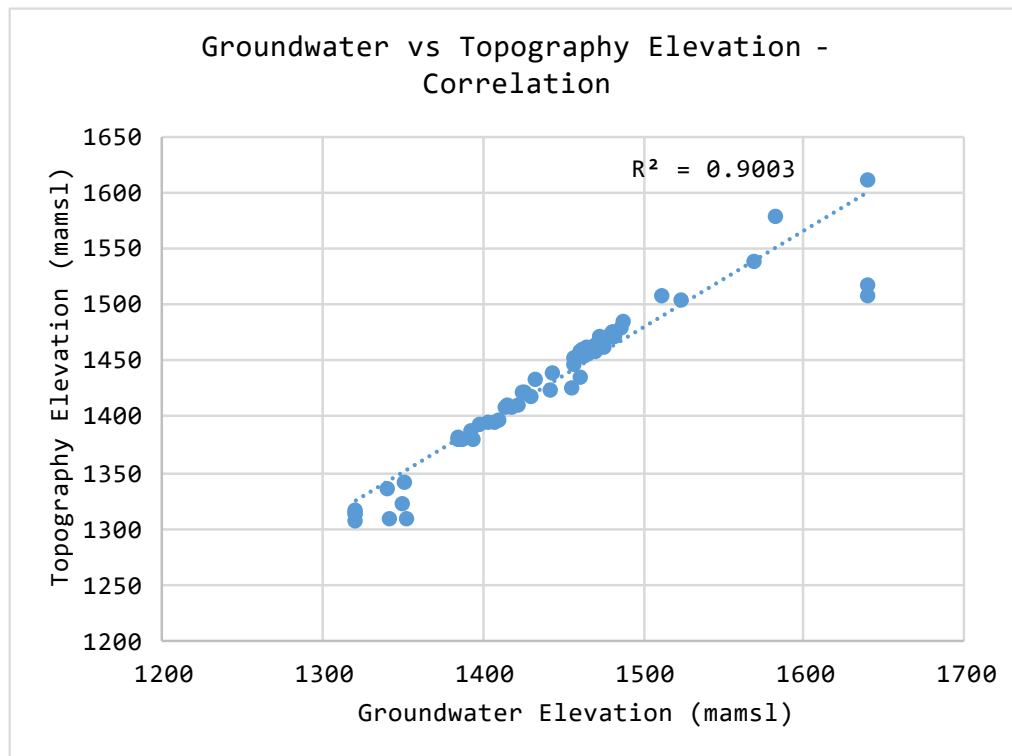
ID	Source	Latitude (WGS84) Decimal Degrees	Longitude (WGS84) Decimal Degrees	Elevation (mamsl)	Water Level (mbgl)
736675	SADAC GIP / NGA 2022	-27.06383	30.39031	1322	2.1
736687	SADAC GIP / NGA 2023	-27.02717	30.41504	1351	15
611988	SADAC GIP / NGA 2024	-26.974167	30.400833	1351	No Data

GCS (2022) identified two (2) groundwater boreholes within a 5km radius of the proposed co-disposal facility (namely FB7 and FB8) that are used for groundwater supply. The boreholes are used by Kangra to supply water to the Community Health Centre.

### 3.6 Depth to groundwater

According to (Vegter, 1995) and (DWAF, 2006), the groundwater levels within the region are expected to range from 15 to 30 mbgl (meters below ground level). Available monitoring boreholes data for Kangra suggest a water level range from 1.28 to 131 mbgl (nearing the MQW underground workings in the mountains), with an average water level in the order of 12.4 mbgl for the MQE area.

Available water level data for boreholes in the area suggest there is a good correlation between the surface topography and the groundwater table (refer to Figure 3-8,  $R \sim 90\%$ ). The groundwater table is expected to mimic the topography and be shallower closer to perennial streams (i.e. these are prominent groundwater contributions to base-flow areas or areas where groundwater seepage from the resource into the aquifer units may take place).



**Figure 3-8: Groundwater elevation vs topography elevation - correlation (Kangra Monitoring Holes)**

### 3.7 Wetland areas

Based on available National Wetland Freshwater Ecosystem Priority Areas (NFEPA) (Van Deventer, 2018) the non-perennial and perennial drainage areas situated downstream of the proposed co-disposal facility are classified as channelled valley bottom (CVB) wetland areas of the Mesic Highveld Grassland Bioregion (refer to Figure 1-3).

In terms of wetland geo-hydrology, base flow is considered the most important contributor to wetland health. Base flow (refer to Figure 3-9) is a non-process-related term to signify low amplitude high-frequency flow in a river during dry or fair-weather periods. Base flow is not a measure of the volume of groundwater discharged into a river or wetland, but it is recognised that groundwater contributes to the base-flow component of river or wetland flow.

Available literature (WRC, 2015; DWAF, 2006) suggests groundwater contribution to baseflow ranges from 9.8 mm/yr (PITMAN MODEL) to 43.45 mm/yr (HUGHES MODEL). This relates to approximately 2% to 6% of rainfall.

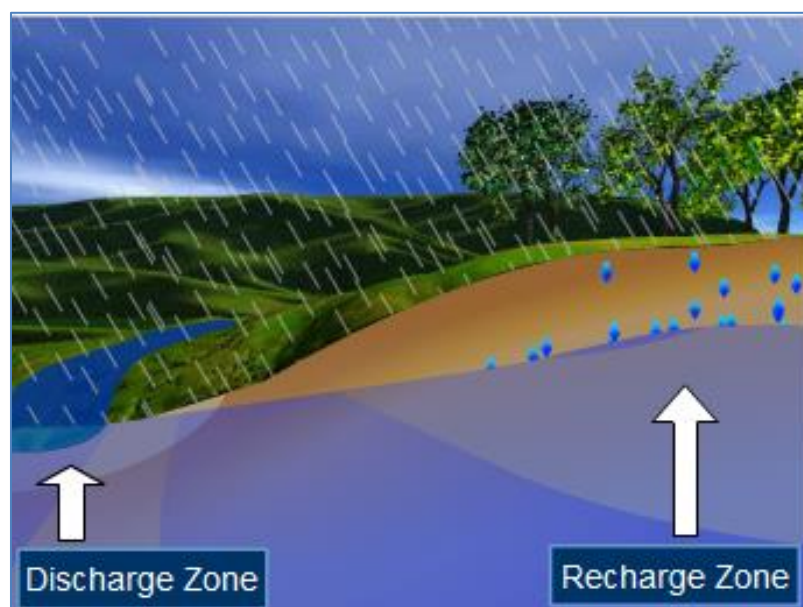


Figure 3-9: Groundwater base-flow concept (DWS, 2011)

### 3.8 Present ecological state (PES) and environmental sensitivity and ecological importance (EIS) - quaternary scale

Table 3-4 provides a summary of the PES and EIS for the quaternary catchment associated with the project area (WRC, 2015). It is recommended that the resource management objectives (RMO) for wetlands in the project area need to maintain the current PES and EIS post development

Table 3-4: Summary of PES and EIS for the Quaternary Catchment

Quat	PES	EIS
W51B	Class B: Largely Natural	High

### 3.9 Overview of site hydrological cycle

Based on the information attained for the study area (as presented in this section), existing groundwater and surface water users, climate, runoff and estimated base flow to wetland areas, a sub-catchment-specific hydrological cycle was developed (refer to Figure 3-10). *The impact of the proposed/existing activities at the site on the cycle was considered in the hydrological impact assessment.*

With regards to the hydrological cycle for the combined sub-catchment areas, the following is estimated:

- The average rainfall is in the order of 15.68 Mm<sup>3</sup>/yr (50% of the total water budget);
- Average runoff accounts for a volume in the order of 2.11 Mm<sup>3</sup>/yr (6.7% of the total water budget);
- The average groundwater contribution to base-flow to rivers/wetlands/streams is in the order of 0.89 Mm<sup>3</sup>/yr (2.8% of the total water budget);
- Evaporation accounts for a volume in the order of 11.9 Mm<sup>3</sup>/yr (37.9% of the total water budget); and
- Estimated groundwater use on a sub-catchment level accounts for 259.2 m<sup>3</sup>/yr (0.001%) and surface water use accounts for 0 Mm<sup>3</sup>/yr - very low volumes on a sub-catchment scale.

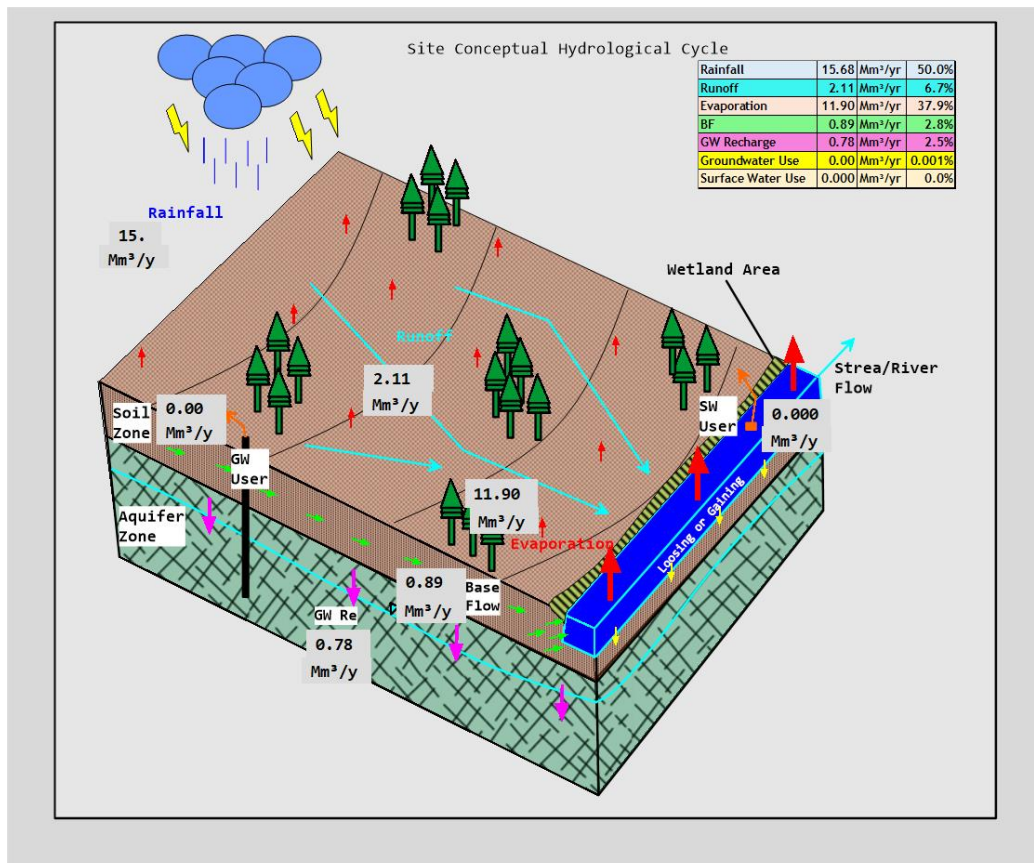


Figure 3-10: Simplified overview of the hydrological cycle at the site

## 4 WATER QUALITY

The MQE area consists of mine infrastructure, open cast areas, an overburden dump, a discard dump, pollution control dams, settling ponds and underground mine workings. A total of (19) nineteen groundwater sites and twenty-three (23) surface water sites exist in the MQE area and are monitored quarterly or monthly (depending on the sampling site type).

The sampling points at MQE are summarised in Table 4-1 and Table 4-2, and shown in Figure 8-1. This section captures the latest groundwater and quality results as presented in the GCS Monitoring Report for the MQE operations (GCS, August 2022).

**Table 4-1: MQE surface water sampling sites**

Site ID	Latitude	Longitude
	(WGS84)	(WGS84)
Below Highwall Seepage	-27.0300	30.39053
Canal Along Main Road	-27.00575	30.4068
Discard Dump Dam 1	-27.01555	30.40247
Discard Dump Seepage 1	-27.01161	30.4032
Discard Plant	-27.02391	30.41937
Discharge into Heyshope Dam	-27.02665	30.40522
DS of Natural Seepage	-27.03175	30.42167
East Heyshope	-27.03188	30.40492
Enprotec Filter Discharge	-27.02567	30.41827
Export Plant	-27.02275	30.41793
Heyshope Dam Water / Abstraction	-27.0317	30.42058
Highwall Seepage	-27.02541	30.38938
Improtect Clarified	-27.02516	30.4177
Inland Plant	-27.02232	30.41798
Pit D East	-27.01373	30.39485
Plant Set Pond / Dam 2	-27.01917	30.41457
Plant Water Dam 3	-27.02003	30.41356
Water Treatment Maquasa Plant East	-27.02252	30.41292
West Heyshope	-27.03175	30.4054
924	-27.02259	30.43474
932	-27.00536	30.43202
933	-27.01793	30.41272
CSW04	-27.016445	30.412429
Monitoring Localities		
Drinking Water Localities		
Internal Process Water		



**Table 4-2: MQE groundwater sampling sites**

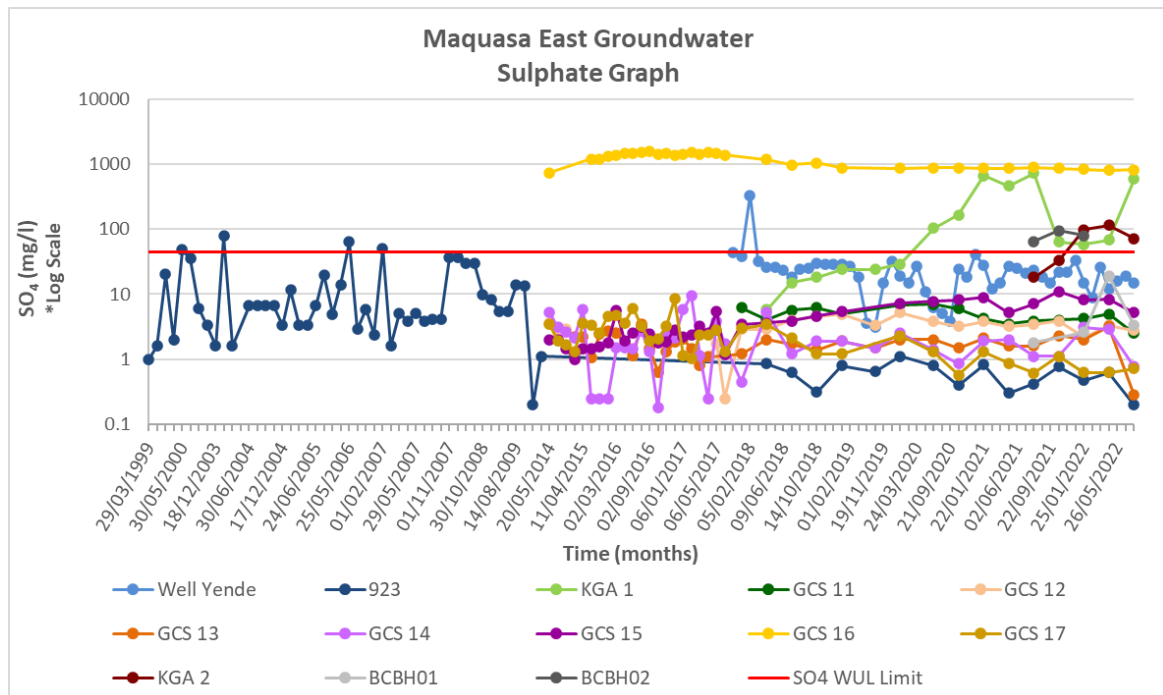
Site ID	Latitude	Longitude
	(WGS84)	(WGS84)
Well Yende	-27.02777	30.3892
Lab Filter	-27.02332	30.4155
Mbokazi Borehole	-27.00873	30.39835
Improtect Drinking Water Filtered	-27.02535	30.41737
Clinic Drinking Water	-27.02327	30.41408
Madonsela	-27.04415	30.37783
Shongwe Family	-26.99156	30.3553
923	-27.02103	30.42525
KGA 1	-27.0262	30.42043
GCS 11	-27.01114	30.40944
GCS 12	-27.01545	30.41217
GCS 13	-27.0333	30.42472
GCS 14	-27.03068	30.42221
GCS 15	-27.03058	30.41795
GCS 16	-27.03122	30.40452
GCS 17	-27.03267	30.40267
KGA 2	-27.01943	30.41199
BCBH01	-27.011241	30.410672
BCBH02	-27.012980	30.407350
Monitoring Localities		
Drinking Water Localities		
Internal Process Water		

#### 4.1 Groundwater Quality

The following observations were made during the 2022 second-quarter monitoring event:

- All groundwater monitoring points exhibited relatively neutral to slightly alkaline pH conditions, ranging between 6.5 and 7.6.
- BH 923, BCBH01, GCS11, GCS12, GCS13, GCS14 and GCS15 showed low to no significant impact from the site in July 2022.
  - Only nitrate concentrations slightly exceeded the WUL limit at GCS11, GCS12, GCS14 and GCS15, ranging between 0.3 and 3.2 mg/l, which is considered to be low to moderately low.
- The water quality at Well Yende, KGA1, KGA2, GCS16 and GCS17 was non-compliant when compared to the WUL limits.
  - Several parameter concentrations exceeded the WUL limits in July 2022:
    - Chloride and/or sodium were elevated at Well Yende and GCS17.
    - KGA2 indicated elevated EC and TDS concentrations during the July 2022 sampling event.
    - EC, TDS, total hardness, magnesium, sodium, potassium and chloride concentrations were elevated at KGA1.

- EC, TDS, total alkalinity, total hardness, calcium, magnesium, sodium, potassium and chloride were significantly elevated at GCS16.
- Sulphate concentrations varied at the site; refer to Figure 4-1.
  - Sulphate at GCS16 has displayed a stable trend over time, consistently exceeding the WUL limit, recorded as 819 mg/l in July 2022. GCS16 is decanting directly from the underground workings at Maquasa East into a pollution control dam which is situated near the Heyshope Dam.
  - Sulphate at KGA1 has displayed an increasing trend over time and currently exceeds the WUL limit. A notable increase was observed in July 2022, recorded as 585 mg/l. KGA1 is situated downgradient of the Discard Plant.
  - Sulphates at KGA2 indicated an increasing trend over time, exceeding the WUL limits since October 2021. A decrease was observed in July 2022, recorded as 72 mg/l.
  - The remaining points displayed low sulphate concentrations (< 16 mg/l).
- Additionally, nitrate concentrations exceeded the WUL limit at KGA1 and GCS16 ranging between 1.1 and 3.2 mg/l.
- In terms of metal concentrations, manganese exceeded the WUL limits at GCS16 (0.48 mg/l) and KGA1 (0.48 mg/l).



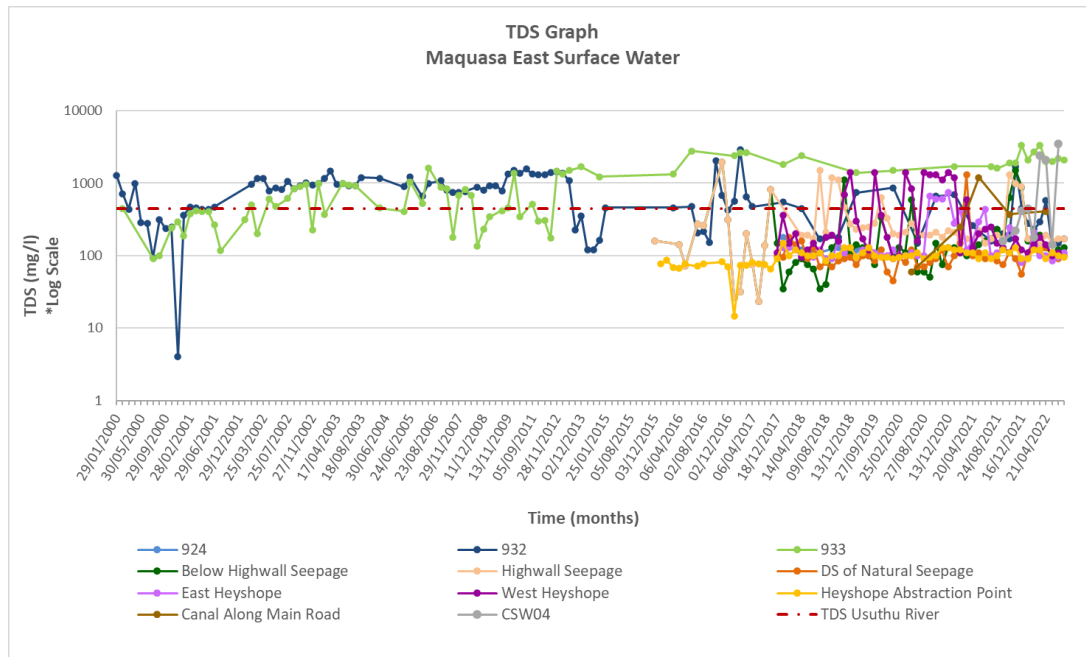
**Figure 4-1: Maquasa East logarithmic groundwater sulphate graph**

## 4.2 Surface Water Quality

One new surface water point (CSW04) was added to the surface water monitoring network in July 2021. Canal Along Main Road was dry throughout the second quarter whilst CSW04 was dry during the July 2022 sampling event.

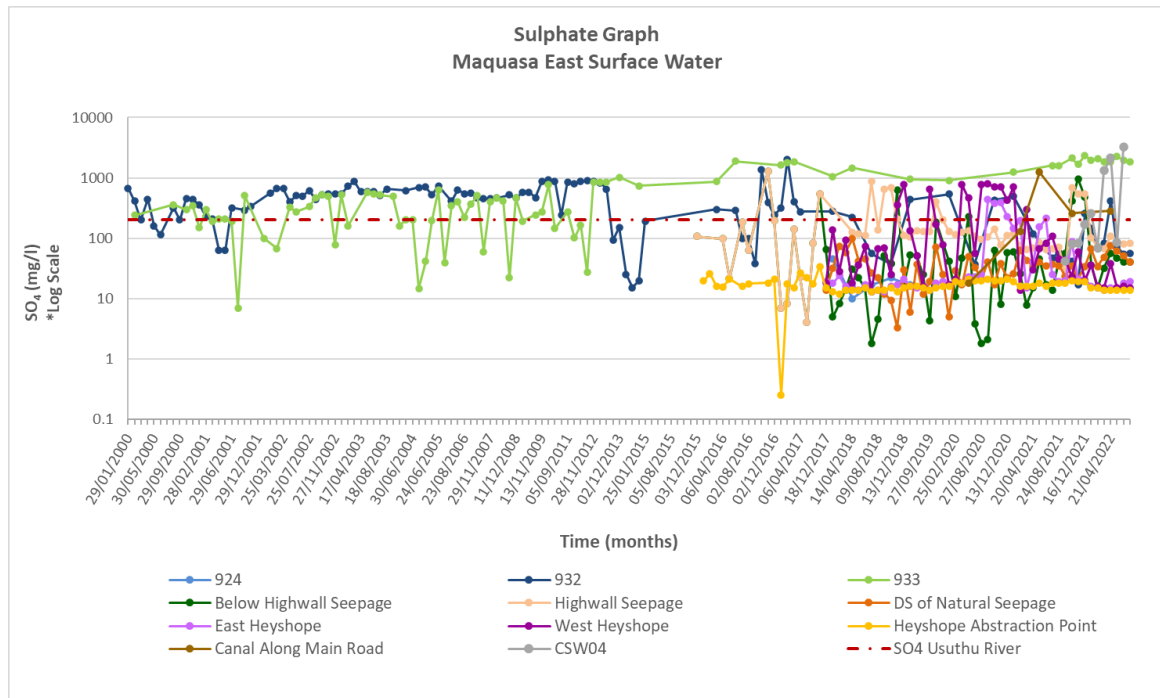
The following observations were made during the 2022 second quarter:

- All surface water monitoring points exhibited neutral to slightly alkaline pH conditions throughout the second quarter, ranging between 6.8 and 8.3.
- Surface water points Below Highwall Seepage, Highwall Seepage, D/S of Natural Seepage, East Heyshope, Heyshope Dam Abstraction, West Heyshope and SW 932 displayed low to no significant impact from the site.
  - In terms of metal concentrations, manganese (< 0.65 mg/l) was elevated at Below Highwall Seepage, Highwall Seepage and SW 932 during the second quarter of 2022. Iron (< 0.15 mg/l) was elevated at East Heyshope, Heyshope Dam Abstraction and West Heyshope during the second quarter of 2022.
  - Aluminium concentrations were elevated at Heyshope Dam Abstraction and West Heyshope during the second quarter of 2022. The source is most likely the upstream discard dump. Aluminium is commonly associated with burnt clinker material generated by discard dumps.
  - Ammonia concentrations were elevated at Below Highwall Seepage, Highwall Seepage, D/S of Natural Seepage, East Heyshope, Heyshope Dam Abstraction, West Heyshope and SW 932 during the June 2022 sampling event, ranging between 7.3 and 7.9 mg/l.
- CSW04 and SW 933 indicated an impact from the site during the 2022 second quarter period. CSW04 was compliant with the Usuthu River Catchment TWQG during the May 2022 sampling event and could not be sampled during the July 2022 sampling event due to low water levels.
  - EC, TDS, calcium and sodium concentrations exceeded the Usuthu River Catchment TWQGs at SW 933 throughout the second quarter. TDS ranged between 2 00 mg/l and 3 300 mg/l; refer to Figure 4-2.
  - During the June 2022 sampling event, CSW04 indicated elevated EC, TDS, calcium and sodium concentrations exceeding the Usuthu River Catchment TWQGs. Elevated salt concentrations at CSW04 are likely due to evaporation at this locality causing the water to become more concentrated.



**Figure 4-2: Maquasa East logarithmic surface water TDS graph**

- Sulphate concentrations predominantly exceeded the Usuthu River Catchment TWQG at CSW04 and SW 933; refer to Figure 4-3.
  - Sulphate at SW 933, located downstream of the underground workings, has historically fluctuated however, a relatively stable trend has been observed since 2013. Sulphate ranged between 1 840 and 2 260 mg/l in the second quarter.
  - Sulphate at most localities indicated slight decreases in concentrations during the second quarter.
  - Sulphate exceeded the Usuthu River Catchment TWQG at CSW04 (3 230 mg/l) during the June 2022 sampling event.
- Additionally, ammonia (8 mg/l) and nitrate (30 mg/l) were elevated at CSW04 during the June 2022 sampling event. SW 933 indicated elevated ammonia (7.8 mg/l) concentrations during the June 2022 sampling event.
- In terms of metal concentrations, manganese was in exceedance at SW 933 and CSW04, ranging between 3 and 10.0 mg/l.



**Figure 4-3: Maquasa East logarithmic surface water sulphate graph**

#### 4.3 Concluding remarks on water quality

The groundwater quality results for boreholes Well Yende, KGA1, KGA2, BCBH02, GCS16 and GCS17 indicate an impact from the site. KGA1 and GCS16 indicate the most significant impact, which is most likely a result of combined seepage from the discard facility and underground workings. These boreholes have displayed consistently non-compliant water quality, representative of high sulphate mine drainage as a result of decanting mine water from the underground workings.

Surface water points Canal Along Main Road, CSW04, SW 932 and SW 933 indicated an impact from the site; the remaining points displayed low to no significant impact.

The predominant trend at this site indicates intermittently impacted surface water quality. This may suggest periodic decant or dilution following rainfall events, at certain sample positions.



## 5 FLOOD LINE ASSESSMENT

Flood peak flow for the perennial stream portion associated with the sub-catchment was estimated with the Rational Method (3), Standard Design Flood (SDF) and Midgley & Pitman (MIPI) Method (refer to **Appendix A**). Design rainfall was retrieved from station 0407639W and used to calculate peak flow volumes. Table 5-1 provides a summary of the design rainfall data used to calculate peak flows, and time concentrations were calculated based on the sub-catchment sizes and parameters. The upper limit “U” was used to estimate worst-case peak flows.

**Table 5-1: Summary of design rainfall data used for peak flow estimates**

Duration	Return Period (years)						
	2U	5U	10U	20U	50U	100U	200U
5 min	17.3	23	27.1	31.3	37.2	42.1	47.3
10 min	22	29.2	34.4	39.7	47.1	53.3	60
15 min	25.3	33.5	39.5	45.6	54.2	61.3	68.9
30 min	31.6	41.9	49.5	57.1	67.8	76.7	86.3
45 min	36.1	47.8	56.4	65.1	77.3	87.5	98.4
1 hr	39.6	52.5	61.9	71.5	84.9	96.1	108
1.5 hr	45.1	59.9	70.6	81.5	96.8	109.6	123.2
2 hr	49.6	65.7	77.5	89.5	106.3	120.3	135.2
4 hr	58	77	90.8	104.8	124.5	140.9	158.4
6 hr	63.7	84.5	99.6	115	136.6	154.5	173.7
8 hr	68	90.2	106.4	122.8	145.8	165	185.5
10 hr	71.5	94.9	111.9	129.2	153.4	173.7	195.2
12 hr	74.6	98.9	116.7	134.7	159.9	181	203.5
16 hr	79.6	105.7	124.6	143.9	170.8	193.3	217.3
20 hr	83.8	111.2	131.1	151.4	179.7	203.4	228.6
24 hr	87.4	115.9	136.7	157.8	187.4	212.1	238.3
1 day	74.1	98.3	115.9	133.9	158.9	179.9	202.2
2 days	86.9	115.3	135.9	157	186.4	210.9	237.1
3 days	95.4	126.5	149.2	172.3	204.6	231.5	260.2
4 days	105.5	140	165	190.6	226.3	256.1	287.8
5 days	114.1	151.3	178.5	206.1	244.7	276.9	311.2
6 days	121.6	161.3	190.2	219.7	260.8	295.2	331.8
7 days	128.4	170.3	200.8	231.8	275.3	311.6	350.2

## 5.1 Estimated floods return periods

Calculated peak flows are summarised in Table 5-2. The RM(3) and MIPI methods produced lower peak flows when compared to the DSF method. The geometric average of the methods was applied to the HEC-RAS model. The flood line assessment is aimed at providing a worst-case inundation scenario to evaluate potential flooding risks. The peak flows presented are for the existing project setting.

**Table 5-2: Summary of design peak flows for the delineated sub-catchments (m<sup>3</sup>/s)**

Catchment	Method											
	RM (3)			SDF			MIPI			Geometric Mean		
	1:20yr	1:50yr	1:100yr	1:20yr	1:50yr	1:100yr	1:20yr	1:50yr	1:100yr	1:20yr	1:50yr	1:100yr
	(m <sup>3</sup> /s)											
HRU1	9	13	17	23	33	42	21	28	33	<u>16</u>	<u>23</u>	<u>29</u>
HRU2	35	52	71	61	89	113	41	54	63	<u>44</u>	<u>63</u>	<u>80</u>
HRU3	33	49	67	54	78	99	32	42	49	<u>39</u>	<u>54</u>	<u>69</u>
HRU4	24	35	48	47	69	87	31	41	48	<u>33</u>	<u>46</u>	<u>59</u>
HRU5	43	64	87	54	80	101	36	47	55	<u>44</u>	<u>62</u>	<u>79</u>
HRU6	16	23	32	32	47	59	22	29	34	<u>22</u>	<u>32</u>	<u>40</u>
HRU7	69	101	138	115	168	213	72	94	111	<u>83</u>	<u>117</u>	<u>148</u>

## 5.2 Flood line modelling

### 5.2.1 Software

HEC-RAS 6.1 (September 2021) was used to model the flood elevation profile for the 1:50 and 1:100-year flood events. HEC-RAS is a hydraulic programme designed to perform one-dimensional hydraulic calculations for a range of applications, from a single watercourse to a full network of natural or constructed channels. The software is used worldwide and has consequently been thoroughly tested through numerous case studies.

### 5.2.2 Topography profile data

A triangulated irregular network (TIN) from the 30 m DTM (JAXA, 2022) forms the foundation for the HEC-RAS model and was used to extract elevation data for the river profile together with the river cross-sections. Furthermore, the TIN was used to determine placement positions for the cross-sections along with the river profile, such that the watercourse can be accurately modelled to the resolution of the provided topographical data. The positions of the river sections were further refined, by evaluating Google Earth Imagery and its correlation to the DTM elevations (i.e., does the actual position of a river/stream correlate to the sub-catchment drainage line generated).

### 5.2.3 *Manning's roughness coefficients*

Manning's roughness factor (n) is used to describe the channel and adjacent floodplains' resistance to flow. A Manning factor of 0.03 to 0.035 best represents the frictional characteristics of the riverbanks and 0.03 for the channels (river).

### 5.2.4 *Inflow and boundary conditions*

Based on the HRUs and the confirmed drainage lines/streams in the project area, six (6) HEC-RAS rivers were defined, consisting of both normal depth (upstream) and critical depth slope boundary conditions. The normal depth slope was determined based on the ALOS DTM slope rise for the given sub-catchment drainage line.

### 5.2.5 *Hydraulic structures*

Hydraulic structures were not incorporated into the HEC-RAS model. Modelling of the hydraulic structures would have been hampered by the lack of good resolution topographical data (better than 30 m ALOS and 5 m contours).

### 5.2.6 *Model assumptions*

In line with the development of the flood lines, the following assumptions were made:

- The topographic data provided was of sufficient accuracy and coverage to enable hydraulic modelling at a suitable level of detail.
- The Manning's 'n' values used are considered suitable for use in the flooding events modelled, representing all the channels and floodplains.
- No abstractions or discharges into the stream sections were considered during the modelling.
- Hydraulic structures were not entered into the model due to the resolution of available topography data.
- Steady-state hydraulic modelling was undertaken, which assumes the flow is continuous at the peak rate; and
- A mixed flow regime that is tailored to both subcritical and supercritical flows was selected for running the steady-state model.

### 5.3 Model results

The 1:50-year and 1:100-year flood lines are shown in Figure 5-1. From the flood lines produced, it is noted that all the proposed infrastructure will be situated outside probable zones of inundation. There is no likely flooding risk.

### 5.4 Site-specific sensitivity & buffers (avoidance areas)

Based on the outputs of the flood line, no avoidance areas are recommended. However, the 1:100-year flood lines serve as future development buffer areas.

### 5.5 Limitations

Steady-state flood modelling was undertaken which is a conservative approach as it ignores the effect of storage within the system and therefore produces higher flood levels than would be expected to occur. A steady-state model will result in worst-case (conservative) estimates of flooding, and resultant flood levels and floodplain extents would decrease if unsteady state modelling were undertaken using an inflow hydrograph as opposed to continuous peak flow.

Despite the above-mentioned, Manning coefficients for the vegetation observed, and the low-resolution topographic data, the flood risk to the surface infrastructure has been adequately assessed for the project area. No further flood modelling work is considered necessary and would only be considered necessary when more detailed topographical data is available.



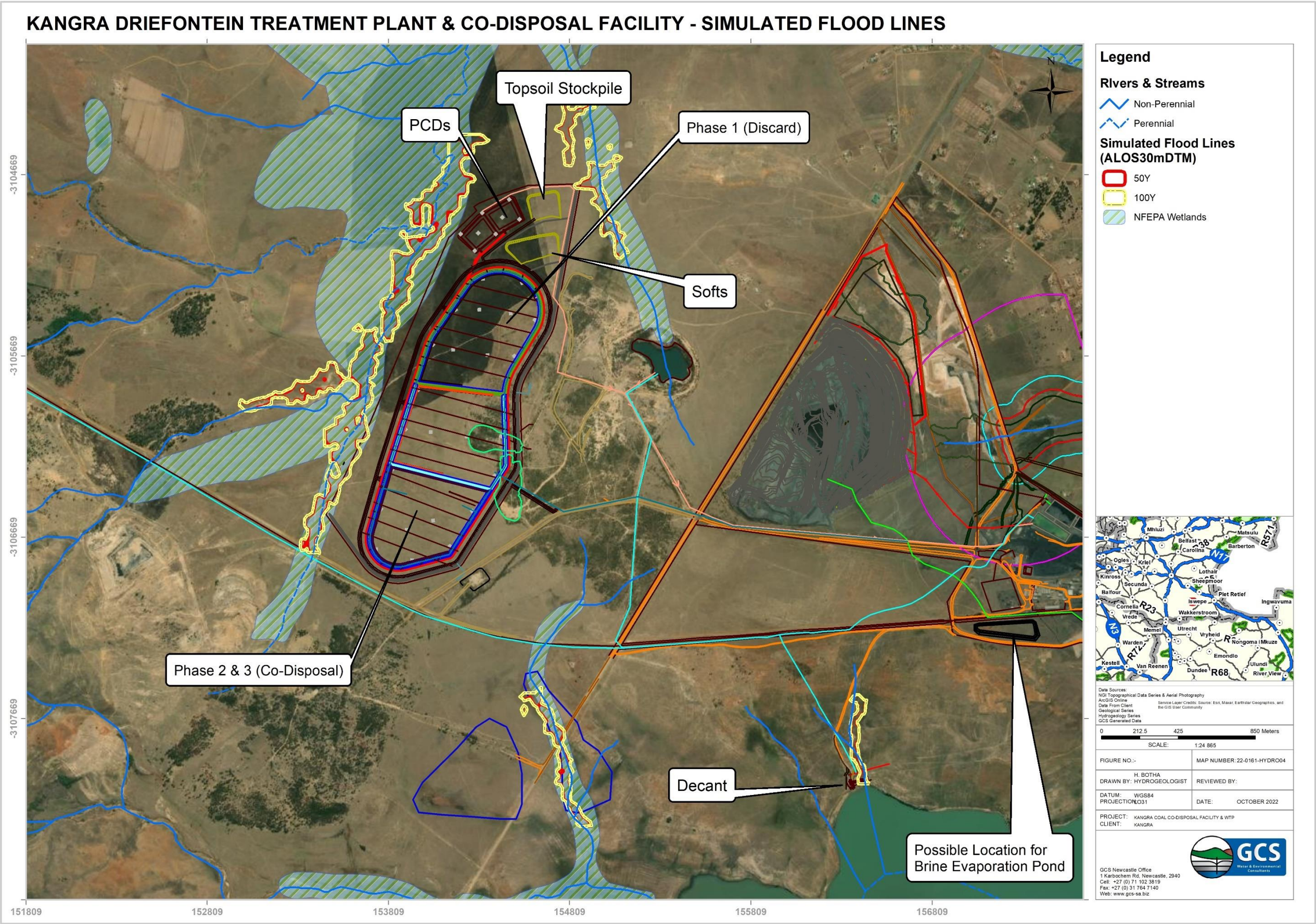


Figure 5-1: Simulated 1:50 and 1:100 year flood lines



---

## 6 CONCEPTUAL STORMWATER MANAGEMENT PLAN

The following section describes the CSWMP developed and is based on available hydrological data and site layout data.

### 6.1 Aim of the stormwater management plan

The CSWMP aims to:

- Illustrate likely stormwater sub-catchments (HRUs) and preferential overland runoff flow paths.
- Determine likely dirty and clean water HRUs (if any).
- Provide water containment and diversion systems to prevent the mixing of clean and dirty water, prevent soil erosion and flooding; and
- Attenuate stormwater back to the natural environment.

### 6.2 Existing stormwater infrastructure & proposed on-site stormwater management as per the design report

No existing stormwater systems were identified for the project area and the development site. However, it is understood that GFK (2022) are undertaking the detailed stormwater designs and PCD and dam sizing for the proposed WTP and co-disposal facility.

From draft schematics provided by GFK (2022), the following is noted (refer to Figure 6-1 and Figure 6-2):

- The co-disposal facility will be lined with an impermeable barrier;
- All the drainage and infiltration water will be captured by an under-drain system and diverted to the PCDs;
- A clean water interception and diversion trench is incorporated into the designs, to divert any runoff emanating from upper drainage areas; and
- A dirty water cutoff trench is incorporated into the design to capture any poor-quality runoff and prevent sedimentation from the co-disposal facility.

The PCDs and WRDs were sized by GFK to handle 1:2 to 1:100-year storm events and will be operated at a capacity that accommodates 1:2 to 1:100-year flooding events.

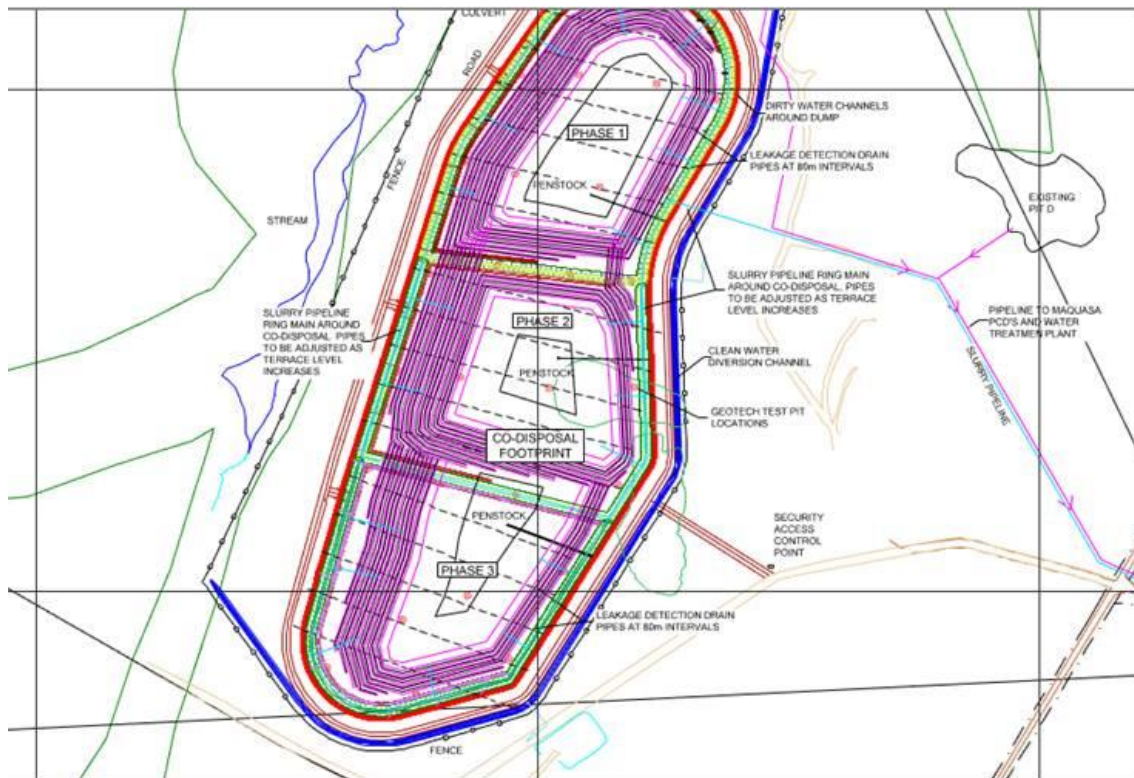


Figure 6-1: Draft layout of co-disposal (GFK, 2022)

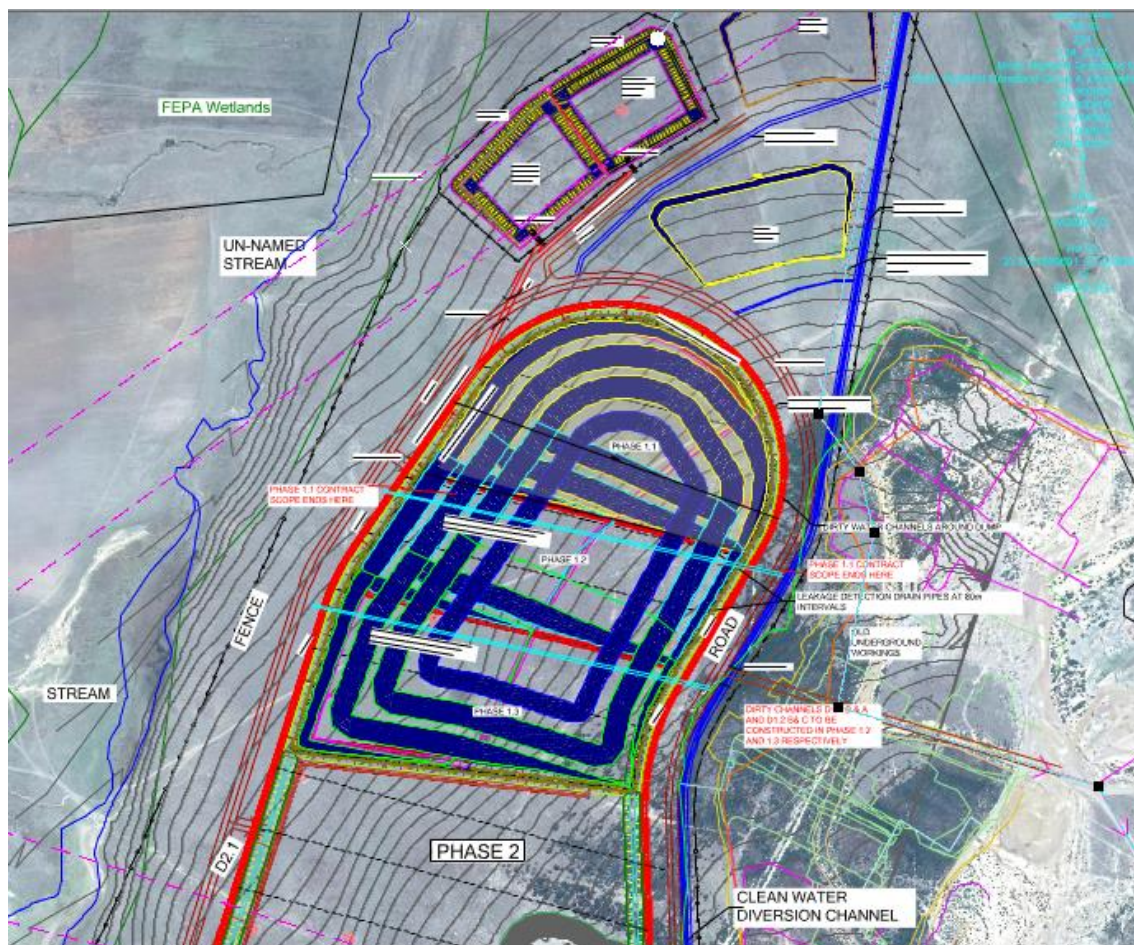


Figure 6-2: Discard dump Phase 1 (GFK, 2022)

### 6.3 Delineation of clean and dirty water areas

A total of five (5) small stormwater sub-catchments were delineated for the project area, three (3) of which are considered potentially dirty water areas (i.e. areas associated with the PCDs, and runoff from the co-disposal facility).

Efforts should be made in managing runoff from the upstream areas associated with the site back to the surrounding soils, and then managing the distribution of the accumulated water back to the environment. All runoff from the co-disposal facility as well as potential seepage and overflow from the PCDs should be captured and pumped to the PCDs. Stormwater monitoring will help determine the quality of the stormwater and the likely environmental impacts if released.

*As the proposed WTP and brine pond are situated in areas with existing stormwater systems, as well as in dirty areas, these were not included in this investigation.*

### 6.4 Assumptions & limitations

The following assumptions pertain to the CSWMP:

- Dynamic stormwater modelling and sizing of stormwater systems to an engineering degree is not part of the scope of this hydrology assessment.
- GFK will be sizing the PCDs and associated infrastructure. The stormwater peak flows in this report are purely conceptual, and can aid the sizing process undertaken by the engineers.
- No stormwater modelling was undertaken. The concepts presented should be modelled by a professional engineer.

### 6.5 Stormwater peak flows

Stormwater drainage directions expected from the site are shown in Figure 6-3. The rational method was used to calculate the stormwater peak flows for the sub-catchments delineated for the project area. The soils in the study area have an SCS rating of C soil types, with a high erodibility rating. Considering the vegetation cover observed on-site and the probable increase in land imperviousness, a run-off coefficient (C) in the order of 0.95 (95%) is estimated (Kindersley, 2012). 1:2, 1:10, 1:50 and 1:100 year return periods are presented and are tabulated in Table 6-2.

The 24hr design rainfall for station 0635862W was used to simulate the 1:2, 1:10, 1:50 and 1:100 year storm return periods (refer to Table 5-1). The potential stormwater from the sub-catchments and that of the development area are captured in Table 6-2. The stormwater infrastructure should be sized by a Registered Engineer to handle these minimum peak flow estimates, as per the proposed sizing and systems in the next section.

**Table 6-1: Summary of design rainfall data used for peak flow estimates**

Duration	Return Period (years)						
	2	5	10	20	50	100	200
24 hr	87.4	115.9	136.7	157.8	187.4	212.1	238.3

**Table 6-2: Stormwater return period estimates for sub-catchments and the development areas**

Storm HRU	Q2 -m <sup>3</sup> /s	Q10 -m <sup>3</sup> /s	Q50 -m <sup>3</sup> /s	Q100 -m <sup>3</sup> /s
D1	13.661	21.367	29.292	33.153
D2	14.685	22.969	31.487	35.638
D3	1.168	1.827	2.505	2.835
HRU1-C1	5.865	9.173	12.574	14.232
HRU2-C1	1.697	2.655	3.640	4.119

## 6.6 Proposed stormwater management measures

### 6.6.1 Construction phase

During the construction phase, it is recommended that sandbags and temporary berms (as per visual observations and ongoing weekly inspections during construction) be used, to manage stormwater runoff (if storms do occur). It is recommended that the construction phase take place during dry months, with a decreased probability of storm events. Temporary stormwater systems should be sufficient to manage the stormwater at the site during the construction phase.

### 6.6.2 Operational phase

Considering the proposed activities, the calculated peak flows and the ecological sensitivity of the project area, a mixture of free drainage from upstream catchments, interception of clean runoff water and capturing of poor quality runoff and seepage from the co-disposal facility and PCDs, as well as dedicated stormwater conveyance and capture systems, is proposed.

As the draft designs already have these systems in place, it is only recommended that the outlet drains of the clean water diversion trench be regulated by rock rip rap or vegetated covers, to decrease peak flows and capture sediment that makes it into the trench. The conceptual stormwater system is shown in Figure 6-4.

For detailed stormwater designs, we refer the reader of this report to the GFK (2022) engineering design report.

### **6.7 Other stormwater considerations**

The following should be considered during the live cycle of the project:

- Minimise vegetation disturbance during construction.
- Re-vegetate as soon as possible to establish and maintain good ground cover across the site.
- Conduct regular inspections and maintenance of the site to ensure that vegetation cover is adequate, and no rivulets are generated.

### **6.8 Proposed stormwater monitoring requirements**

It is advised that stormwater monitoring of the engineered stormwater system that will be put in place by the developer be undertaken, to ensure that the proposed stormwater system functions correctly. The following is proposed:

1. Routine hydraulic monitoring (i.e., observations of any blockages in the stormwater system) and cleaning out of the stormwater systems.
2. Routine re-vegetation and maintenance of the trenches, collection sumps, silt traps, and drains, to ensure optimum operation.
3. Water quality monitoring during storm events.



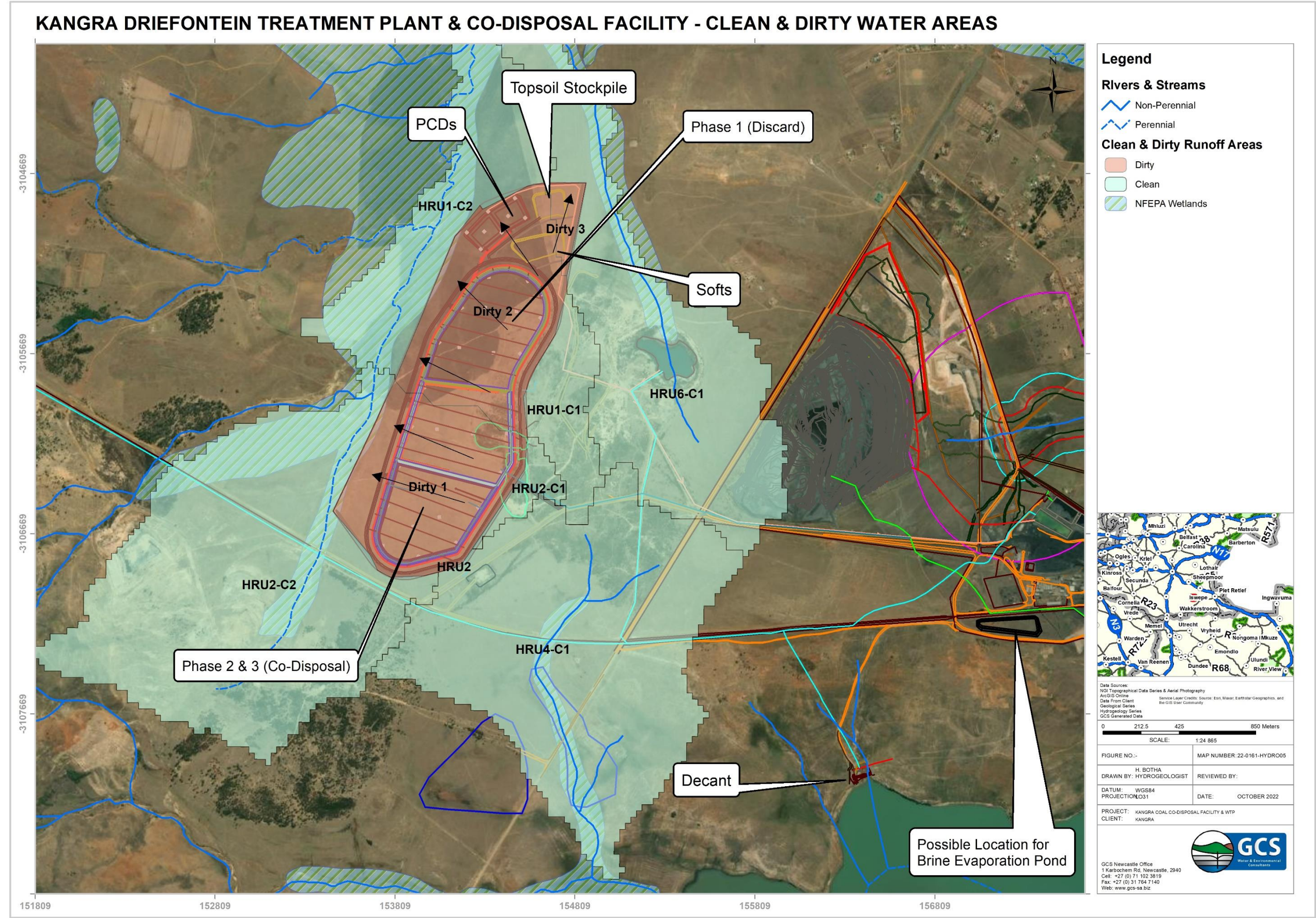


Figure 6-3: Dirty and clean stormwater catchments



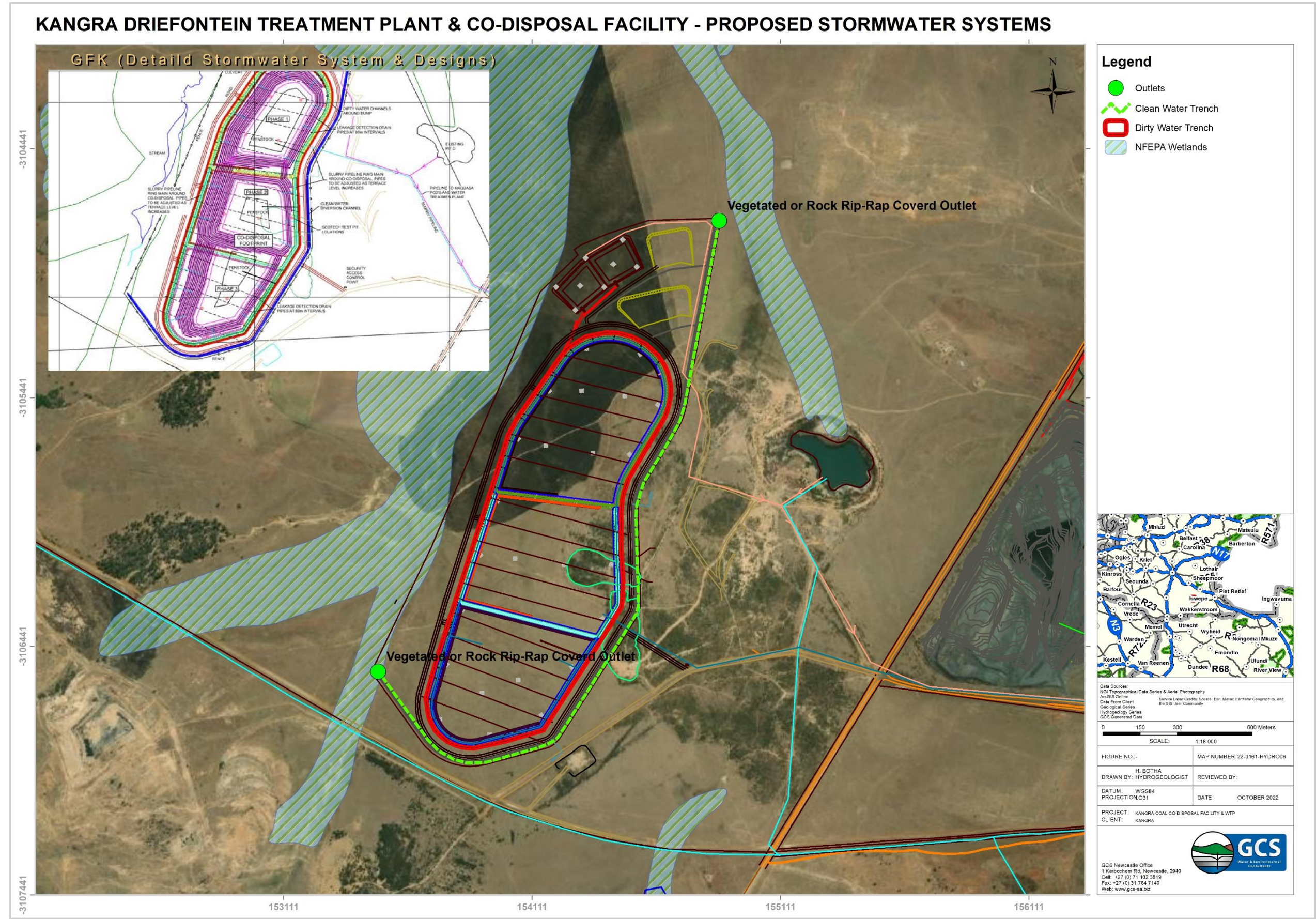


Figure 6-4: Conceptual stormwater management system



## 7 RISK ASSESSMENT & MITIGATION

The anticipated hydrological risk concerning the construction and operational phase of the WTP and co-disposal facility were assessed. The SPR model (DWAF, 2008) was used to evaluate potential pollution sources and primary receptors within the study area.

Risk assessment entails understanding the generation of a hazard, the probability that the hazard will occur, and the consequences if it should occur. The net consequence is established by the following equation:

$$\text{Consequence} = (\text{Duration} + \text{Extent} + \text{Irreplaceability of resource}) \times \text{Severity}$$

And the environmental significance of an impact was determined by multiplying consequence by probability. The risk significance rating is summarised in Table 7-1.

**Table 7-1: Risk rating scale**

Criteria	Rating Scales
Significance	Very high - negative (-49 to -66)
	High - negative (-37 to -48)
	Moderate - negative (-25 to -36)
	Low - negative (-13 to -24)
	Neutral - Very low (0 to -12)
	Low-positive (0 to 12)
	Moderate-positive (13 to 24)
	High-positive (37 to 48)
	Very high - positive (49 to 66)

In terms of the proposed developments, several hydrological risks were identified. The potential impacts identified and environmental significance for the construction, operational and closure phases are listed in Table 7-2 to Table 7-4.

### 7.1 Pre-mining/development phase

The activities during the pre-development phase will generally include the following:

- Typical earthworks are required to start construction of the disposal facility and WTP;
- Installation of liners/impermeable barriers;
- Excavation for the establishment of water management dams and systems;
- Establishment of access roads and other logistics infrastructure;
- Establishment of service platforms, material handling areas and other temporary infrastructure;
- Construction of the WTP facility, and stormwater system associated with the co-disposal facility; and

- The initial placing of discard/slurry mixtures, topsoil and soft rock on the designated dumps.

The identified risks for the construction/development phase include (refer to Table 7-2 ):

- The destruction of the localised geological units during excavations. This impact is permanent and is therefore not included in the impact table as no mitigation measures can be recommended.
- Clearing topsoil from footprint areas will influence the rate of infiltration of water to the shallow groundwater system and/or base-flow component to shallow streams.
- Handling of waste and transport of material can cause various types of spills (domestic waste, hydrocarbons) which can infiltrate and contaminate the groundwater system.
- Poor quality mine drainage from the coal waste.
- Oil and fuel spills and leakages at hard park areas may cause poor-quality seepage and soil contamination.
- Stripping of the topsoil may cause temporary sedimentation in the rivers and streams downstream of the site.

The continuation of the existing monitoring plan during construction is critical. This will ensure that water quality is continuously monitored. The collected information should be used as part of an active water management system and act as an early warning system for the application of mitigation measures. Except for the destruction of the geology, the other identified impacts during the construction phase are rated low after mitigation and management measures are applied. The identified impacts are therefore not likely to negatively affect the commencement of the proposed project.

## 7.2 Operational phase

The activities during the operational phase of the WTP and co-disposal facility include:

- Deposition of coal slurry and coal discard on one footprint. There is a possibility of the addition of brine to the discard dump.
- Seepage or spillages from Brine stored in the brine evaporation pond;
- Dirty runoff from surface water infrastructure, and potential spillages from stormwater systems (i.e. dirty water trenches) and containment systems (i.e. the PCDs).

The identified risks for the operational phase include (refer to Table 7-3).

- The destruction of the localised geological units as the opencast workings are developed. This impact is permanent and is therefore not included in the impact table as no mitigation measures can be recommended.

- Analyses showed that acid mine drainage (AMD) formation is expected and poor-quality leachate can occur based on the leaching potential of the material. This can influence runoff, soil, and groundwater quality. Containment systems are proposed and need to be regularly checked to ensure no seepage to the environment takes place.
- Poor quality runoff from the WTP and co-disposal facility.
- Poor quality seepage associated with the WTP brine effluent pond, co-disposal facility, soil stockpiles, and vehicles accessing the site (spillages of hydrocarbons) could impact the soils, and impact runoff water quality.
- Siltation of stormwater systems.

As the co-disposal facility is designed to contain potential seepage from the coal waste and to capture runoff from the site, low impacts are predicted. Impacts relating to the proposed PCDs and brine effluent ponds will likely only impact the environment if there are spillages or leakages from these facilities.

The treatment of decanting from the Heyshope decant containment dam is considered a very positive intervention in terms of limiting the impact on the Heyshope Dam.



---

### 7.3 Closure and decommissioning phases

The closure and decommissioning phases will be per an agreed and approved closure plan for the WTP (if decant ceases) and co-disposal facility. This will entail:

- Termination of landfill/ co-disposal activities onto the co-disposal footprint area and rehabilitation;
- Installation of long-term stormwater systems or upgrades to the operational stormwater system; and
- Termination of treatment activities and brine generation (only if no decant from the old MQE workings takes place).

The identified risks for these phases include (refer to Table 7-4):

- Poor quality seepage and runoff from the co-disposal facility;
- Poor quality seepage from vehicles accessing the site to do rehabilitation work; and
- Siltation of stormwater systems.

### 7.4 Cumulative impacts and impacts on the hydrological cycle

As all activities will take place on the same property, there will be cumulative impacts. The proposed WTP and brine storage pond are zoned in an area where existing mine impacts are noted.

The construction and operational phase risk table includes cumulative risk about the site, and activities thereon. Considering the sub-catchment conceptual hydrological cycle and the activities associated with the site and surroundings, no impacts are expected in terms of the hydrological cycle. This is due to the proposed site activities not significantly altering the hydrological functions of the given environment.

Table 7-2: Construction (preparation and development) phase hydrological risk

Component Being Impacted On	Activity Which May Cause the Impact	Activity	Pre- Mitigation							Recommended Mitigation Measures	Post Mitigation							Confidence
			Duration	Extent	Potential for impact on irreplaceable resources	Severity	Consequence	Probability	Significance		Duration	Extent	Severity	Potential for impact on irreplaceable resources	Consequence	Probability	Significance	
Vadose zone soils	Disturbing vadose zone during soil excavations/activities.	Earthworks	Long-Term (4)	Site (2)	Yes (1)	High (-3)	Highly detrimental (-19 to -24) (-21)	Definite (2)	High - negative (-37 to -48) (-42)	<ul style="list-style-type: none"> <li>Only excavate areas applicable to the project area.</li> <li>Keep the site clean of all general and domestic waste.</li> <li>All development footprint areas to remain as small as possible and vegetation clearing to be limited to what is essential.</li> <li>Retain as much indigenous vegetation as possible.</li> <li>Exposed soils to be protected using a suitable covering.</li> <li>Existing roads should be used as far as practical to gain access to the site, and crossing the streams in areas where no existing crossing is apparent should be unnecessary, but if it is essential crossings should be made at right angles.</li> </ul>	Long-Term (4)	Site (2)	Yes (1)	Probable (-2)	Low - negative (-13 to -24) (-14)	Definite (2)	Moderate - negative (-25 to -36) (-28)	Medium
Primary Surface Water Receivers - > Non-perennial and non-perennial streams > Wetlands	Surface water contamination and sedimentation from the following activities: <ul style="list-style-type: none"> <li>Equipment and vehicles are washed in the water bodies (when there is water);</li> <li>Erosion and sedimentation of watercourses due to unforeseen circumstances (i.e. bad weather); and</li> <li>Alteration of natural drainage lines which may lead to ponding or increased runoff patterns (i.e. may cause stagnant water levels or increase erosion).</li> </ul>	Earthworks	Long-Term (4)	Site (2)	Yes (1)	Probable (-2)	Moderately detrimental (-13 to -18) (-14)	Definite (2)	Moderate - negative (-25 to -36) (-28)	<ul style="list-style-type: none"> <li>Install a temporary cut-off trench (if required) to contain poor-quality runoff.</li> <li>Cover soil stockpiles with a temporary liner to prevent contamination (where required and visually determined).</li> <li>Park vehicles in designated areas.</li> </ul>	Long-Term (4)	Site (2)	Yes (1)	Probable (-1)	Slightly detrimental (-7 to -12) (-7)	Probable (1)	Neutral - Very low (0 to -12) (-7)	Medium
Perched Water Table Dewatering	Temporary dewatering of perched groundwater (only expected during intense storm events and shortly thereafter).	Earthworks	Long-Term (4)	Site (2)	Yes (1)	Low (-1)	Slightly detrimental (-7 to -12) (-7)	Definite (2)	Low (12 to -25) (-14)	<ul style="list-style-type: none"> <li>Water quality monitoring and routine visual assessment for contamination.</li> <li>Discharge dewatered / rainwater collected into the nearby stream. May require authorisation. If water is contaminated, discharge to the closest greywater system (depending on the extent of contamination)</li> </ul>	Long-Term (4)	Site (2)	Yes (1)	Negligible (0)	Negligible (0 to -6) (-0)	Probable (1)	Neutral - Very low (0 to -12) (0)	Medium

Table 7-3: Operational phase hydrological risk

Component Being Impacted On	Activity Which May Cause the Impact	Activity	Pre- Mitigation							Recommended Mitigation Measures	Post Mitigation							Confidence
			Duration	Extent	Potential for impact on irreplaceable resources	Severity	Consequence	Probability	Significance		Duration	Extent	Severity	Potential for impact on irreplaceable resources	Consequence	Probability	Significance	
Vadose zone soils	Seepage from the co-disposal facility (landfill), PCDs and brine effluent pond  • Poor quality seepage and runoff from vehicles parked at the site.	Site activities	Long-Term (4)	Site (2)	Yes (1)	Low (-1)	Slightly detrimental (-7 to -12) (-7)	Probable (1)	Neutral - Very low (0 to -12) (-7)	<ul style="list-style-type: none"> <li>Keep the site clean of all general and domestic waste.</li> <li>Water quality of the streams and sewer line monitoring.</li> <li>soil covers in areas where erosion is noted, and dust suppression of the landfill to prevent dust migration onto soils.</li> </ul>	Long-Term (4)	Site (2)	Yes (1)	Probable (-1)	Slightly detrimental (-7 to -12) (-7)	Probable (1)	Neutral - Very low (0 to -12) (-7)	Medium
Primary Surface Water Receivers - > Non-perennial and non-perennial streams > Wetlands	Stormwater runoff from WTP and co-disposal facility  • Potential surface water contamination as a result of poor stormwater drainage on-site.  • Increased erosion due to vegetation loss.  • Contaminated runoff water into nearby streams from parked vehicles at the site.  • Sedimentation of watercourses due to altered runoff patterns.	Mine activities	Long-Term (4)	Site (2)	Yes (1)	High (-3)	Highly detrimental (-19 to -24) (-21)	Definite (2)	High - negative (-37 to -48) (-42)	<ul style="list-style-type: none"> <li>Water quality monitoring and visual assessments.</li> <li>Routine hydraulic monitoring of the stormwater system (monthly)</li> </ul>	Long-Term (4)	Site (2)	Yes (1)	Low (-1)	Slightly detrimental (-7 to -12) (-7)	Definite (2)	Low (12 to -25) (-14)	Medium
	Seepage from the co-disposal facility  • Poor quality seepage into the subsoils from landfill may impact soil quality, and eventually lead to poor quality seepage into the surroundings.	Mine activities	Long-Term (4)	Site (2)	Yes (1)	High (-3)	Highly detrimental (-19 to -24) (-21)	Definite (2)	High - negative (-37 to -48) (-42)	<ul style="list-style-type: none"> <li>Water quality monitoring and visual assessments.</li> <li>Routine inspections of all stormwater systems.</li> <li>Ensure the facility is lined.</li> <li>Ensure slopes are shaped to prevent erosion.</li> </ul>	Long-Term (4)	Site (2)	Yes (1)	Low (-1)	Slightly detrimental (-7 to -12) (-7)	Definite (2)	Low (12 to -25) (-14)	Medium
	Treatment of decanting water into Heyshope Dam	Treatment activities	Long-Term (4)	Site (2)	Yes (1)	High (3)	Highly beneficial (19 to 24) (21)	Definite (2)	High-positive (37 to 48) (42)	No mitigation is required.								High

Table 7-4: Closure Phase Hydrological Risks

Component Being Impacted On	Activity Which May Cause the Impact	Activity	Pre-Mitigation							Recommended Mitigation Measures	Post Mitigation							Confidence
			Duration	Extent	Potential for impact on irreplaceable resources	Severity	Consequence	Probability	Significance		Duration	Extent	Severity	Potential for impact on irreplaceable resources	Consequence	Probability	Significance	
Vadose zone soils	Disturbing vadose zone during rehabilitation actions associated with the landfill (co-disposal facility).  The reshaping and rehabilitation of the co-disposal facility will be beneficial to the environment. Capping and reducing infiltration into the dump will help mitigate any poor-quality seepage.	Earthworks	Long-Term (4)	Site (2)	Yes (1)	Probable (-2)	Moderately detrimental (-13 to -18) (-14)	Definite (2)	Moderate - negative (-25 to -36) (-28)	<ul style="list-style-type: none"> <li>Only excavate areas applicable to the project area.</li> <li>Keep the site clean of all general and domestic waste.</li> <li>Revegetate the co-disposal facility.</li> <li>Cover the co-disposal facility with a suitable impermeable capping layer or compact t reduce recharge into the landfill.</li> </ul>	Medium Term (4)	Site (2)	Yes (1)	High (3)	Highly beneficial (19 to 24) (21)	Definite (2)	High-positive (37 to 48) (42)	Medium
Primary Surface Water Receivers -  > Non-perennial and non-perennial streams > Wetlands	<i>Seepage from the co-disposal facility</i> <ul style="list-style-type: none"> <li>Poor quality seepage into the subsoils from landfill may impact soil quality, and eventually lead to poor quality seepage into the surroundings.</li> </ul>	The net result of facilities constructed and rehabilitation thereof	Long-Term (4)	Footprint (1)	Yes (1)	Probable (-1)	Negligible (-6 to 0) (-6)	Probable (1))	Neutral - Very low (0 to -12) (-6)	<ul style="list-style-type: none"> <li>After rehabilitation takes place, there should be limited seepage from the dump.</li> <li>Routine inspections and water quality monitoring of the boreholes and surface water streams downstream of the site (quarterly) should be sufficient to determine closure objectives.</li> </ul>								Medium
	<i>Stormwater runoff from WTP and co-disposal facility</i> <ul style="list-style-type: none"> <li>Potential surface water contamination as a result of poor stormwater drainage on-site.</li> <li>Increased erosion due to vegetation loss.</li> <li>Contaminated runoff water into nearby streams from parked vehicles at the site.</li> <li>Sedimentation of watercourses due to altered runoff patterns.</li> </ul>	The net result of facilities constructed and rehabilitation thereof	Long-Term (4)	Footprint (1)	Yes (1)	Low (-1)	Negligible (-6 to 0) (-6)	Probable (1)	Neutral - Very low (0 to -12) (-6)	<ul style="list-style-type: none"> <li>After rehabilitation takes place, there should be limited seepage from the dump.</li> <li>Routine inspections and water quality monitoring of the boreholes and surface water streams downstream of the site (quarterly) should be sufficient to determine closure objectives.</li> <li>Routine hydraulic monitoring of the stormwater system (monthly)</li> </ul>								Medium

## 8 SURFACE WATER MONITORING

Kangra coal has an existing surface water monitoring system in place. The monitoring network is considered sufficient for the large scale, but may not be sensitive enough to verify local impacts associated with the proposed co-disposal facility. The WTP is considered a lower-risk infrastructure when compared to the co-disposal facility and hence will not require dedicated surface water monitoring.

It is proposed that at least 3 additional surface water monitoring points be added to the existing water monitoring network. The proposed additional surface monitoring points are listed in Table 8-1 and the positions are shown in Figure 8-1.

**Table 8-1: Proposed monitoring points**

Site	Type	Latitude	Longitude
GCS-SW1	Surface Water	-27.014373	30.380725
GCS-SW2	Surface Water	-27.007210	30.383816
GCS-SW3	Surface Water	-26.997385	30.394284



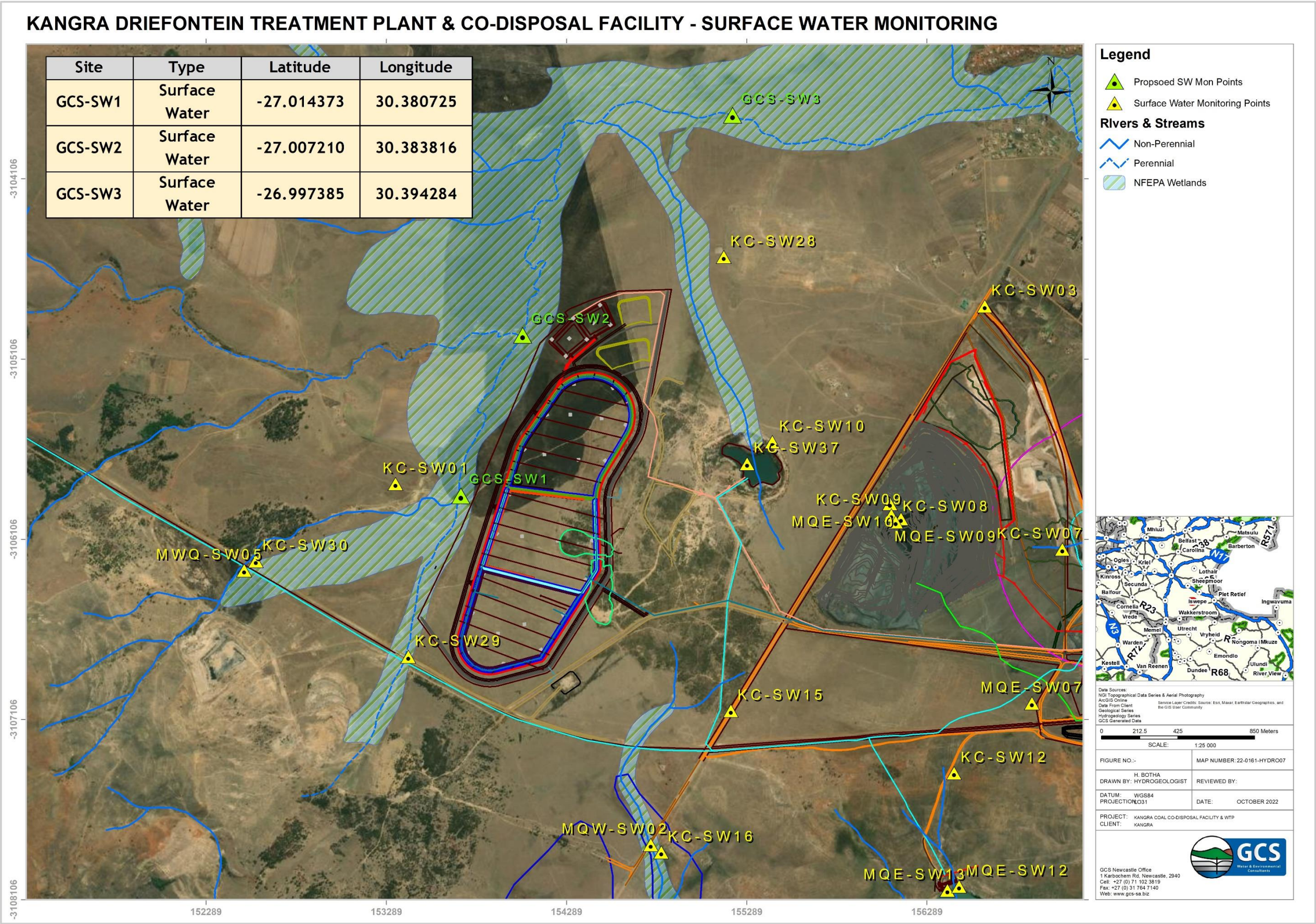


Figure 8-1: Proposed additional surface water monitoring points



## 9 CONCLUSIONS

Based on the investigation undertaken, the following conclusions are made:

- The site is situated in Quaternary W51B of the Pongola to Mtamvuna Water Management Area.
  - The site means annual precipitation (MAP) is in the order of 769 mm/yr.
  - Natural runoff was recorded as approximately 103.5 mm/yr, which represents approximately 13% of the MAP.
  - Evaporation is reported as 1 200 to 1 300 mm/annum (S-Pan).
- The delineated drainage lines associated with the project area can be considered moderate flood hazard areas, based on the peak flows estimated and the flooding depth observed from the HEC-RAS model output. From the flood lines produced, it is noted that all the proposed infrastructure (co-disposal site, PCDs, WTP and brine effluent pond) will be situated outside probable zones of inundation. Hence, there is no likely flooding risk.
- The non-perennial and perennial streams downstream of the co-disposal facility, NFEPA wetland units and vadose zone soils are the main receptors of potential surface-related pollution at the site.
- The hydrological risk was evaluated (refer to Section 7) and the hydrological risk of the proposed activities range from high for the construction phase, to moderate and low for the operational and closure phases. Rehabilitation of the co-disposal facility and treatment of decanting water via the WTP are predicted to have positive or environmental impacts. Mitigation measures were proposed to circumvent potential impacts identified during the construction to closure phases (refer to Section 7).
- As all activities will take place on the same property, there will be cumulative impacts. The proposed WTP and brine storage pond are zoned in an area where existing mine impacts are noted. The construction and operational phase risk table includes cumulative risk about the site, and activities thereon. Considering the sub-catchment conceptual hydrological cycle and the activities associated with the site and surroundings, no impacts are expected in terms of the hydrological cycle. This is due to the proposed site activities not significantly altering the hydrological functions of the given environment.
- Several additional monitoring points are proposed, to be incorporated into the existing surface water monitoring program for the mine.

## 9.1 Avoidance areas

Limited sedimentation and erosion for the drainage lines and streams associated with the site are anticipated. The flood lines also suggest no flooding risk associated with the proposed development. The 1:100-year flood line should be considered an avoidance area (buffer area) (CSIR, 2005).

Care should be taken if development is to take place within the exclusion zone. If development does take place in the exclusion zone, proper flooding protocols and erosion prevention measures should be implemented. This could include gabion mattresses and cut-off walls, gutters and drains, roadside curbs, reed beds or stilling basins at discharged areas, integrated into the engineering designs for the development. Sub-surface infrastructure (i.e. sewer lines, water pipes etc.) will be less susceptible to surface flood damage, and can highly likely be constructed in the demarcated flood line areas. It should, however, be noted that soils on steeply sloped areas (> 1:4) should be compacted to prevent slope failure which could cause mass wasting and sub-surface infrastructure damage. These systems would need to be sized by a civil engineer, considering runoff patterns and stormwater flow velocities from the final engineering designs for the development.

If linear infrastructure is zoned to occur in the demarcated flood line areas, the structures are to be designed to such a degree by a professional engineer to:

1. Prevent environmental damage if a flood does occur;
2. Prevent slope failure on the water course banks;
3. Prevent increased flooding potential;
4. Withstand the flood peak flow forces and buoyancy forces;
5. Effectively convey flood water/stormwater for safe discharge to the environment; and
6. Have erosion control measures in place at any point of discharge into the environment (stilling basins, reed beds, energy damping blocks or mats, gabion mattresses etc).

## 9.2 Mitigation measures for inclusion in the EMPr

The following mitigation measures can be implemented as part of the EMPr to further reduce the risk of flooding on site and contribution to stormwater generation potential:

- Stormwater management should focus on the following, for each site, before the work takes place:
  - Assess the site constraints and any site-specific concerns, including:
    - Specific vegetation that may need to be identified and/or isolated from the site disturbance.
    - Highly erodible soils may require additional erosion control measures.

- 
- The type of construction should consider landform. Avoid slab-on-ground construction on steep sites.
  - Up-slope drainage catchments that may need to be diverted around the work site.
  - Workspace limitations may require site-specific sediment control measures and/or the extensive use of skips or bins for material storage and waste management.
  - Expected rainfall intensity during the period of disturbance (wet season vs dry season).
  - **Stabilise the site entry/exiting points:**
    - A stabilised site access must be established and if possible, limited to one point only. The access allows for the construction vehicles to enter the work area of goods while preventing the unnecessary tracking of sediment onto the nearby environment from multiple locations. A stabilised entry/exit point normally consists of a stabilised rock pad.
  - **Prevent erosion & manage stockpiles:**
    - Suitable material storage areas must be located up-slope of the main sediment barrier (e.g. sediment fence).
    - Stockpiles kept on site for more than two weeks will require an impervious cover (e.g. builder's plastic or geofabric) to protect against raindrop impact. Stockpiles of sandy material located behind a sediment fence will only need a protective cover if the stockpiles are likely to be exposed to strong winds.
    - On steep sites and sites with limited available space, erodible materials may need to be stored in commercial-sized bins or mini-skips before use.
  - **Manage Site Waste**
    - Adequate waste receptacles must be provided on-site and maintained in a way that potential and actual environmental harm resulting from such material waste is minimised.
    - Building activities must be carried out on a pervious surface, such as grass or open soil, or in such a manner that all sediment-laden runoff is prevented from discharging into a water body.

- Based on the above mentioned, it is recommended that work take place in dry months, and don't leave excavations open or the area unrehabilitated before a rainfall month occurs. If work does commence in wet seasons, it is advised that the measures in this document be considered, as well as any means to prevent erosion and sediment runoff (i.e. temporary sandbags, reed beds, re-vegetation, temporary stilling basins, temporary berms etc.).
- Ensure a stormwater management plan is implemented, and that all stormwater systems are kept clean of any debris to reduce flooding risk.
- Ensure that eroded areas are re-vegetated, to ensure reduced sedimentation risk and reduced runoff volumes to the streams.
- Have fuel/oil spill kits on-site, for immediate clean-up of any hydrocarbons during the proposed activities. Park vehicles in dedicated areas, with drip trays to manage potential leakages.
- Conduct regular inspections and maintenance of the site to ensure that vegetation cover is adequate, and no rivulets are generated.

### **9.3 Reasoned opinion on whether the activity should be authorized**

Based on the risks identified, and assuming the mitigation measures proposed will be implemented, it is proposed that the construction of the co-disposal facility and the WTP and the authorization of these activities be considered. This is grounded on the assumption that the proposed mitigation measures (Section 7), EMPr and EIA recommendations are implemented during the construction, operational and closure phases of the project.



## APPENDIX A: PEAK FLOW ESTIMATES

## HRU1

RATIONAL METHOD 3							
Description of catchment		HRU1					
River detail		Unnamed Tributary					
Calculated by		Hendrik Botha				Date	Friday, 14 October 2022
Physical characteristics							
Size of catchment (A)	1.549	km <sup>2</sup>	Rainfall region		W5A		
Longest watercourse (L)	1.99	km	Area distribution factors				
Average slope (S <sub>av</sub> )	0.0056	m/m	Rural (a)	Urban (B)	Lakes (y)		
Dolomite area (D%)	0	%	1	0	0		
Mean annual rainfall(MAR)	768	mm					
Rural			URBAN				
Surface slope	%	Factor	C <sub>s</sub>	Description	%	Factor	C <sub>2</sub>
Vleis and pans (<3%)	35.66	0.03	1.07	Lawns			
Flat areas (3 - 10%)	63.80	0.08	5.10	Sandy,flat<2%	0	0.08	0
Hilly (10 - 30%)	0.53	0.16	0.08	Sandy,steep>7%	0	0.16	0
Steep Areas (>30%)	0.00	0.26	0.00	Heavy s,flat<2%	0	0.15	0
Total	99.99	0.53	6.26	Heavy s,steep>7%	0	0.3	0
Permeability	%	Factor	C <sub>p</sub>	Residential Areas			
Very permeable	80	0.04	3.20	Houses	0	0.5	0
Permeable	20	0.08	1.60	Flats	0	0.6	0
Semi-permeable	0	0.16	0.00	Industry			
Impermeable	0	0.26	0.00	Light industry	0	0.6	0
Total	100	0.54	4.80	Heavy industry	0	0.7	0
Vegetation	%	Factor	C <sub>v</sub>	Business			
Thick bush & plantation	18	0.04	0.72	City centre	0	0.8	0
Light bush & farm-lands	29	0.11	3.19	Suburban	0	0.65	0
Grasslands	51.5	0.21	10.82	Streets	0	0.75	0
No vegetation	1	0.25	0.25	Max flood	0	1	0
Total	99.5	0.61	14.98	Total (C <sub>2</sub> )	0		0
Time of concentration (TC)							
Overland flow		Defined watercourse		Use Defined watercourse			
$T_c = 0.604 \left( \frac{rL}{\sqrt{S_{av}}} \right)^{0.467}$		$T_c = \left[ \frac{0.87 L^2}{1000 S_{AV}} \right]^{0.385}$					
1.822	hours	0.829	hours				
Run-off coefficient							
Return Period (years)	2	5	10	20	50	100	PMF
Run-off coefficient, C <sub>i</sub>	0.260	0.260	0.260	0.260	0.260	0.260	0.900
Adjusted for dolomitic areas, C <sub>id</sub>	0.260	0.260	0.260	0.260	0.260	0.260	0.900
Adj factor for initial saturation, F <sub>i</sub>	0.5	0.55	0.6	0.67	0.83	1	1.00
Adjusted run - off coefficient, C <sub>IT</sub>	0.130168	0.1431848	0.1562016	0.174	0.216	0.260	0.900
Combined run - off coefficient, C <sub>T</sub>	0.130168	0.1431848	0.1562016	0.174	0.216	0.260	0.900
Rainfall							
Return Period (years)	2	5	10	20	50	100	PMF
Point rainfall (mm), P <sub>T</sub>	48.00	63.64	75.04	86.65	102.92	116.49	130.93
Point Intensity (mm/h), P <sub>R</sub>	57.87	76.72	90.48	104.47	124.08	140.45	157.85
Area reduction factor (%),ARF <sub>T</sub>	1.086	1.086	1.086	1.086	1.086	1.086	1.086
Average intensity (mm/hour),I <sub>T</sub>	62.826	83.294	98.227	113.421	134.712	152.478	171.375
Return Period (years)	2	5	10	20	50	100	PMF
Peak flow (m3/s)	3.519	5.132	6.602	8.512	12.525	17.08	66.36

STANDARD DESIGN FLOOD (SDF) METHOD							
Description of catchment		HRU1					
River detail	Unnamed Tributary						
Calculated by	Hendrik Botha			Date	14/10/2022		
Physical characteristics							
Size of catchment (A)	1.549	km <sup>2</sup>	Days of thunder per year (R)		54	days	
Longest watercourse (L)	1.99	km	Time of concentration, $t_c$		49.766	minutes	
Average slope ( $S_{av}$ )	0.006	m/m	Time of concentration, $T_c$		$T_c = \left[ \frac{0.87 L^2}{1000 S_{AV}} \right]^{0.385}$		0.8294
SDF Basin	28						
2-year return period rainfall (M)	75	mm					
TR102 n-day rainfall data							
Weather Service Station				MAP	768	mm	
Weather Service Station no.				Coordinates			
Duration	Return Period (years)						
	2	5	10	20	50	100	200
Rainfall							
Return Period (years), T	2	5	10	20	50	100	200
Point precipitation depth (mm) $P_{t,T}$	31.5	53.1	69.4	85.8	107.4	123.7	140.1
Area reduction factor (%), $ARF_T$	1.086	1.086	1.086	1.086	1.086	1.086	1.086
Average intensity (mm/hour), $I_T$	41.2	69.5	90.8	112.2	140.5	161.9	183.3
Run-off coefficient							
Calibration factors	$C_2$ (%)	15		$C_{100}$ (%)		60	
Return Period (years), T	2	5	10	20	50	100	200
Return period factors ( $Y_T$ )	0	0.84	1.28	1.64	2.05	2.33	2.58
Run-off coefficient, $C_T$	0.150	0.312	0.397	0.467	0.546	0.600	0.648
Peak flow (m3/s)	2.66	9.33	15.53	22.54	33.01	41.80	51.13

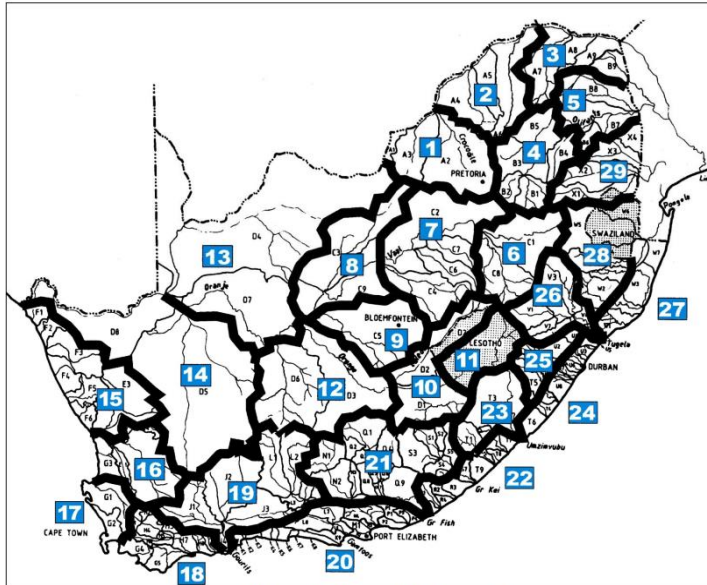
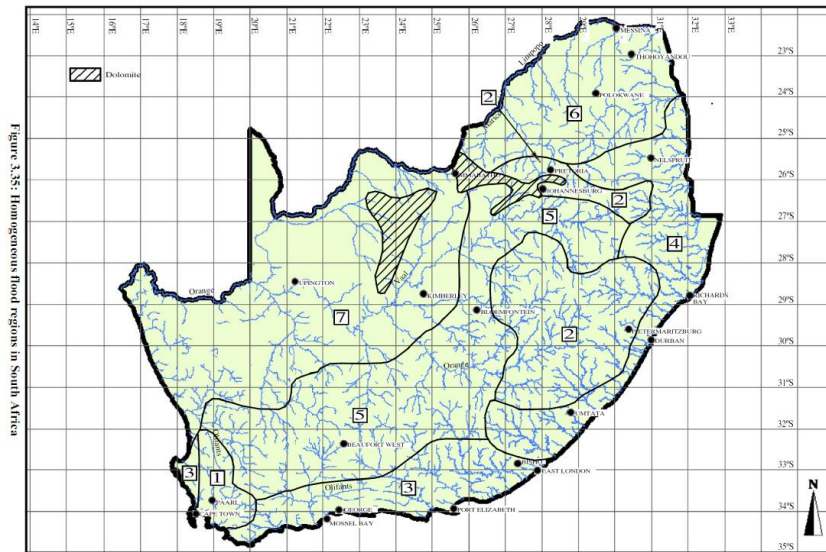


Figure 3.30: Standard Design Flood drainage basins

MIDGLEY & PITMAN (MIPI) METHOD														
River Detail	Catchment Area	MAP	S	L	Lc	Constant $K_r$				Catchment Parameter	Peak Flows			
	(km <sup>2</sup> )	(mm)	m/m	km	km	1:10 year	1:20 year	1: 50 year	1: 100 year	(Dimensionless)	1:10 year	1:20 year	1: 50 year	1: 100 year
HRU1	1.549	768	0.0056	1.99	1.2	0.83	1.04	1.36	1.6	0.0485	17.06	21.38	27.96	32.89



## HRU2

RATIONAL METHOD 3							
Description of catchment		HRU2					
River detail		Unnamed Tributary					
Calculated by		Hendrik Botha				Date	
						Friday, 14 October 2022	
Physical characteristics							
Size of catchment (A)	2.609	km <sup>2</sup>	Rainfall region		WSA		
Longest watercourse (L)	1.08	km	Area distribution factors				
Average slope (S <sub>av</sub> )	0.0123	m/m	Rural (a)	Urban (b)	Lakes (y)		
Dolomite area (D%)	0	%	1	0	0		
Mean annual rainfall(MAR)	768	mm					
Rural			URBAN				
Surface slope	%	Factor	C <sub>s</sub>	Description	%	Factor	C <sub>2</sub>
Vleis and pans (<3%)	8.46	0.03	0.25	Lawns			
Flat areas (3 - 10%)	42.12	0.08	3.37	Sandy,flat<2%	0	0.08	0
Hilly (10 - 30%)	39.28	0.16	6.28	Sandy,steep>7%	0	0.16	0
Steep Areas (>30%)	10.14	0.26	2.64	Heavy s,flat<2%	0	0.15	0
Total	100.00	0.53	12.54	Heavy s,steep>7%	0	0.3	0
Permeability	%	Factor	C <sub>p</sub>	Residential Areas			
Very permeable	80	0.04	3.20	Houses	0	0.5	0
Permeable	20	0.08	1.60	Flats	0	0.6	0
Semi-permeable	0	0.16	0.00	Industry			
Impermeable	0	0.26	0.00	Light industry	0	0.6	0
Total	100	0.54	4.80	Heavy industry	0	0.7	0
Vegetation	%	Factor	C <sub>v</sub>	Business			
Thick bush & plantation	11	0.04	0.44	City centre	0	0.8	0
Light bush & farm-lands	11	0.11	1.21	Suburban	0	0.65	0
Grasslands	61.3	0.21	12.87	Streets	0	0.75	0
No vegetation	17	0.25	4.25	Max flood	0	1	0
Total	100.3	0.61	18.77	Total (C <sub>2</sub> )	0		0
Time of concentration (TC)							
Overland flow		Defined watercourse		Use Defined watercourse			
$T_c = 0.604 \left( \frac{rL}{\sqrt{S_{av}}} \right)^{0.467}$		$T_c = \left[ \frac{0.87 L^2}{1000 S_{AV}} \right]^{0.385}$					
1.140	hours	0.383	hours				
Run-off coefficient							
Return Period (years)	2	5	10	20	50	100	PMF
Run-off coefficient, C <sub>1</sub>	0.361	0.361	0.361	0.361	0.361	0.361	0.900
Adjusted for dolomitic areas, C <sub>1D</sub>	0.361	0.361	0.361	0.361	0.361	0.361	0.900
Adj factor for initial saturation, F <sub>t</sub>	0.5	0.55	0.6	0.67	0.83	1	1.00
Adjusted run - off coefficient, C <sub>1T</sub>	0.180588	0.1986468	0.2167056	0.242	0.300	0.361	0.900
Combined run - off coefficient, C <sub>T</sub>	0.180588	0.1986468	0.2167056	0.242	0.300	0.361	0.900
Rainfall							
Return Period (years)	2	5	10	20	50	100	PMF
Point rainfall (mm), P <sub>T</sub>	41.14	54.57	64.33	74.30	88.23	99.87	112.25
Point Intensity (mm/h), P <sub>h</sub>	107.50	142.60	168.11	194.14	230.55	260.98	293.32
Area reduction factor (%),ARF <sub>T</sub>	1.033	1.033	1.033	1.033	1.033	1.033	1.033
Average intensity (mm/hour),I <sub>T</sub>	111.076	147.341	173.704	200.606	238.222	269.671	303.085
Return Period (years)	2	5	10	20	50	100	PMF
Peak flow (m3/s)	14.537	21.212	27.280	35.181	51.755	70.59	197.69

STANDARD DESIGN FLOOD (SDF) METHOD							
Description of catchment		HRU2					
River detail	Unnamed Tributary						
Calculated by	Hendrik Botha			Date	14/10/2022		
Physical characteristics							
Size of catchment (A)	2.609	km <sup>2</sup>	Days of thunder per year (R)		54	days	
Longest watercourse (L)	1.08	km	Time of concentration, $t_c$		22.964	minutes	
Average slope ( $S_{av}$ )	0.012	m/m	Time of concentration, $T_c$		$T_c = \left[ \frac{0.87 L^2}{1000 S_{AV}} \right]^{0.385}$		0.3827
SDF Basin	28						
2-year return period rainfall (M)	75	mm					
TR102 n-day rainfall data							
Weather Service Station			MAP		768	mm	
Weather Service Station no.			Coordinates				
Duration	Return Period (years)						
	2	5	10	20	50	100	200
Rainfall							
Return Period (years), T	2	5	10	20	50	100	200
Point precipitation depth (mm) $P_{t,T}$	24.5	41.3	54.1	66.8	83.6	96.4	109.1
Area reduction factor (%), $ARF_T$	1.033	1.033	1.033	1.033	1.033	1.033	1.033
Average intensity (mm/hour), $I_T$	66.2	111.6	146.0	180.4	225.8	260.2	294.6
Run-off coefficient							
Calibration factors	$C_2$ (%)	15		$C_{100}$ (%)		60	
Return Period (years), T	2	5	10	20	50	100	200
Return period factors ( $Y_T$ )	0	0.84	1.28	1.64	2.05	2.33	2.58
Run-off coefficient, $C_T$	0.150	0.312	0.397	0.467	0.546	0.600	0.648
Peak flow (m3/s)	7.19	25.25	42.02	61.01	89.34	113.14	138.40

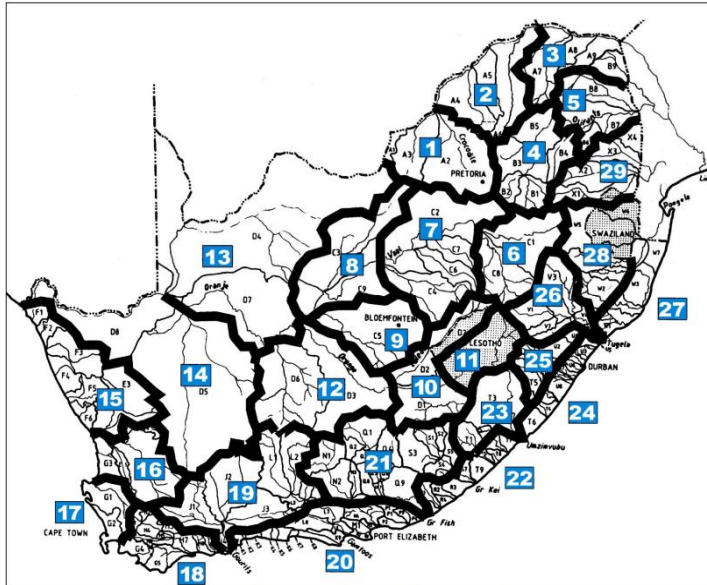
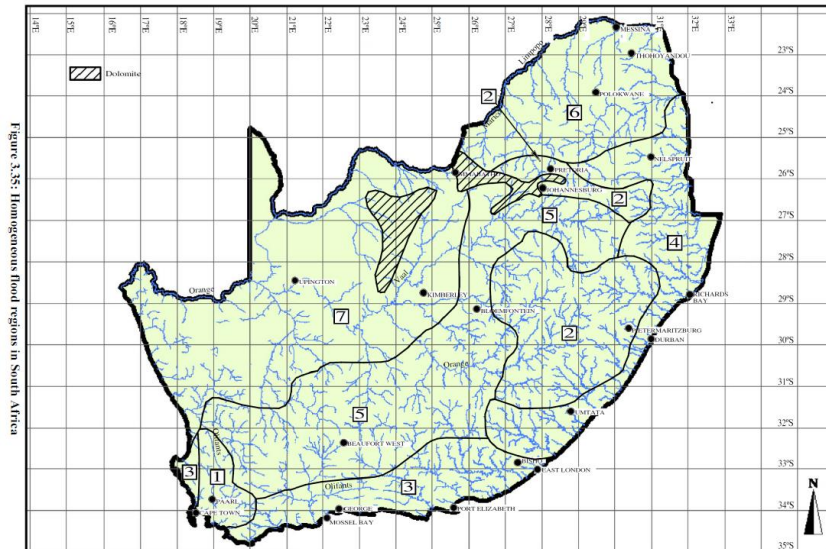


Figure 3.30: Standard Design Flood drainage basins



MIDGLEY & PITMAN (MPI) METHOD														
River Detail	Catchment Area	MAP	S	L	Lc	Constant $K_r$				Catchment Parameter	Peak Flows			
	(km <sup>2</sup> )	(mm)	m/m	km	km	1:10 year	1:20 year	1: 50 year	1: 100 year	(Dimensionless)	1:10 year	1:20 year	1: 50 year	1: 100 year
HRU2	2.609	768	0.0123	1.08	1.01	0.83	1.04	1.36	1.6	0.2653	32.76	41.05	53.69	63.16



**Figure 3.35: Homogeneous flood regions in South Africa**

## HRU3

RATIONAL METHOD 3								
Description of catchment		HRU3						
River detail		Unnamed Tributary						
Calculated by		Hendrik Botha			Date		Friday, 14 October 2022	
Physical characteristics								
Size of catchment (A)	1.89	km <sup>2</sup>	Rainfall region		WSA			
Longest watercourse (L)	1.148	km	Area distribution factors					
Average slope (S <sub>av</sub> )	0.0308	m/m	Rural (a)	Urban (b)	Lakes (y)			
Dolomite area (D%)	0	%	1	0	0			
Mean annual rainfall(MAR)	768	mm						
Rural			URBAN					
Surface slope	%	Factor	C <sub>s</sub>	Description	%	Factor	C <sub>2</sub>	
Vleis and pans (<3%)	8.46	0.03	0.25	Lawns				
Flat areas (3 - 10%)	42.12	0.08	3.37	Sandy,flat<2%	0	0.08	0	
Hilly (10 - 30%)	39.28	0.16	6.28	Sandy,steep>7%	0	0.16	0	
Steep Areas (>30%)	10.14	0.26	2.64	Heavy s,flat<2%	0	0.15	0	
Total	100.00	0.53	12.54	Heavy s,steep>7%	0	0.3	0	
Permeability	%	Factor	C <sub>p</sub>	Residential Areas				
Very permeable	80	0.04	3.20	Houses	0	0.5	0	
Permeable	20	0.08	1.60	Flats	0	0.6	0	
Semi-permeable	0	0.16	0.00	Industry				
Impermeable	0	0.26	0.00	Light industry	0	0.6	0	
Total	100	0.54	4.80	Heavy industry	0	0.7	0	
Vegetation	%	Factor	C <sub>v</sub>	Business				
Thick bush & plantation	8	0.04	0.32	City centre	0	0.8	0	
Light bush & farm-lands	4	0.11	0.44	Suburban	0	0.65	0	
Grasslands	77.4	0.21	16.25	Streets	0	0.75	0	
No vegetation	10	0.25	2.50	Max flood	0	1	0	
Total	99.4	0.61	19.51	Total (C <sub>2</sub> )	0			
Time of concentration (TC)								
Overland flow		Defined watercourse		Use Defined watercourse				
$T_c = 0.604 \left( \frac{rL}{\sqrt{S_{av}}} \right)^{0.467}$		$T_c = \left[ \frac{0.87 L^2}{1000 S_{AV}} \right]^{0.385}$						
0.946	hours	0.282	hours					
Run-off coefficient								
Return Period (years)	2	5	10	20	50	100	PMF	
Run-off coefficient, C <sub>1</sub>	0.369	0.369	0.369	0.369	0.369	0.369	0.900	
Adjusted for dolomitic areas, C <sub>1D</sub>	0.369	0.369	0.369	0.369	0.369	0.369	0.900	
Adj factor for initial saturation, F <sub>t</sub>	0.5	0.55	0.6	0.67	0.83	1	1.00	
Adjusted run - off coefficient, C <sub>1T</sub>	0.184293	0.2027223	0.2211516	0.247	0.306	0.369	0.900	
Combined run - off coefficient, C <sub>T</sub>	0.184293	0.2027223	0.2211516	0.247	0.306	0.369	0.900	
Rainfall								
Return Period (years)	2	5	10	20	50	100	PMF	
Point rainfall (mm), P <sub>T</sub>	38.85	51.49	60.72	70.13	83.27	94.26	105.95	
Point Intensity (mm/h), P <sub>h</sub>	137.92	182.80	215.56	248.96	295.62	334.62	376.10	
Area reduction factor (%),ARF <sub>T</sub>	1.038	1.038	1.038	1.038	1.038	1.038	1.038	
Average intensity (mm/hour),I <sub>T</sub>	143.093	189.659	223.650	258.299	306.707	347.169	390.210	
Return Period (years)	2	5	10	20	50	100	PMF	
Peak flow (m3/s)	13.845	20.185	25.967	33.488	49.261	67.18	184.37	

STANDARD DESIGN FLOOD (SDF) METHOD							
Description of catchment		HRU3					
River detail	Unnamed Tributary						
Calculated by	Hendrik Botha			Date	14/10/2022		
Physical characteristics							
Size of catchment (A)	1.89	km <sup>2</sup>	Days of thunder per year (R)		54	days	
Longest watercourse (L)	1.148	km	Time of concentration, $t_c$		16.902	minutes	
Average slope ( $S_{av}$ )	0.031	m/m	Time of concentration, $T_c$		$T_c = \left[ \frac{0.87 L^2}{1000 S_{AV}} \right]^{0.385}$		0.2817
SDF Basin	28						
2-year return period rainfall (M)	75	mm					
TR102 n-day rainfall data							
Weather Service Station			MAP		768	mm	
Weather Service Station no.			Coordinates				
Duration	Return Period (years)						
	2	5	10	20	50	100	200
Rainfall							
Return Period (years), T	2	5	10	20	50	100	200
Point precipitation depth (mm) $P_{t,T}$	21.7	36.7	48.0	59.3	74.2	85.5	96.8
Area reduction factor (%), $ARF_T$	1.038	1.038	1.038	1.038	1.038	1.038	1.038
Average intensity (mm/hour), $I_T$	80.1	135.1	176.8	218.4	273.4	315.0	356.7
Run-off coefficient							
Calibration factors	$C_2$ (%)	15		$C_{100}$ (%)		60	
Return Period (years), T	2	5	10	20	50	100	200
Return period factors ( $Y_T$ )	0	0.84	1.28	1.64	2.05	2.33	2.58
Run-off coefficient, $C_T$	0.150	0.312	0.397	0.467	0.546	0.600	0.648
Peak flow (m3/s)	6.31	22.15	36.86	53.51	78.36	99.24	121.39

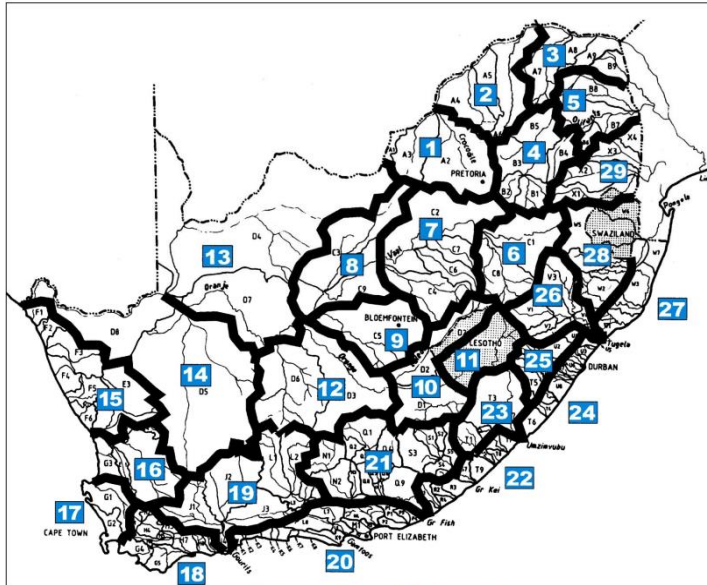
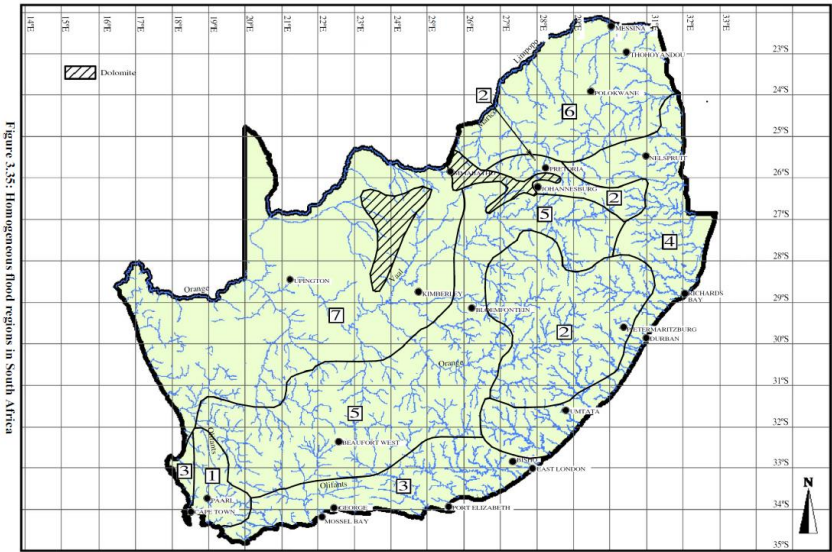


Figure 3.30: Standard Design Flood drainage basins

MIDGLEY & PITMAN (MIPI) METHOD														
River Detail	Catchment Area	MAP	S	L	Lc	Constant K <sub>r</sub>				Catchment Parameter	Peak Flows			
	(km <sup>2</sup> )	(mm)	m/m	km	km	1:10 year	1:20 Year	1: 50 year	1: 100 year	(Dimensionless)	1:10 year	1:20 Year	1: 50 year	1: 100 year
HRU3	1.89	768	0.0308	1.15	1.47	0.83	1.04	1.36	1.6	0.1966	25.43	31.86	41.67	49.02



## HRU4

RATIONAL METHOD 3								
Description of catchment		HRU4						
River detail		Unnamed Tributary						
Calculated by		Hendrik Botha			Date		Friday, 14 October 2022	
Physical characteristics								
Size of catchment (A)	1.84	km <sup>2</sup>	Rainfall region		WSA			
Longest watercourse (L)	1.18	km	Area distribution factors					
Average slope (S <sub>av</sub> )	0.0201	m/m	Rural (a)	Urban (b)	Lakes (y)			
Dolomite area (D%)	0	%	1	0	0			
Mean annual rainfall(MAR)	768	mm						
Rural			URBAN					
Surface slope	%	Factor	C <sub>s</sub>	Description	%	Factor	C <sub>2</sub>	
Vleis and pans (<3%)	12.24	0.03	0.37	Lawns				
Flat areas (3 - 10%)	72.04	0.08	5.76	Sandy,flat<2%	0	0.08	0	
Hilly (10 - 30%)	14.94	0.16	2.39	Sandy,steep>7%	0	0.16	0	
Steep Areas (>30%)	0.78	0.26	0.20	Heavy s,flat<2%	0	0.15	0	
Total	100.00	0.53	8.72	Heavy s,steep>7%	0	0.3	0	
Permeability	%	Factor	C <sub>p</sub>	Residential Areas				
Very permeable	80	0.04	3.20	Houses	0	0.5	0	
Permeable	20	0.08	1.60	Flats	0	0.6	0	
Semi-permeable	0	0.16	0.00	Industry				
Impermeable	0	0.26	0.00	Light industry	0	0.6	0	
Total	100	0.54	4.80	Heavy industry	0	0.7	0	
Vegetation	%	Factor	C <sub>v</sub>	Business				
Thick bush & plantation	17	0.04	0.68	City centre	0	0.8	0	
Light bush & farm-lands	4	0.11	0.44	Suburban	0	0.65	0	
Grasslands	75.6	0.21	15.88	Streets	0	0.75	0	
No vegetation	3	0.25	0.75	Max flood	0	1	0	
Total	99.6	0.61	17.75	Total (C <sub>2</sub> )	0		0	
Time of concentration (TC)								
Overland flow		Defined watercourse		Use Defined watercourse				
$T_c = 0.604 \left( \frac{rL}{\sqrt{S_{av}}} \right)^{0.467}$		$T_c = \left[ \frac{0.87 L^2}{1000 S_{AV}} \right]^{0.385}$						
1.059	hours	0.339	hours					
Run-off coefficient								
Return Period (years)	2	5	10	20	50	100	PMF	
Run-off coefficient, C <sub>1</sub>	0.313	0.313	0.313	0.313	0.313	0.313	0.900	
Adjusted for dolomitic areas, C <sub>1D</sub>	0.313	0.313	0.313	0.313	0.313	0.313	0.900	
Adj factor for initial saturation, F <sub>t</sub>	0.5	0.55	0.6	0.67	0.83	1	1.00	
Adjusted run - off coefficient, C <sub>1T</sub>	0.156348	0.1719828	0.1876176	0.210	0.260	0.313	0.900	
Combined run - off coefficient, C <sub>T</sub>	0.156348	0.1719828	0.1876176	0.210	0.260	0.313	0.900	
Rainfall								
Return Period (years)	2	5	10	20	50	100	PMF	
Point rainfall (mm), P <sub>T</sub>	40.25	53.38	62.93	72.68	86.31	97.70	109.80	
Point Intensity (mm/h), P <sub>h</sub>	118.70	157.40	185.58	214.34	254.52	288.11	323.79	
Area reduction factor (%),ARF <sub>T</sub>	1.046	1.046	1.046	1.046	1.046	1.046	1.046	
Average intensity (mm/hour),I <sub>T</sub>	124.119	164.591	194.052	224.129	266.143	301.264	338.579	
Return Period (years)	2	5	10	20	50	100	PMF	
Peak flow (m3/s)	9.919	14.468	18.608	24.000	35.305	48.15	155.75	



STANDARD DESIGN FLOOD (SDF) METHOD							
Description of catchment		HRU4					
River detail	Unnamed Tributary						
Calculated by	Hendrik Botha			Date	14/10/2022		
Physical characteristics							
Size of catchment (A)	1.84	km <sup>2</sup>	Days of thunder per year (R)		54	days	
Longest watercourse (L)	1.18	km	Time of concentration, $t_c$		20.346	minutes	
Average slope ( $S_{av}$ )	0.020	m/m	Time of concentration, $T_c$	$T_c = \left[ \frac{0.87 L^2}{1000 S_{AV}} \right]^{0.385}$			0.3391
SDF Basin	28						
2-year return period rainfall (M)	75	mm					
TR102 n-day rainfall data							
Weather Service Station			MAP		768	mm	
Weather Service Station no.			Coordinates				
Duration	Return Period (years)						
	2	5	10	20	50	100	200
Rainfall							
Return Period (years), T	2	5	10	20	50	100	200
Point precipitation depth (mm) $P_{t,T}$	23.4	39.5	51.7	63.8	79.9	92.1	104.3
Area reduction factor (%), $ARF_T$	1.046	1.046	1.046	1.046	1.046	1.046	1.046
Average intensity (mm/hour), $I_T$	72.2	121.8	159.3	196.9	246.5	284.0	321.5
Run-off coefficient							
Calibration factors	$C_2$ (%)	15		$C_{100}$ (%)		60	
Return Period (years), T	2	5	10	20	50	100	200
Return period factors ( $Y_T$ )	0	0.84	1.28	1.64	2.05	2.33	2.58
Run-off coefficient, $C_T$	0.150	0.312	0.397	0.467	0.546	0.600	0.648
Peak flow (m3/s)	5.54	19.44	32.35	46.96	68.77	87.09	106.53

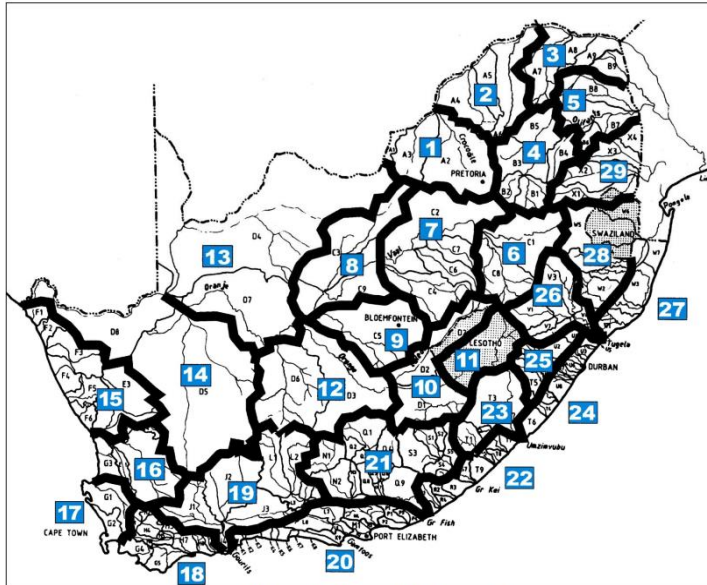
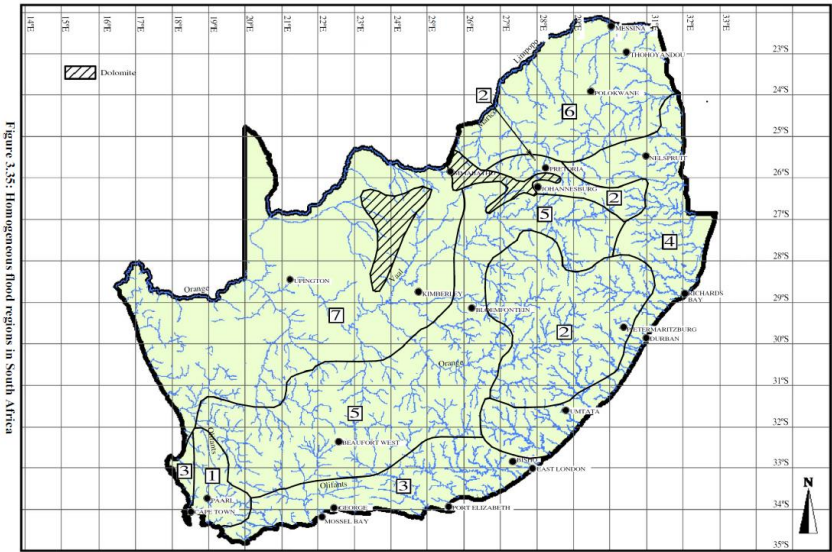


Figure 3.30: Standard Design Flood drainage basins

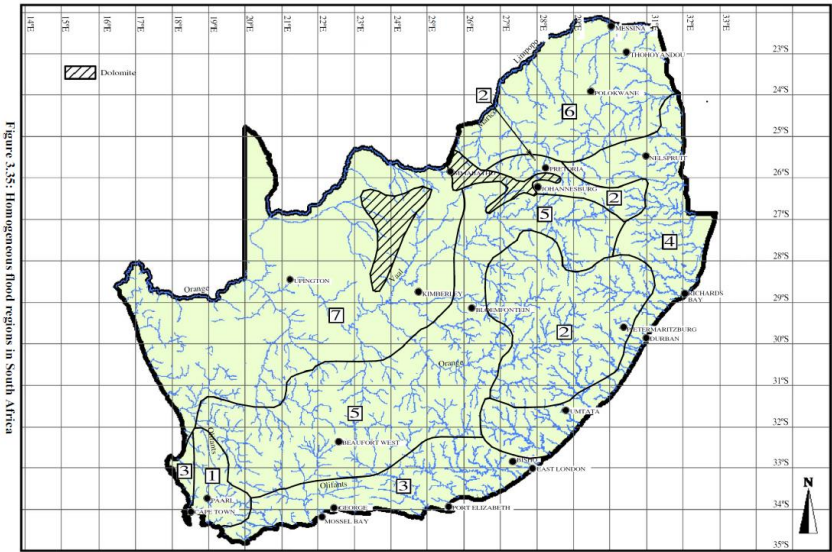
MIDGLEY & PITMAN (MIPI) METHOD														
River Detail	Catchment Area	MAP	S	L	Lc	Constant K <sub>r</sub>				Catchment Parameter	Peak Flows			
	(km <sup>2</sup> )	(mm)	m/m	km	km	1:10 year	1:20 Year	1: 50 year	1: 100 year	(Dimensionless)	1:10 year	1:20 Year	1: 50 year	1: 100 year
HRU4	1.84	768	0.0201	1.18	1.14	0.83	1.04	1.36	1.6	0.1939	24.96	31.27	40.89	48.11



## HRU5

RATIONAL METHOD 3								
Description of catchment		HRU5						
River detail		Unnamed Tributary						
Calculated by		Hendrik Botha			Date		Friday, 14 October 2022	
Physical characteristics								
Size of catchment (A)	1.24	km <sup>2</sup>	Rainfall region		WSA			
Longest watercourse (L)	0.57	km	Area distribution factors					
Average slope (S <sub>av</sub> )	0.0914	m/m	Rural (a)	Urban (b)	Lakes (y)			
Dolomite area (D%)	0	%	1	0	0			
Mean annual rainfall (MAR)	768	mm						
Rural			URBAN					
Surface slope	%	Factor	C <sub>s</sub>	Description	%	Factor	C <sub>2</sub>	
Vleis and pans (<3%)	4.19	0.03	0.13	Lawns				
Flat areas (3 - 10%)	66.11	0.08	5.29	Sandy, flat <2%	0	0.08	0	
Hilly (10 - 30%)	29.70	0.16	4.75	Sandy, steep >7%	0	0.16	0	
Steep Areas (>30%)	0.00	0.26	0.00	Heavy s, flat <2%	0	0.15	0	
Total	100.00	0.53	10.17	Heavy s, steep >7%	0	0.3	0	
Permeability	%	Factor	C <sub>p</sub>	Residential Areas				
Very permeable	80	0.04	3.20	Houses	0	0.5	0	
Permeable	20	0.08	1.60	Flats	0	0.6	0	
Semi-permeable	0	0.16	0.00	Industry				
Impermeable	0	0.26	0.00	Light industry	0	0.6	0	
Total	100	0.54	4.80	Heavy industry	0	0.7	0	
Vegetation	%	Factor	C <sub>v</sub>	Business				
Thick bush & plantation	2	0.04	0.08	City centre	0	0.8	0	
Light bush & farm-lands	16	0.11	1.76	Suburban	0	0.65	0	
Grasslands	75	0.21	15.75	Streets	0	0.75	0	
No vegetation	7	0.25	1.75	Max flood	0	1	0	
Total	100	0.61	19.34	Total (C <sub>2</sub> )	0		0	
$T_c = 0.604 \left( \frac{rL}{\sqrt{S_{av}}} \right)^{0.467}$				$T_c = \left[ \frac{0.87 L^2}{1000 S_{av}} \right]^{0.385}$				
0.529 hours				0.108 hours				
Use Defined watercourse								
Run-off coefficient								
Return Period (years)	2	5	10	20	50	100	PMF	
Run-off coefficient, C <sub>1</sub>	0.343	0.343	0.343	0.343	0.343	0.343	0.900	
Adjusted for dolomitic areas, C <sub>1D</sub>	0.343	0.343	0.343	0.343	0.343	0.343	0.900	
Adj factor for initial saturation, F <sub>t</sub>	0.5	0.55	0.6	0.67	0.83	1	1.00	
Adjusted run - off coefficient, C <sub>1T</sub>	0.1715325	0.18868575	0.205839	0.230	0.285	0.343	0.900	
Combined run - off coefficient, C <sub>T</sub>	0.1715325	0.18868575	0.205839	0.230	0.285	0.343	0.900	
Rainfall								
Return Period (years)	2	5	10	20	50	100	PMF	
Point rainfall (mm), P <sub>T</sub>	32.13	42.59	50.31	58.04	68.92	77.97	87.72	
Point Intensity (mm/h), P <sub>h</sub>	297.26	394.08	465.48	536.99	637.62	721.38	811.61	
Area reduction factor (%), ARF <sub>T</sub>	1.022	1.022	1.022	1.022	1.022	1.022	1.022	
Average intensity (mm/hour), I <sub>T</sub>	303.836	402.797	475.779	548.874	651.728	737.339	829.568	
Return Period (years)	2	5	10	20	50	100	PMF	
Peak flow (m3/s)	17.952	26.178	33.733	43.455	63.921	87.13	257.17	

MIDGLEY & PITMAN (MPI) METHOD														
River Detail	Catchment Area	MAP	S	L	Lc	Constant K <sub>r</sub>				Catchment Parameter	Peak Flows			
	(km <sup>2</sup> )	(mm)	m/m	km	km	1:10 year	1:20 Year	1: 50 year	1: 100 year	(Dimensionless)	1:10 year	1:20 Year	1: 50 year	1: 100 year
HRU5	1.24	768	0.0914	0.57	0.53	0.83	1.04	1.36	1.6	1.2409	28.55	35.77	46.78	55.03



STANDARD DESIGN FLOOD (SDF) METHOD							
Description of catchment		HRU5					
River detail	Unnamed Tributary						
Calculated by	Hendrik Botha			Date	14/10/2022		
Physical characteristics							
Size of catchment (A)	1.24	km <sup>2</sup>	Days of thunder per year (R)		54	days	
Longest watercourse (L)	0.57	km	Time of concentration, $t_c$		6.485	minutes	
Average slope ( $S_{av}$ )	0.091	m/m	Time of concentration, $T_c$	$T_c = \left[ \frac{0.87 L^2}{1000 S_{AV}} \right]^{0.385}$			0.1081
SDF Basin	28						
2-year return period rainfall (M)	75	mm					
TR102 n-day rainfall data							
Weather Service Station			MAP		768	mm	
Weather Service Station no.			Coordinates				
Duration	Return Period (years)						
	2	5	10	20	50	100	200
Rainfall							
Return Period (years), T	2	5	10	20	50	100	200
Point precipitation depth (mm) $P_{t,T}$	13.1	22.2	29.0	35.8	44.9	51.7	58.5
Area reduction factor (%), $ARF_T$	1.022	1.022	1.022	1.022	1.022	1.022	1.022
Average intensity (mm/hour), $I_T$	124.3	209.6	274.2	338.8	424.1	488.7	553.3
Run-off coefficient							
Calibration factors	$C_2$ (%)	15		$C_{100}$ (%)		60	
Return Period (years), T	2	5	10	20	50	100	200
Return period factors ( $Y_T$ )	0	0.84	1.28	1.64	2.05	2.33	2.58
Run-off coefficient, $C_T$	0.150	0.312	0.397	0.467	0.546	0.600	0.648
Peak flow (m3/s)	6.42	22.54	37.51	54.46	79.75	101.00	123.55

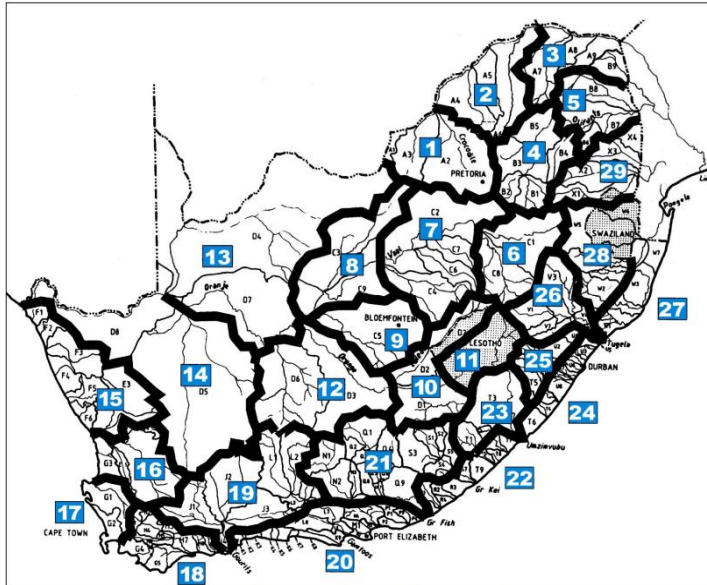


Figure 3.30: Standard Design Flood drainage basins



## HRU6

RATIONAL METHOD 3							
Description of catchment		HRU6					
River detail		Unnamed Tributary					
Calculated by		Hendrik Botha				Date	
						Friday, 14 October 2022	
Physical characteristics							
Size of catchment (A)	1.36	km <sup>2</sup>	Rainfall region		WSA		
Longest watercourse (L)	1.33	km	Area distribution factors				
Average slope (S <sub>av</sub> )	0.0170	m/m	Rural (a)	Urban (b)	Lakes (y)		
Dolomite area (D%)	0	%	1	0	0		
Mean annual rainfall(MAR)	768	mm					
Rural			URBAN				
Surface slope	%	Factor	C <sub>s</sub>	Description	%	Factor	C <sub>2</sub>
Vleis and pans (<3%)	26.40	0.03	0.79	Lawns			
Flat areas (3 - 10%)	73.10	0.08	5.85	Sandy,flat<2%	0	0.08	0
Hilly (10 - 30%)	0.50	0.16	0.08	Sandy,steep>7%	0	0.16	0
Steep Areas (>30%)	0.00	0.26	0.00	Heavy s,flat<2%	0	0.15	0
Total	100.00	0.53	6.72	Heavy s,steep>7%	0	0.3	0
Permeability	%	Factor	C <sub>p</sub>	Residential Areas			
Very permeable	80	0.04	3.20	Houses	0	0.5	0
Permeable	20	0.08	1.60	Flats	0	0.6	0
Semi-permeable	0	0.16	0.00	Industry			
Impermeable	0	0.26	0.00	Light industry	0	0.6	0
Total	100	0.54	4.80	Heavy industry	0	0.7	0
Vegetation	%	Factor	C <sub>v</sub>	Business			
Thick bush & plantation	12	0.04	0.48	City centre	0	0.8	0
Light bush & farm-lands	2	0.11	0.22	Suburban	0	0.65	0
Grasslands	63.1	0.21	13.25	Streets	0	0.75	0
No vegetation	23	0.25	5.75	Max flood	0	1	0
Total	100.1	0.61	19.70	Total (C <sub>2</sub> )	0		0
Time of concentration (TC)							
Overland flow		Defined watercourse		Use Defined watercourse			
$T_c = 0.604 \left( \frac{rL}{\sqrt{S_{av}}} \right)^{0.467}$		$T_c = \left[ \frac{0.87 L^2}{1000 S_{AV}} \right]^{0.385}$					
1.165	hours	0.397	hours				
Run-off coefficient							
Return Period (years)	2	5	10	20	50	100	PMF
Run-off coefficient, C <sub>1</sub>	0.312	0.312	0.312	0.312	0.312	0.312	0.900
Adjusted for dolomitic areas, C <sub>1D</sub>	0.312	0.312	0.312	0.312	0.312	0.312	0.900
Adj factor for initial saturation, F <sub>t</sub>	0.5	0.55	0.6	0.67	0.83	1	1.00
Adjusted run - off coefficient, C <sub>1T</sub>	0.156105	0.1717155	0.187326	0.209	0.259	0.312	0.900
Combined run - off coefficient, C <sub>T</sub>	0.156105	0.1717155	0.187326	0.209	0.259	0.312	0.900
Rainfall							
Return Period (years)	2	5	10	20	50	100	PMF
Point rainfall (mm), P <sub>T</sub>	41.41	54.94	64.77	74.79	88.82	100.55	113.01
Point Intensity (mm/h), P <sub>h</sub>	104.42	138.52	163.30	188.59	223.95	253.52	284.94
Area reduction factor (%),ARF <sub>T</sub>	1.066	1.066	1.066	1.066	1.066	1.066	1.066
Average intensity (mm/hour),I <sub>T</sub>	111.268	147.611	174.018	200.962	238.648	270.157	303.636
Return Period (years)	2	5	10	20	50	100	PMF
Peak flow (m3/s)	6.562	9.576	12.315	15.881	23.363	31.86	103.24

STANDARD DESIGN FLOOD (SDF) METHOD							
Description of catchment		HRU6					
River detail	Unnamed Tributary						
Calculated by	Hendrik Botha			Date	14/10/2022		
Physical characteristics							
Size of catchment (A)	1.36	km <sup>2</sup>	Days of thunder per year (R)		54	days	
Longest watercourse (L)	1.33	km	Time of concentration, $t_c$		22.706	minutes	
Average slope ( $S_{av}$ )	0.017	m/m	Time of concentration, $T_c$	$T_c = \left[ \frac{0.87 L^2}{1000 S_{AV}} \right]^{0.385}$			0.3966
SDF Basin	28						
2-year return period rainfall (M)	75	mm					
TR102 n-day rainfall data							
Weather Service Station			MAP		768	mm	
Weather Service Station no.			Coordinates				
Duration	Return Period (years)						
	2	5	10	20	50	100	200
Rainfall							
Return Period (years), T	2	5	10	20	50	100	200
Point precipitation depth (mm) $P_{t,T}$	24.8	41.9	54.8	67.7	84.7	97.6	110.5
Area reduction factor (%), $ARF_T$	1.066	1.066	1.066	1.066	1.066	1.066	1.066
Average intensity (mm/hour), $I_T$	66.7	112.5	147.2	181.8	227.7	262.3	297.0
Run-off coefficient							
Calibration factors	$C_2$ (%)	15		$C_{100}$ (%)		60	
Return Period (years), T	2	5	10	20	50	100	200
Return period factors ( $Y_T$ )	0	0.84	1.28	1.64	2.05	2.33	2.58
Run-off coefficient, $C_T$	0.150	0.312	0.397	0.467	0.546	0.600	0.648
Peak flow (m3/s)	3.78	13.27	22.08	32.06	46.95	59.46	72.73

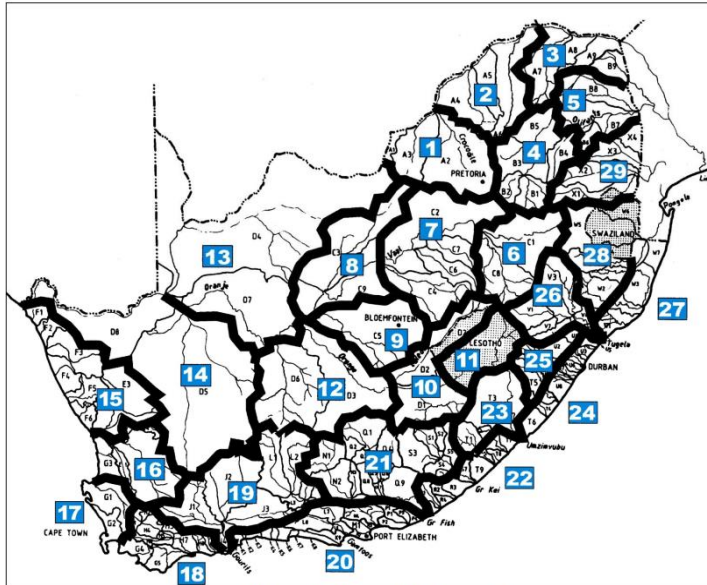
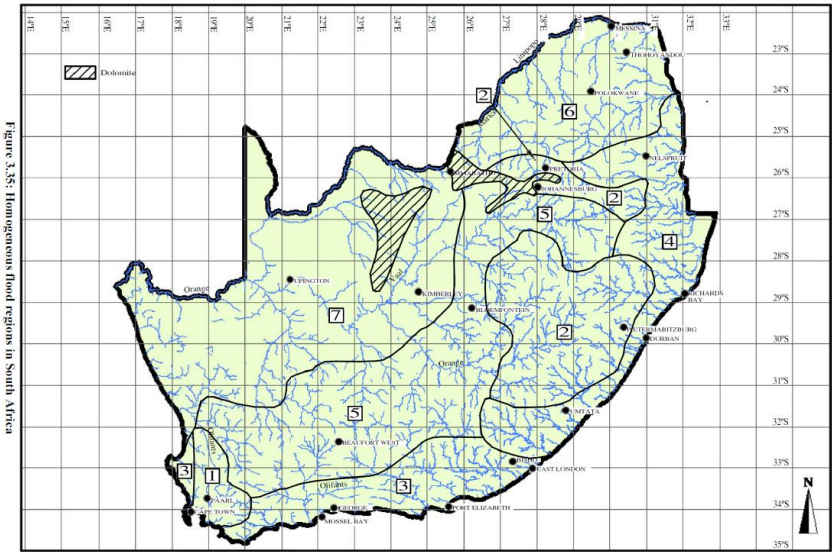


Figure 3.30: Standard Design Flood drainage basins

MIDGLEY & PITMAN (MPI) METHOD														
River Detail	Catchment Area	MAP	S	L	Lc	Constant K <sub>r</sub>				Catchment Parameter	Peak Flows			
	(km <sup>2</sup> )	(mm)	m/m	km	km	1:10 year	1:20 Year	1: 50 year	1: 100 year	(Dimensionless)	1:10 year	1:20 Year	1: 50 year	1: 100 year
HRU6	1.36	768	0.0170	1.33	1.65	0.83	1.04	1.36	1.6	0.0808	17.47	21.89	28.63	33.68



## HRU7

RATIONAL METHOD 3								
Description of catchment		HRU7						
River detail		Unnamed Tributary						
Calculated by		Hendrik Botha			Date		Friday, 14 October 2022	
Physical characteristics								
Size of catchment (A)	9.92	km <sup>2</sup>	Rainfall region		WSA			
Longest watercourse (L)	7.26	km	Area distribution factors					
Average slope (S <sub>av</sub> )	0.0430	m/m	Rural (a)	Urban (B)	Lakes (y)			
Dolomite area (D%)	0	%	1	0	0			
Mean annual rainfall(MAR)	768	mm						
Rural			URBAN					
Surface slope	%	Factor	C <sub>s</sub>	Description	%	Factor	C <sub>2</sub>	
Vleis and pans (<3%)	20.00	0.03	0.60	Lawns				
Flat areas (3 - 10%)	10.00	0.08	0.80	Sandy,flat<2%	0	0.08	0	
Hilly (10 - 30%)	20.00	0.16	3.20	Sandy,steep>7%	0	0.16	0	
Steep Areas (>30%)	50.00	0.26	13.00	Heavy s,flat<2%	0	0.15	0	
Total	100.00	0.53	17.60	Heavy s,steep>7%	0	0.3	0	
Permeability	%	Factor	C <sub>p</sub>	Residential Areas				
Very permeable	80	0.04	3.20	Houses	0	0.5	0	
Permeable	20	0.08	1.60	Flats	0	0.6	0	
Semi-permeable	0	0.16	0.00	Industry				
Impermeable	0	0.26	0.00	Light industry	0	0.6	0	
Total	100	0.54	4.80	Heavy industry	0	0.7	0	
Vegetation	%	Factor	C <sub>v</sub>	Business				
Thick bush & plantation	5.91	0.04	0.24	City centre	0	0.8	0	
Light bush & farm-lands	2.6	0.11	0.29	Suburban	0	0.65	0	
Grasslands	89.4	0.21	18.77	Streets	0	0.75	0	
No vegetation	2.08	0.25	0.52	Max flood	0	1	0	
Total	99.99	0.61	19.82	Total (C <sub>2</sub> )	0		0	
Time of concentration (TC)								
Overland flow		Defined watercourse		Use Defined watercourse				
$T_c = 0.604 \left( \frac{rL}{\sqrt{S_{av}}} \right)^{0.467}$		$T_c = \left[ \frac{0.87 L^2}{1000 S_{AV}} \right]^{0.385}$						
2.072	hours	1.025	hours					
Run-off coefficient								
Return Period (years)	2	5	10	20	50	100	PMF	
Run-off coefficient, C <sub>1</sub>	0.422	0.422	0.422	0.422	0.422	0.422	0.900	
Adjusted for dolomitic areas, C <sub>1D</sub>	0.422	0.422	0.422	0.422	0.422	0.422	0.900	
Adj factor for initial saturation, F <sub>t</sub>	0.5	0.55	0.6	0.67	0.83	1	1.00	
Adjusted run - off coefficient, C <sub>1T</sub>	0.211082	0.2321902	0.2532984	0.283	0.350	0.422	0.900	
Combined run - off coefficient, C <sub>T</sub>	0.211082	0.2321902	0.2532984	0.283	0.350	0.422	0.900	
Rainfall								
Return Period (years)	2	5	10	20	50	100	PMF	
Point rainfall (mm), P <sub>T</sub>	49.90	66.11	77.98	90.05	106.95	121.04	136.03	
Point Intensity (mm/h), P <sub>h</sub>	48.68	64.49	76.07	87.85	104.34	118.08	132.71	
Area reduction factor (%),ARF <sub>T</sub>	1.004	1.004	1.004	1.004	1.004	1.004	1.004	
Average intensity (mm/hour),I <sub>T</sub>	48.899	64.777	76.410	88.240	104.804	118.607	133.299	
Return Period (years)	2	5	10	20	50	100	PMF	
Peak flow (m3/s)	28.442	41.445	53.333	68.775	101.192	137.98	330.58	

STANDARD DESIGN FLOOD (SDF) METHOD							
Description of catchment		HRU7					
River detail	Unnamed Tributary						
Calculated by	Hendrik Botha			Date	14/10/2022		
Physical characteristics							
Size of catchment (A)	9.92	km <sup>2</sup>	Days of thunder per year (R)		54	days	
Longest watercourse (L)	7.26	km	Time of concentration, $t_c$		61.504	minutes	
Average slope ( $S_{av}$ )	0.043	m/m	Time of concentration, $T_c$	$T_c = \left[ \frac{0.87 L^2}{1000 S_{AV}} \right]^{0.385}$			1.0251
SDF Basin	28						
2-year return period rainfall (M)	75	mm					
TR102 n-day rainfall data							
Weather Service Station				MAP		768	mm
Weather Service Station no.				Coordinates			
Duration	Return Period (years)						
	2	5	10	20	50	100	200
Rainfall							
Return Period (years), T	2	5	10	20	50	100	200
Point precipitation depth (mm) $P_{t,T}$	33.4	56.3	73.6	90.9	113.9	131.2	148.5
Area reduction factor (%), $ARF_T$	1.004	1.004	1.004	1.004	1.004	1.004	1.004
Average intensity (mm/hour), $I_T$	32.7	55.1	72.1	89.1	111.6	128.6	145.5
Run-off coefficient							
Calibration factors	$C_2$ (%)	15		$C_{100}$ (%)		60	
Return Period (years), T	2	5	10	20	50	100	200
Return period factors ( $Y_T$ )	0	0.84	1.28	1.64	2.05	2.33	2.58
Run-off coefficient, $C_T$	0.150	0.312	0.397	0.467	0.546	0.600	0.648
Peak flow (m3/s)	13.51	47.44	78.95	114.61	167.83	212.54	259.99

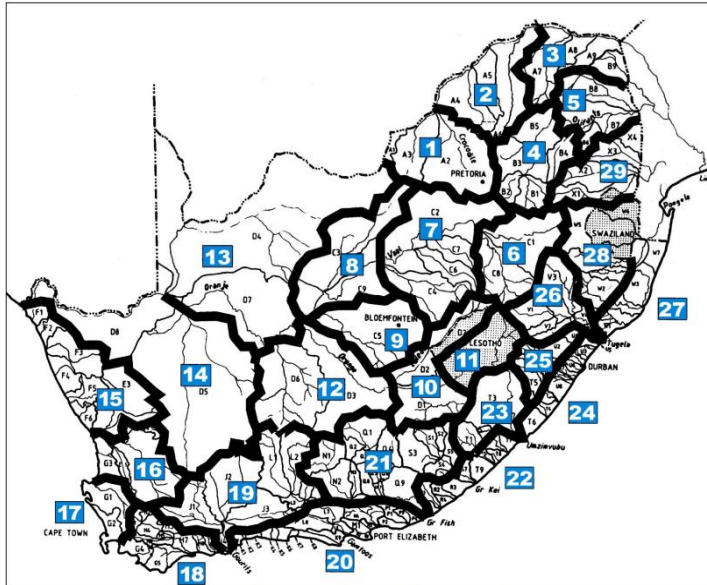
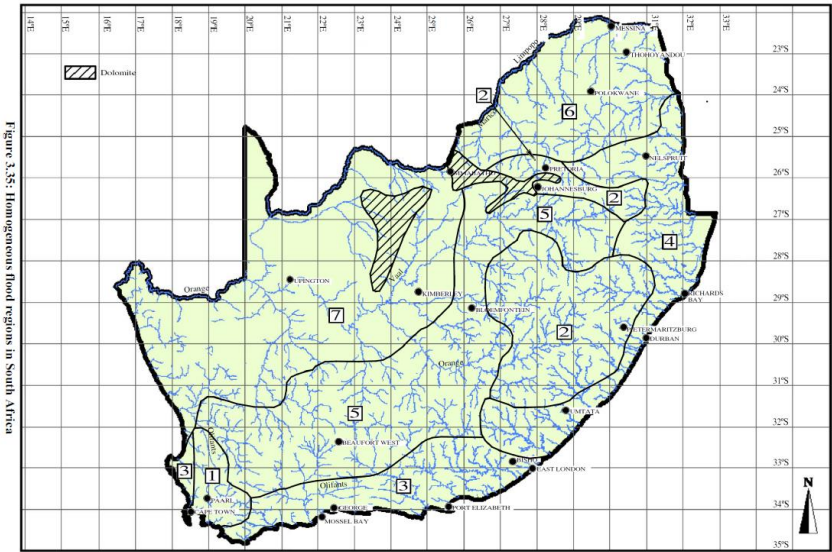


Figure 3.30: Standard Design Flood drainage basins



MIDGLEY & PITMAN (MPI) METHOD														
River Detail	Catchment Area	MAP	S	L	Lc	Constant K <sub>r</sub>				Catchment Parameter	Peak Flows			
	(km <sup>2</sup> )	(mm)	m/m	km	km	1:10 year	1:20 Year	1: 50 year	1: 100 year	(Dimensionless)	1:10 year	1:20 Year	1: 50 year	1: 100 year
HRU7	9.92	768	0.0430	7.26	3.5	0.83	1.04	1.36	1.6	0.0810	57.59	72.16	94.36	111.01



---

**APPENDIX B: WATER QUALITY CERTIFICATES**

---

**APPENDIX C: DISCLAIMER AND DECELERATION OF INDEPENDENCE**

The opinions expressed in this Report have been based on site /project information supplied to GCS (Pty) Ltd by Kangra Coal (Pty) and are based on public domain data, field data and data supplied to GCS by the client. GCS has acted and undertaken this assessment objectively and independently.

GCS has exercised all due care in reviewing the supplied information. Whilst GCS has compared key supplied data with expected values, the accuracy of the results and conclusions are entirely reliant on the accuracy and completeness of the supplied data. GCS does not accept responsibility for any errors or omissions in the supplied information and does not accept any consequential liability arising from commercial decisions or actions resulting from them.

Opinions presented in this report, apply to the site conditions, and features as they existed at the time of GCS's investigations, and those reasonably foreseeable. These opinions do not necessarily apply to conditions and features that may arise after the date of this report, about which GCS had no prior knowledge nor had the opportunity to evaluate.

## DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

### PROJECT TITLE

Hydrology Assessment for the Proposed Co-Disposal Facility & Water Treatment Plant at Kangra Maquasa East Operations

### SPECIALIST INFORMATION

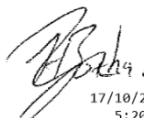
Specialist Company Name:	GCS Environmental SA		
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	2	Percentage Procurement Recognition
Specialist name:	Hendrik Botha		
Specialist Qualifications:	MSc Environmental Sciences (Geohydrology & Geochemistry) BSc Hons. Environmental Sciences (Hydrology) BSc. Geology and Chemistry		
Professional affiliation/registration:	PR SCI NAT 400139/17		
Physical address:	1 Karbochem Road, Newcastle, KZN		
Postal address:			
Postal code:	2940	Cell:	
Telephone:	071 102 3819	Fax:	
E-mail:	hendrikb@gcs-sa.biz		

---

DECLARATION BY THE SPECIALIST

I, Hendrik Botha, declare that –

- I act as the independent specialist in this application.
- I will perform the work relating to the application objectively, 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 concerning 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 realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.



17/10/2022  
5:20:13  
Pr.Sci.Nat (400139/17)

---

Signature of the Specialist

---

GCS

---

Name of Company:

---

17 November 2023

---

Date



## CV OF SPECIALIST



Hendrik Botha

**Technical Director**

LinkedIn:

**CORE SKILLS**

- Project management
- Analytical and numerical groundwater modelling
- Geochemical assessments and geochemical modelling
- Hydrogeology, hydrological assessments & yield assessments
- Hydrology, floodline modelling & storm water management
- Groundwater vulnerability, impact, and risk assessments
- Technical report writing
- GIS and mapping

**DETAILS****Qualifications**

- BSc Chemistry and Geology (Environmental Sciences) (2012)
- BSc Hons Hydrology (Environmental Sciences) (2013)
- MSc Geohydrology and Hydrology (Environmental Sciences) (2014-2016)

**Membership**

- Groundwater Division of GSSA
- Groundwater Association of KwaZulu Natal Member
- International Mine Water Association (IMWA)

**Languages**

- Afrikaans - Speak, read, write.
- English - Speak, read, write.

**Projects undertaken in**

- South Africa
- Nigeria
- Namibia
- Liberia

**PROFILE**

Hendrik (Henri) Botha is currently the manager of the GCS Newcastle Office and occupies the role of principal hydrogeologist. Groundwater, geochemistry and surface hydrology, as well as knowledge of water chemistry together with GIS, and analytical and numerical modelling skills, are some of his sought-after expertise. General and applied logical knowledge are his key elements in problem-solving.

**Professional Affiliations:**

SACNASP Professional Natural Scientist (400139/17)

**Areas of Expertise:**

- Waste classification and Impact Assessments
- Aquifer vulnerability assessments
- Geochemical sampling, data interpretation and modelling
- Geophysical surveys and data interpretation
- GIS
- Water quality sampling and data interpretation
- Groundwater impact and risk assessments
- Numerical and Conceptual Visual Modelling (Visual Modflow, ModflowFLEX, Voxler, RockWorks, Surfer and Excel)
- Hydrogeology (Hydrological Soil Types) & Soils Assessments
- Floodline Modelling (HEC-RAS)
- Stormwater Management Systems and Modelling
- Surface Water Yield Assessments
- Water and Salt Balances



SCAN ME  
PROJECT RECORD

Page 1 of 8

## **APPENDIX E-4: GEOHYDROLOGICAL ASSESSMENT**


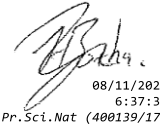

# **Geohydrological Assessment for the Proposed Co-Disposal Facility & Water Treatment Plant at Kangra Maquasa East Operations**

**Version - Final 1  
17 November 2023**

**Kangra Coal  
GCS Project Number: 22-0161\_GW  
Client Reference: 111862**



**Geohydrological Assessment for the Proposed Co-Disposal Facility & Water Treatment Plant at Kangra Maquasa East Operations****Report  
Version - Final 1****17 November 2023****Kangra Coal  
22-0161\_GW****DOCUMENT ISSUE STATUS**

<b>Report Issue</b>	Final 1		
<b>GCS Reference Number</b>	GCS Ref - 22-0161_GW		
<b>Client Reference</b>	111862		
<b>Title</b>	Geohydrological Assessment for the Proposed Co-Disposal Facility & Water Treatment Plant at Kangra Maquasa East Operations		
	<b>Name</b>	<b>Signature</b>	<b>Date</b>
<b>Author 1 (Hydrogeologist)</b>	Shuaib Dustay (MSc, PriSciNat)	 08/11/2023	17 November 2023
<b>Author 2 / Director</b>	Hendrik Botha (MSc, PriSciNat)	 08/11/2022 6:37:36 Pr.Sci.Nat (400139/17)	17 November 2023
<b>Proof Reader</b>	Lisa Botha (BSc, Hons.)		17 November 2023

**LEGAL NOTICE**

This report or any proportion thereof and any associated documentation remain the property of GCS until the mandator effects payment of all fees and disbursements due to GCS in terms of the GCS Conditions of Contract and Project Acceptance Form. Notwithstanding the aforesaid, any reproduction, duplication, copying, adaptation, editing, change, disclosure, publication, distribution, incorporation, modification, lending, transfer, sending, delivering, serving or broadcasting must be authorised in writing by GCS.

---

## **DECLARATION OF INDEPENDENCE**

GCS (Pty) Ltd was appointed to conduct this specialist groundwater study and to act as the independent groundwater specialist. GCS objectively performed the work, even if this results in views and findings that are not favourable. GCS has the expertise in conducting the specialist investigation and does not have a conflict of interest in the undertaking of this study. This report presents the findings of the investigations which include the activities set out in the scope of work.



## APPENDIX 6 OF THE EIA REGULATION - CHECKLIST AND REFERENCE FOR THIS REPORT

**Table 1 - Requirements from Appendix 6 of GN 326 EIA Regulation 2017**

Requirements from Appendix 6 of GN 326 EIA Regulation 2017	Chapter
(a) Details of: (i) The specialist who prepare the reports; and (ii) the expertise of that specialist to compile a specialist report including a curriculum vitae	Appendix G.
(b) Declaration that the specialist is independent in a form as may be specialities by the competent authority	Appendix G.
(c) Indication of the scope of, and purpose for which, the report was prepared	Section 2
(cA) Indication of the quality and age of base data used for the specialist report	Sections 1, 2, 4 and 5.
(cB) A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Sections 6, 7 and 8
(d) Duration, Date and seasons of the site investigation and the relevance of the season to the outcome of the assessment	Section 1.2
(e) Description of the methodology adopted in preparing the report or carrying out the specialised process include of equipment and modelling used	Section 4
(f) Details of an assessment of the specifically identified sensitivity of the site related to the proposed activity or activities and its associate's structures and infrastructure, inclusive of a site plan identifying alternative	Sections 1, 2, 4 and 5
(g) Identification of any areas to be avoided, including buffers	Section 10.2.
(h) Map superimposing the activity and associated structures and infrastructure on environmental sensitivities of the site including areas to be avoided, including buffers	Section 1, 3, 5 6, 7 and 8.
(i) Description of any assumptions made and uncertainties or gaps in knowledge	Sections 1, 7, and 8.
(j) A description of the findings and potential implications of such findings on the impact of the proposed activity including identified alternatives on the environment or activities	Sections 7, 8 and 10.
(k) Mitigation measures for inclusion in the EMPr	Sections 9 and 10.
(l) Conditions for inclusion in the environmental authorisation	Refer to recommendations in Section 10.
(m) Monitoring requirements for inclusion in the EMPr or environmental authorisation	Refer to recommendations in Section 10.
(n) Reasoned opinion - (i) as to whether the proposed activity, activities or portions thereof should be authorised. (iA) regarding the acceptability of the proposed activity or activities; and (ii) if the opinion is that the proposed activity, activities or portions thereof should be authorised, and avoidance, management, and mitigation measures should be included in the EMPr, and where applicable, the closure plan	Section 10.3.
(o) <i>Description of any consultation process that was undertaken during preparing the specialist report</i>	<i>None required.</i>
(p) <i>A summary and copies of any comments received during any consultation process and where applicable all responses thereto</i>	<i>None required.</i>
(q) <i>Any other information requested by the competent authority</i>	<i>None required.</i>

## CONTENTS PAGE

Declaration of Independence .....	iii
Appendix 6 of the EIA Regulation - CHECKLIST and Reference for this Report .....	iv
CONTENTS PAGE.....	i
List of Figures.....	ii
List of Tables.....	iii
List of Appendices .....	iv
Glossary of Terms .....	v
LIST OF ACRONYMS .....	viii
<b>1 Introduction .....</b>	<b>1</b>
1.1 Project background.....	1
1.1.1 Water Treatment Plant:.....	1
1.1.2 Co-Disposal Facility.....	2
1.2 Study relevance to the season in which it was undertaken .....	3
1.3 Objectives .....	4
1.4 The layout of this report.....	4
<b>2 Scope of work .....</b>	<b>6</b>
<b>3 Area of investigation .....</b>	<b>8</b>
3.1 Sub-catchments / hydrological response units (HRUs) .....	8
3.2 Local geology & soils.....	8
3.3 Climate.....	12
3.3.1 Temperature .....	12
3.3.2 Wind speed and direction .....	13
3.3.3 Rainfall and evaporation .....	13
3.3.4 Runoff .....	15
<b>4 Methodology .....</b>	<b>16</b>
4.1 Literature review and desktop study .....	18
4.2 Hydrological overview .....	18
4.3 Groundwater users in the study area.....	19
4.4 Field investigation .....	19
4.4.1 Field hydrocensus.....	20
4.4.2 Geophysical assessment findings .....	22
4.4.3 Aquifer slug testing .....	26
4.5 Geochemical assessment.....	29
4.5.1 ABA .....	29
4.5.2 NAG .....	32
4.6 Mineralogy and total element analyses .....	33
4.7 Acid potential.....	33
4.8 Static leach testing .....	35
4.9 Numerical model development.....	36
4.9.1 Model software package .....	36
4.9.2 Governing Equations .....	36
4.9.3 Model confidence level classification.....	37
4.10 Geohydrological risk assessment .....	38
4.11 Water monitoring plan .....	38
<b>5 Prevailing groundwater conditions.....</b>	<b>39</b>
5.1 Aquifer characteristics, classification, and groundwater recharge .....	39
5.2 Aquifer transmissivity .....	42
5.3 Groundwater recharge .....	42
5.4 Aquifer storage .....	43
5.5 Depth to groundwater .....	43
5.6 Wetland areas .....	44

5.7	Present ecological state (PES) and environmental sensitivity and ecological importance (EIS) - quaternary scale .....	44
5.8	Aquifer contextualization and extent .....	45
5.9	Groundwater quantity .....	45
5.9.1	Quaternary catchment .....	45
5.9.2	Sub-catchment delineation.....	46
5.9.3	Groundwater balance .....	46
5.10	Hydrochemistry.....	47
5.10.1	Groundwater Levels.....	47
5.10.2	Groundwater Quality.....	48
5.10.3	Surface Water Quality .....	49
<b>6</b>	<b>Site conceptual model .....</b>	<b>53</b>
6.1	Sources .....	53
6.2	Pathways .....	53
6.3	Receptors.....	54
<b>7</b>	<b>Numerical groundwater model.....</b>	<b>56</b>
7.1	Model objective .....	56
7.2	Assumptions and limitations .....	56
7.3	Conceptualisation and Model Grid .....	58
7.3.1	Boundary Conditions.....	58
7.3.2	Construction of the Finite Difference Grid .....	59
7.3.3	Vertical Discretization.....	59
7.3.4	Time Discretization .....	60
7.3.5	Transient State Model Simulation Time.....	60
7.3.6	Input Parameters / Initial Model Conditions.....	64
7.3.7	Model Calibration .....	65
7.4	Calibrated flow models.....	69
7.5	Simulated 2022 plume and 20-year plumes .....	69
<b>8</b>	<b>Geohydrological Risks Assessment &amp; Mitigation Measures .....</b>	<b>72</b>
8.1	Pre-mining/development phase.....	72
8.2	Operational Phase .....	73
8.3	Closure and Post-Closure Phase .....	74
<b>9</b>	<b>Groundwater monitoring .....</b>	<b>79</b>
<b>10</b>	<b>Conclusions .....</b>	<b>81</b>
10.1	Proposed Groundwater Management Aspects .....	82
10.1.1	Operational / Decommission .....	82
10.1.2	Groundwater closure objectives .....	82
10.2	Recommendations.....	83
10.3	Identification of any areas that should be avoided .....	84
10.4	Reasoned opinion on whether WULA should not be granted .....	85
<b>11</b>	<b>Bibliography .....</b>	<b>85</b>

## LIST OF FIGURES

Figure 1-1:	Proposed WTP and possible brine evaporation pond.....	2
Figure 1-2:	Proposed Co-Disposal Facility (Phase 1 already approved, Phase 2 & 3 will be co-disposal) 3	
Figure 1-3:	Site locality and drainage .....	5
Figure 3-1:	Local geology.....	10
Figure 3-2:	Sub-catchments and land cover types .....	11
Figure 3-3:	Average yearly temperatures (Meteoblue, 2022) .....	12
Figure 3-4:	Wind rose (Meteoblue, 2022).....	13

Figure 3-5:	Average rainfall for Station 0407639W & WR2012 evaporation .....	14
Figure 3-6:	Simulated natural (unmodified) runoff for W51B .....	15
Figure 4-1:	Hydrocensus borehole locations .....	21
Figure 4-2:	Mag line 1 .....	23
Figure 4-3:	Mag line 2 .....	23
Figure 4-4:	Mag line 3 .....	24
Figure 4-5:	Mag line 4 .....	24
Figure 4-6:	Mag line 5 .....	25
Figure 4-7:	Mag line 6 .....	25
Figure 4-8:	Mag line 7 .....	26
Figure 4-9:	Geophysical investigation area .....	28
Figure 4-10:	Slurry deposit at discard dump .....	29
Figure 4-11:	Dry discard deposit .....	29
Figure 4-12:	Acid Potential - based on sample AP/NP and %S.....	34
Figure 4-13:	Numerical groundwater modelling process .....	36
Figure 4-14:	Monitoring Process .....	38
Figure 5-1:	Local hydrogeology .....	41
Figure 5-2:	Groundwater elevation vs topography elevation - correlation (Kangra Monitoring Holes) .....	43
Figure 5-3:	Groundwater base-flow concept (DWS, 2011) .....	44
Figure 5-4:	Groundwater level time trend graph for Maquasa East .....	47
Figure 5-5:	Maquasa East logarithmic groundwater sulphate graph .....	49
Figure 5-6:	Maquasa East logarithmic surface water TDS graph .....	50
Figure 5-7:	Maquasa East logarithmic surface water sulphate graph.....	51
<b>Figure 5-8:</b>	<b>Monitoring Network for Maquasa East</b> .....	52
Figure 6-1:	Site conceptual model .....	55
Figure 7-1:	Model grid & conductivity .....	62
Figure 7-2:	Model boundary conditions .....	63
Figure 7-3:	Steady-state model calibration achieved .....	66
Figure 7-4:	Flow model calibration achieved (2022).....	66
Figure 7-5:	Sulphate plume calibration achieved (2017-2018 period).....	67
Figure 7-6:	PEST Sensitivity Analysis - Histogram .....	68
Figure 7-7:	PEST Sensitivity Analysis - Weighted Parameter Sensitivity .....	68
Figure 7-8:	Calibrated flow model .....	70
Figure 7-9:	Calibrated 2022 SO <sub>4</sub> plumes, 50Y and 100Y unmitigated plumes from proposed developments .....	71
Figure 9-1:	Proposed groundwater monitoring points .....	80

## LIST OF TABLES

Table 3-1:	MAP of nearest rainfall stations .....	13
Table 4-1:	Project methodology flow diagram .....	17
Table 4-2:	Groundwater users within a 2.5 km radius of the site.....	19
Table 4-3:	Field hydrocensus boreholes identified in the project area .....	20
Table 4-4:	Geophysical Survey Record Summary .....	22
Table 4-5:	Summary of slug test results .....	27
Table 4-6:	ABA and NAG screening criteria (adapted from (Price, 1997) and (Fourie, 2014) .....	31
Table 4-7:	NAG screening methods used (Edited from (Miller, et al., 1997) .....	32
Table 4-8:	XRD results and mineral classification .....	33
Table 4-9:	Summary of ABA and NAG screening results .....	34
Table 4-10:	Summary of 1:20 DW Leachate Analytical Results.....	35
Table 5-1:	Aquifer characteristics and classification .....	39
Table 5-2:	Summary of aquifer transmissivity .....	42
Table 5-3:	Summary of PES and EIS for the Quaternary Catchment .....	44
Table 5-4:	Summarised Quaternary Catchment Information.....	45
Table 5-5:	Groundwater reserve determination .....	46
Table 7-1:	Summary of the target water quality range as per DWAF guidelines.....	57

---

Table 7-2: Identification of the real-world boundaries and the adopted model boundary conditions .....	59
Table 7-3: Model Simulation Time .....	61
Table 7-4: Input parameters to the flow model .....	64
Table 8-1: Risk rating scale.....	72
Table 8-2: Pre-mining / construction phase hydrogeological risk.....	76
Table 8-3: Operational phase hydrogeological risk.....	77
Table 8-4: Closure Phase Hydrogeological Risks .....	78
Table 9-1: Proposed monitoring points .....	79
Table 11-1: Proposed Criteria and Rating Scales to be used in the Assessment of the Potential Impacts .....	126
Table 11-2: Explanation of Assessment Criteria.....	128

## LIST OF APPENDICES

Appendix A: Photographic Log .....	87
Appendix B: Geophysical Investigation.....	92
Appendix C: Laboratory Certificates .....	113
Appendix D: Risk Assessment Methodology.....	126
Appendix E: Model Confidence MATRIX .....	130
Appendix F: Disclaimer .....	131
Appendix G: Details OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH .....	132
Appendix H: CV of Specialist .....	134



---

## GLOSSARY OF TERMS

A **confined aquifer** is a formation in which the groundwater is isolated from the atmosphere at the point of discharge by impermeable geologic formations; confined groundwater is generally subject to a pressure greater than atmospheric pressure.

**Advection** is the process by which solutes are transported by the bulk motion of the flowing groundwater.

An **unconfined, water-table** or phreatic aquifer are different terms used for the same aquifer type, which is bounded from below by an impermeable layer. The upper boundary is the water table, which is in contact with the atmosphere so that the system is open.

**Aquifer** - A body of rock, consolidated or unconsolidated, that is sufficiently permeable to conduct groundwater and to yield significant quantities of water to wells and springs.

**Aquifuge**: An impermeable body of rock which contains no interconnected openings or interstices and therefore neither absorbs nor transmits water.

**Compartment** - In a slope-aquifer system, an area formed by the undulation of the water table generally conforms to undulation in the overlying topography. The crests of the water-table undulations represent natural groundwater divides that, under natural conditions, restrict the movement of groundwater to the boundaries of the compartment.

**Cone of Depression** - A depression in the potentiometric surface of a body of groundwater that has the shape of an inverted cone and develops around a well/mineshaft/open-pit mine from which water is being withdrawn.

**Discharge Area** - An area in which there is an upward component of the hydraulic head in an aquifer. Groundwater flows toward the land surface in a discharge area and escapes as a spring, seep, or baseflow to streams, or by evaporation and transpiration.

**Dispersion** is the measure of the spreading and mixing of chemical constituents in groundwater caused by diffusion and mixing due to microscopic variations in velocities within and between pores.

**Drawdown** - The decline of the water table or potentiometric surface as a result of withdrawals from wells or excavations.

**Effective porosity** is the percentage of the bulk volume of a rock or soil that is occupied by interstices that are connected.

**Equipotential line** - A line in a two-dimensional groundwater flow field on which the total hydraulic head is the same at all points.

**Fault** - A fracture or fracture zone along which there has been displacement of the sides relative to one another parallel to the fracture.

**Fracture** - A crack, joint, fault or another form of break-in rocks caused by mechanical failure.

**The groundwater table** is the surface between the zone of saturation and the zone of aeration, also the surface of an unconfined aquifer.

**Heterogeneous** indicates non-uniformity in a structure.

**Hydraulic conductivity (K)** is the volume of water that will move through a porous medium in unit time under a unit hydraulic gradient through a unit area measured perpendicular to the area [L/T]. Hydraulic conductivity is a function of permeability and the fluid's density and viscosity.

**The hydraulic gradient** is the rate of change in the total head per unit distance of flow in each direction.

**Hydraulic Head** - Generally, the altitude of the free surface of a body of water above a given datum.

---

**Hydrodynamic dispersion** - Processes of mechanical dispersion and molecular diffusion.

**Interflow** - The lateral movement of water in the unsaturated zone during and immediately after precipitation. Interflow occurs when the zone above a low permeability horizon becomes saturated and lateral flow is initiated parallel to the barrier.

**Joint** - A fracture in rock along which there has been no visible movement.

**Mechanical dispersion** is the process whereby a group of pollutants are spread in a longitudinal as well as a transverse direction because of velocity distributions.

**Metamorphic Rock** - A rock formed at depth in the earth's crust from pre-existing rocks by mineralogical, chemical and structural changes caused by high temperature, pressure and other factors. Examples include slate, schist and gneiss.

**An observation borehole** is a borehole drilled at a selected location to observe parameters such as water levels.

**Perched Water Table** - The upper surface of a body of unconfined groundwater is separated from the main body of groundwater by the unsaturated material.

**Permeability** is related to hydraulic conductivity but is independent of the fluid density and viscosity and has the dimensions  $L^2$ . Hydraulic conductivity is therefore used in all the calculations.

**pH** is a measure of the acidity or alkalinity of a solution, numerically equal to 7 for neutral solutions, increasing with increasing alkalinity and decreasing with increasing acidity.

**Piezometric head** ( $\phi$ ) is the sum of the elevation and pressure head. An unconfined aquifer has a water table, and a confined aquifer has a piezometric surface, which represents a pressure head. The piezometric head is also referred to as the hydraulic head.

**Porosity** - The ratio of the aggregate volume of interstices in a rock or soil to its total volume. It is usually stated as a percentage.

**Potentiometric Surface** - An imaginary surface representing the total head of groundwater and defined by the level to which water rises in tightly-based wells. The water table is a potentiometric surface.

**Pumping tests** are conducted to determine aquifer or borehole characteristics.

**Recharge** is the addition of water to the zone of saturation through the vadose/unsaturated zone.

**Sandstone** is a sedimentary rock composed of abundant rounded or angular fragments of sand set in a fine-grained matrix (silt or clay) and firmly united by a cementing material.

**Sedimentary Rock** - A layered rock resulting from the consolidation of sediment deposited by some geologic agent such as water, wind, or ice. Typical sedimentary rocks include sandstone, limestone and shale.

**Shale** is a fine-grained sedimentary rock formed by the consolidation of clay, silt or mud. It is characterised by a finely laminated structure and is sufficiently indurated so that it will not fall apart on wetting.

**Specific storage** ( $S_o$ ), of a saturated confined aquifer, is the volume of water that a unit volume of aquifer releases from storage under a unit decline in hydraulic head. In the case of an unconfined (phreatic, water-table) aquifer; specific yield is the water that is released or drained from storage per unit decline in the Finite Difference water table.

**The static water level** is the level of water in a borehole that is not affected by the withdrawal of groundwater.

**Storativity** is the two-dimensional form of the specific storage and is defined as the specific storage multiplied by the saturated aquifer thickness.

**Total dissolved solids (TDS)** is a term that expresses the quantity of dissolved material in a sample of water.

**Transmissivity** (*T*) is the two-dimensional form of hydraulic conductivity and is defined as the hydraulic conductivity multiplied by the saturated aquifer thickness.

**The vadose zone** is the zone containing water under pressure less than that of the atmosphere, including soil water, intermediate vadose water, and capillary water. This zone is limited above the land surface and below the surface of the zone of saturation, that is, the water table.

**Water-table** is the surface between the vadose zone and the groundwater, that surface of a body of unconfined groundwater at which the pressure is equal to that of the atmosphere.

## LIST OF ACRONYMS

Acronym	Description
DEM	Digital Elevation Model
DWA	Department of Water Affairs
DWAF	Department of Water and Forestry
DWS	Department of Water and Sanitation (previously DWA and DWAF)
DWS	Department of Water and Sanitation
EMPR	Environmental Management Plan Report
FD	Finite Difference
GCS	GCS Water and Environment Consultants (Pty) Ltd
GRIP	Groundwater Information Project
GW	Groundwater
h	Potentiometric head
ha	Hectare
HDPE	High-Density Polyethylene (Plastic)
HMP	Hydrogeological Management Plan
HRU	Hydrological Response Unit
IWULA	Integrated Water Use License Application
IWWMP	Integrated Waste and Water Management Plan
K (k)	Hydraulic Conductivity (m/day)
K <sub>xx</sub>	Hydraulic Conductivity on the x-axis (m/day)
K <sub>yy</sub>	Hydraulic Conductivity on the y-axis (m/day)
K <sub>zz</sub>	Hydraulic Conductivity on the z-axis (m/day)
m	Metres
m <sup>3</sup>	Cubic Metres
MAE	Mean annual evaporation
mamsl	Meters above mean sea level
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
mbgl	Meters below ground level
n	Porosity
NEMA	National Environmental Management Agency
NGDB	National Groundwater Database
n-Value	Manning's Roughness Coefficients
NWA	National Water Act, 1998 (Act No. 36 of 1998)
PCD	Pollution Control Dam
PCD	Pollution Control Dam
PEST	Parameter Estimation Simulation
PFD	Process flow diagram
Re	Recharge (%)
S	Storativity
SANS	South African National Standards
S <sub>s</sub>	Specific Storage
SW	Surface Water
S <sub>y</sub>	Specific Yield
T	Transmissivity (m <sup>2</sup> /d)
t	Time (days)
TDS	Total dissolved solids
USG	Unstructured Grid
W	Groundwater Flux
WMA	Water Management Area
WQ	Water Quality
WR2012	Water Resources of South Africa 2012
Y (Yr.)	Years
ZOI	Zone of Influence
θ	Porosity

## 1 INTRODUCTION

GCS Water and Environment (Pty) Ltd (GCS) was appointed by Kangra Coal (Pty) Ltd to undertake a geohydrology assessment for the proposed development of a Co-Disposal Facility and Water Treatment Plant (WTP) in the Maquasa East, near Driefontein, Mpumalanga Province (refer to Figure 1-3). The project falls in quaternary catchment W51B of the Pongola to Mtamvuna Water Management Area (WMA) (DWS, 2016).

### 1.1 Project background

Kangra Coal is an existing coal mine located in Driefontein, near Piet Retief, in the Mkhondo Local Municipality within the Gert Sibande District Municipality. The Maquasa East (MQE) operations include the historical opencast and underground operations. Kangra is proposing to construct a water treatment plant as well as a co-disposal facility at their Maquasa East operations. The treatment plant will be used to treat water from the existing decant point as well as any surplus water within the mining operations.

#### 1.1.1 Water Treatment Plant:

Decant is currently observed in the form of clear groundwater discharge emanating from the old underground workings at MQE close to the Heyshope Dam. This decant is observed at an elevation range of approx. 1303 to 1306 mamsl and is contained in an unlined contamination dam. This excess decant is currently pumped from the unlined dam back to the MQE PCDs. Based on available data from previous studies undertaken at the mine decant observed emanating from the old workings occurs at a rate ranging from 1 220 to 2 700 m<sup>3</sup>/d (average 1 800 m<sup>3</sup>/d), depending on the rainfall season.

Kangra intends to upgrade the current contamination dam with a correctly lined dam as approved by the Department of Water and Sanitation to prevent any seepages onto the Heyshope Dam. The decant will be pumped into the proposed wastewater treatment plant that will be situated close to the Maquasa East PCDs. Construction and operation of the discussed infrastructure will trigger listed activities that will require authorisation.

The master layout plan associated with the proposed water treatment plant and brine storage facilities proposed (and existing PCDs) is shown in Figure 1-1.

It should also be noted that Kangra is investigating the possibility of storing brine on the discard dump/co-disposal that will come from the water treatment plant. This is one of the two options, with the other being dedicated brine evaporation ponds. GCS has not yet received confirmation as to which option Kangra are opting for, thus impacts relating to both are considered in this assessment.



Treated water will be discharged into the Heyshope dam at the existing decant rate at pristine water quality (in line with GA limits for treated effluent discharge), and therefore will likely not have a negative impact on water quantity or quality. Compared to the active decant water quality, the proposed activity is predicted to improve the Heyshope water quality. Proposed discharge will take place at an existing abstraction point west of Driefontein, that is no longer in use.

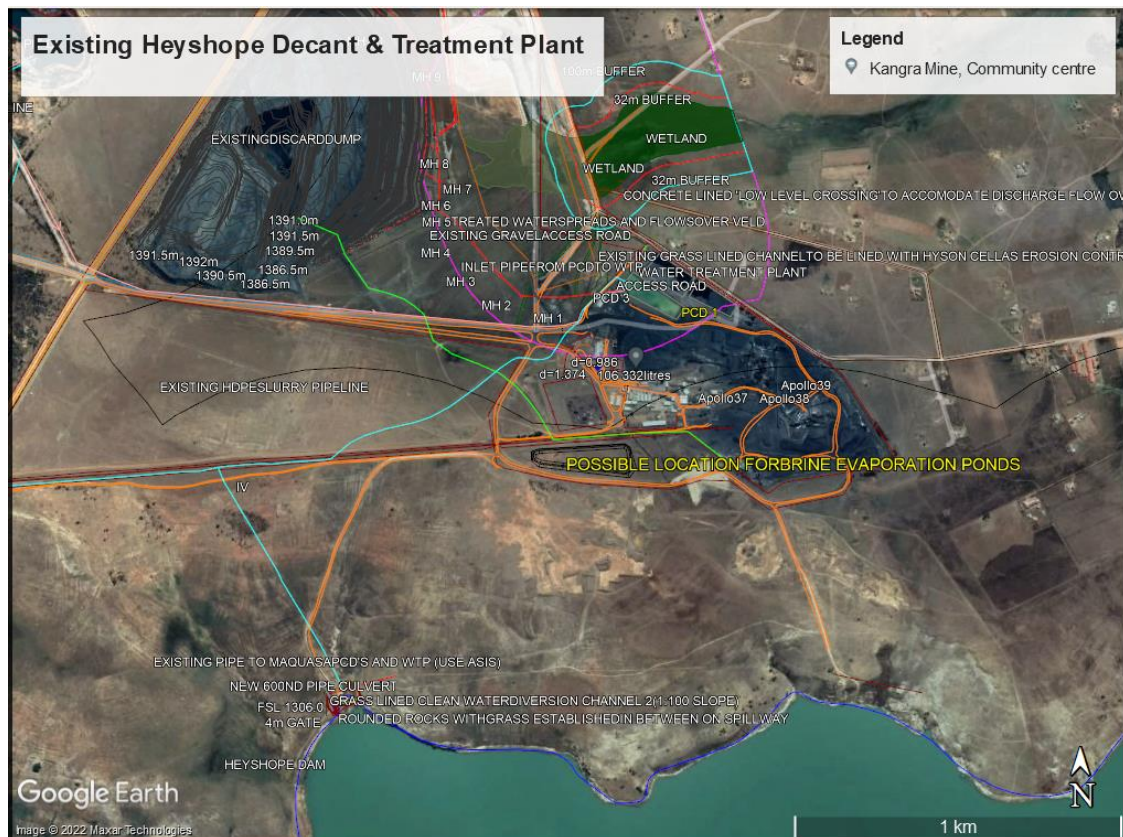


Figure 1-1: Proposed WTP and possible brine evaporation pond

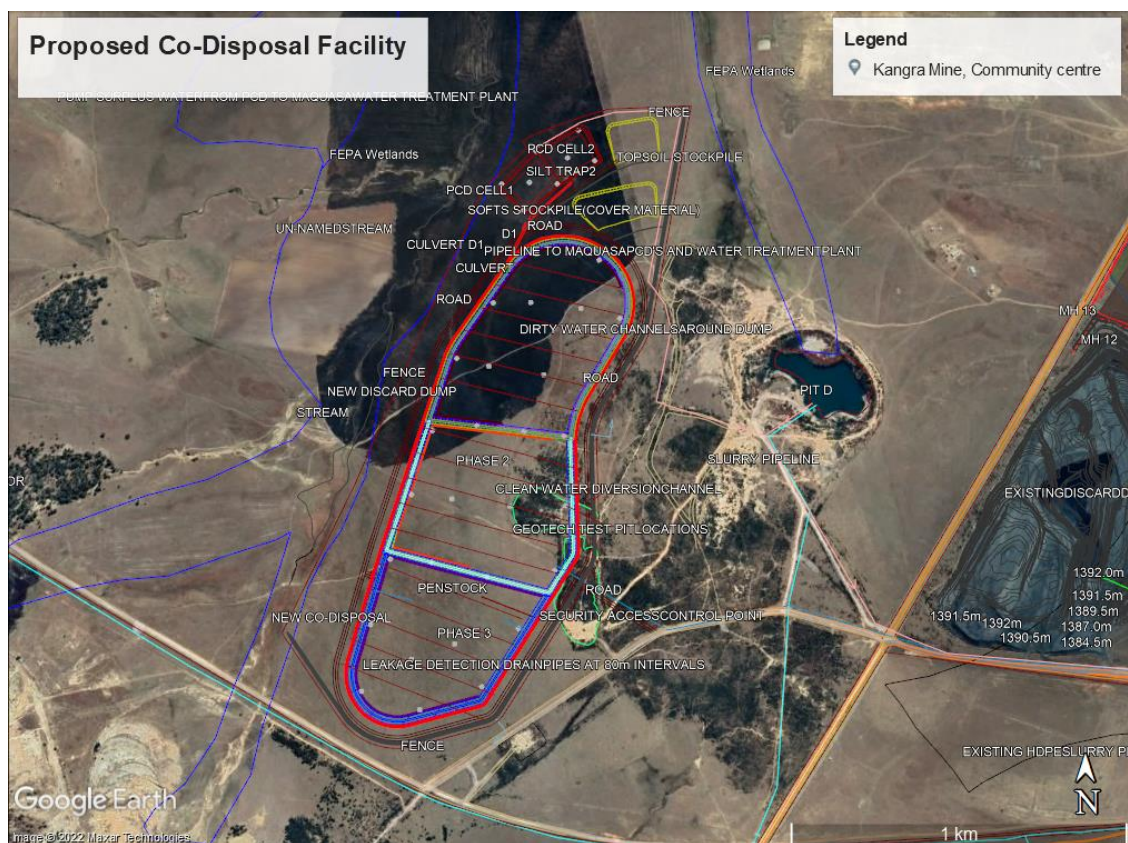
### 1.1.2 Co-Disposal Facility

The discard dump at MQE has an approved environmental authorisation and a water use license. As a result of changing operational requirements, there is now a need for a co-disposal facility at MQE, this co-disposal facility is not authorised.

- The co-disposal facility will be located within the MQE operation on the remaining (RE) portion of the farm Rooikop 18 HT. The co-disposal facility will accommodate discarded produced from the benefaction plant located at Maquasa East, which currently washes and processes coal from the surrounding Kangra Coal operations and will receive coal from future expansion areas.

- This discard dump was originally designed as a three-compartment side hill-type dump with a footprint of approximately 65ha. The three-compartment layout allows for a modular implementation approach with the benefit of delaying capital expenditure. The implementation of this project will be done in two phases:
- Phase 1 will entail the use of the approved discard dump, and
- Phases 2 and 3 will entail the use of a co-disposal facility that requires authorisations.

In the phases, the plan is to build the full waste dump over 20 years. Phase 1 (7 years capacity), Phase 2 (7 years capacity), and Phase 3 (6 years capacity). GFK are undertaking detailed designs of the dump, as well as stormwater sizing. The facility will be lined with an impermeable barrier. The layout plan for the co-disposal facility is shown in Figure 1-2.



**Figure 1-2: Proposed Co-Disposal Facility (Phase 1 already approved, Phase 2 & 3 will be co-disposal)**

## 1.2 Study relevance to the season in which it was undertaken

This study was undertaken as a once-off study and relies on field-generated data, backed by historical geohydrological and climate data for the site, as well as recognised geo-hydrological and water resource databases for South Africa. Data generated during the time of this study is not seasonally bound as average yearly data was applied where required and as scientifically acceptable.

### 1.3 Objectives

The objectives of this study, were as follows:

- Undertake a site walkover assessment to identify natural and man-made drainage lines and establish baseline surface water quality.
- Evaluate the site's hydrological setting (i.e., climate, rainfall, drainage, etc.).
- Understand and characterize the geohydrological setting, to set a basis for evaluating potential impacts relating to the proposed activities.
- Review existing specialist groundwater reports for Maquasa East and monitoring data for the existing groundwater monitoring system, to verify groundwater quantity and quality and impacts thereon.
- Develop a site conceptual model (CSM) to illustrate the geohydrological setting, underlying aquifers and groundwater flow paths.
- Understand all risks associated with the Maquasa East activities on the groundwater environment:
  - The groundwater model was developed to more fully characterize the groundwater flow systems (i.e. particle flow analyses); and
  - To determine the Zone of Influence (ZOI)/impact area of the proposed dump on the groundwater environment (i.e. pumping borehole zones of influence [ZOIf] and potential pollution migration - zone of impact [ZOIp]).
  - The Australian Groundwater Modelling Guidelines (Barnett, et al., 2012) were considered to ensure that the numerical model adheres to international norms and standards.
- Produce a comprehensive report which can be used for decision-making purposes and input into the WULA.

### 1.4 The layout of this report

The report has been structured, as far as possible, as per *Annexure D of the Government Gazette (GN267 of 24 March 2017)* applicable to geohydrological studies for environmental impacts assessment/water use license applications. This report further considers Appendix 6 of EIA guidelines.



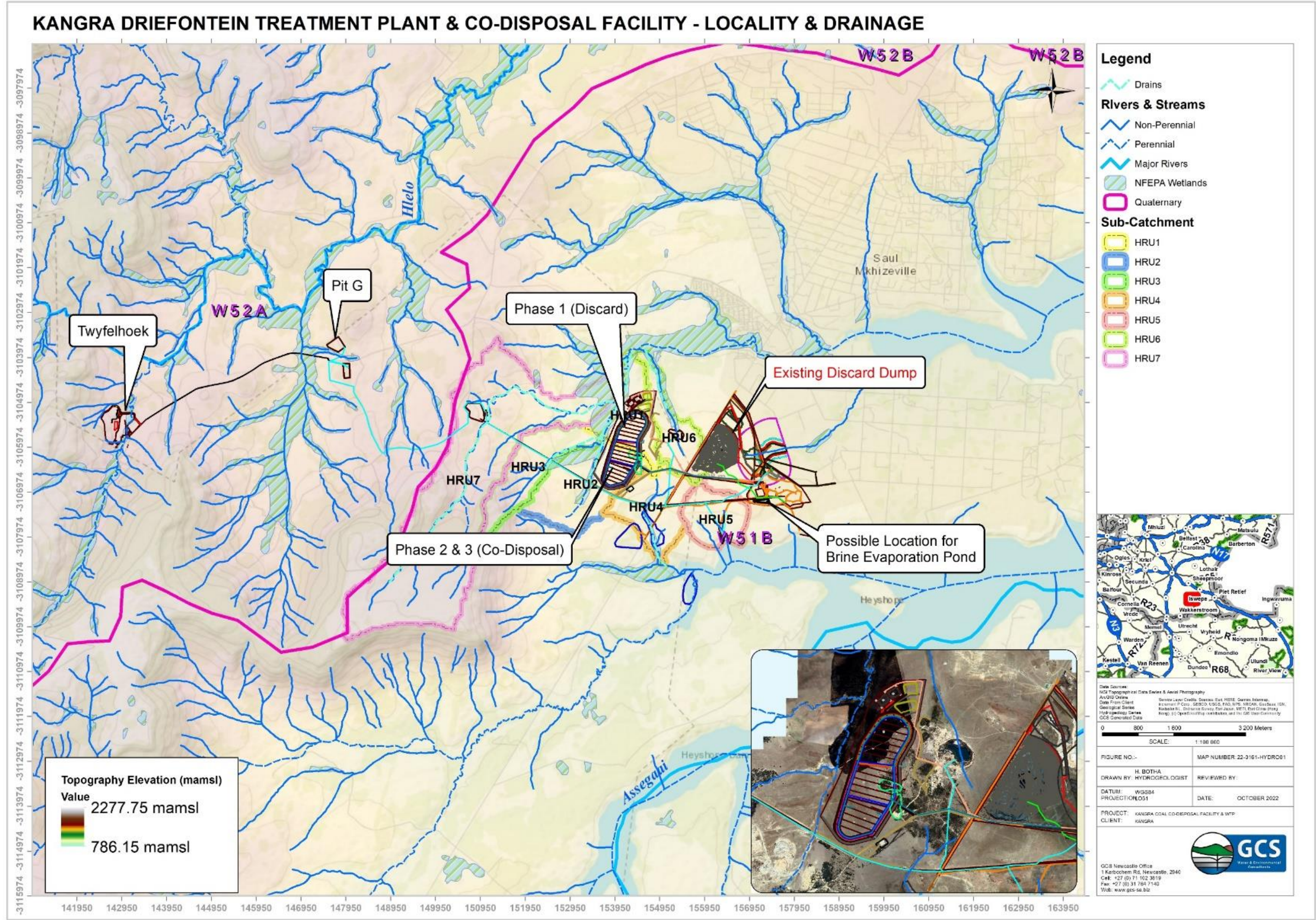


Figure 1-3: Site locality and drainage



---

## 2 SCOPE OF WORK

The scope of work completed is as follows:

### 1. Desktop data review:

- a. All available reports relating to the site were assessed, including a review of all geohydrology, hydrology, hydrochemistry, and geology literature data.
- b. GCS water monitoring data for the site were assessed and integrated into this investigation.
- c. A desktop-level hydrocensus was conducted. The National Groundwater Archive (NGA, 2019), Groundwater Resource Information Project (GRIP, 2016) and the Southern African Development Community Groundwater Information Portal (SADAC GIP) databases were assessed to identify existing groundwater users in the area.

### 2. Baseline Hydrology Review:

- a) Hydro-meteorological data collection and analysis.
- b) Catchment delineation and drainage characteristics.
- c) Determination of catchment hydraulic and geometric parameters.

### 3. Field investigation:

- a) A site walk-over assessment was undertaken to map sensitive groundwater-surface water interaction zones identified on a desktop level.
- b) Several geophysical traverses were conducted to identify preferential groundwater flow paths and to site future monitoring boreholes.
- c) Slug testing was conducted on suitable boreholes at the site.
- d) A groundwater hydrocensus was conducted within a 5 km radius of the proposed development.

### 4. Hydrogeological and geological conceptual model:

- a. A hydrogeological and geological site conceptual model was developed with data obtained for the study area - focussing on the proposed co-disposal facility.

### 5. Groundwater numerical flow and transport modelling:

- a. A steady-state model was developed and calibrated with data available for the study area. The steady-state model was converted to a transient-state model to enable scenario modelling. The following were evaluated:
  - i. Groundwater flow velocities and directions;



- 
- ii. Groundwater depth; and
  - iii. Likely source term impacts.

**6. Geohydrological risk and impact assessment:**

- a) A risk assessment was conducted based on the source-pathway-receptor principle.
- b) The potential impacts associated with the development of the co-disposal facility on the groundwater and subsequent surface water environments were evaluated.

**7. Monitoring plan:**

- a) A groundwater and surface water monitoring plan, with mitigation measures, was developed for the site based on the baseline assessment of the site conditions.

**8. Reporting:**

- a) This report encompassing all work done as well as a risk assessment and monitoring plan was compiled.

### 3 AREA OF INVESTIGATION

The following section supplies a brief overview of the regional setting, topography, climate, and geological and soil occurrences in the project area. The information in this section was obtained from the public domain, fieldwork and reports for the project.

#### 3.1 Sub-catchment hydrological response units (HRUs)

Seven (7) hydrological response unit (HRUs) describes the natural drainage for the study area (using a 1:1 000 stream count and 30 m DTM fill) - refer to Figure 1-3. The sub-catchment relates well to desktop-delineated drainage lines for the project area, as well as verified streams associated with the project area.

Primary drainage from the position of the proposed co-disposal site, and much of the MQE area is towards the northeast, to the perennial Egude River, which makes up the bottom inflow of the Heyshope Dam. Drainage from the southern portions of the MQE area, and Maquasa West (MQW) is towards the south, via several perennial and non-perennial drainage lines, towards the southern inflow of the Heyshope Dam. The Heyshope Dam is therefore the end received of any surface water-related pollution that may take place at the MQE operations. The sub-catchments that are associated with the proposed co-disposal facility are HRU1 to 3, and HRU6. The sub-catchment associated with the proposed treatment area is HRU5.

#### 3.2 Local geology & soils

According to the 1:250 000 geological series (2730 Vryheid), the local surface geology is characterised by occurrences of dolerite, and sediments associated with the Vryheid Formation, of the Eccra Group, of the Karoo Sequence (DMEA, 1998g) - refer to Figure 3-1.

Numerous Jurassic-age dolerite dykes and sills intruded the Vryheid Formation at various stratigraphic levels. In general, the area has been divided into two (2) lithological units:

- arenite - siliciclastic coal-bearing rocks of the Eccra Group; and
- dolerite - late-stage igneous rock which has been emplaced into the sedimentary rocks.

During the deposits of sediments in the still sagging basin, the tension in the crust due to continuing sagging led to failure and subsequently intrusion of the Post-Karoo dolerite sills and dykes along weak zones (e.g. fault/fracture zones). Consequently, dykes and sills varying between a few centimetres to a couple of metres in thickness intruded. Although the proposed Project is situated within the Ermelo Coalfield, the coal seams of interest have been logged as the Utrecht Coalfield seams of Gus and Dundas. The Gus seam lies stratigraphically above the Dundas seam with a parting of ~15 to 20 m. The Gus seam occurs at a depth of approximately 100 m from the surface with an average width of ~1 to 2 m, whilst the Dundas seam occurs at a depth of approximately 45 m from the surface with varying thickness.

---

According to the Land types of South Africa databases (Land Type Survey Staff, 1972 - 2006c), the soils in the area typically conform to land types of the Bb36 group, which typically entail red and yellow, dystrophic/mesotrophic, apedal soils with plinthic subsoils (plinthic soils comprise > 10% of land type, red soils comprise < 33% of land type). According to WR2012 soil data for the area, the erodibility of the soils for the area can be considered medium (WRC, 2015) - refer to Figure 3-2.

In terms of Hydrological Soil Types, the soils in the project area are classified as Type C, with an erosion factor of 7 and runoff factor of about 0.39.



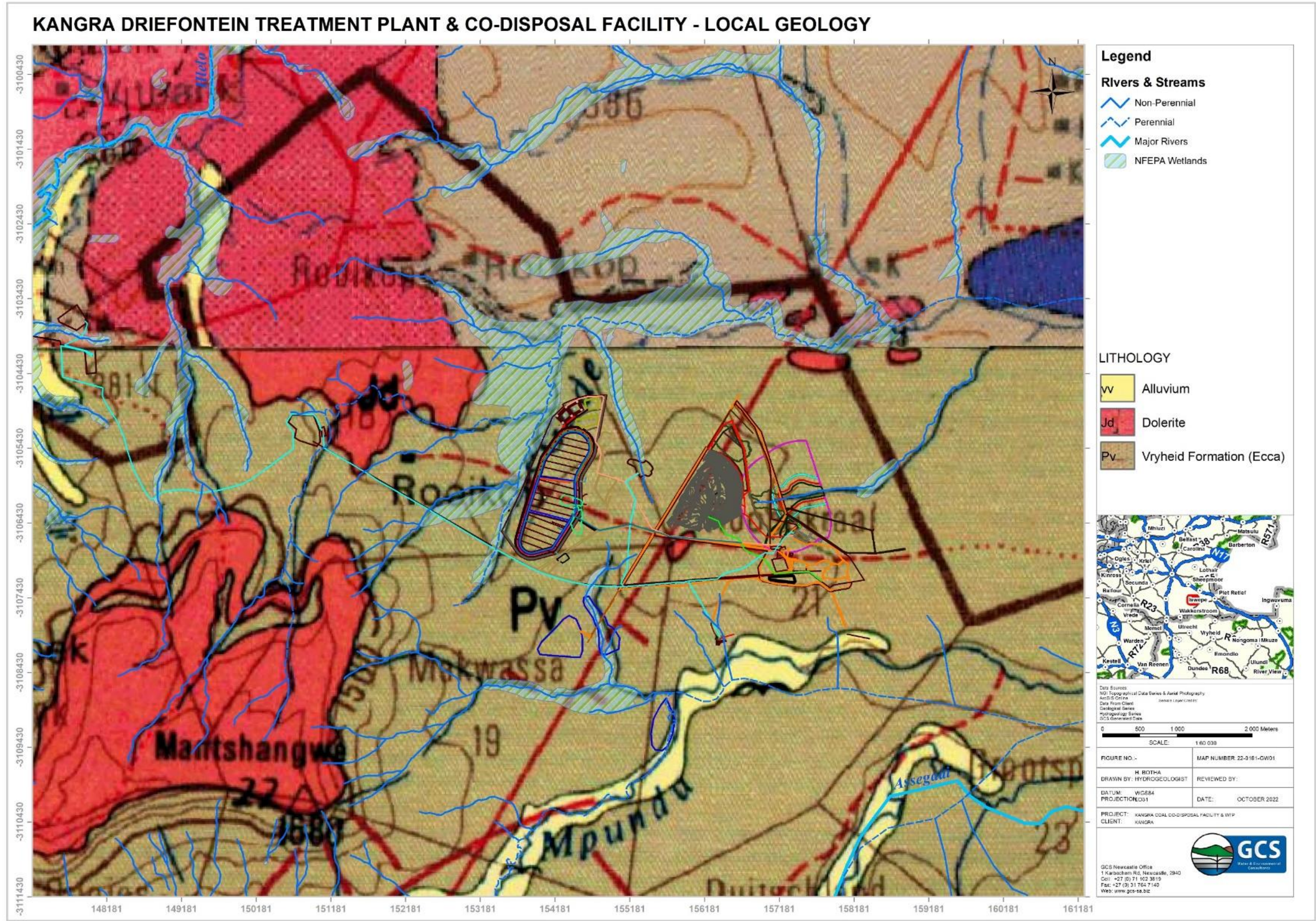


Figure 3-1: Local geology



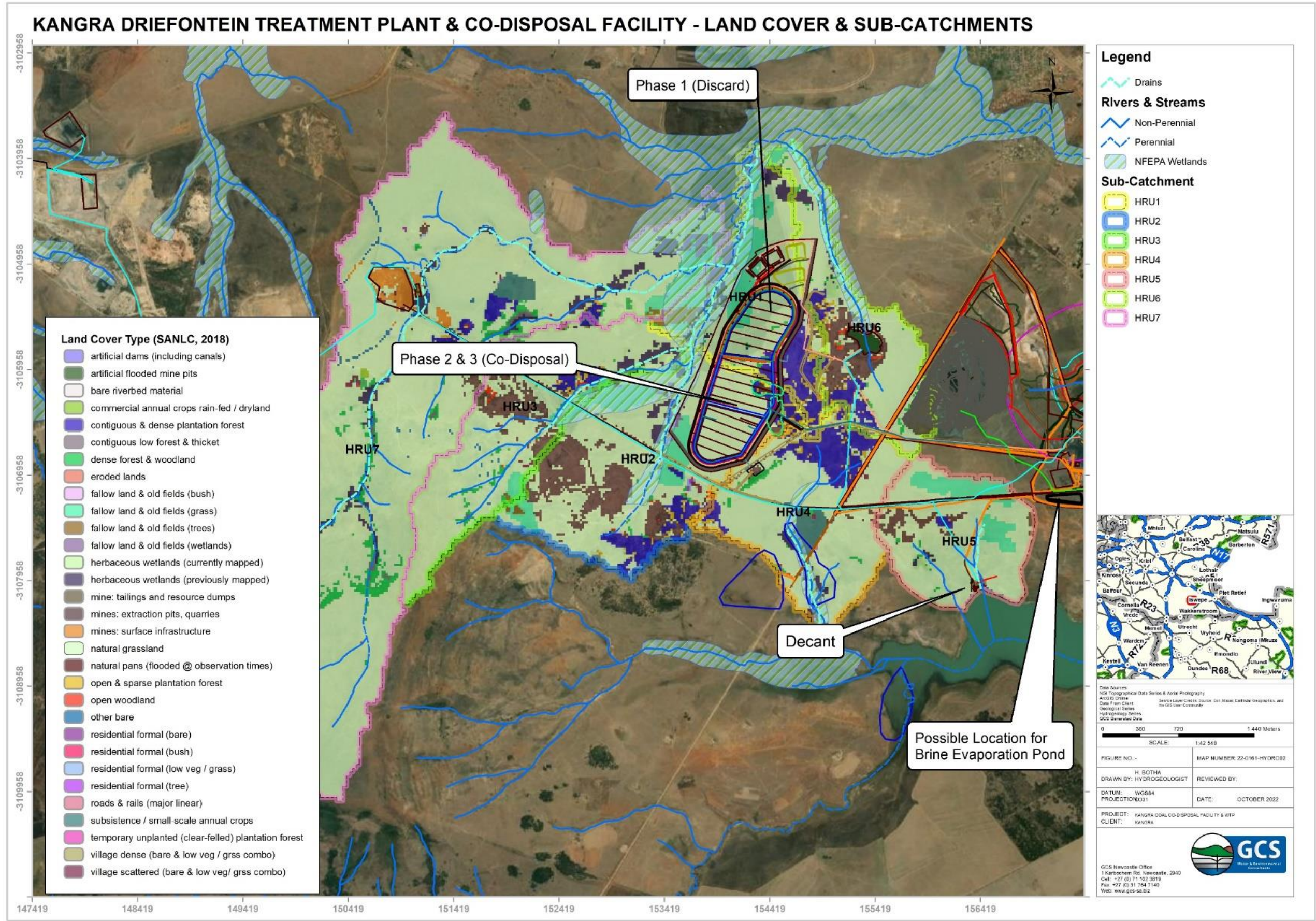


Figure 3-2: Sub-catchments and land cover types



### 3.3 Climate

Climate, amongst other factors, influences soil-water processes. The most influential climatic parameter is rainfall. Rainfall intensity, duration, evaporative demand and runoff were considered in this study to indicate rainfall partitioning within the project area.

#### 3.3.1 Temperature

The average yearly temperature (refer to Figure 3-3) for the project area ranges from 25 to 33°C (high) and -4 to -2°C (Low). The study area is situated in a subtropical highland climate or temperate oceanic climate with dry winters (Cwb) area, as per the Köppen Climate Classification (Kottek, et al., 2006). The project area receives summer rainfall.

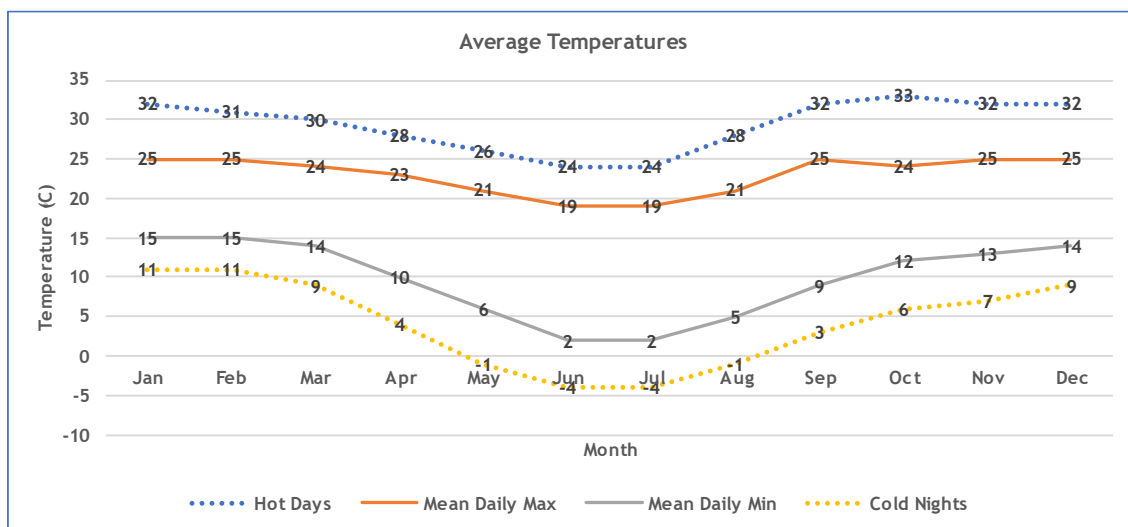


Figure 3-3: Average yearly temperatures (Meteoblue, 2022)

### 3.3.2 Wind speed and direction

Figure 3-4 shows the wind rose for the project area (Vryheid used as reference) and presents the number of hours per year the wind blows from the indicated direction. The wind blows from WW, ENE and E more often, at velocities ranging from 1 km/hr to 28 km/hr; and from other directions but less frequently and at lower velocities (< 19 km/hr).



Figure 3-4: Wind rose (Meteoblu, 2022)

### 3.3.3 Rainfall and evaporation

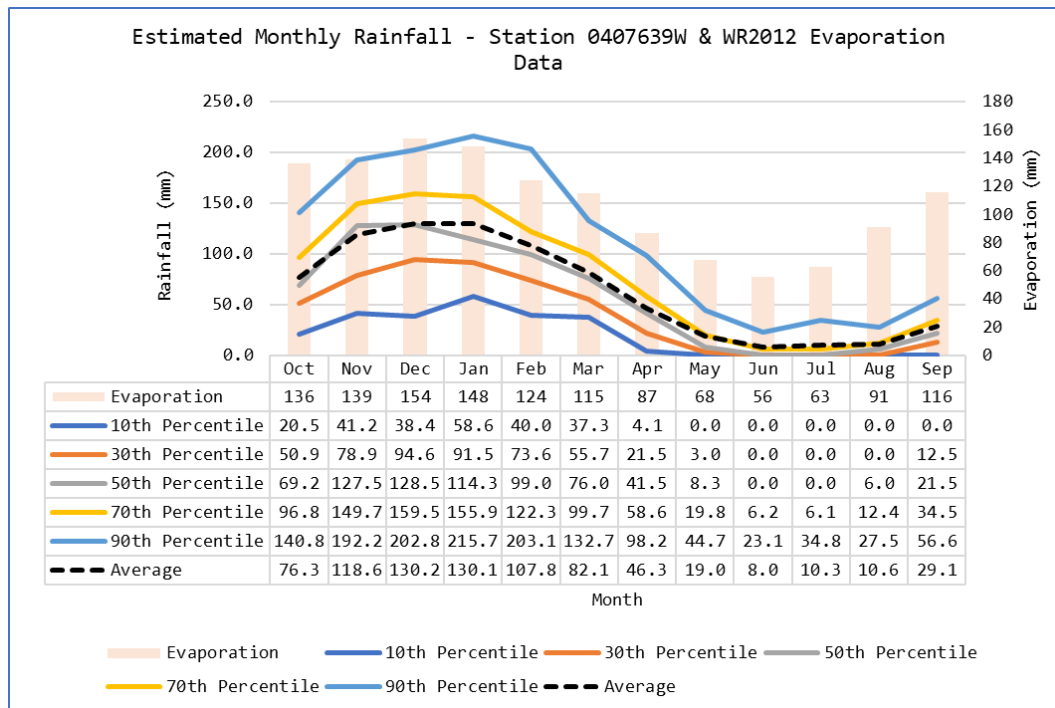
The project area is situated in rainfall zone W5A. The mean annual precipitation (MAP) measured at several rainfall stations that fall close to the site is summarised in Table 3-1, below.

Table 3-1: MAP of nearest rainfall stations

Station Name	ID	MAP (mm/yr)
GROOT RIETVLEI	0407639_W	770
DIRKIESDORP (POL)	0407730_W	681
SPITSKOP	0407397_W	800
BRERETON PARK	0443807_W	900
Average		787.75

The monthly rainfall data used to calculate MAP was obtained from rainfall station 0407639W (Grootvlei). The rainfall record is for the period 1929 to 2003 (74 years). Monthly rainfall for the site is likely to be distributed as shown in Figure 3-5, below.

Available rainfall data suggest a MAP ranging from 482 (30<sup>th</sup> percentile) to 1372 (90<sup>th</sup> percentile) mm/yr. The average rainfall is in the order of 768 mm/yr. The project area falls within evaporation zone 13A, of which Mean Annual Evaporation (MAE) ranges from 1 200 to 1 300 mm/yr. The MAE far exceeds the MAP for the site, which implies greater evaporative losses when compared to incident rainfall. Monthly evapotranspiration for the site is likely to be distributed as shown in Figure 3-5, below.



**Figure 3-5: Average rainfall for Station 0407639W & WR2012 evaporation**

### 3.3.4 Runoff

Runoff from natural (unmodified) catchments for quaternary catchment W51B is simulated in WR2012 (WRC, 2015) as being equivalent to 103.5 mm/yr (or 13% of the MAP). This is approximately 51.369 Mm<sup>3</sup>/yr NMAR for the surface area of W51B.

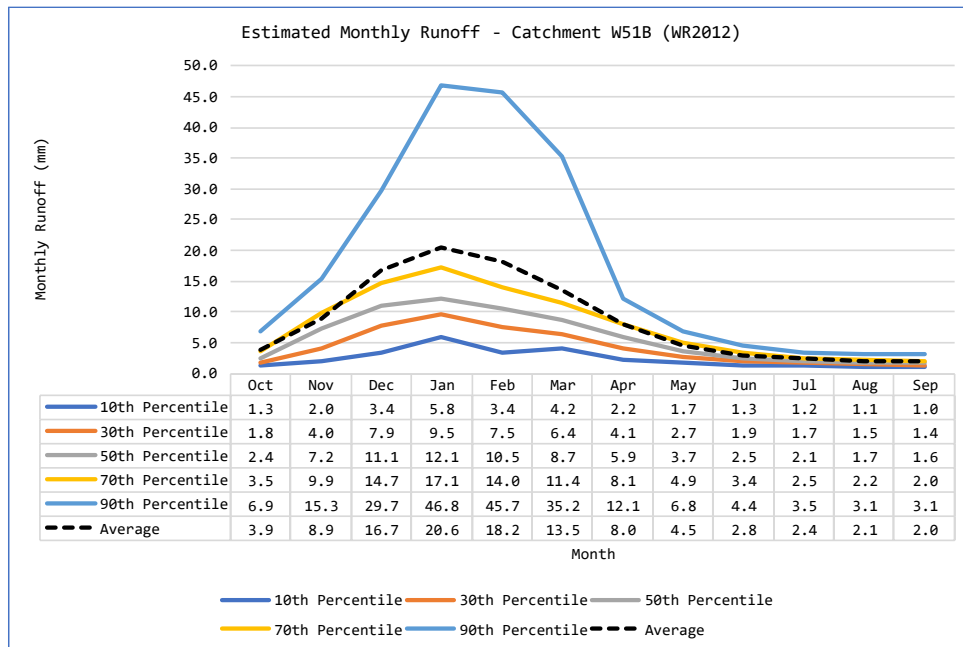
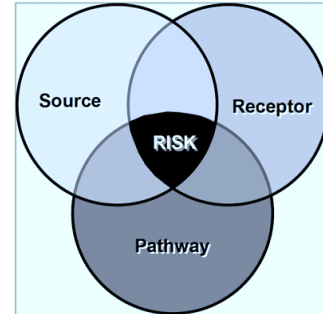


Figure 3-6: Simulated natural (unmodified) runoff for W51B

## 4 METHODOLOGY

A logical and holistic approach was adopted to assess the study area. The Best Practice Guidelines for Impact Prediction (G4) (Department of Water Affairs and Forestry [DWAF], 2008), were considered to define and understand the three basic components of the geohydrological risk associated with the site activities:

- **Source term** - The source of the risk;
- **Pathway** - The pathway along which the risk propagates;  
and
- **Receptor** - The target that experiences the risk.



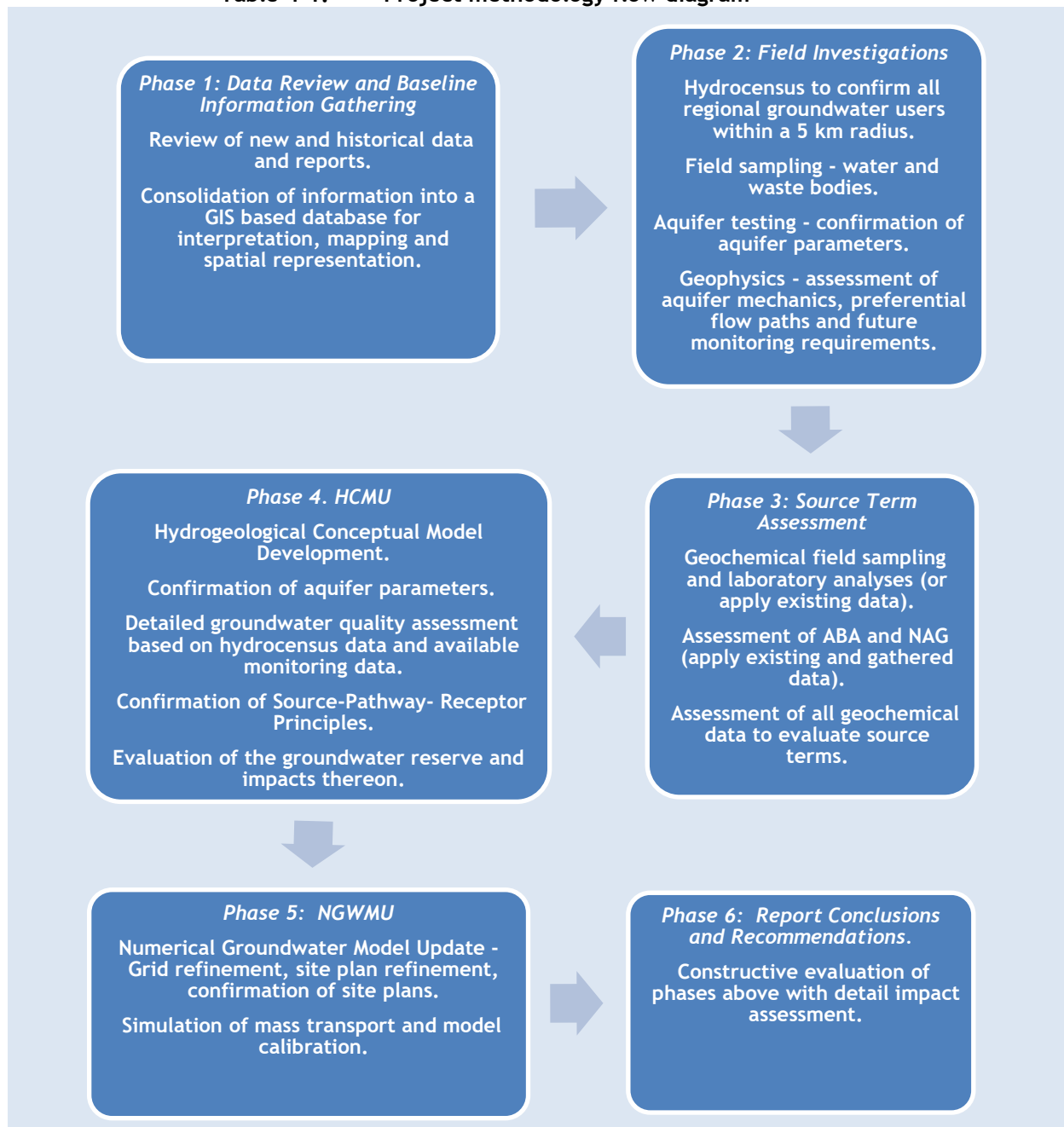
The approach was used to assess:

1. How the existing/proposed site activities could impact groundwater *Quality*; and
2. How the existing/proposed site activities could affect the groundwater *Quantity*.

Subsequently, a groundwater model was developed to illustrate the conceptual understanding of the groundwater flow system. Groundwater modelling is an efficient tool for groundwater management and remediation. Models are a simplification of reality to investigate certain phenomena or to predict future behaviour. The challenge is to simplify the reality in a way that does not adversely influence the accuracy and ability of the model output to meet the intended objectives. In terms of quality control, the Australian Groundwater Modelling Guidelines (Barnett, et al., 2012) were considered to ensure that the numerical model adheres to international norms and standards. Table 4-1 presents an overview of the project methodological approach followed.



Table 4-1: Project methodology flow diagram



#### 4.1 Literature review and desktop study

The following sources supply an overview of the geohydrological conditions of the project area, as per the desktop information reviewed for this assessment:

- Groundwater Resource Information Project (GRIP, 2016)), National Groundwater Database Archives (NGA, 2019).
- SADC Groundwater Information Portal (SADC GIP) borehole data (SADC GIP, 2022)
- 2829 Vryheid - 1:500 000 Hydrogeological map series (King, et al., 1998).
- 2930 Vryheid - 1:250 000 Geological map series (DMEA, 1998g).
- Literature on similar geology and hydrogeology:
  - A South African Aquifer System Management Classification (Parsons, 1995);
  - Aquifer Classification of South Africa (DWA, 2012);
  - Karoo Aquifers: Their Geology, Geometry and Physical Properties. Water Research Council (WRC) Report No: 457/1/98 (Botha, et al., 1998);
  - Karoo Groundwater Atlas Volume 2 (Woodford, 2013); and
  - The relationship between South African geology and geohydrology (Lourens, 2013).
- GCS internal database and reports for Kangra (refer to reference list).

#### 4.2 Hydrological overview

Hydrometeorological data for the study area were obtained from various sources including the South African Water Resources Study WR2012 database (Bailey & Pitman, 2015), South African Atlas of Agrohydrology, and Climatology (Schulze, 1997), and the Daily Rainfall Data Extraction Utility (Lynch, 2004). Moreover, sources such as the Köppen Climate Classification (Kottek, et al., 2006), World Climate Data CMIP6 V2.1 (Eyring, 2016), and Meteoblue (Meteoblue, 2022) were used to refine hydrological data.

These sources provided means of determining the Mean Annual Precipitation (MAP), Mean Annual Runoff (MAR), and Mean Annual Evaporation (MAE) of the study site as well as the design rainfall data. Data was applied to the site water balance calculations, runoff peak flow estimates for flood line modelling and stormwater runoff peak flow estimates for stormwater system sizing (where applicable to this study).

### 4.3 Groundwater users in the study area

According to Water Allocation Registration Management System (WARMS, 2019), there are no WARMS water users within a 5 km radius of the proposed activity. According to SADAC GIP and National Groundwater Activities (NGA) data, there are at least 3 registered boreholes within a 5 km radius of the proposed activities (refer to Figure 1-3 and Table 4-2).

**Table 4-2: Groundwater users within a 2.5 km radius of the site**

ID	Source	Latitude (WGS84) Decimal Degrees	Longitude (WGS84) Decimal Degrees	Elevation (mamsl)	Water Level (mbgl)
736675	SADAC GIP / NGA 2022	-27.06383	30.39031	1322	2.1
736687	SADAC GIP / NGA 2023	-27.02717	30.41504	1351	15
611988	SADAC GIP / NGA 2024	-26.974167	30.400833	1351	No Data

### 4.4 Field investigation

The field investigation took place from 6 to 21 October 2022. The following summarises the findings and work completed:

1. A hydrocensus was undertaken within the project area and within a 5 km radius of the proposed discard. Nine (9) boreholes could be located in the field, two (2) of which are fitted with pumps (FB7 and FB8) and the rest are used for monitoring. The boreholes fitted with pumps are sealed, and no water levels could be obtained.
2. A geophysical assessment with the use of magnetic methods was undertaken on the Maquasa East property, specifically focusing on the proposed co-disposal discard. The survey aims to identify any subterranean structures which promote/limit groundwater movement through the area. Future monitoring boreholes will be sited and drilled into structures identified, where possible.
3. Slug aquifer tests were conducted on MBH5 and MBH3 to determine hydraulic permeabilities to supplement the numerical groundwater model development as well as the risk assessment.

#### 4.4.1 Field hydrocensus

Table 4-3 provides a list of field boreholes identified in the project area with the spatial distribution of boreholes shown in Figure 4-1. A photographic log of photos taken during the field investigation is available in **Appendix A**.

**Table 4-3: Field hydrocensus boreholes identified in the project area**

ID	Source	Latitude (WGS84) Decimal Degrees	Longitude (WGS84) Decimal Degrees	Elevation (mamsl)	Water Level (mbgl)
MBH4	Field	30.38519	-27.0081	1332	7.1
FB7	Field	30.41598	-26.998	1228.79	Could not measure/Sealed
FB8	Field	30.41766	-26.9991	1320.94	Could not measure/Sealed
FB9	Field	30.39507	-27.0236	1357.45	Could not measure/Sealed
FB10	Field	30.39573	-27.0231	1371.3	22.8
MQW1	Field	30.34877	-27.0078	1466.88	3.1
MBH5	Field	30.38149	-27.0157	1339.21	5.15
MBH3	Field	30.38799	-27.0158	1369.75	12.18
FB12	Field	30.34989	-27.0092	1469.62	17.1



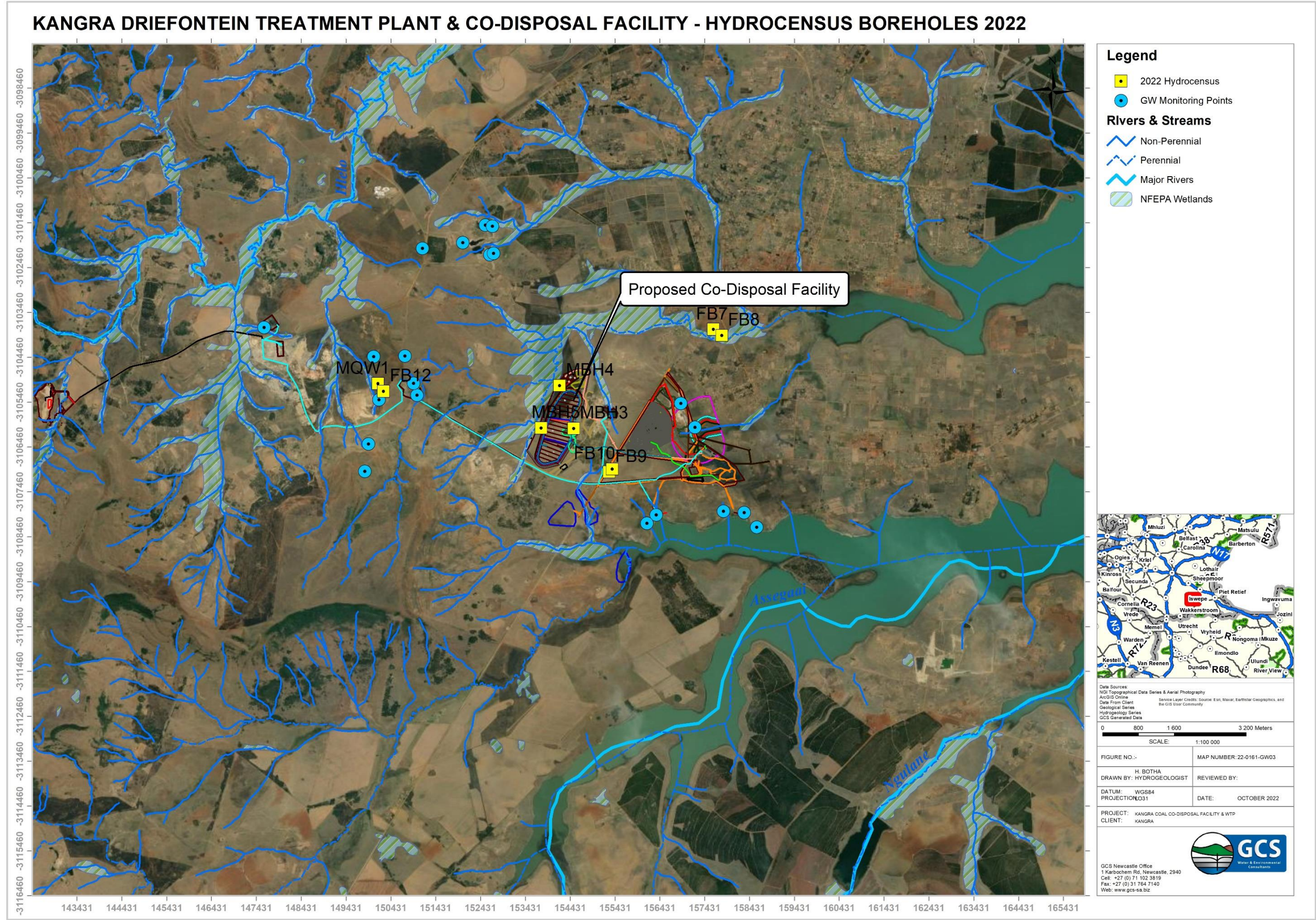


Figure 4-1: Hydrocensus borehole locations



#### 4.4.2 Geophysical assessment findings

The geophysical investigation aimed to identify any subterranean structures which promote/limit groundwater movement through the area. The detailed geophysical investigation methodology and data interpretation are available in **Appendix B**. The findings are briefly summarised as follows:

- Seven (7) Magnetic (Mag) profiles were completed (refer to Table 4-4). The Mag traverse varied from approximately 500 m to 2.4 km lengths. Mag readings were taken at 10 m intervals. The spatial orientation of the survey and resulting profile lines are indicated in Figure 4-9.
- Based on the geophysical investigation undertaken, and the geophysical method applied, no evidence of contact zones could be identified. Hence, the area investigated is highly likely void of these preferential flow path structures. Groundwater movement is therefore expected to be via the bulk aquifer rock, in connected fractures or intergranular sedimentary occurrences.
- It is important to calibrate the magnetic data generated, by drilling boreholes in the anomalies identified. The proposed drilling positions are captured in Section 9 as part of the proposed groundwater monitoring improvements for the site.

**Table 4-4: Geophysical Survey Record Summary**

Traverse Number	Traverse Direction	Coordinates				Traverse Length [m]	Geological Target
		Line Start		Line End			
		Latitude [DD]	Longitude [DD]	Latitude [DD]	Longitude [DD]		
Line 1	SSW-NNE	-27.023740	30.379095	-27.004351	30.387018	~2360	Lineament (dyke) and geological formations boundaries
Line 2	NE-SW	-27.023053	30.381174	-27.005158	30.391205	~2430	Lineament (dyke) and geological formations boundaries
Line 3	SE-NW	-27.023727	30.383178	-27.021526	30.378342	~560	Lineament (dyke) and geological formations boundaries
Line 4	NNE-SSW	-27.021670	30.378498	-27.014713	30.380873	~850	Lineament (dyke) and geological formations boundaries
Line 5	NNE-SSW	-27.014962	30.381219	-27.006637	30.385266	~1080	Lineament (dyke) and geological formations boundaries
Line 6	W-E	-27.005931	30.385603	-27.004662	30.390827	~590	Lineament (dyke) and geological formations boundaries
Line 7	SW-NE	-27.023803	30.382935	-27.019889	30.389451	~880	Lineament (dyke) and geological formations boundaries

**Note/s:**

Unit and coordinate system description:

- [DD] - decimal degrees
- [m] - metres

Datum: WGS84

#### 4.4.2.1 Magnetic Line 1

Line 1 was conducted from the south-southwest to the north-northeast over the length of the proposed discard dump footprint. The total length of the line was approx. 2360 m. The magnetic anomalies observed, suggest the presence of a shallow dolerite sill from  $x \approx 690$  m to  $x \approx 1140$ , followed by several magnetic anomalies with the most prominent observed at  $x \approx 1800$  m and  $x \approx 2100$  m. The anomalies suggest that there are likely several contact areas between thin dolerite dykes, as well as dolerite dykes nearing the northern portion of the site (refer to Figure 4-2). The presence of these structures needs to be confirmed by drilling.

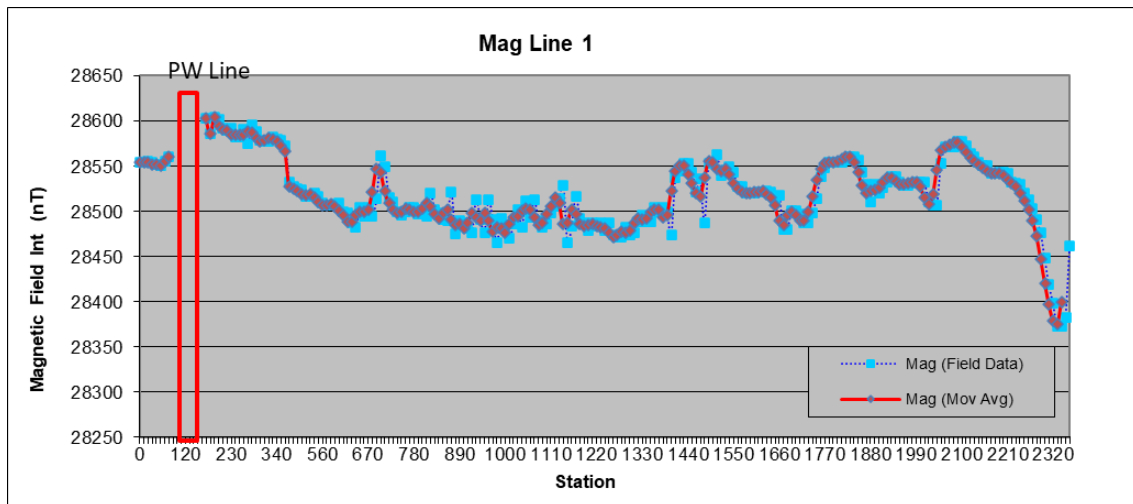


Figure 4-2: Mag line 1

#### 4.4.2.2 Magnetic Line 2

Line 2 was conducted from the northeast to the southwest direction over the length of the proposed discard dump footprint. The total length of the line was approx. 2430 m. The result from the survey indicates a magnetic spike at 1040 m, which could represent the contact between the previously rehabilitated dump and the natural ground. A magnetic spike (and then drop) exists at station 2270. This could indicate the presence of a geological contact (refer to Figure 4-3).

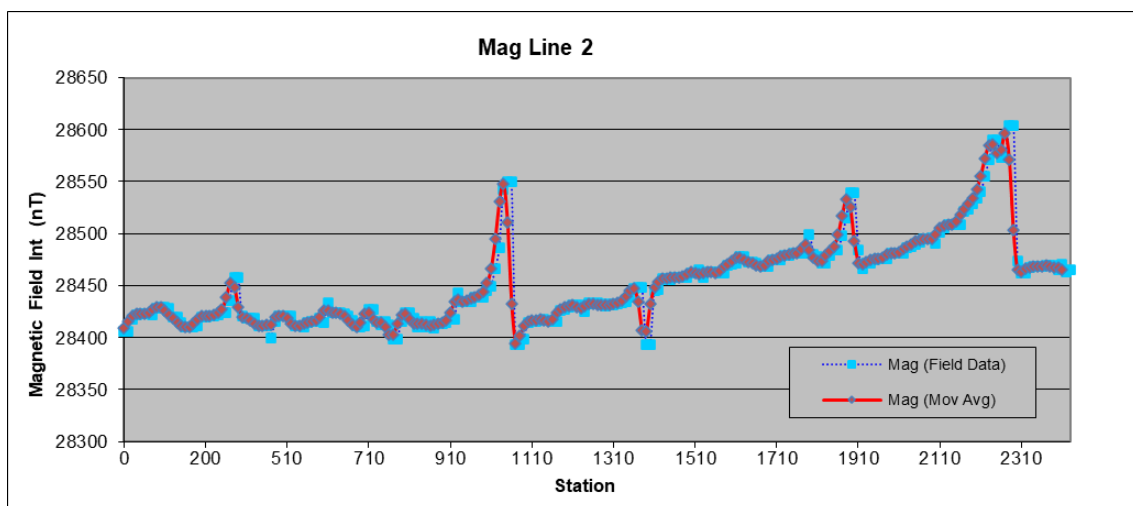


Figure 4-3: Mag line 2

#### 4.4.2.3 Magnetic Line 3

Line 3 was conducted from the southeast to the northwest direction across the southern boundary of the proposed discard dump footprint. The total length of the line was approx. 560 m. The result from the magnetic survey suggests the presence of a thin dolerite dyke, at position  $x \approx 220$  to 290 m (refer to Figure 4-4).

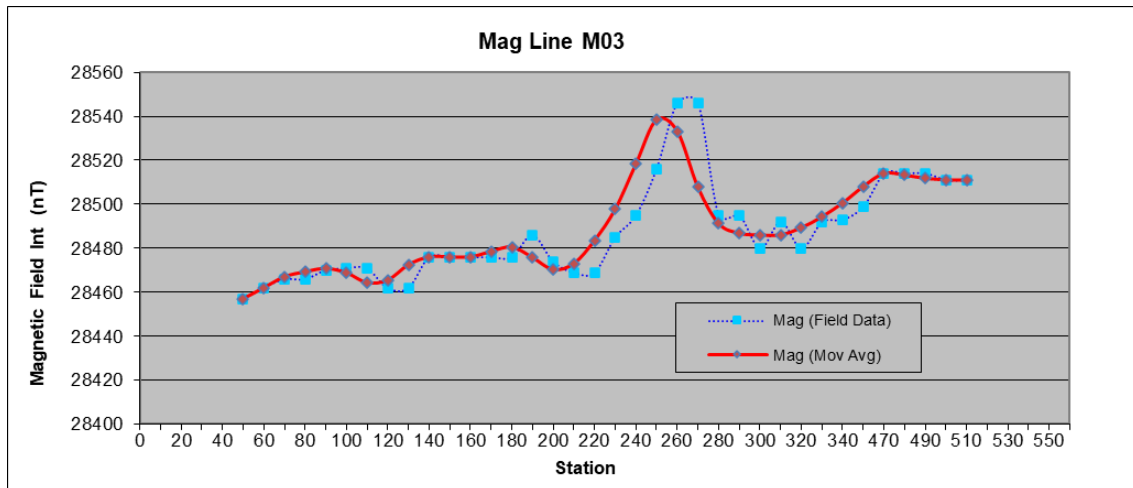


Figure 4-4: Mag line 3

#### 4.4.2.4 Magnetic Line 4

Line 4 was conducted from the southwest to the northeast direction along the lower western boundary of the proposed discard dump footprint. The total length of the line was approx. 850 m. There was a lot of noise on this line, as a result of shallow Ferricrete outcrops. However, after refining the data, the presence of a likely dolerite dyke is noted from  $x \approx 500$  m to  $x \approx 620$  m (refer to Figure 4-5). The data correspond well to Line 1.

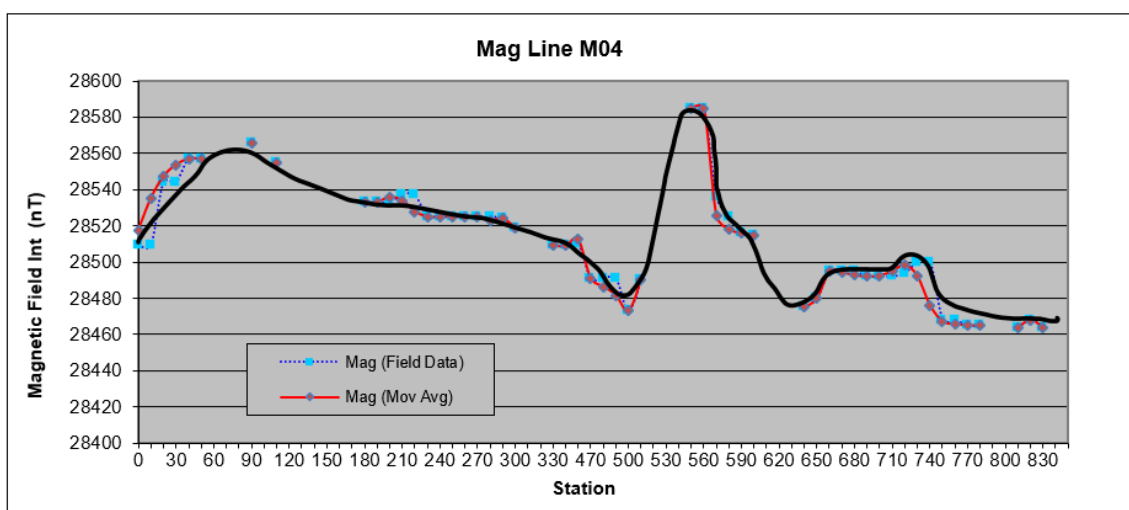


Figure 4-5: Mag line 4

#### 4.4.2.5 Magnetic Line 5

Line 5 was conducted from the north-northeast to the south-southwest direction along the upper western boundary of the proposed discard dump footprint. The total length of the line was approx. 1080 m. The result from the survey indicates two distinct parabola anomalies at  $x \approx 710$  m and  $x \approx 960$  m (refer to Figure 4-6). The data suggest the presence of two (2) shallow thin dolerite dykes. The data correspond well to Line 1.

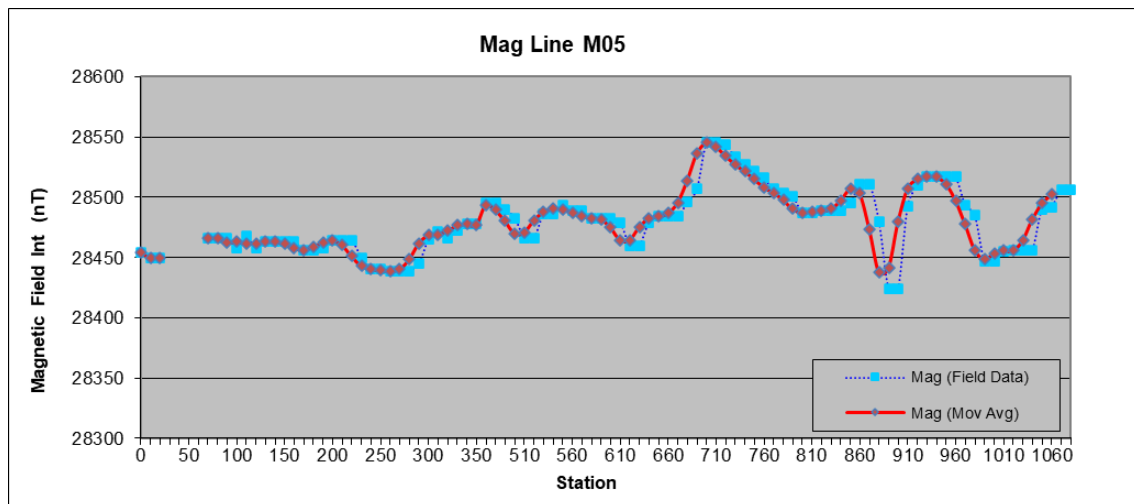


Figure 4-6: Mag line 5

#### 4.4.2.6 Magnetic Line 6

Line 6 was conducted from the west to the east direction along the northern boundary of the proposed discard dump footprint. The total length of the line was approx. 590 m. The result from the survey shows the presence of a shallow weathered dolerite sill (refer to Figure 4-7). Ferricrete was also observed in this area, with the outcrop of the Ferricrete relating well to the observed peak anomalies.

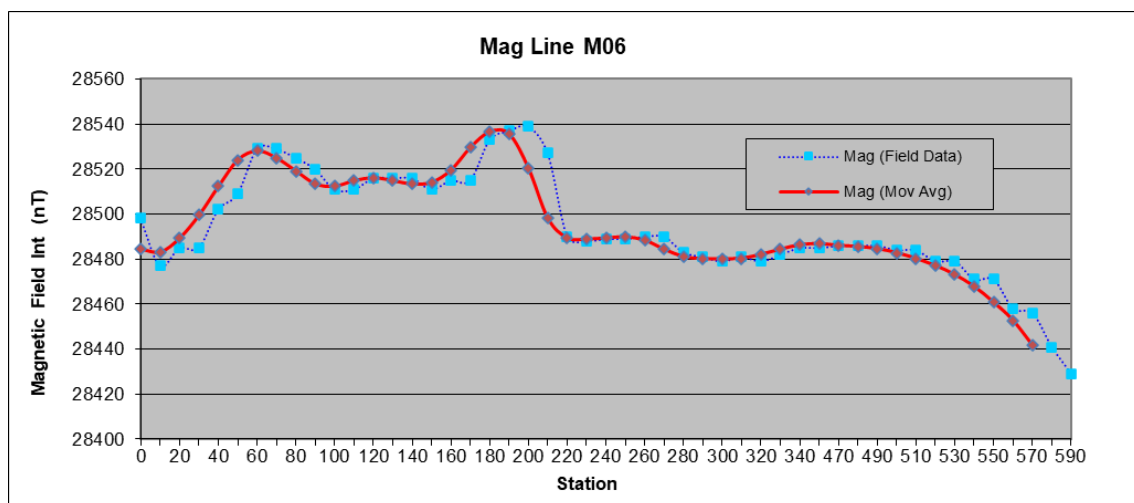


Figure 4-7: Mag line 6

#### 4.4.2.7 Magnetic Line 7

Line 7 was conducted from the southwest to the northeast direction along the southeastern boundary of the proposed discard dump footprint. The total length of the line was approx. 880 m. The result from the survey suggests the presence of a dolerite dyke nearing  $x \approx 530$  m.

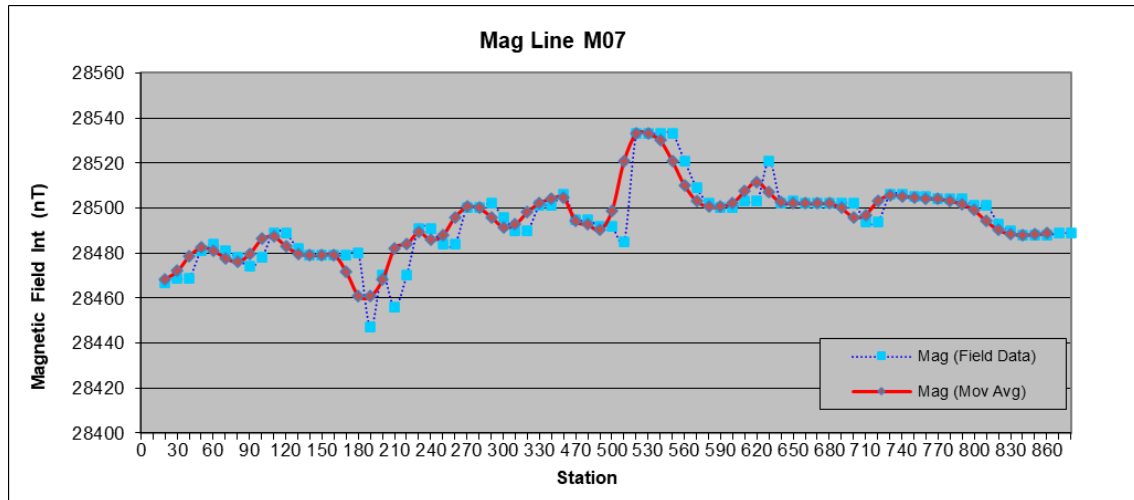


Figure 4-8: Mag line 7

#### 4.4.3 Aquifer slug testing

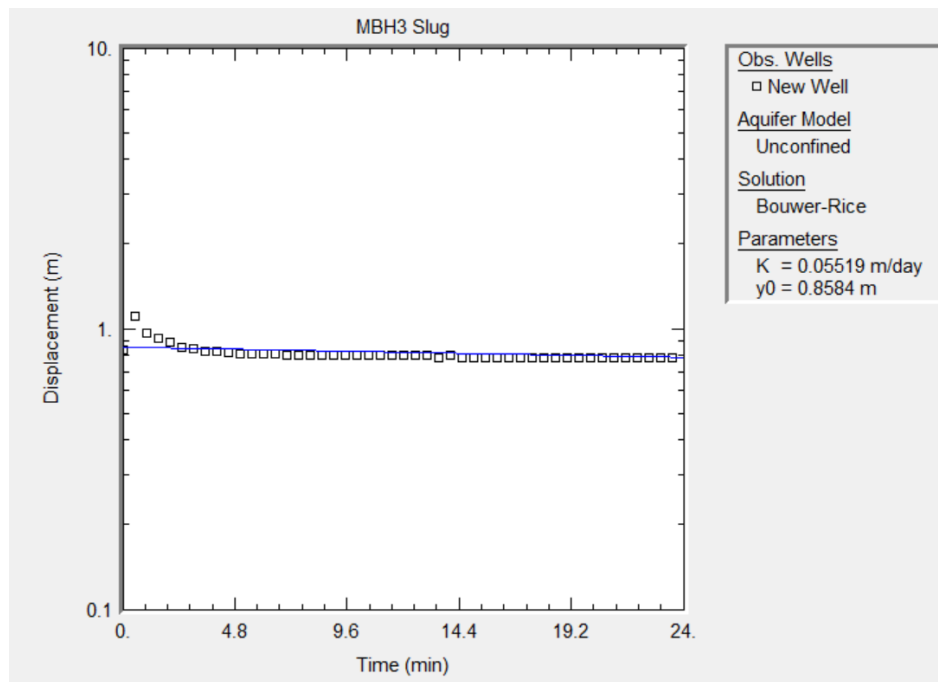
As mentioned above, two (2) slug tests were conducted. A slug test is a controlled field experiment performed by groundwater hydrologists to estimate the hydraulic properties of aquifers in which the water level in a control well is caused to change suddenly (rise or fall) and the subsequent water-level response (displacement or change from static) is measured through time in the control well and one or more surrounding observation wells. Slug tests are frequently designated as rising-head or falling-head tests to describe the direction of water-level recovery in the control well following test initiation. Other terms sometimes used instead of slug test include bail-down test, slug-in test and slug-out test (AQTESOLV, 2022)

The goal of a slug test, as in any aquifer test, is to estimate the hydraulic properties of an aquifer system such as hydraulic conductivity. The aquifer test results are summarized in Table 4-5, and the diagnostic analyses plot using the Bower-Rice (1976). A saturated hydraulic thickness of 30 m is assumed, and the K-values estimated are for the weathered zone.

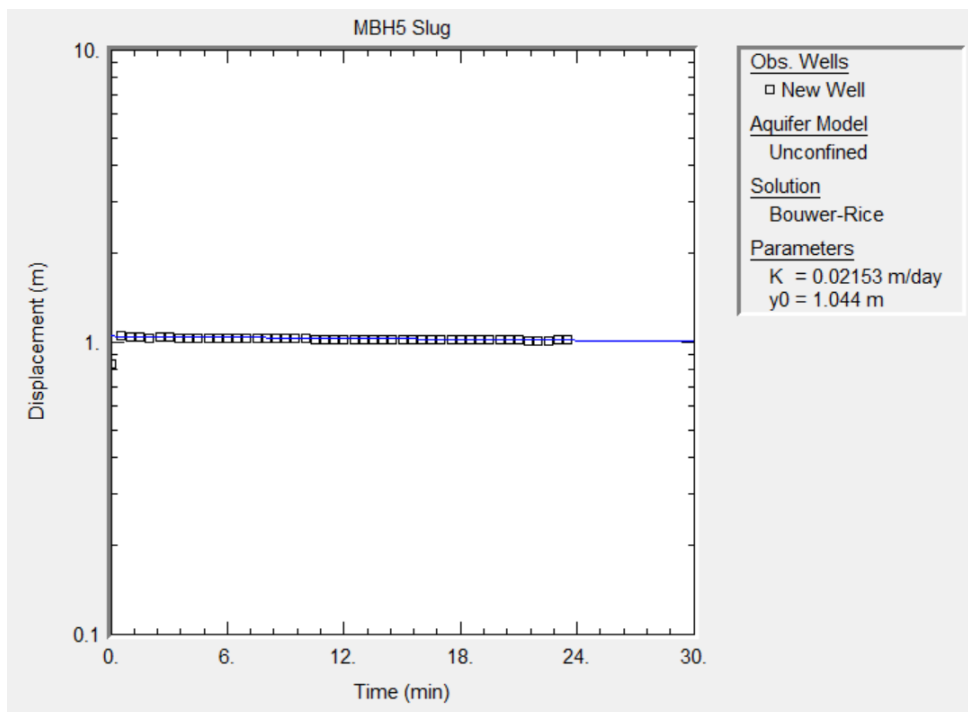


**Table 4-5: Summary of slug test results**

Borehole ID	Est. K (m/day)
MBH3	0.06
MBH5	0.02



MBH3



MBH5



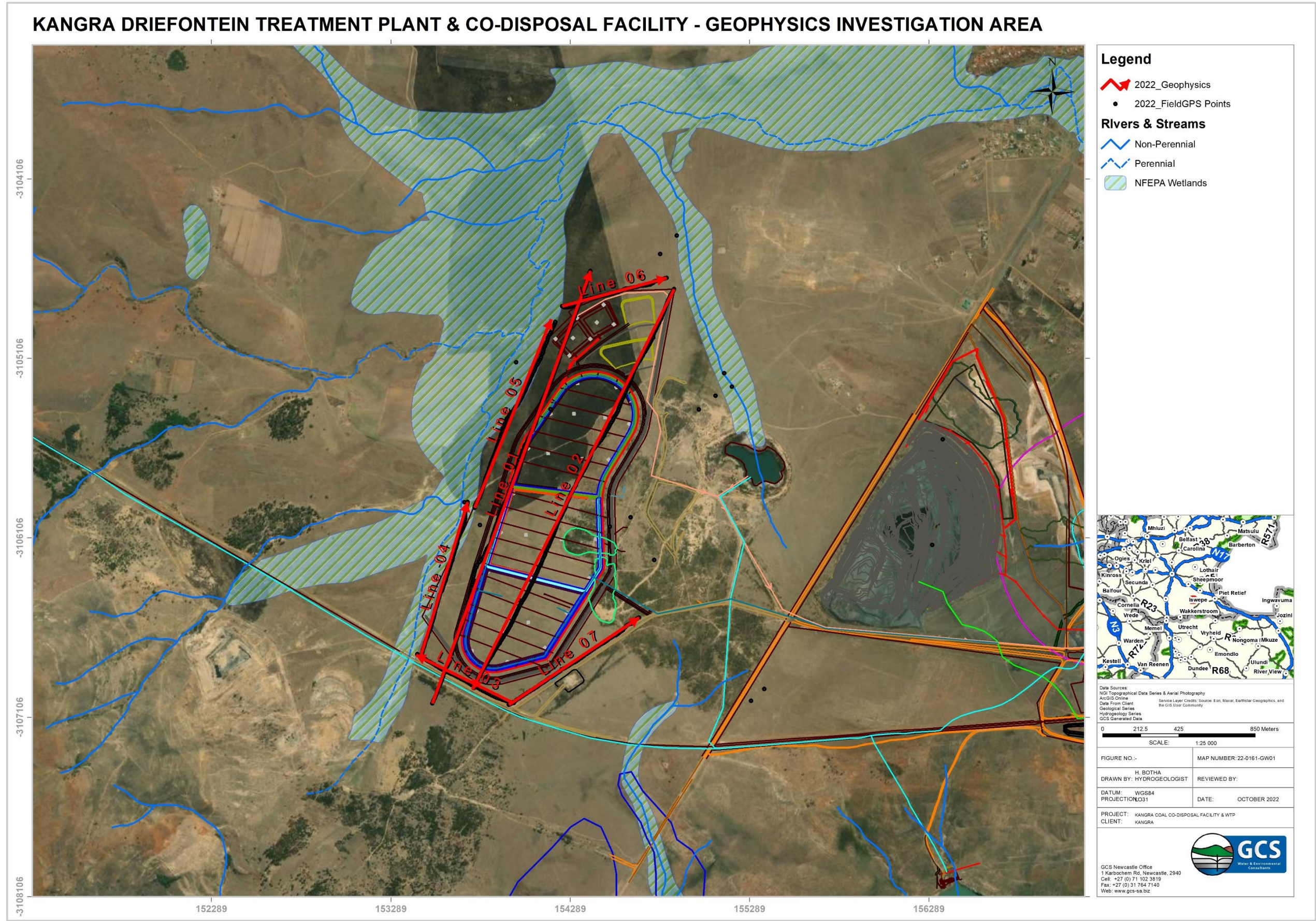


Figure 4-9: Geophysical investigation area



#### 4.5 Geochemical assessment

Two (2) rock/material samples were subjected to static geochemical testing. The samples were obtained from the slurry (refer to Figure 4-10) and dry (refer to Figure 4-11) material from the existing discard dump at MQE.

Two (2) types of static testing were used to assess the acid (short & long-term) and neutralisation potential of the rock at the mine, namely Acid-Base Accounting (ABA) and Net Acid Generation (NAG).



Figure 4-10: Slurry deposit at discard dump



Figure 4-11: Dry discard deposit

##### 4.5.1 ABA

ABA is a static test where the net potential of the rock to produce acidic drainage is determined. The percentage sulfur (%S), the AP (acid potential), the NP (neutralisation potential) and the Net Neutralization Potential (NNP) of the rock material are determined in this test, as an important first-order assessment of the potential leachate that could be expected from the rock material. The ABA screening criteria as described by (Price, 1997) are listed in Table 4-6. The components of an ABA analysis are further explained below:

- If pyrite is the only sulphide in the rock the AP is determined by multiplying the %S with a factor of 31.25. The unit of AP is kg CaCO<sub>3</sub>/t rock and indicates the theoretical amount of calcite neutralized by the acid produced.
- The NP is determined by treating a sample with a known excess of standardized hydrochloric or sulfuric acid (the sample and acid are heated to ensure a complete reaction). The paste is then back titrated with standardized sodium hydroxide to determine the amount of unconsumed acid. NP is also expressed as kg CaCO<sub>3</sub>/t rock to represent the amount of calcite theoretically available to neutralize the acidic drainage; and
- NNP is determined by subtracting AP from NP (EPA, 1994).

---

For the material to be classified in terms of its AD potential, the ABA results could be screened in terms of its NNP, %S and NP: AP ratio as follows:

- A rock with  $\text{NNP} < 0 \text{ kg CaCO}_3/\text{t}$  will theoretically have a net potential for acidic drainage. A rock with  $\text{NNP} > 0 \text{ kg CaCO}_3/\text{t}$  rock will have a net potential for the neutralization of acidic drainage. Because of the uncertainty related to the exposure of the carbonate minerals or the pyrite for reaction, the interpretation of whether a rock will be net acid generating or neutralizing is more complex. Research has shown that a range from  $-20 \text{ kg CaCO}_3/\text{t}$  to  $20 \text{ kg CaCO}_3/\text{t}$  exists which is defined as a “grey” area in determining the net acid generation or neutralization potential of rock. Material with an NNP above this range is classified as Rock Type IV - No Potential for Acid Generation and material with an NNP below this range as Rock Type I - Likely Acid Generating; and
- (Soregaroli & Lawrence, 1998) further states that samples with less than 0.3% sulphide sulphur are regarded as having insufficient oxidisable sulphides to sustain long-term acid generation. Material with a %S below 0.3% is therefore classified as Rock Type IV - No Potential for Acid Generation, and material with a %S of above 0.3%, as Rock Type I - Likely Acid Generating.

**Table 4-6: ABA and NAG screening criteria (adapted from (Price, 1997) and (Fourie, 2014))**

ABA: NPR Screening Criteria			ABA: %S Screening Criteria			ABA: NNP Screening Criteria		
Potential Acid Generation	NP: AP (NPR)	Comments	Potential Acid Generation	% S	Comments	Potential Acid Generation	NP: AP (NPR)	Comments
Rock Type I: Likely Acid Generating.	< 1	Likely AMD generating.	Rock Type IV: No Potential for Long-Term Acid Generation	< 0.3%	The sample may produce AMD bit will be short term.	Rock Type IV: No potential Acid Generation.	> 20	No AMD potential
Rock Type II: Possibly Acid Generating.	1-2	Possibly AMD generates if NP is insufficiently reactive or is depleted at a faster rate than sulphides.				Rock Type I: Likely Acid Generation.	< -20	Likely AMD potential
Rock Type III: Low Potential for Acid Generation.	2-4	Not potentially AMD generating unless significant preferential exposure of sulphides along fracture planes, or extremely reactive sulphides in combination with insufficient reactive NP.	Rock Type I: Likely Long-Term Acid Generation	> 0.3%	Potential for long-term AMD.	Uncertain	20 to -20	The sample may become acidic or remain neutral. Use the conjunction of the other criteria to resolve this uncertainty.
Rock Type IV: No Potential for Acid Generation.	> 4	No further AMD testing is required unless materials are to be used as a source of alkalinity.						



#### 4.5.2 NAG

In the NAG test hydrogen peroxide ( $\text{H}_2\text{O}_2$ ) is used to oxidize sulphide minerals to predict the acid generation potential of the sample.

The NAG test provides a direct assessment of the potential for a material to produce acid after a period of exposure (to a strong oxidant) and weathering. The test can be used to refine the results of the ABA predictions (refer to Table 4-7).

In general, the static NAG test involves the addition of 25 ml of 30%  $\text{H}_2\text{O}_2$  to 0.25 g of sample in a 250 ml wide-mouth conical flask, or equivalent. The sample is covered with a watch glass and placed in a fume hood or well-ventilated area. Once "boiling" or effervescing ceases, the solution can cool to room temperature and the final pH (NAG pH) is determined. A quantitative estimation of the amount of net acidity remaining (the NAG capacity) in the sample is determined by titrating it with NaOH to pH 4.5 (and/or pH 7.0) to obtain the NAG Value (Lapakko & Lawrence, 1993).

**Table 4-7: NAG screening methods used (Edited from (Miller, et al., 1997)**

Rock Type	NAG pH	NAG Value ( $\text{H}_2\text{SO}_4$ kg/t)	NNP ( $\text{CaCO}_3$ kg/t)
Rock Type Ia. High Capacity Acid Forming.	< 4	> 10	Negative
Rock Type Ib. Lower Capacity Acid Forming.	< 4	$\leq 10$	-
Uncertain, possibly Ib.	< 4	> 10	Positive
Uncertain.	$\geq 4$	0	Negative
Rock Type IV. Non-acid Forming.	$\geq 4$	0	Positive

#### 4.6 Mineralogy and total element analyses

The mineralogical composition of the solid rock samples was determined using X-ray diffraction (XRD). The XRD results and a simplified classification of the identified minerals are listed in Table 4-8. The results are summarised as follows:

- Boromuscovite (32.3%) is the dominant mineral in the dry sample whereas Quartz (45.7%) is by far the dominant mineral in the slurry sample;
- Quartz (26.4%), Orthoclase (18.7%) and Calcite (14.7%) are the other dominant minerals in the dry sample;
- Diapose (14.9%), Enstatite (13.1%), Orthoclase (8.9%) and Muscovite (7.9%) are the other major minerals found in the slurry sample;

No sulphide-bearing minerals were identified however, Calcite and Aragonite (5.1%) were identified in the dry sample. These are carbonate-bearing minerals which are typically associated with acid generation/neutralisation reactions.

**Table 4-8: XRD results and mineral classification**

Sample ID	K-DISCARD	K-SLURRY
Rock Type > Mineralogy	Dry Discard	Slurry
Aragonite	5.1	
Calcite	14.7	
Diapose		14.9
Enstatite		13.1
Franklinite	2	0.7
Magnesite		7.6
Muscovite	32.3	7.9
Orthoclase	18.7	8.9
Phlogopite		1.3
Portlandite	0.8	
Quartz	26.4	45.7
Totals	100	100.1

#### 4.7 Acid potential

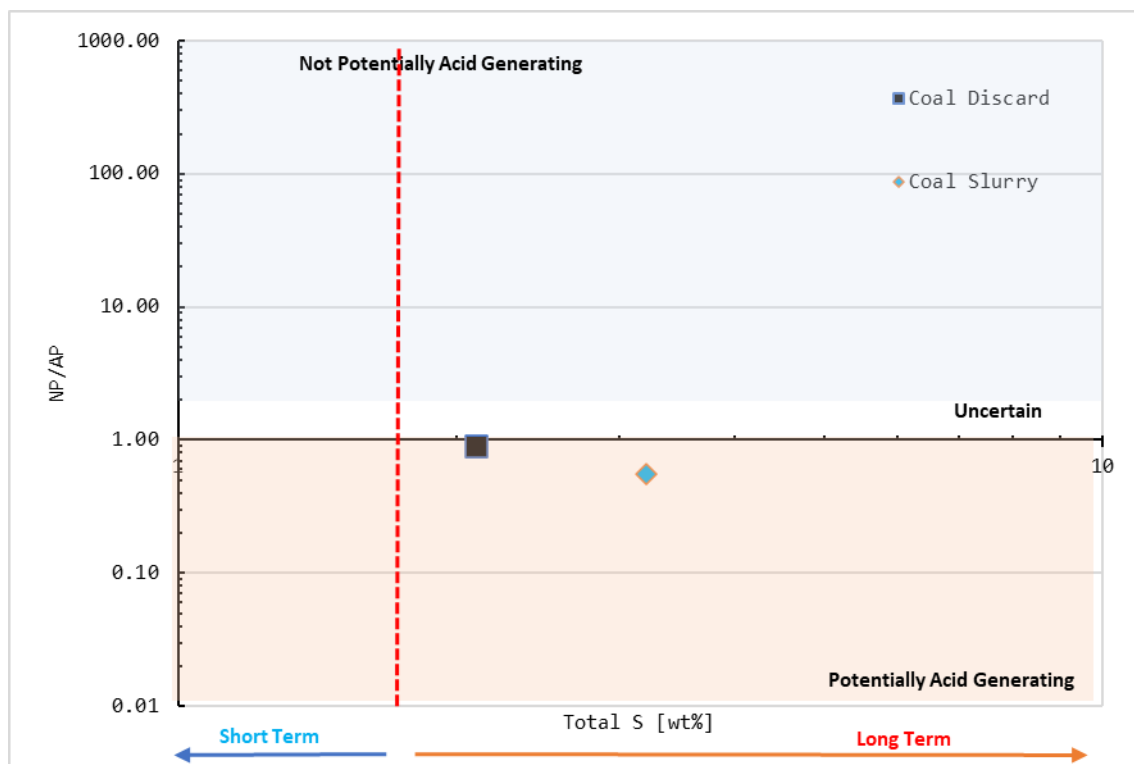
The Acid-Base Accounting (ABA) and Net Acid Generation (NAG) screening results are presented in Table 4-9. Figure 4-12 presents the acid potential of the samples, based on NP/AP and %S. Based on the screening results, the following is noted:

- The net acid potential (NNP) and nag screening suggest no long-term acid potential (AP). However, the ABA and %S paint a different picture in terms of the material AP.
- Samples are potentially acid generating (PAG) and long-term acid drainage is associated with the samples analysed; and

- NAG results suggest that samples are PAG.

**Table 4-9: Summary of ABA and NAG screening results**

Sample ID	K-DISCARD	K-SLURRY
Description	Coal Discard	Coal Slurry
Paste pH	7.36	8.01
Total %S	2.01	3.24
Sulphide %S	0.854	0.846
AP CaCO <sub>3</sub> kg/t	62.8	101
NP CaCO <sub>3</sub> kg/t	56.3	56.3
NNP CaCO <sub>3</sub> kg/t	29.9	29.6
NP/AP	0.896	0.556
NAG pH: (H <sub>2</sub> O <sub>2</sub> )	7.38	3.07
NAG (kg H <sub>2</sub> SO <sub>4</sub> /t)	0	16.6
Rock Type NNP	IV - AMD not likely	IV - AMD not likely
Rock Type %S	I - long-term AMD	I - long-term AMD
Rock Type NP/AP	I - long-term AMD	I - long-term AMD



**Figure 4-12: Acid Potential - based on sample AP/NP and %S**

#### 4.8 Static leach testing

1-20 (rock to water ratio) distilled water (DW) tests were conducted on the samples obtained. The leachate analytical results are summarised in Table 4-10, below. The following is noted from the static leach testing results:

- All samples exhibit near-neutral pH conditions;
- Sulphate (SO<sub>4</sub>) and calcium (Ca) concentrations are observed to be high, compared to DWAD ideal water limits for potable water use.
- Several metals are observed to be present in the leachate.

**Table 4-10: Summary of 1:20 DW Leachate Analytical Results**

Locality		K-DISCARD	K-SLURRY1	DWAf 1996 Domestic Use WQO
Sample type		Geochem	Geochem	
Sampled date		10-Oct-2022	10-Oct-2022	
Geo - Reagent water Leach 1:20				
20 - pH	pH	8.1	8.11	4-9
20 - EC	mS/m	55.4	91.5	0 - 70
01 - Alk	mg CaCO <sub>3</sub> /l	41.9	44.8	ns
02 - Cl	mg/l	2.3	6.38	0 - 100
03 - SO4	mg/l	220	421	0 - 200
04 - PO4	mg/l	-0.005	-0.005	ns
06 - NO3	mg/l	-0.194	-0.194	0 - 6
30 - Ca	mg/l	90	106	0 - 32
30 - Mg	mg/l	7.91	17.4	0 - 30
30 - Na	mg/l	6.19	57.3	0 - 100
30 - K	mg/l	6.58	8.28	0 - 50
31 - Al	mg/l	-0.002	-0.002	0 - 0.1
31 - Fe	mg/l	-0.004	-0.004	0 - 0.1
31 - Mn	mg/l	0.043	0.095	0 - 0.05
31 - Cd	mg/l	-0.002	-0.002	
31 - Co	mg/l	-0.003	-0.003	
31 - Cr	mg/l	-0.003	-0.003	
31 - Cu	mg/l	0.005	0.01	
31 - Ni	mg/l	-0.002	-0.002	
31 - Pb	mg/l	-0.004	-0.004	
31 - Zn	mg/l	-0.002	-0.002	
33 - B	mg/l	-0.013	-0.013	
33 - Ba	mg/l	0.066	0.054	
33 - Be	mg/l	-0.005	-0.005	
33 - V	mg/l	-0.001	-0.001	
32 - Bi	mg/l	0.011	0.015	
32 - Ag	mg/l	-0.001	-0.001	
32 - Ga	mg/l	0.002	0.002	
32 - Li	mg/l	0.006	0.009	
33 - Mo	mg/l	0.039	0.052	
32 - Rb	mg/l	0.01	0.011	
33 - Sr	mg/l	1.35	2.65	
32 - Te	mg/l	-0.001	-0.001	
32 - Tl	mg/l	-0.037	-0.037	
Below Detection limits				

## 4.9 Numerical model development

The modelling processes followed are indicated in Figure 4-13.

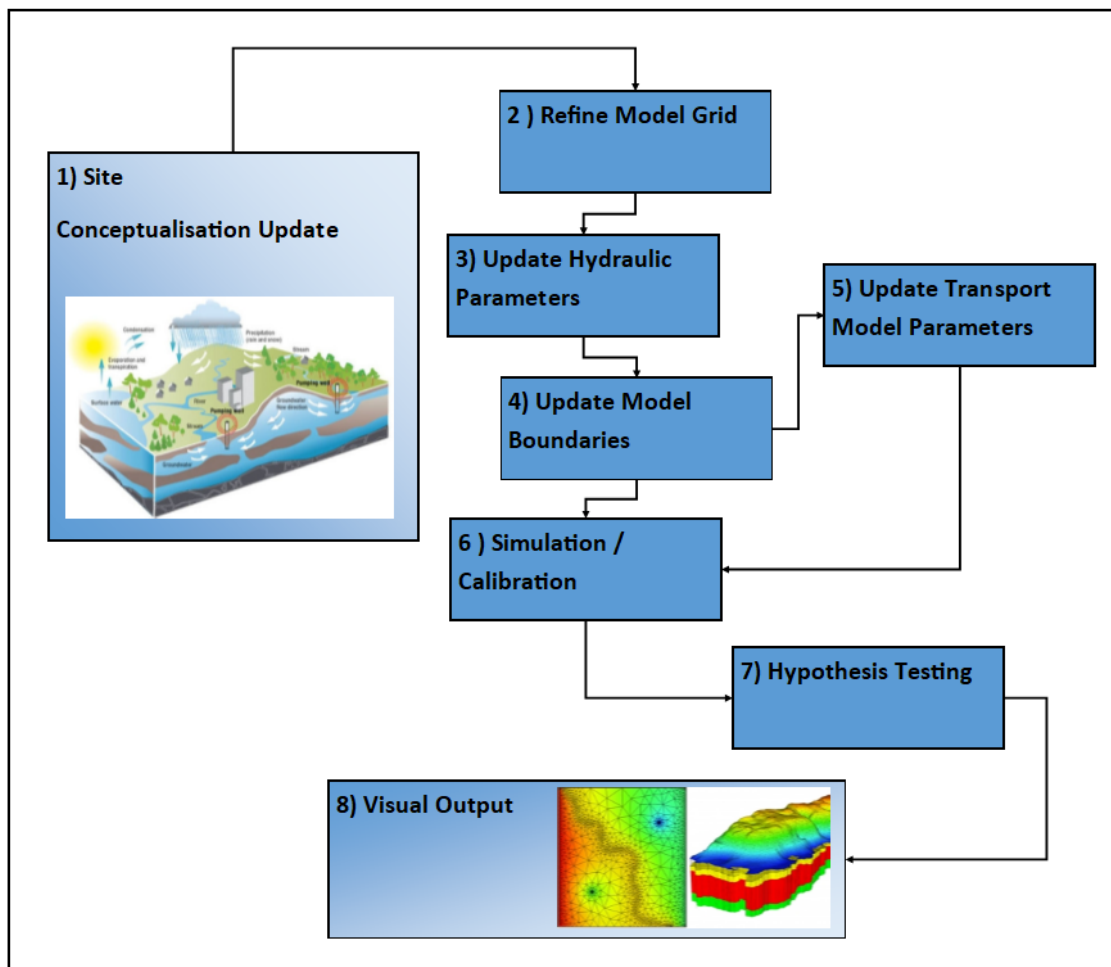


Figure 4-13: Numerical groundwater modelling process

### 4.9.1 Model software package

The numerical model for the project was constructed using Visual Modflow 6.1 Pro, Build 7088.31257, a pre-and post-processing package for the modelling code MODFLOW. MODFLOW is a modular three-dimensional groundwater flow model developed by the United States Geological Survey (Harbaugh, et al., 2000). MODFLOW uses 3D finite-difference discretisation and flow codes to solve the governing equations of groundwater flow.

### 4.9.2 Governing Equations

The numerical model used in this modelling study was based on the conceptual model developed from the findings of the desktop and the baseline investigations. The simulation model simulates groundwater flow based on a three-dimensional cell-centred grid and may be described by the following partial differential equation:

$$\frac{\partial}{\partial x} \left( K_{xx} \frac{\partial h}{\partial x} \right) + \frac{\partial}{\partial y} \left( K_{yy} \frac{\partial h}{\partial y} \right) + \frac{\partial}{\partial z} \left( K_{zz} \frac{\partial h}{\partial z} \right) \pm W = S_s \frac{\partial h}{\partial t} \quad \text{Equation 1}$$



where:

- $K_{xx}$ ,  $K_{yy}$ , and  $K_{zz}$  are values of hydraulic conductivity along the  $x$ ,  $y$ , and  $z$  coordinate axes, which are assumed to be parallel to the major axes of hydraulic conductivity (L/T).
- $h$  is the potentiometric head (L).
- $W$  is a volumetric flux per unit volume representing sources and/or sinks of water,

with:

- $W < 0.0$  for flow out of the ground-water system, and  $W > 0.0$  for flow in (T-1).
- $S_s$  is the specific storage of the porous material (L-1), and
- $t$  is time (T).

Equation 1, when combined with boundary and initial conditions, describes transient three-dimensional groundwater flow in a heterogeneous and anisotropic medium, provided that the principal axes of hydraulic conductivity are aligned with the coordinate directions (Harbaugh, et al., 2000).

#### **4.9.3 Model confidence level classification**

The Australian Groundwater Modelling Guidelines (Barnett, et al., 2012) refer to the following two principles that were considered in the numerical calibration process (refer to Appendix B):

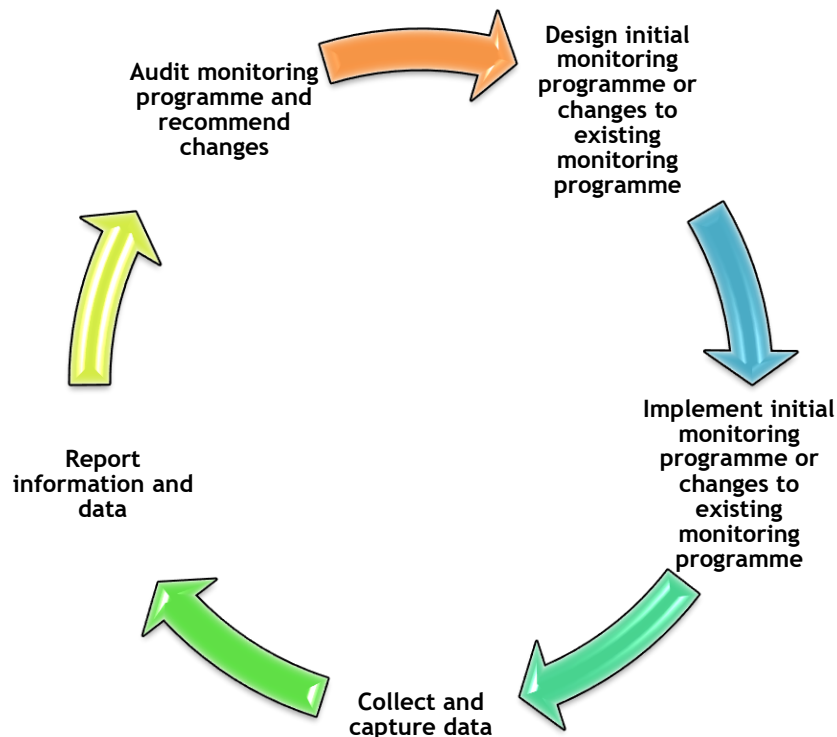
- **Guiding Principle 2.3:**
  - A target model confidence level classification should be agreed upon and documented at an early stage of the project to help clarify expectations. The classification can be estimated from a semi-quantitative assessment of the available data on which the model is based (both for conceptualisation and calibration), the way the model is calibrated and how the predictions are formulated.
  - GCS aimed to construct a Class 2 flow and transport model. Class 2 models are founded on sufficient hydrogeological data (i.e. water level data and aquifer hydraulic parameters) and can be used to predict the future behaviour of a groundwater aquifer system.
- **Guiding Principle 2.4:**
  - The initial assessment of the confidence level classification should be revisited at later stages of the project, as many of the issues that influence the classification may not be known at the model planning stage.

#### 4.10 Geohydrological risk assessment

As per GNR 982 of the EIA Regulations (2014), the significance of potential hydrological impacts was assessed. The risk assessment methodology and ratings applied to the study area and proposed activities are available in **Appendix C**.

#### 4.11 Water monitoring plan

The monitoring network is based on the principles of a monitoring network design as described by the DWAF Best Practice Guidelines: G3 Monitoring (DWAF, 2007). The methodological approach that the monitoring plan follows is represented in Figure 4-14, below.



**Figure 4-14: Monitoring Process**

A groundwater monitoring plan was drafted and is based on the existing monitoring points, the site's conceptual model and risk assessment.

## 5 PREVAILING GROUNDWATER CONDITIONS

The following section supplies an overview of the prevailing geohydrological conditions encountered in the area for the proposed redevelopment. The data were derived from available literature sources and completed fieldwork.

### 5.1 Aquifer characteristics, classification, and groundwater recharge

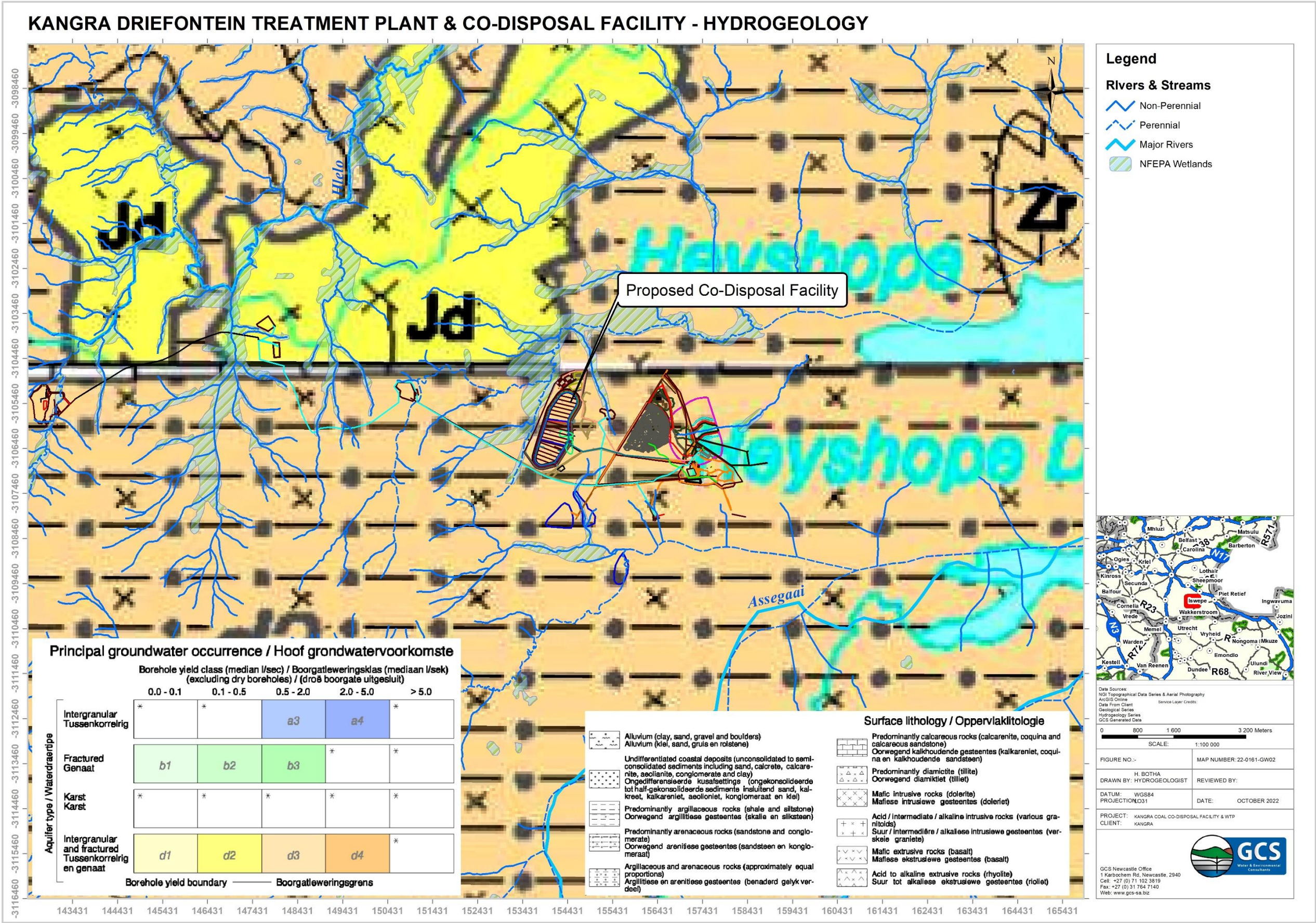
The general aquifer characteristics and aquifer classification are summarised in Table 5-1.

**Table 5-1: Aquifer characteristics and classification**

Characteristics	Aquifer Classification
<p>The aquifer can be referred to as being primarily both intergranular (nearing alluvium areas) and intergranular &amp; fractured (King, et al., 1998).</p> <p>Groundwater is typically encountered in:</p> <ul style="list-style-type: none"> <li>• Fractures and bedrock contacts are recharged through overlying saturated sands;</li> <li>• Contacts between lithologies or unconformities; and</li> <li>• Dolerite dyke contacts (King, et al., 1998)</li> </ul> <p>The weathered rock aquifer hosted within the Vryheid Formation Sediments is classified as the uppermost weathered rock. Exploratory drilling at the site shows an average depth of weathering of less than ~12 mbgl with borehole yields generally less than 2 L/s. Discrete and localised variations in hydraulic parameters may exist due to geological structural features (e.g. fractures, fault zones) refer to Figure 5-1.</p> <p>The fractured rock aquifer is classified as a thick sequence of sediments (i.e. sandstone, shale, siltstone, carbonaceous shale and coal). The matrix of the Vryheid Formation Sediments has a very low primary porosity; therefore, groundwater storage and movement are predominantly confined and are associated with geological structures and associated fracturing throughout the unit.</p> <p>Water strikes with discrete fracture zones generally range between ~20 and ~50 mbgl with moderate to high borehole yields (&gt;3 L/s). Higher yields (~5 to &gt;10 L/s) are largely associated with dolerite intrusion contact zones.</p> <p>Transmissivity values (GCS, 2012), analysed using several analytical (Cooper-Jacob, Theis) methods, range from ~0.4 to ~30 m<sup>2</sup>/d.</p>	<p>Based on a review of available data, it is evident that the key aquifer host media within the regional Project area can be generalised as follows:</p> <ol style="list-style-type: none"> <li>1. Unconsolidated aquifer - Alluvial material;</li> <li>2. Semi-confined aquifer - weathered rock; and</li> <li>3. Fractured rock aquifer. The aquifer present is classified as a Minor Aquifer system (Parsons, 1995)</li> </ol> <p>minor aquifer region which is a moderately-yielding aquifer system of variable water quality, with reported yields ranging from 0.5 to 2 l/sec -Class D3 aquifer.</p>

Characteristics	Aquifer Classification
The aquifer is an important contributor to groundwater baseflow to streams and rivers (King, et al., 1998). Groundwater contribution to baseflow (BF) on a quaternary scale is estimated to range from 4.91 mm/yr [Pitman Model] to 25.7 mm/yr [Hughes Estimate].	







## 5.2 Aquifer transmissivity

Available aquifer transmissivity values (T-values) for Maquasa East, West and Nooitgesien are summarised in Table 5-2. The T values were used to parameterise analytical and numerical flow models for the site.

**Table 5-2: Summary of aquifer transmissivity**

BH ID	SWL	Abstraction Rate	Duration of Test (Constant Drawdown and Recovery)	Maximum Drawdown	Transmissivity (m <sup>2</sup> /d)	
	(mbgl)	(l/s)	(min)	(m)	Cooper-Jacob Method	Theis Method
GCS 11	11.44	0.8	215	31.42	1	0.5
GCS 12	2.87	1.09	185	34.29	1.76	1.58
GCS 13	6.98	1.08	183	23.24	0.67	0.9
GCS 14	13.88	1	183	35.69	0.89	0.9
GCS 15	1.61	1.51	540	8.87	6.2	7.5
GCS 16	8.71	1.1	189	34.73	1.6	1.6
GCS 17	9.71	1.2	245	34.44	2.5	1.78
GCS 18	4.25	0.9	185	29.76	0.8	0.6
GCS 19	3.98	0.3	140	26.52	0.76	0.88
GCS 20	4.26	0.63	360	32.69	1.9	1.3
GCS 21	4.39	0.75	360	11.84	2.6	2.6
GCS 22	5.29	1.4	110	32.94	1.6	1
GCS 23	13.96	1.09	245	33.22	1.4	1.25
GCS 24	3.93	0.75	480	5.21	11.6	14.2
GCS 25	12.32	0.39	187	31.82	0.6	0.4
GCS 26	6.84	0.42	360	28.21	4	1.2
GCS 27	13.57	1.26	360	23.67	3.5	7.7
GCS 28	15.71	1.48	290	17.09	28.2	13.9
GCS 29	21.87	0.9	185	35.13	0.8	0.7
GCS 30	7.08	1.22	75	30.05	1.8	1.5
MBH3	12.18	NA	Slug. Bower-Rice (1976).	Slug	0.006	
MBH5	5.15	NA	Slug. Bower-Rice (1976).	Slug	0.2	
Average					3.71	3.10
Geomean					1.96	1.65

## 5.3 Groundwater recharge

Recharge processes are using direct and indirect infiltration of precipitation. Based on values sourced from the scientific literature (i.e. Hodgson et al, 2007), a recharge of 1 to 5% of the annual precipitation is estimated for the fractured rock aquifer unit.

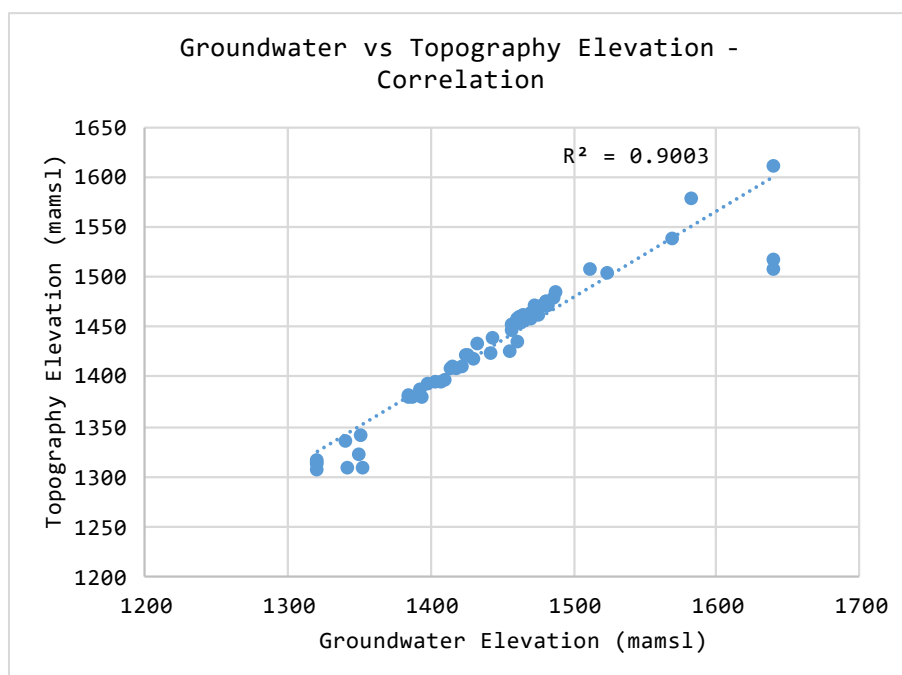
## 5.4 Aquifer storage

According to King *et al.* (1998) and DWAF (2006), the aquifer storage/storage coefficient is in the order of magnitude of  $< 3.1 \times 10^{-3}$  (unitless) - supported by available pump test data. The porosity of the aquifer is expected to range from 15 to 20%. Literature data suggest that aquifer storage coefficients range from 5 to 10%.

## 5.5 Depth to groundwater

According to (Vegter, 1995) and (DWAF, 2006), the groundwater levels within the region are expected to range from 15 to 30 mbgl (meters below ground level). Available monitoring boreholes data for Kangra suggest a water level range from 1.28 to 131 mbgl (nearing the MQW underground workings in the mountains), with an average water level in the order of 12.4 mbgl for the MQE area.

Available water level data for boreholes in the area suggest there is a good correlation between the surface topography and the groundwater table (refer to Figure 5-2,  $R \sim 90\%$ ). The groundwater table is expected to mimic the topography and be shallower closer to perennial streams (i.e. these are prominent groundwater contributions to base-flow areas or areas where groundwater seepage from the resource into the aquifer units may take place).



**Figure 5-2: Groundwater elevation vs topography elevation - correlation (Kangra Monitoring Holes)**

## 5.6 Wetland areas

Based on available National Wetland Freshwater Ecosystem Priority Areas (NFEPA) (Van Deventer, 2018) the non-perennial and perennial drainage areas situated downstream of the proposed co-disposal facility are classified as channelled valley bottom (CVB) wetland areas of the Mesic Highveld Grassland Bioregion (refer to Figure 1-3).

In terms of wetland geo-hydrology, base flow is considered the most important contributor to wetland health. Base flow (refer to Figure 5-3) is a non-process-related term to signify low amplitude high-frequency flow in a river during dry or fair-weather periods. Base flow is not a measure of the volume of groundwater discharged into a river or wetland, but it is recognised that groundwater contributes to the base-flow component of river or wetland flow.

Available literature (WRC, 2015; DWAF, 2006) suggests groundwater contribution to baseflow ranges from 9.8 mm/yr (PITMAN MODEL) to 43.45 mm/yr (HUGHES MODEL). This relates to approximately 2% to 6% of rainfall.

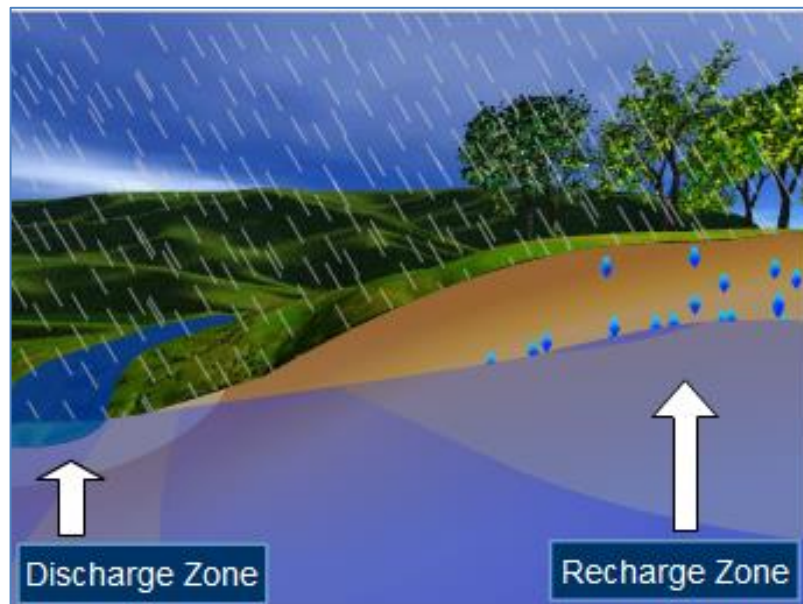


Figure 5-3: Groundwater base-flow concept (DWS, 2011)

## 5.7 Present ecological state (PES) and environmental sensitivity and ecological importance (EIS) - quaternary scale

Table 5-3 provides a summary of the PES and EIS for the quaternary catchment associated with the project area (WRC, 2015). It is recommended that the resource management objectives (RMO) for wetlands in the project area need to maintain the current PES and EIS post development

Table 5-3: Summary of PES and EIS for the Quaternary Catchment

Quat	PES	EIS
W51B	Class B: Largely Natural	High

## 5.8 Aquifer contextualization and extent

As groundwater flow behaviour is aligned to surface water flow conditions, it was assumed that the aquifer extent for the work conducted by GCS coincides with the surface water catchment boundaries.

## 5.9 Groundwater quantity

Intermediate groundwater (GW) Reserve Determination (IGRD) was conducted for the study area to establish the GW reserve. The IGRD aims to quantify the likely impact of the proposed development on the GW reserve.

It is necessary, from a GW point of view, to quantify the GW quantity and likely impact on the groundwater reserve as a result of rainfall, and an interception. Moreover, the GW balance gives an estimate of how much GW can safely be abstracted from the aquifer if an abstraction borehole is drilled.

The IGRD considers the following parameters:

- Effective recharge from rainfall and specific geological conditions.
- Basic human needs for the sub-catchment.
- GW contribution to surface water (baseflow).
- Existing and proposed abstraction; and
- Surplus reserve.

The data used for the calculation was derived from the WRC 90 Water Resources of South Africa 2012 Study (WR2012) and GW Resource Assessment Ver. 2 (GRAII) datasets.

### 5.9.1 Quaternary catchment

Data were obtained from the Groundwater Resource Directed Measures (GRDM). The site falls within the quaternary catchment W51B as indicated in Table 5-4.

**Table 5-4: Summarised Quaternary Catchment Information**

Quaternary Catchment	Total Area (km <sup>2</sup> )	Recharge (mm/a)	Rainfall (mm/a)	Baseflow (mm/a)
W51B	496.5	7.4	864.3	4.9 [PITMAN MODEL]

### 5.9.2 Sub-catchment delineation

Seven (7) hydrological response unit (HRUs) describes the natural drainage for the study area (using a 1:1 000 stream count and 30 m DTM fill) - refer to **Figure 1-3**. The sub-catchment relates well to desktop-delineated drainage lines for the project area, as well as verified streams associated with the project area.

Primary drainage from the position of the proposed co-disposal site, and much of the MQE area is towards the northeast, to the perennial Egude River, which makes up the bottom inflow of the Heyshope Dam. Drainage from the southern portions of the MQE area, and Maquassa West (MQW) is towards the south, via several perennial and non-perennial drainage lines, towards the southern inflow of the Heyshope Dam. The Heyshope Dam is therefore the end received of any surface water-related pollution that may take place at the MQE operations. The sub-catchments that are associated with the proposed co-disposal facility are HRU1 to 3, and HRU6. The sub-catchment associated with the proposed treatment area is HRU5.

### 5.9.3 Groundwater balance

The groundwater balance and hence the reserve determination on a sub-catchment scale is summarised in Table 5-5. It can be seen that there is a surplus amount of 521 895 m<sup>3</sup>/a available on a sub-catchment scale. As no groundwater abstraction is propped, the impact on the reserve is estimated to be zero.

**Table 5-5: Groundwater reserve determination**

Description	MQE Co-disposal Discard Site Delineated Sub-catchment
Recharge through Precipitation	837 268 [m <sup>3</sup> /a]
Basic Human Need	46 [m <sup>3</sup> /a]
Existing Abstraction	28 [m <sup>3</sup> /a]
Proposed Abstraction	54750 [m <sup>3</sup> /a]
Baseflow	260548 [m <sup>3</sup> /a]
Surplus Amount	521 895 [m <sup>3</sup> /a]

**Note/s:**

[m<sup>3</sup>/a] - cubic metres per annum



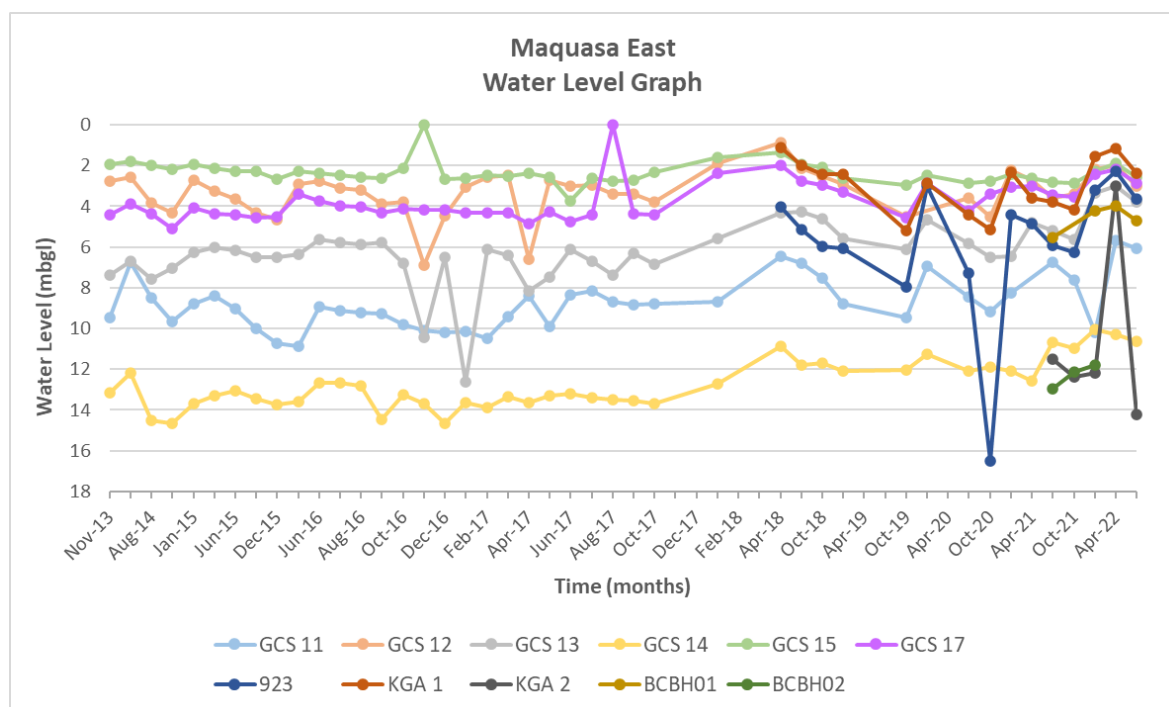
## 5.10 Hydrochemistry

The following section supplies an overview of the groundwater hydrochemistry for the project area. Data were derived from field sampling and analyses done by GCS in 2022 as part of an ongoing monitoring program. A total of nineteen groundwater sites and twenty-three surface water sites have been identified in MQE. The spatial representation of these monitoring points can be seen in Figure 5-8.

### 5.10.1 Groundwater Levels

Shallow groundwater levels (< 8.0 mbgl) characterise the majority of the project area. Boreholes GCS14 and BCBH02 (non-operational) are characterised by deeper groundwater levels (> 10.0 mbgl); refer to Figure 5-4.

- Fluctuating water levels have been observed at most sites over time, although most boreholes indicate predominantly stable trends. All boreholes indicated a decrease in water levels during the July 2022 measurement event.
  - The most notable decrease observed in July 2022 was recorded at KGA2 (a decrease of 11.2 mbgl).



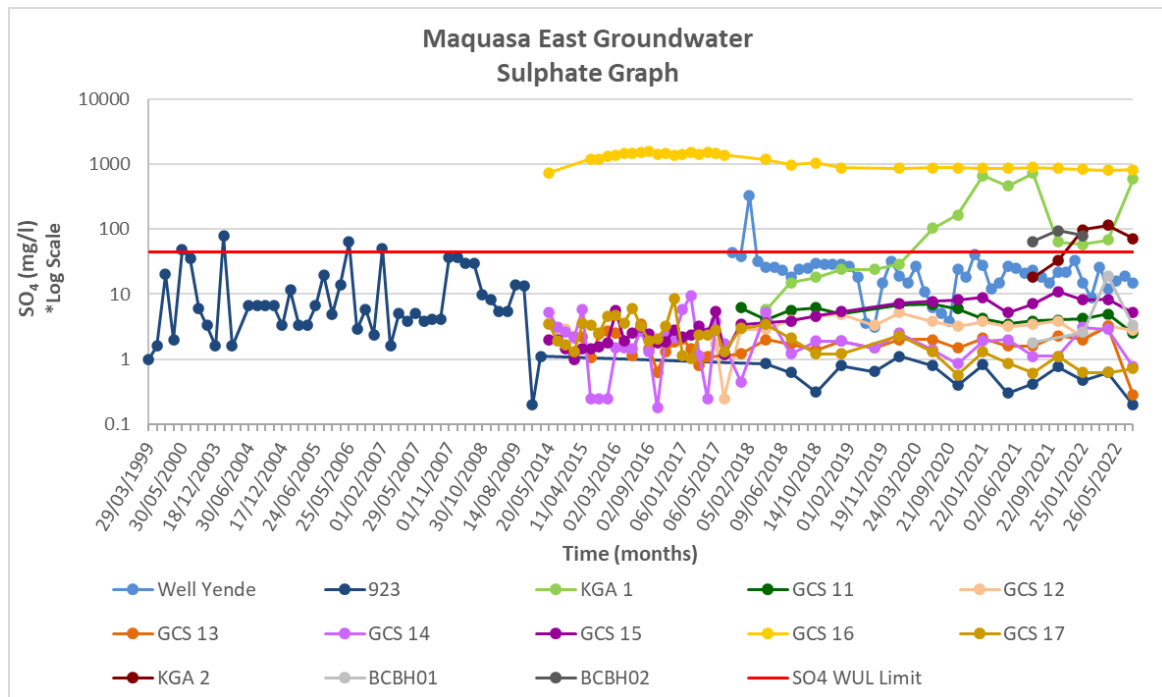
**Figure 5-4: Groundwater level time trend graph for Maquasa East**

### 5.10.2 Groundwater Quality

The following observations were made during the 2022 second-quarter monitoring event:

- All groundwater monitoring points exhibited relatively neutral to slightly alkaline pH conditions, ranging between 6.5 and 7.6.
- BH 923, BCBH01, GCS11, GCS12, GCS13, GCS14 and GCS15 showed low to no significant impact from the site in July 2022.
  - Only nitrate concentrations slightly exceeded the WUL limit at GCS11, GCS12, GCS14 and GCS15, ranging between 0.3 and 3.2 mg/l, which is considered to be low to moderately low.
- The water quality at Well Yende, KGA1, KGA2, GCS16 and GCS17 was non-compliant when compared to the WUL limits.
  - Several parameter concentrations exceeded the WUL Limits in July 2022:
    - Chloride and/or sodium were elevated at Well Yende and GCS17.
    - KGA2 indicated elevated EC and TDS concentrations during the July 2022 sampling event.
    - EC, TDS, total hardness, magnesium, sodium, potassium and chloride concentrations were elevated at KGA1.
    - EC, TDS, total alkalinity, total hardness, calcium, magnesium, sodium, potassium and chloride were significantly elevated at GCS16.
  - Sulphate concentrations varied at the site; refer to Figure 5-5.
    - Sulphate at GCS16 has displayed a stable trend over time, consistently exceeding the WUL limit, recorded as 819 mg/l in July 2022. GCS16 is decanting directly from the underground workings at Maquasa East into a pollution control dam which is situated near the Heyshope Dam.
    - Sulphate at KGA1 has displayed an increasing trend over time and currently exceeds the WUL limit. A notable increase was observed in July 2022, recorded as 585 mg/l. KGA1 is situated downgradient of the Discard Plant.
    - Sulphates at KGA2 indicated an increasing trend over time, exceeding the WUL limits since October 2021. A decrease was observed in July 2022, recorded as 72 mg/l.
    - The remaining points displayed low sulphate concentrations (< 16 mg/l).
  - Additionally, nitrate concentrations exceeded the WUL limit at KGA1 and GCS16 ranging between 1.1 and 3.2 mg/l.

- In terms of metal concentrations, manganese exceeded the WUL limits at GCS16 (0.48 mg/l) and KGA1 (0.48 mg/l).



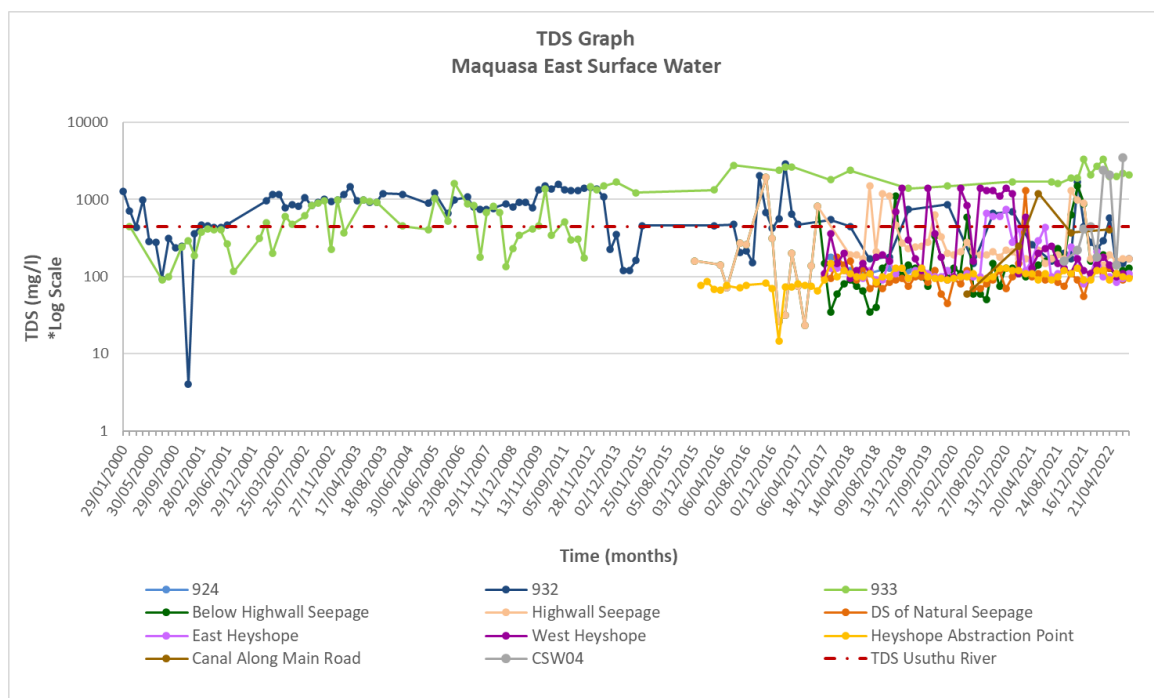
**Figure 5-5: Maquasa East logarithmic groundwater sulphate graph**

### 5.10.3 Surface Water Quality

The following observations were made during the 2022 second quarter:

- All surface water monitoring points exhibited neutral to slightly alkaline pH conditions throughout the second quarter, ranging between 6.8 and 8.3.
- Surface water points Below Highwall Seepage, Highwall Seepage, D/S of Natural Seepage, East Heyshope, Heyshope Dam Abstraction, West Heyshope and SW 932 displayed low to no significant impact from the site.
  - In terms of metal concentrations, manganese (< 0.65 mg/l) was elevated at Below Highwall Seepage, Highwall Seepage and SW 932 during the second quarter of 2022. Iron (< 0.15 mg/l) was elevated at East Heyshope, Heyshope Dam Abstraction and West Heyshope during the second quarter of 2022.
  - Aluminium concentrations were elevated at Heyshope Dam Abstraction and West Heyshope during the second quarter of 2022. The source is most likely the upstream discard dump. Aluminium is commonly associated with burnt clinker material generated by discard dumps.
  - Ammonia concentrations were elevated at Below Highwall Seepage, Highwall Seepage, D/S of Natural Seepage, East Heyshope, Heyshope Dam Abstraction, West Heyshope and SW 932 during the June 2022 sampling event, ranging between 7.3 and 7.9 mg/l.

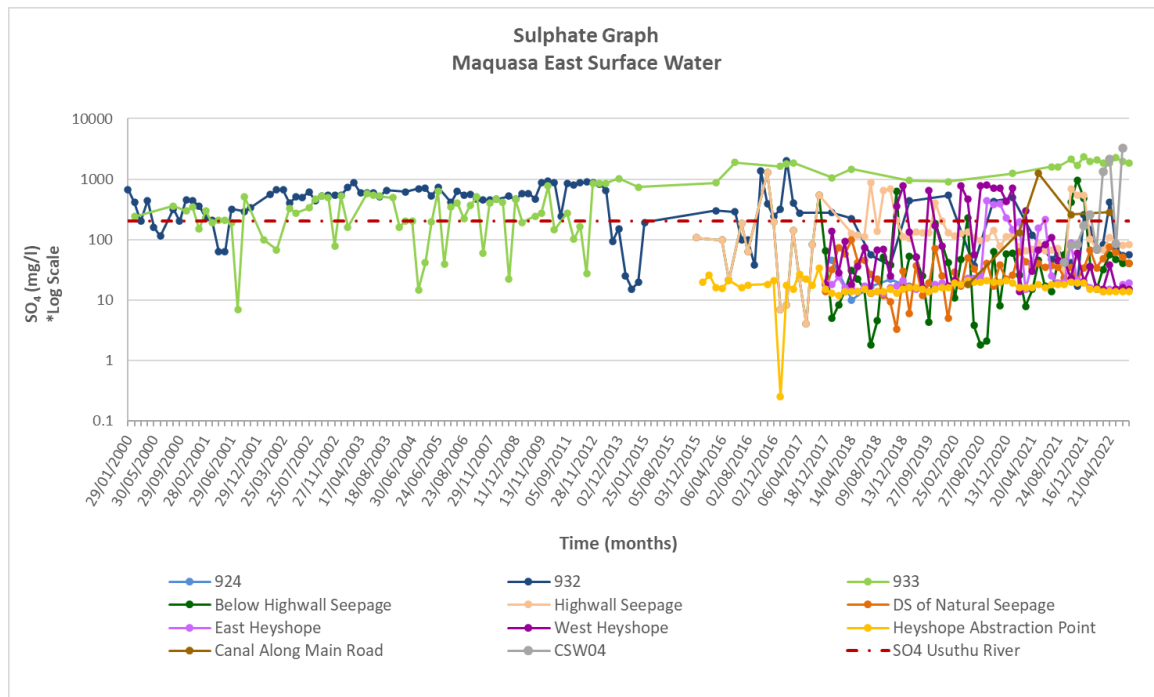
- CSW04 and SW 933 indicated an impact from the site during the 2022 second quarter period. CSW04 was compliant with the Usuthu River Catchment TWQG during the May 2022 sampling event and could not be sampled during the July 2022 sampling event due to low water levels.
  - EC, TDS, calcium and sodium concentrations exceeded the Usuthu River Catchment TWQGs at SW 933 throughout the second quarter. TDS ranged between 2 00 mg/l and 3 300 mg/l; refer to Figure 5-6.
  - During the June 2022 sampling event, CSW04 indicated elevated EC, TDS, calcium and sodium concentrations exceeding the Usuthu River Catchment TWQGs. Elevated salt concentrations at CSW04 are likely due to evaporation at this locality causing the water to become more concentrated.



**Figure 5-6: Maquasa East logarithmic surface water TDS graph**

- Sulphate concentrations predominantly exceeded the Usuthu River Catchment TWQG at CSW04 and SW 933; refer to Figure 5-7.
  - Sulphate at SW 933, located downstream of the underground workings, has historically fluctuated however, a relatively stable trend has been observed since 2013. Sulphate ranged between 1 840 and 2 260 mg/l in the second quarter.
  - Sulphate at most localities indicated slight decreases in concentrations during the second quarter.

- Sulphate exceeded the Usuthu River Catchment TWQG at CSW04 (3 230 mg/l) during the June 2022 sampling event.
- Additionally, ammonia (8 mg/l) and nitrate (30 mg/l) were elevated at CSW04 during the June 2022 sampling event. SW 933 indicated elevated ammonia (7.8 mg/l) concentrations during the June 2022 sampling event.
- In terms of metal concentrations, manganese was in exceedance at SW 933 and CSW04, ranging between 3 and 10.0 mg/l.



**Figure 5-7: Maquasa East logarithmic surface water sulphate graph**



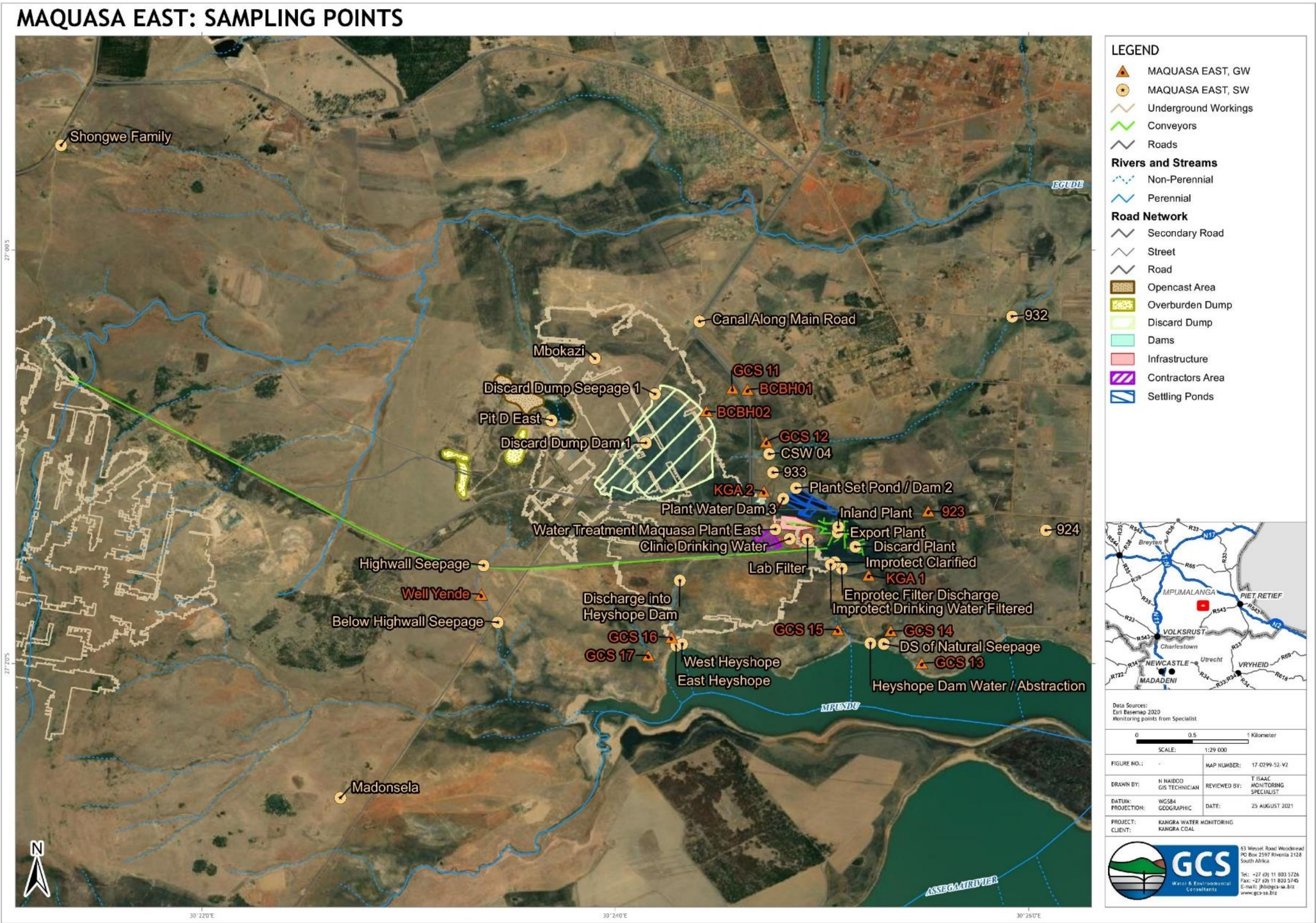


Figure 5-8: Monitoring Network for Maquasa East



## 6 SITE CONCEPTUAL MODEL

The hydrogeological conceptualisation describes the Project's hydrogeological environment and is based on the source-pathway-receptor principle. The site conceptual model developed for the site is shown in Figure 6-1.

Based on the groundwater data collected, it is confirmed that two (2) aquifers exist in the area:

- A shallow unconfined aquifer system associated with weathered Ecca sediments; and
- A deeper confined intergranular and fractured aquifer network is associated with the argillaceous and arenaceous rocks associated with the Vyheid Formation. The aquifer units may be intercepted and compartmented by intrusive dolerite sills and sykes.

### 6.1 Sources

The geochemical characterisation of the discarded material indicated that the material is likely to act as a source of contamination. Based on the geochemical analysis of the discarded material, the sulphate concentrations range between ~220 and ~420 mg/L (TDDS 800 to 1200 mg/l), as a result of pyrite oxidation. Aluminium, iron and manganese will be present at elevated concentrations in acid mine drainage.

The co-disposal facility and the brine treatment pond will be lined by a comprehensively engineered barrier liner system consisting inter alia of a combination of clay and geosynthetic membranes, with leakage detection and collection system/s in place. This is to ensure full containment and to minimise the risk of contaminating the underlying aquifer system/s.

Therefore, the proposed discard storage facility and associated infrastructure are unlikely to act as a significant contaminant source provided the liner system/s is not compromised during construction, operation and post-closure.

### 6.2 Pathways

Based on the aquifer characteristics (e.g. weathering depth, groundwater strike and static water levels), the hydrogeological system at the Project site can be categorised into two aquifers: shallow weathered rock/material aquifer and deeper fractured rock aquifer hosted within the Vryheid Formation sediments.

Shallow weathered rock/material aquifer - Vryheid Formation sediments comprise highly weathered material and have an average thickness of between ~5 and ~12 m. Due to the limited depth extent and average depth to groundwater (between ~9 and ~12 m), it is unlikely that this system will comprise a significant groundwater potential. However; in terms of seepage emanating contaminant transport, this aquifer is considered important. No site-specific aquifer hydraulic characteristics are available for this aquifer unit.

*Deeper fractured rock aquifer - Vryheid Formation sediments* comprise a thick sequence of interlayered sediments with limited primary porosity. Secondary structures are likely to result in the development of discrete zones of high hydraulic conductivity. Limited structural information is available due to the localised Project extent, relative to the extent of the Vryheid Formation and available data. Although specific differences in the lithological units of this formation are observed (e.g. degree of weathering and alteration etc.), the lithology of this formation can be considered similar across the Project site. No site-specific aquifer hydraulic characteristics are available for this aquifer unit.

Groundwater across the Project site flow towards the northwest (a subdued reflection of the surface topography), with groundwater levels varying from the surface (seepage) to ~12 mbgl. The variation in groundwater levels is most likely a result of localised structural features (i.e. barrier) traversing the Project site. Recharge processes are using direct and indirect infiltration of precipitation. Project-specific recharge values are not known. Based on values sourced from the scientific literature (i.e. Hodgson *et al*, 2007), a recharge of 1 to 3% of the annual precipitation is estimated for the fractured rock aquifer unit. Recharge within the footprint of the proposed discard storage facility is considered insignificant due to the proposed liner system.

The ephemeral alluvial aquifer system located down-gradient of the Project site is regarded as a potential discharge zone.

### 6.3 Receptors

Although there are no groundwater-dependent receptors within the immediacy of the Project site, the ephemeral flow system is considered sensitive due to its locality concerning the Project site. Provided the integrity of the liner system/s is not compromised during the construction, operation and closure and post-closure phases of the Project, no impacts are expected.

With regards to the proposed brine storage pond, the weathered aquifer zone and the Heyshope dam are the receptors of potential pollution.



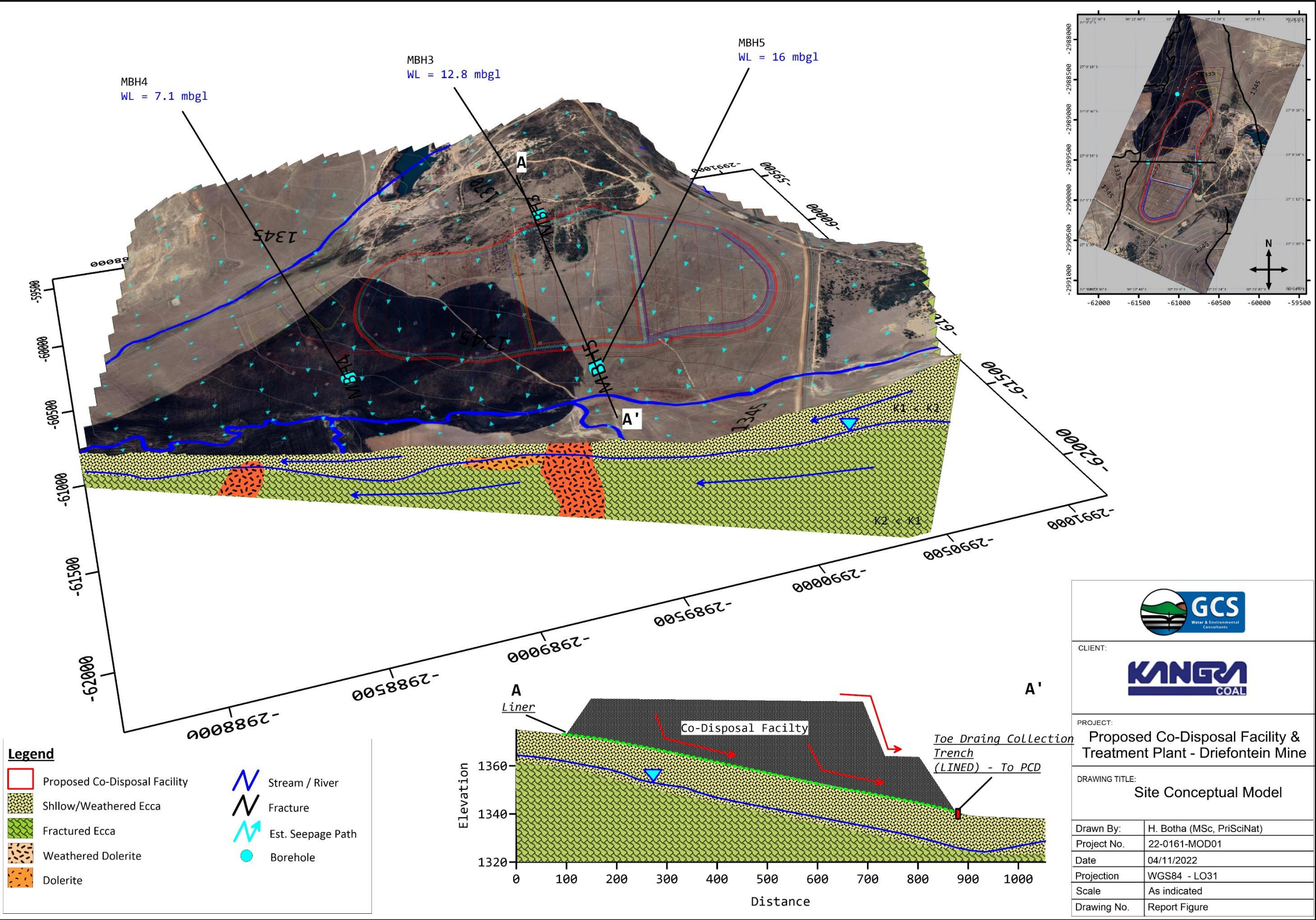


Figure 6-1: Site conceptual model

## 7 NUMERICAL GROUNDWATER MODEL

The following section supplies an overview of the numerical flow and transport model developed to assess the likely impacts associated with the proposed co-disposal facility and the treatment plant (and brine storage pond). The conceptual model was used to develop the numerical groundwater flow and transport model.

### 7.1 Model objective

The groundwater flow and transport models were developed to:

1. Understand the operational groundwater flow system.
2. Simulate the existing Zone of Impacts (ZOIp) associated with the Maquasa East operations, and
3. simulate the potential cumulate impacts associated with the development of the proposed infrastructure.
  - a) A worst-case scenario was simulated, where the facilities are not lined (Please Note: The engineering designs propose lining the facilities with impermeable barriers).
  - b) Simulate preferential flow paths from the proposed co-disposal facility and the WTP & brine storage pond.
  - c) Simulate potential plume movement from unlined facilities and calibrate the plume with the existing monitoring boreholes.  $\text{SO}_4$  was used to illustrate plume movement.  $\text{SO}_4$  is a well-known pollution tracer for SA mined (INAP, 2022).
4. Incorporate findings into the groundwater monitoring and management plan to assess hydrogeological risk and impacts in the area.

### 7.2 Assumptions and limitations

There are uncertainties in the groundwater flow simulated by a numerical model. These uncertainties are due to:

- Simplifications and assumptions in the design of the model.
- Uncertainty in the boundary conditions and input parameters; and
- Limited data is available to calibrate the model to the observed groundwater flow systems.

The model uncertainties and assumptions are as follows:

- Recharge for rehabilitated opencast areas is estimated at 15% of the MAP, while the regional aquifer recharge is estimated in the order of 5% of the MAP (Hughes, 2004).



- Available water levels were averaged and assumes to have been constant for one (1) hydrological year. No time-series water level data were made available for the Maquasa East boreholes. This is a best-case scenario applied, due to limited data.
- Transmissivity, storage and porosity values for similar rock types in the area are assumed to be in the same order as available data (refer to Section 5.3).
- The plume presentation indicates a 250 mg/l and 1000 mg/l sulphate plume contour line (also referred to as the Zone of Impact “ZOIp”):
  - The above-mentioned was applied to demarcate contaminated groundwater zones.
  - The 200 mg/l and 1000 mg/l zones represent the 1996 DWAF Target Water Quality Range for Domestic Use (DWAF, 1996b) and Livestock Watering (DWAF, 1996c), respectively.
  - These guidelines are not intended to be used for environmental compliance and are used only as a benchmark value, as a means of contextualising the results. Table 7-1 lists the target water quality range for sulphate as per the DWAF 1996 guideline document.
- The numerical model was updated with the latest hydrochemistry and hydrogeological information available for the Maquasa Operations (2022).

**Table 7-1: Summary of the target water quality range as per DWAF guidelines**

System	Target Water Quality Range - SO <sub>4</sub> (mg/l)			
Aquatic Ecosystems (DWAF, 1996d)	N/A			
Domestic (DWAF, 1996b)	Human Consumption			
	0-200			
Recreation (DWAF, 1996e)	Full Contact		Intermediate Contact	
	NA		NA	
Industry (DWAF, 1996f)	Category 1	Category 2	Category 3	Category 4
	0-30	0-80	0-200	0-500
Agriculture (DWAF, 1996c)	Livestock Watering	Irrigation	Agriculture	
	0-1000	N/A	N/A	

### 7.3 Conceptualisation and Model Grid

Based on the available data, a conceptual model of the study area was formulated. The conceptual model explains the aquifers that occur in the area, the spatial relationship between the aquifers, aquifer thickness, general geology, groundwater levels and flow directions.

#### 7.3.1 Boundary Conditions

Boundary conditions express how the considered domain interacts with its environment. In other words, they express the conditions of known water flux, or known variables, such as the hydraulic head. Different boundary conditions result in different solutions, hence the importance of stating the correct boundary conditions. Boundary condition options in MODFLOW can be specified either as:

- Specified head or Dirichlet; or
- Specified flux or Neumann; or
- Mixed or Cauchy boundary conditions.

From the conceptual point of view, it was essential to meet two criteria to the maximum extent possible:

- The modelled area should be defined by natural geological and hydrogeological boundary conditions, i.e. the model domain should preferably encompass entire hydrogeological structures; and
- The mesh size of the model grid has to correspond to the nature of the problem being addressed with the model.

Local hydraulic boundaries were identified for model boundaries. They are represented by:

- Local watershed boundaries;
- Topographical highs;
- Constant head and general head boundaries; and
- The delineated area of the entire model domain.

These hydraulic boundaries were selected far enough from the area of investigation to not influence the numerical model behaviour artificially.

The model boundaries and model grid are shown in Figure 7-1 and Figure 7-2. Table 7-2 provides a summary of the boundaries, boundary descriptions and boundary conditions specified in the hydrogeological model.

**Table 7-2: Identification of the real-world boundaries and the adopted model boundary conditions**

Boundary	Boundary Description	Boundary Condition
Top	The top surface of the water table	Mixed type: Drain cells for main rivers and non-perennial drainage streams.  Constant head and general head boundaries for dams (i.e. Heyshope Dam)  Recharge is constant for the model area. Recharge flux is applied to the highest active cell. Artificial recharge is not considered for unknown values.
North	No-flow boundary and stream/river	Topographical high/low/stream
East	No-flow boundary and stream/river	Topographical low, streams/drain, and constant head boundary for Heyshope Dam
South	No-flow boundary and stream/river	Topographical highs/lows and streams
West	No-flow boundary and river	Topographical high /stream

### 7.3.2 Construction of the Finite Difference Grid

Compilation of the finite difference grid using the Visual MODFLOW graphic user interface facilitated the construction of a rectangular horizontal grid, as well as vertical geometry provided for each of the layers. The flow model was set up as a three-layer, confined / semi-confined aquifer.

The positions of the different geological boundaries are incorporated into the modelling grid. A grid refinement of 5-40 m x 5-40 m cells for the MQE and MQW areas which gradually coarsens away from the site was applied. This is standard practice and does not influence the accuracy of the results obtained.

### 7.3.3 Vertical Discretization

Along the vertical direction, the steady-state hydrogeological model is structured in 5 model layers. The layer positions were selected to best incorporate the conceptual model and to allow for accurate horizontal and vertical groundwater flow in the model. The following layers were defined:

- Layer 1 - Topographic elevation and combination of the dolerite sill intrusion of the mountain area up to a maximum depth of 110 mbgl; and weathered and partly-weathered Eccu formation sediments up to a maximum depth of 25 mbgl.

- Layer 2- Lower weathered and main coal seam occurrence in the area. The layer corresponds to the approximate underground working depth and generally dips in the direction of the coal seam. The layer thickness was set to 5 m to ensure that the MODFLOW numerical engines properly simulate the underground flow and transport regimes.
- Layer 3 - Lower weathered and main coal seam occurrence in the area. Follows the dip and direction of layer 2. The layer thickness was set to 10 m to ensure that the MODFLOW numerical engines properly simulate the underground flow and transport regimes.
- Layer 4 - Lower weathered (transition zone) and partly fractured aquifer (Ecca group) > 30-60 mbgl.
- Layer 5 - Deeply fractured basement aquifer > 60 mbgl.

#### **7.3.4 Time Discretization**

Time parameters are relevant when modelling transient (time-dependent) conditions. They include time units, the length and number of periods and the number of time steps within each period. All model parameters associated with boundary conditions and various stresses remain constant during one time period. Having more periods allows these parameters to change in time more often (Kresic, 2007).

The steady-state groundwater flow model was used for sensitivity analysis. For the simulation of pollution plume migration and dewatering, the transient simulation was discretized into stress periods of 4 months.

#### **7.3.5 Transient State Model Simulation Time**

The model simulation time runs from the year 1998 to the year 2163. The model simulation time takes into consideration the chronological order of events (i.e. start and end of underground mining, opencast mining etc.) which occurred/occur in the Maquasa and Nooitgesien operations.

Table 7-3 lists the model simulation time. The timeline was simplified to construct the groundwater model. The simulation time was compiled from available reports and satellite imagery for the mining area.

**Table 7-3: Model Simulation Time**

Model Phase	Year	Model Time	Event
Calibration	1995	-	No Mining
	1996	-	MQE Adit Start. No water level or quality data is available.
	1996	-	MQE Discard Dump Start. No water level or quality data is available.
	1998	0	First water level and quality data available. Model Start
	2002	1460	Opencast (Pit G) at MQE commences.
	2003	1825	MQW 1st Adit started.
	2006	2920	Opencast north of MQE (ROMA) commences.
	2007	3285	MQW 2nd Adit started.
	2009	4015	MQW Opencast started.
	2012	5110	MQE South opencast started.
	2013	5475	MQW opencast extension started. NZ Opencast started.
	2014	5840	MQE + MQW pit rehabilitation / backfilling started.
	2015	6205	NZ opencast mining and MQW underground mining. Calibrated Flow and Transport Model Time
	2016	6570	
	2017	6935	
	2018	7300	
	2019	7665	
	2020	8030	
	2021	8395	
	2022	8760	Calibration 2022
Prediction	2023	9125	Co-Disposal Discard Dump Constructed
	2043	16425	Co-Disposal Discard Dump
	2093	34675	50Y Plume (No Mitigation) - Based on the calibrated model.
	2143	52925	100Y Plume (No Mitigation) - Based on the calibrated model.
	2163	60225	Simulation End



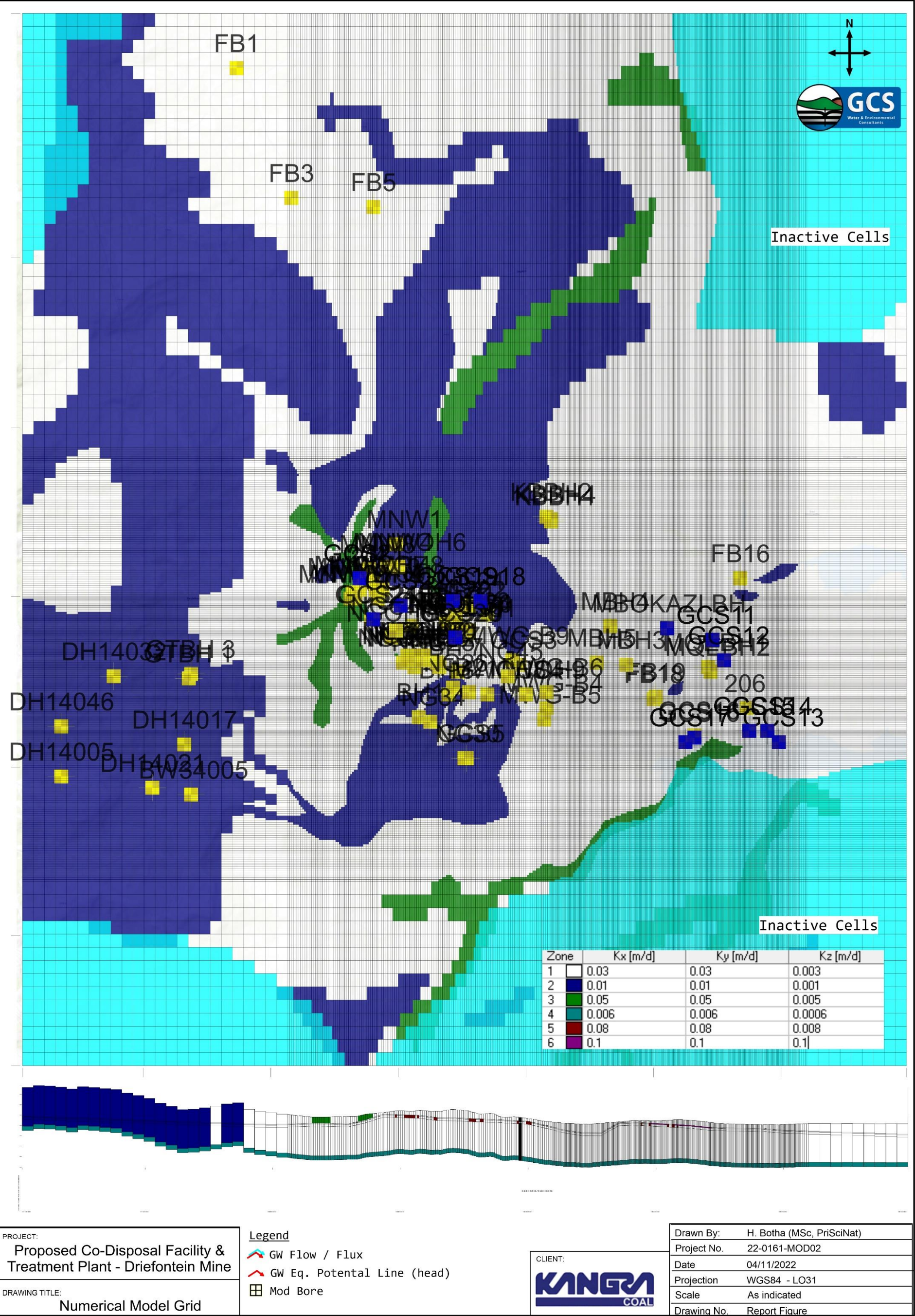


Figure 7-1: Model grid & conductivity



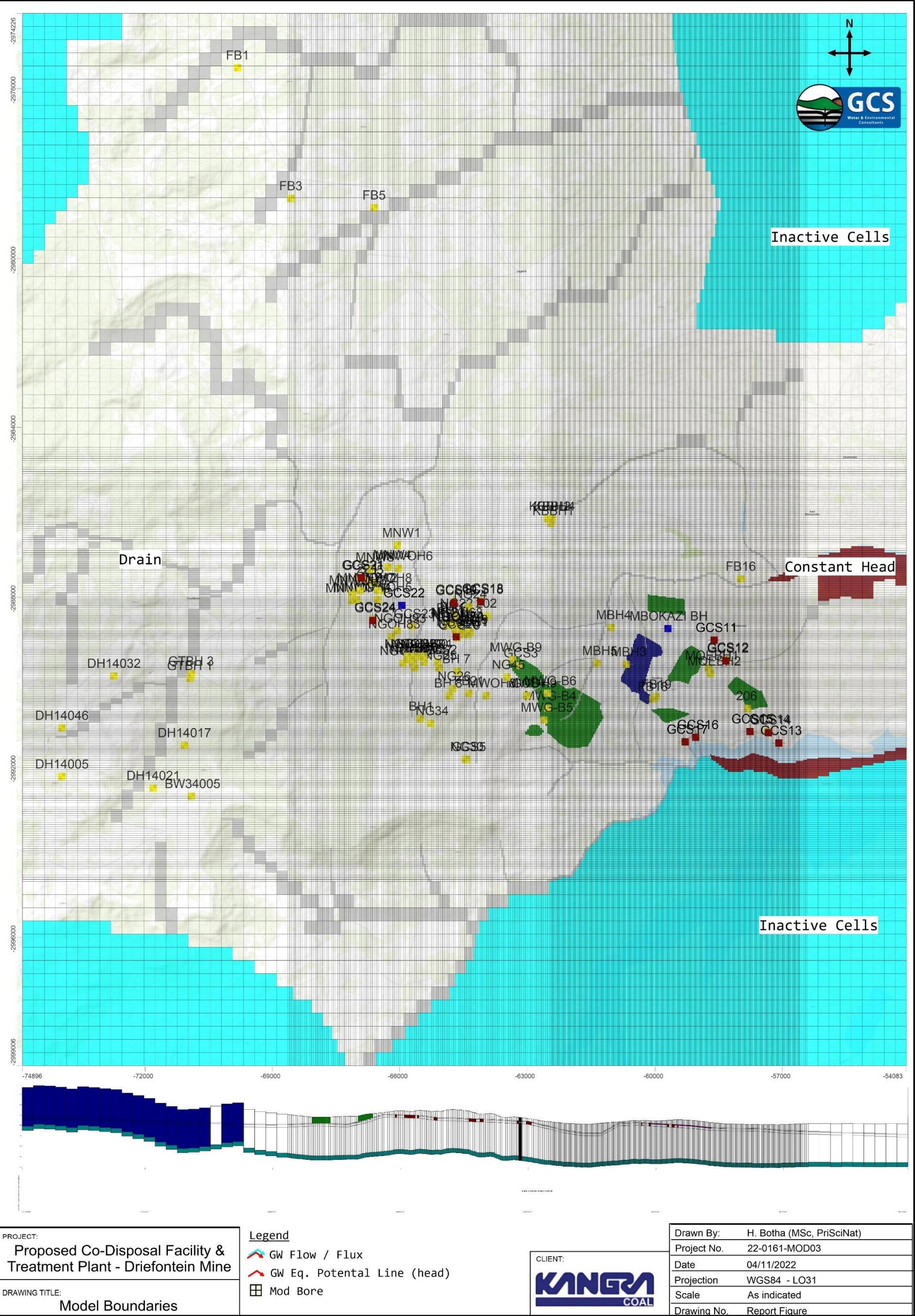


Figure 7-2: Model boundary conditions



### 7.3.6 Input Parameters/Initial Model Conditions

Model input parameters for this flow model are divided into two groups:

1. Hydrogeological parameters (hydraulic conductivity, recharge and aquifer storage); and
2. Initial conditions.

The initial estimates for the hydraulic properties were assigned based on the aquifer test results for the 2013 test work conducted for Maquasa East and West. These hydraulic conductivity values were assigned to geological layers in the model area. The initial estimates were used for a combination of Parameter Estimation Simulation (PEST)<sup>1</sup> and manual calibration.

The initial head conditions, specified in the steady-state model, were estimated from topography. Initial transient model heads were derived from the steady-state model results.

Five per cent (5%) recharge of average annual rainfall was applied, which is approximately 48 mm/a. Due to the anticipated homogeneous nature of the geology in the study area, similar parameter values were assigned to the entire model domain.

Table 7-4 summarises the input parameters used in the steady state and transient state flow models.

**Table 7-4: Input parameters to the flow model**

Parameter	Value used
Horizontal Hydraulic conductivity (Kxy)	0.001 to 0.08 m/day
Vertical Hydraulic conductivity (Kz)	0.0001 to 0.008 m/day
Specific storage coefficient (Ss)	In the order of $1 \times 10^{-5}$
Specific yield (Sy)	0.2 - 0.3
Recharge (Re)	48 mm/yr
Porosity (n) (total)	0.1 - 0.5
Top elevation	Corresponded to surface topography.
Bottom elevation of the 1 <sup>st</sup> layer - extrapolated for rest of model grid	Corresponded to elevation 5 metres above the interpolated coal floor. Describes the weathered and partly weathered Ecca and dolerite aquifer rock in the area. Follows the curvature of the coal seam with a > thickness at the mountain area and < thickness further away from the mountainous area (110 m to 25 m)
Bottom fixed elevation of the 2 <sup>nd</sup> layer	Corresponds to the elevation of the coal floor.

<sup>1</sup> PEST (Parameter Estimation Simulation): automated parameter estimation tool, which provides a sensitivity and uncertainty analysis of the model, and much more.

Parameter	Value used
Bottom fixed elevation of the 3 <sup>rd</sup> layer	Approx. 10 m below the coal floor.
Bottom fixed elevation of the 4 <sup>th</sup> layer	Approx. 50-150 m below the bottom of layer 3. This layer represents the transition area between younger and deeper basement aquifer rock. Follows the curvature of the coal seam.
Bottom fixed elevation of the 5 <sup>th</sup> layers	Approx. 50 m below the bottom of layer 4. This layer represents older Ecca and Karoo rock.

### 7.3.7 Model Calibration

Calibration is the process of finding a set of boundary conditions, stresses and hydrogeological parameters that produce results which most closely match field measurements of hydraulic heads and flows.

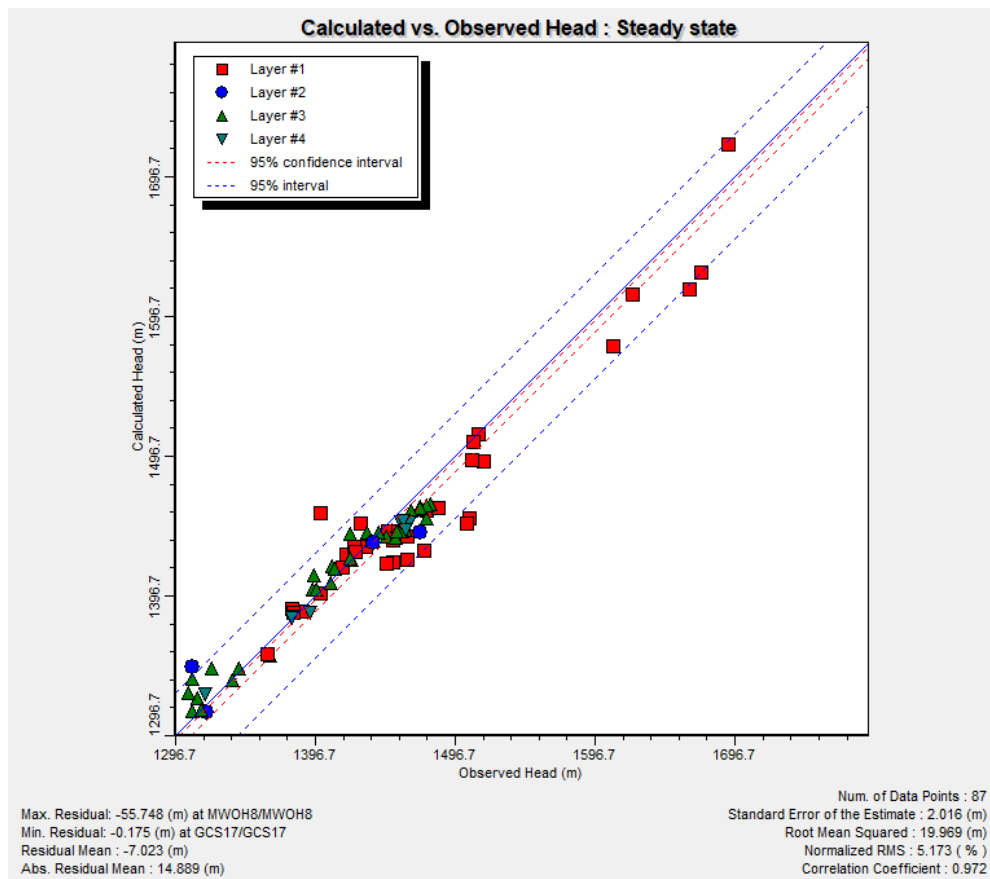
In a catchment scale groundwater flow model, a difference between calculated and measured heads of up to several meters can be tolerated and is usually expressed as a function of the total range of observations. A scaled absolute mean value of below 10% is generally regarded as acceptable for a regional model (Tiedeman and Hills, 2005).

This calibration was done under steady state and transient state conditions. When calibrated, the model can be used to predict the influence of various management scenarios.

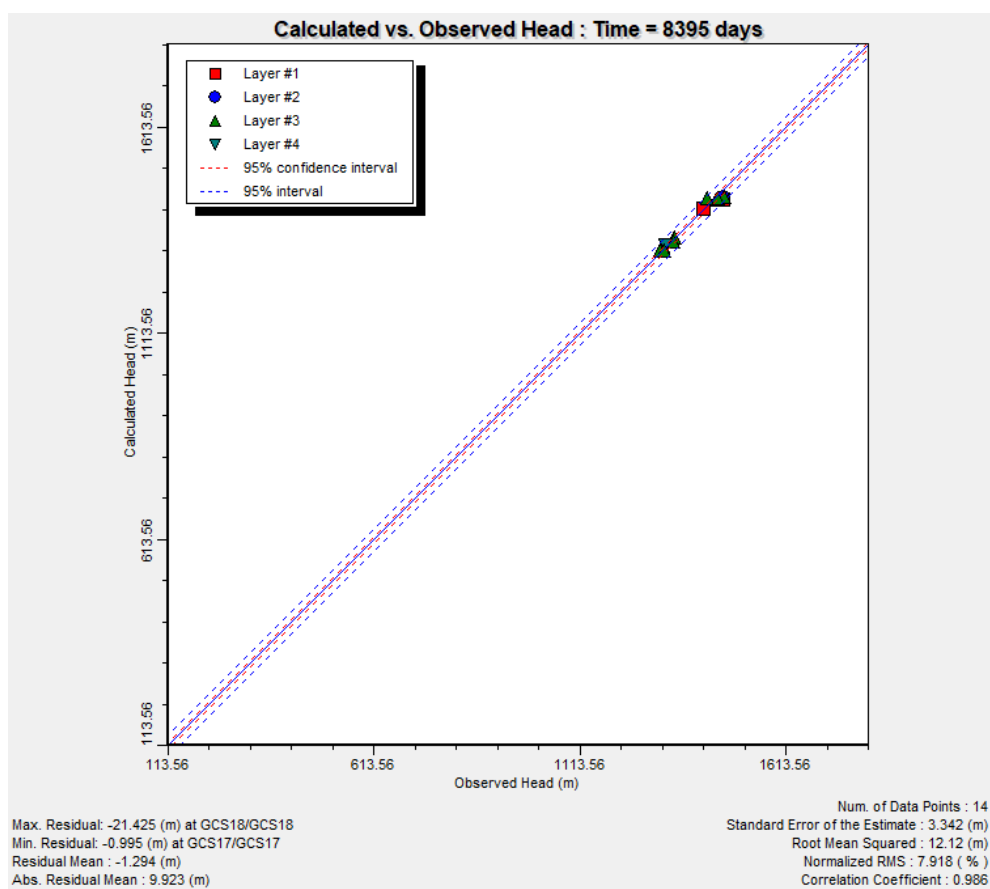
#### 7.3.7.1 Calibration Targets

The groundwater levels and sulphate concentrations of on-site monitoring boreholes for 2002 - 2022 and 1998 - 2022 hydrocensus data were made available for calibration.

The model was calibrated according to average 2022 sulphate and water level data. The steady state, transient state and transport model calibration achieved are shown in Figure 7-3 to Figure 7-5.

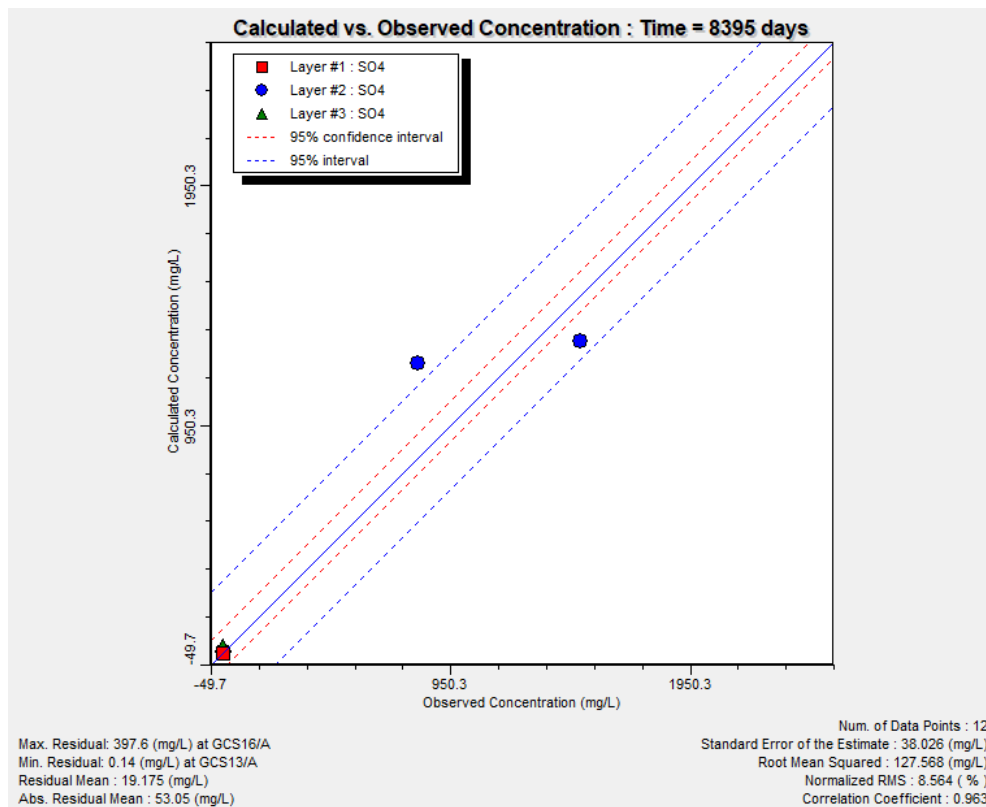


**Figure 7-3: Steady-state model calibration achieved**



**Figure 7-4: Flow model calibration achieved (2022)**





**Figure 7-5: Sulphate plume calibration achieved (2017-2018 period)**

#### 7.3.7.2 Model sensitivity

A sensitivity analysis was carried out on the calibrated steady-state model using zones to assess the influence on groundwater level and flow dimensions by running the model in the *PEST* and sensitivity mode.

It can be seen from Figure 7-6 that the calibrated residuals (calculated heads vs observed heads) are slightly skewed towards the right. However, most of the data plots within the normalised distribution of the dataset are used for calibration.

The following parameters were observed to be sensitive (refer to Figure 7-7):

- Changes in horizontal hydraulic conductivity values ( $K_x$  and  $K_y$ );
- Recharge (indicated as par001); and
- Storage (SS) within layer 2.

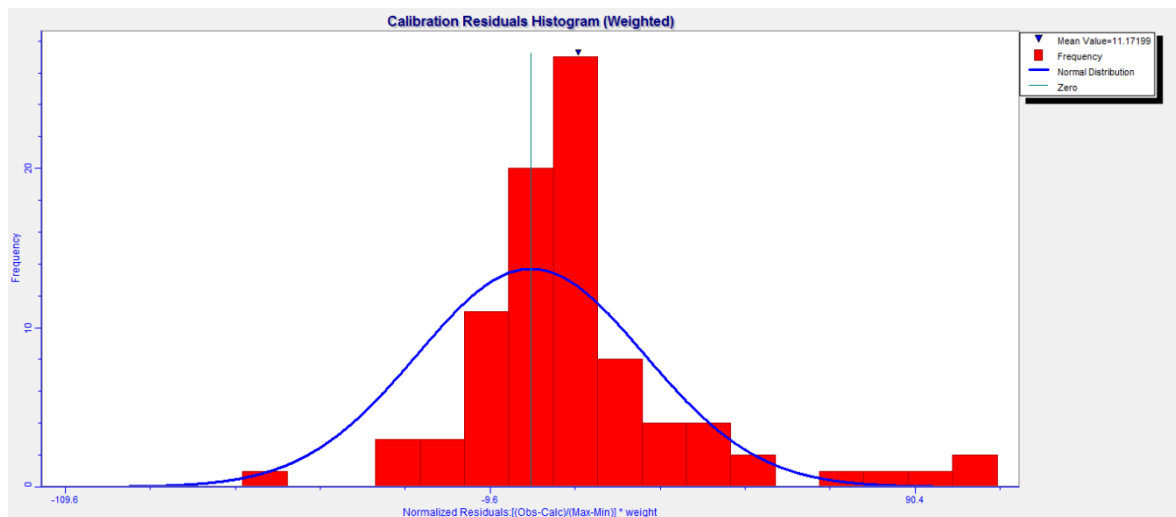


Figure 7-6: PEST Sensitivity Analysis - Histogram

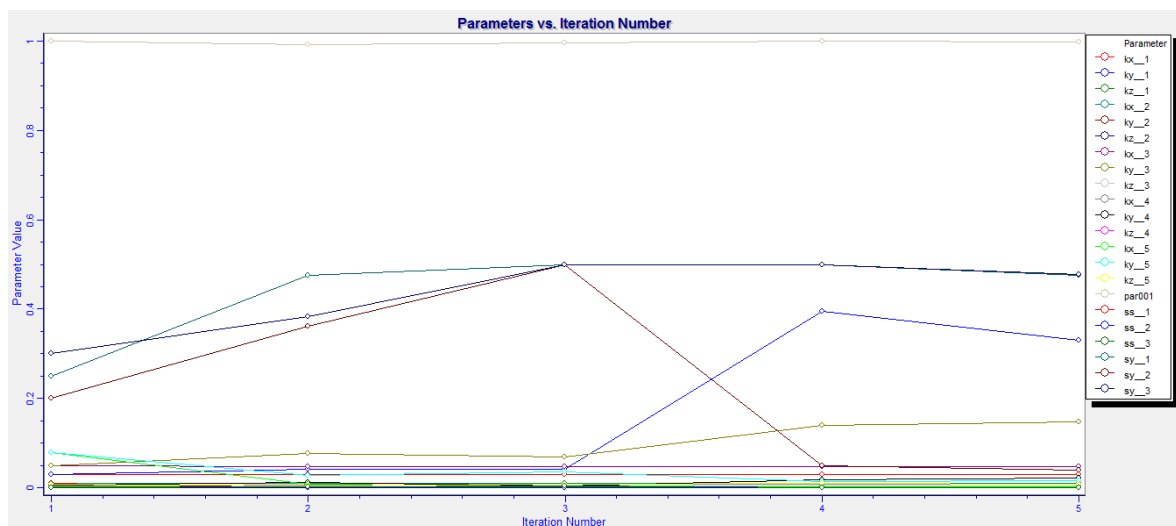


Figure 7-7: PEST Sensitivity Analysis - Weighted Parameter Sensitivity

#### 7.4 Calibrated flow models

The calibrated flow model with simulated groundwater elevations is shown in Figure 7-8. The following is noted when evaluating the flow model (*with a focus on the proposed co-disposal facility, WTP and brine storage facility*):

- The groundwater table mimics the topography.
- Groundwater flow from the co-disposal facility is towards the northwest, towards the stream.
- Groundwater flow from the proposed brine pond is towards the south, towards the Heyshope dam.
- Groundwater flow for the Maquasa East and the proposed WTP area is towards the northeast.
- The flow model indicates groundwater flow velocities ranging from 0.01 (min) to 1.75 (max) m/day (or 638 m/yr). Groundwater movement in the weathered zone is greater than that of the deeper aquifer zones, as well as several orders greater in the alluvium zones when compared to the host rock.

#### 7.5 Simulated 2022 plume and 20-year plumes

The calibrated TDS for the Maquasa East well as the predicted 50-year and 100-year sulphate plume movement from the proposed co-disposal facility and WTP brine pond is shown in Figure 7-9.

It can be seen that there is an existing mining impact in the Maquasa East area, primarily as a result of the old rehabilitated opencast operations, partially flooded underground workings and the coal processing and beneficiation area.

The 50-year and 100-year predictions are based on a 'no mitigation' scenario, where the proposed facilities are not lined. It can be seen from the 50-year and 100-year predictions, that the proposed co-disposal facility and the WTP may add to the existing impact footprint. The 250 mg/l plume front does not intercept the surrounding water courses and remains close to the proposed facilities.

If the facilities are lined, as is proposed by the engineering designs for Type C waste streams, then no poor-quality seepage is expected. There may then only be a slight risk of contaminant runoff during storm events.



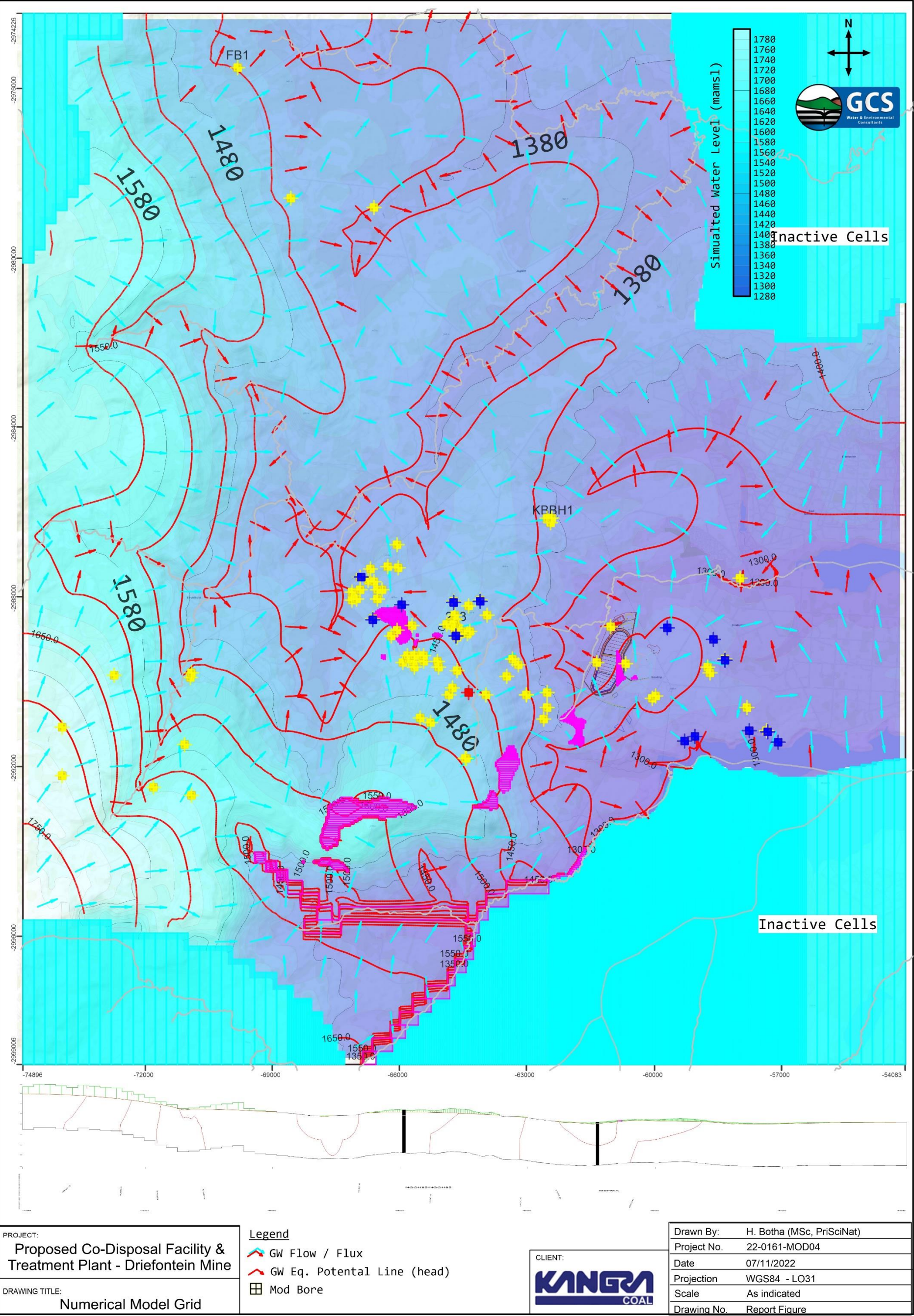


Figure 7-8: Calibrated flow model



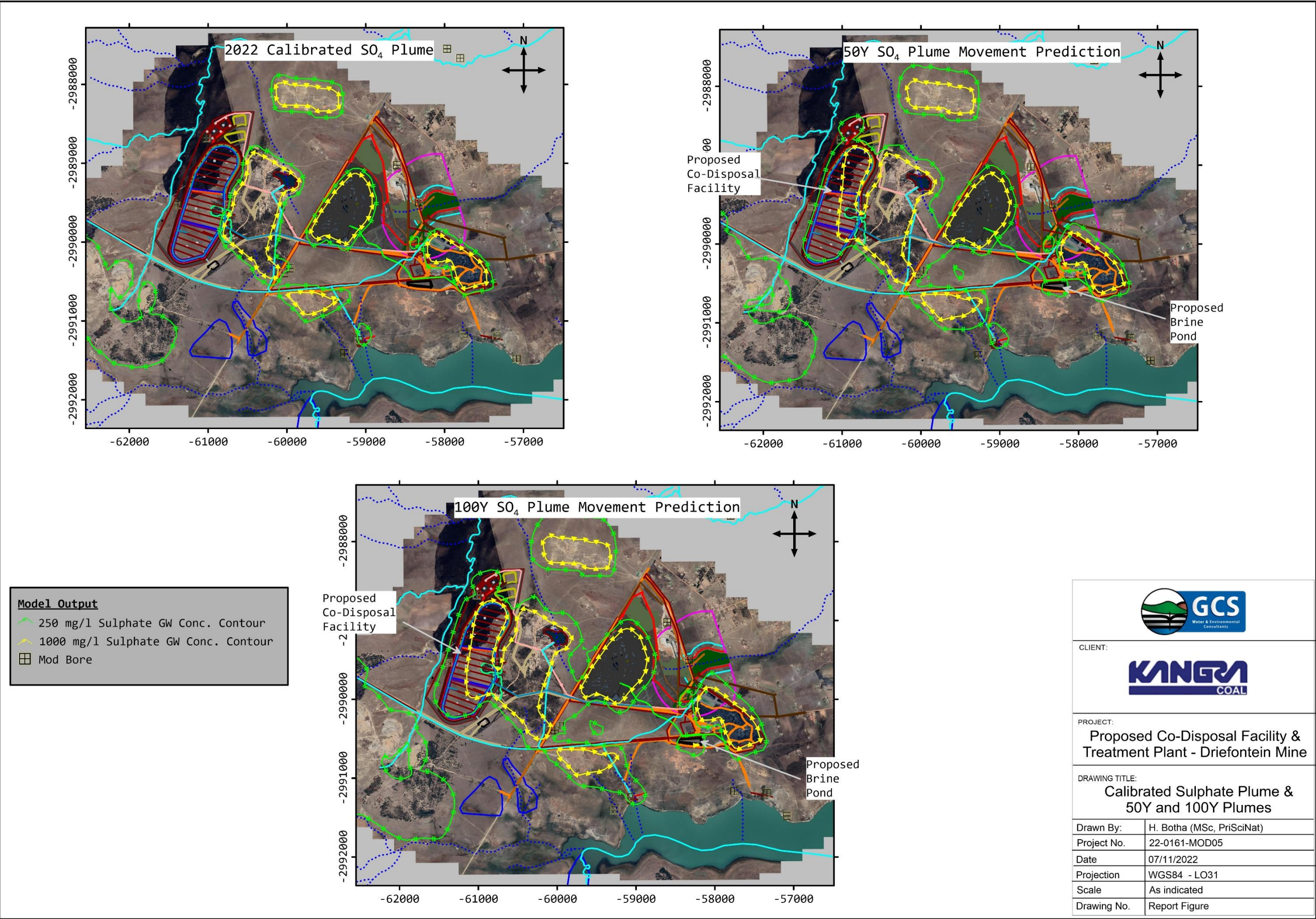


Figure 7-9: Calibrated 2022 SO<sub>4</sub> plumes, 50Y and 100Y unmitigated plumes from proposed developments



## 8 GEOHYDROLOGICAL RISKS ASSESSMENT & MITIGATION MEASURES

Risk assessment entails the understanding of the generation of a hazard, the probability that the hazard will occur, and the consequences should it occur. The risk assessment is based on the conceptual site model and the numerical model outputs, and further incorporates a worst-case scenario approach.

The anticipated geohydrological risks identified are discussed in Sections 8.1 to 8.3. The net consequence of geohydrological risk was established by the following equation:

$$\text{Consequence} = (\text{Duration} + \text{Extent} + \text{Irreplaceability of resource}) \times \text{Severity}$$

The environmental significance of an impact was determined by multiplying the consequence by probability. The risk significance rating is summarised in Table 8-1.

**Table 8-1: Risk rating scale**

Criteria	Rating Scales
Significance	Very high - negative (-49 to -66)
	High - negative (-37 to -48)
	Moderate - negative (-25 to -36)
	Low - negative (-13 to -24)
	Neutral - Very low (0 to -12)
	Low-positive (0 to 12)
	Moderate-positive (13 to 24)
	High-positive (37 to 48)
	Very high - positive (49 to 66)

In terms of the proposed developments, several hydrological risks were identified. The potential impacts identified and environmental significance for the construction, operational and closure phases are listed in Table 8-2, Table 8-3 and Table 8-4.

### 8.1 Pre-mining/development phase

The activities during the pre-development phase will generally include the following:

- vegetation clearance;
- topsoil and sub-soil stripping and stockpiling; and
- construction and introduction of infrastructure (i.e. roads, discard storage facility), including the risk of spillage of oils/fuel.

The identified risks for the construction/development phase include (Table 8-2):

- Typical earthworks are required to start construction of the disposal facility and WTP. This includes the destruction of the localised geological units during excavations. This impact is permanent and is therefore not included in the impact table as no mitigation measures can be recommended.

- Clearing topsoil from footprint areas will influence the rate of infiltration of water to the shallow groundwater system and/or base-flow component to shallow streams. The establishment of compacted areas during infrastructure and haul road construction reduces the recharge to the underlying aquifers due to increased runoff.
- The potential spillage of hydrocarbons from construction equipment during the construction of infrastructure, topsoil and overburden stripping as well as haul road construction which has the potential to cause the pollution of groundwater and surface water resources.

The continuation of the existing monitoring plan during construction is critical. This will ensure that water quality is continuously monitored. The collected information should be used as part of an active water management system and act as an early warning system for the application of mitigation measures. Except for the destruction of the geology, the other identified impacts during the construction phase are rated low after mitigation and management measures are applied. The identified impacts are therefore not likely to negatively affect the commencement of the proposed project.

## 8.2 Operational Phase

During the operational phase, minimal impact on the groundwater system/s is expected, due to Kangra's commitment to design the facility to mitigate all adverse environmental impacts on groundwater resources (i.e. liner system, concurrent rehabilitation methodology).

The key activities that could have a potential impact on groundwater in this phase include:

- Deposition of coal slurry and coal discard on one footprint. There is a possibility of the addition of brine to the discard dump; and
- Seepage and runoff from the proposed discard storage facility and associated infrastructure (e.g. PCD/s).

The identified risks for the operational phase include (refer to Table 8-3).

- Analyses showed that acid mine drainage (AMD) formation is expected and poor-quality leachate can occur based on the leaching potential of the material. This can influence runoff, soil, and groundwater quality. Containment systems are proposed and need to be regularly checked to ensure no seepage to the environment takes place;
- Liner system (i.e. storage facility and PCDs) - deterioration/damage to the liner system (during construction and operational phases) will cause contaminated seepage to migrate from the site (both vertically and laterally);

- Uncontrolled or emergency release - uncontrolled and/or emergency release of effluent from the PCD/s will cause contaminated seepage to migrate from the site (both vertically and laterally).

The installation of a comprehensively engineered barrier liner system reduces the recharge of aquifers due to containment. This is considered a LOW impact, localised and of long duration.

### **8.3 Closure and Post-Closure Phase**

The closure and decommissioning phases will be per an agreed and approved closure plan for the WTP (if decant ceases) and co-disposal facility. This will entail:

- Termination of landfill/ co-disposal activities onto the co-disposal footprint area and rehabilitation; and
- Installation of long-term stormwater systems or upgrades to the operational stormwater system.

The identified risks for these phases include (refer to Table 8-4):

- Poor quality seepage and runoff from the co-disposal facility; and
- Poor quality seepage from vehicles accessing the site to do rehabilitation work.

Apart from continuous monitoring, engineering and managerial mitigation measures, including the evaluation of newly identified impacts during the construction and operational phases, the key closure and post-closure objective would be to minimise infiltration of precipitation.

To achieve this objective, it is proposed that a regulating authority-approved engineered designed capping is constructed to limit precipitation and oxygen infiltration and to enhance run-off and evaporation. This will assist in the management of potential high seepage at the facility toe after closure. The impacts are expected to have a HIGH positive significance rating due to Kangra's proposed facility and associated infrastructure design criteria.

### **8.4 Cumulative impacts and impacts on the hydrological cycle**

As all activities will take place on the same property, there will be cumulative impacts. The proposed discard dump is zoned in an area where existing mine impacts are noted. The construction and operational phase risk table includes cumulative risks about the site, and activities thereon. Considering the sub-catchment and the activities associated with the site and surroundings, no impacts are expected in terms of the site hydrogeology. This is due to the proposed dump being lined, negating the risk of contamination reaching the groundwater system.

---

Treated water will be discharged into the Heyshope dam at the existing decant rate at pristine water quality (in line with GA limits for treated effluent discharge), and therefore will likely not have a negative impact on water quantity or quality. Compared to the active decant water quality, the proposed activity is predicted to improve the Heyshope water quality. Proposed discharge will take place at an existing abstraction point west of Driefontein, that is no longer in use.

Table 8-2: Pre-mining/construction phase hydrogeological risk

Component Being Impacted On	Activity Which May Cause the Impact	Activity	Pre- Mitigation							Recommended Mitigation Measures	Post Mitigation							Confidence
			Duration	Extent	Potential for impact on irreplaceable resources	Severity	Consequence	Probability	Significance		Duration	Extent	Severity	Potential for impact on irreplaceable resources	Consequence	Probability	Significance	
Vadose zone soils	Disturbing vadose zone during soil excavations/activities.	Earthworks	Long-Term (4)	Site (2)	Yes (1)	High (-3)	Highly detrimental (-19 to -24) (-21)	Definite (2)	High - negative (-37 to -48) (-42)	<ul style="list-style-type: none"> <li>Only excavate areas applicable to the project area.</li> <li>Keep the site clean of all general and domestic waste.</li> <li>All development footprint areas to remain as small as possible and vegetation clearing to be limited to what is essential.</li> <li>Retain as much indigenous vegetation as possible.</li> <li>Exposed soils to be protected using a suitable covering.</li> <li>Existing roads should be used as far as practical to gain access to the site, and crossing the streams in areas where no existing crossing is apparent should be unnecessary, but if it is essential crossings should be made at right angles.</li> </ul>	Long-Term (4)	Site (2)	Yes (1)	Probable (-2)	Low - negative (-13 to -24) (-14)	Definite (2)	Moderate - negative (-25 to -36) (-28)	Medium
Groundwater quality	Topsoil and sub-soil stripping and stockpiling	Stockpiling	Long-Term (4)	Site (2)	Yes (1)	Probable (-2)	Moderately detrimental (-13 to -18) (-14)	Definite (2)	Moderate - negative (-25 to -36) (-28)	<ul style="list-style-type: none"> <li>Install a temporary cut-off trench (if required) to contain poor-quality runoff.</li> <li>Cover soil stockpiles with a temporary liner to prevent contamination (where required and visually determined).</li> <li>Park vehicles in designated areas.</li> </ul>	Long-Term (4)	Site (2)	Yes (1)	Probable (-1)	Slightly detrimental (-7 to -12) (-7)	Probable (1)	Neutral - Very low (0 to -12) (-7)	Medium
Perched Water Table Dewatering	Temporary dewatering of perched groundwater (only expected during intense storm events and shortly thereafter).	Earthworks	Long-Term (4)	Site (2)	Yes (1)	Low (-1)	Slightly detrimental (-7 to -12) (-7)	Definite (2)	Low (12 to -25) (-14)	<ul style="list-style-type: none"> <li>Water quality monitoring and routine visual assessment for contamination.</li> <li>Discharge dewatered / rainwater collected into the nearby stream. May require authorisation. If water is contaminated, discharge to the closest greywater system (depending on the extent of contamination)</li> </ul>	Long-Term (4)	Site (2)	Yes (1)	Negligible (0) (-0)	Negligible (0 to -6) (-0)	Probable (1)	Neutral - Very low (0 to -12) (0)	Medium



Table 8-3: Operational phase hydrogeological risk

Component Being Impacted On	Activity Which May Cause the Impact	Activity	Pre- Mitigation							Recommended Mitigation Measures	Post Mitigation							Confidence
			Duration	Extent	Potential for impact on irreplaceable resources	Severity	Consequence	Probability	Significance		Duration	Extent	Severity	Potential for impact on irreplaceable resources	Consequence	Probability	Significance	
Shallow Aquifer System	Seepage from the co-disposal facility (landfill), PCDs and brine effluent pond  • Poor quality seepage and runoff from vehicles parked at the site.	Site activities	Long-Term (4)	Site (2)	Yes (1)	Low (-1)	Slightly detrimental (-7 to -12)  (-7)	Probable (1)	Neutral - Very low (0 to -12)  (-7)	<ul style="list-style-type: none"> <li>Keep the site clean of all general and domestic waste.</li> <li>Water quality monitoring of the groundwater system.</li> </ul>	Long-Term (4)	Site (2)	Yes (1)	Probable (-1)	Slightly detrimental (-7 to -12)  (-7)	Probable (1)	Neutral - Very low (0 to -12)  (-7)	Medium
Groundwater Quality and Quantity	Deposition of coal slurry and coal discard on one footprint.	Mine activities	Long-Term (4)	Site (2)	Yes (1)	High (-3)	Highly detrimental (-19 to -24)  (-21)	Definite (2)	High - negative (-37 to -48)  (-42)	<ul style="list-style-type: none"> <li>Groundwater quality monitoring and visual assessments.</li> <li>Stick to the designated operational footprint as far as possible.</li> </ul>	Long-Term (4)	Site (2)	Yes (1)	Low (-1)	Slightly detrimental (-7 to -12)  (-7)	Definite (2)	Low (12 to -25)  (-14)	Medium
	Seepage and runoff from the proposed discard storage facility and associated infrastructure (e.g. PCD/s)	Mine activities	Long-Term (4)	Site (2)	Yes (1)	High (-3)	Highly detrimental (-19 to -24)  (-21)	Definite (2)	High - negative (-37 to -48)  (-42)	<ul style="list-style-type: none"> <li>Water quality monitoring and visual assessments.</li> <li>Routine inspections of all stormwater systems.</li> <li>Ensure the facility is lined.</li> </ul>	Long-Term (4)	Site (2)	Yes (1)	Low (-1)	Slightly detrimental (-7 to -12)  (-7)	Definite (2)	Low (12 to -25)  (-14)	Medium

Table 8-4: Closure Phase Hydrogeological Risks

Component Being Impacted On	Activity Which May Cause the Impact	Activity	Pre- Mitigation							Recommended Mitigation Measures	Post Mitigation							Confidence
			Duration	Extent	Potential for impact on irreplaceable resources	Severity	Consequence	Probability	Significance		Duration	Extent	Severity	Potential for impact on irreplaceable resources	Consequence	Probability	Significance	
Shallow Aquifer System	The reshaping and rehabilitation of the co-disposal facility will be beneficial to the environment. Capping and reducing infiltration into the dump will help mitigate any poor-quality seepage.	Earthworks	Long-Term (4)	Site (2)	Yes (1)	Probable (-2)	Moderately detrimental (-13 to -18) (-14)	Definite (2)	Moderate - negative (-25 to -36) (-28)	<ul style="list-style-type: none"><li>• Only excavate areas applicable to the project area.</li><li>• Keep the site clean of all general and domestic waste.</li><li>• Revegate the co-disposal facility.</li><li>• Cover the co-disposal facility with a suitable impermeable capping layer or compact t reduce recharge into the landfill.</li></ul>	Medium Term (4)	Site (2)	Yes (1)	High (3)	Highly beneficial (19 to 24) (21)	Definite (2)	High-positive (37 to 48) (42)	Medium
Groundwater Quality	<i>Seepage from the co-disposal facility</i> <ul style="list-style-type: none"><li>• Poor quality seepage into the subsoils from landfill may impact soil quality, and eventually lead to poor quality seepage into the groundwater system.</li></ul>	The net result of facilities constructed and rehabilitation thereof	Long-Term (4)	Footprint (1)	Yes (1)	Probable (-1)	Negligible (-6 to 0) (-6)	Probable (1))	Neutral - Very low (0 to -12) (-6)	<ul style="list-style-type: none"><li>• After rehabilitation takes place, there should be limited seepage from the dump.</li><li>• Routine inspections and water quality monitoring of the boreholes should be sufficient to determine closure objectives.</li></ul>								Medium

## 9 GROUNDWATER MONITORING

Kangra coal has an existing groundwater monitoring system in place. The monitoring network is considered sufficient however, a potential monitoring gap may exist towards the south of the proposed co-disposal facility. The WTP is considered a lower-risk infrastructure when compared to the co-disposal facility and hence will not require dedicated monitoring.

It is proposed that at least 2 additional groundwater monitoring points be added to the existing water monitoring network. The proposed additional groundwater monitoring points are listed in Table 9-1 and the positions are shown in Figure 9-1. The proposed depth of the boreholes is 45m.

**Table 9-1: Proposed monitoring points**

Site	Type	Latitude	Longitude
GCS-GW1	Groundwater	-27.02106	30.37900
GCS-GW2	Groundwater	-27.00522	30.386902



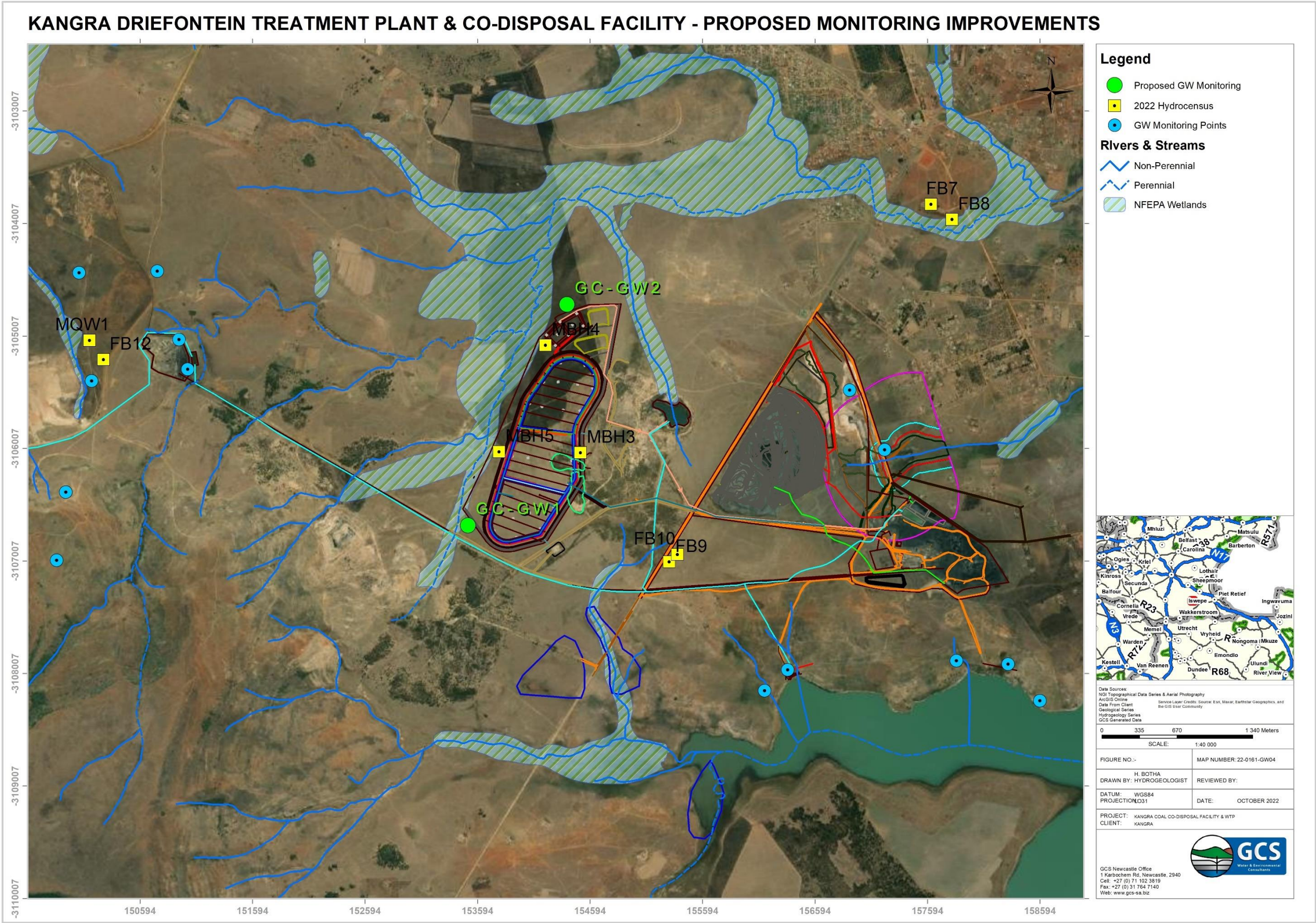


Figure 9-1: Proposed groundwater monitoring points



---

## 10 CONCLUSIONS

Based on the findings of the investigation, the following conclusion is drawn:

- This specialist study focused on the predicted groundwater impact for the proposed co-disposal facility, WTP and brine pond, that Kangra wants to construct at the existing Maquasa East operations.
- The study found that there is an existing impact on the groundwater regime at Maquasa East and that the proposed facilities will be situated in already impacted areas. The facilities will be lined and there is a marginal probability that there will be poor-quality seepage generation via the liner. As such, the geohydrological risks were found to be very low (refer to Section 8). There may still be some risk in the construction phase of the facilities, as well as the probability of poor-quality runoff generation (i.e. during storm events) onto the surrounding soils, which could lead to secondary poor-quality seepage and direct runoff into the perennial streams downstream of the sites.
- According to Guiding Principles 2.3 and 2.4 in the Australian groundwater modelling guidelines (Barnett *et al.*, 2012) the degree of confidence in the groundwater flow and transport model was evaluated:
  - The flow model is assigned a Class 2 confidence level due to the numerous groundwater heads available for calibration. Class 2 models are suitable for assessing higher-risk developments in higher-value aquifers (i.e. major aquifers for groundwater supply or an aquifer highly susceptible to pollution).
  - The transport model is assigned a Class 2 confidence as a sufficient amount of groundwater concentration calibration points are available.



## 10.1 Proposed Groundwater Management Aspects

The following section supplies a brief groundwater management plan which could help to improve the groundwater conditions during the construction, operational and closure phases of the co-disposal facility and WTP facilities at Kangra, and can be considered as commitments in the EMPr.

### 10.1.1 Operational/Decommission

To restrict the local groundwater and surface water impact the following actions are proposed:

- Re-use groundwater seepage collected in soak ways, stormwater trenches, and cut-off trenches and adequately size pollution control facilities.
- Keep dirty areas like workshops and oil and diesel storage areas as small as possible.
- Contain poor quality runoff from dirty areas and divert this water to pollution control dam for re-use.
- Have oil/diesel spill kits on site.
- Confirm groundwater and surface water monitoring protocol and plans.

### 10.1.2 Groundwater closure objectives

The following groundwater closure objectives are proposed:

- To cap the co-disposal facility (and other discard dumps) with an impermeable barrier, to eliminate rainfall infiltration.
- Use the results of the existing monitoring programme to confirm/validate the predicted impacts on groundwater availability and quality after closure;
- Update existing predictive tools to verify long-term impacts on groundwater, if required;
- Present the results to the competent authority on an annual basis to determine compliance with the closure objectives set during the Decommissioning Phase;
- Negotiate and get the groundwater closure objectives approved by the competent authority during the Decommissioning Phase of Kangra Maquasa East Operations, based on the results of the monitoring information obtained during the Operational Phases of the project, and through verification of the numerical model constructed for the project;

- To continue the groundwater quality and groundwater level monitoring for a period of at least two to four years after the plant and waste facilities are decommissioned to establish post-closure groundwater level and quality trends. The monitoring information must be used to update, verify and recalibrate the predictive tools used during the study to increase confidence in the closure objectives and management plans;
- To present the results of the monitoring programme to the competent authority on an annual basis. The post-closure monitoring programme will be re-evaluated on an annual basis in consultation with competent authority;
- To negotiate closure with competent authority based on the results of the groundwater monitoring undertaken, after the two to four-year post-closure monitoring periods.

## 10.2 Recommendations

The following recommendations are made:

- It is recommended that several groundwater monitoring boreholes be drilled at the sited locations (refer to Section 9).
- Rock/waste samples should be collected bi-annually from all waste streams (specifically waste stockpiles), to maintain a clear understanding of the ARD and leachate potential of the waste streams. The samples should be submitted for geochemical testing which includes Acid-Base Accounting (ABA), Net Acid Generation (NAG), and Static and kinetic leach testing. The geochemical test work will help to determine the chemical composition of the leachate produced by the various waste facilities. This will assist with understating ways to reduce seepage from these waste streams and assist in closure assessments.
- The following can be done to improve the assumptions and understanding of the groundwater aquifer and hence improve the numerical groundwater model confidence:
  - Based on available aquifer data, is recommended that 24-hour pump tests be performed on three (3) different boreholes situated within each proposed groundwater management area (so 9 in total). Aquifer pump test data will help to determine and confirm invaluable aquifer parameter data (aquifer storage, aquifer specific yield and aquifer transmissivity) which cannot be determined by slug testing.

- 
- All monitoring boreholes drilled in the area should note groundwater occurrences as well as strike depths. The data can be used to update the conceptual hydrogeological model which is incorporated into the numerical flow model.
    - Water levels of dedicated monitoring boreholes that will be drilled, as well as any new boreholes which are discovered in the area during routine hydrocensus updates, should be monitored (quarterly dedicated holes, bi-annual hydrocensus).
  - It is recommended that the numerical groundwater model and transport model be updated annually, to:
    - Recalibrate the flow system based on the dedicated monitoring boreholes drilled and routine water level monitoring data gathered for the site.
    - Confirm preferential flow paths and groundwater migration velocities as new geological data is attained via mining.
    - Evaluate the spatial impact (i.e. SO<sub>4</sub> plume) calibrated with the proposed monitoring borehole data.
    - Confirm long-term liabilities associated with the workings (i.e. predict likely changes in flow fields etc.); and
    - Ensure no monitoring network gaps exist (i.e. check if the monitoring network is representative of the site).
  - The numerical groundwater model should be updated when changes to the site plan occur, and at least 5 years before decommissioning and site closure. It is important to verify groundwater quality objectives for the closure phase, and predict what the lingering impact will be if Kangra Maquasa East Operations are closed.
  - Ensure that all dams and leachate ponds are operated to capacities to prevent overflow during 1:50 and 1:100yr storm events.

### 10.3 Identification of any areas that should be avoided

No dedicated groundwater buffer areas are recommended. Operations should however be kept within the earmarked footprint.

#### 10.4 Reasoned opinion on whether WULA should not be granted

This assessment cannot find any grounds or identify high geohydrological that could potentially not enable the approval of the construction of the co-disposal facility and the WTP and the authorization of these activities. This is grounded on the assumption that the proposed mitigation measures (Section 8) and monitoring improvements (Section 9) will be implemented, with routine numerical groundwater model updates.



### 11 BIBLIOGRAPHY

- AQTESOLV, 2022. *Slug Testing*. [Online]  
Available at: <http://www.aqtesolv.com/slug-tests/slug-tests.htm>  
[Accessed 29 07 2022].
- ARC, 2006. *Lan Types of South Africa*, s.l.: Pretoria: Agricultural Research Council.
- Bailey, A. & Pitman, W., 2015. *Water Resources of South Africa 2012 Study (WR2012): Executive Summary Version 1*. WRC Report No. K5/2143/1, Gezina, South Africa: Water Research Commission Report.
- Bailey, A. & Pitman, W., 2015. *Water Resources of South Africa 2012 Study (WR2012): Executive Summary Version 1*. WRC Report No. K5/2143/1., Gezina, South Africa: Water Research Commission Report: s.n.
- Barnett, B. et al., 2012. *Australian groundwater modelling guidelines*. ISBN- 978-1-921853-91-3, s.l.: s.n.
- Botha, J. et al., 1998. *Karoo Aquifers: Their Geology, Geometry and Physical Properties*, s.l.: WRC Report No: 457/1/98.
- DEA, 2019. *South African National Land Cover (SANLC) 2018*, South Africa: DEA on 1st October 2019.
- DMEA, 1998g. *1:250 000 Geological Series - 2730 Vryheid*, s.l.: s.n.
- DWA, 2012. *Aquifer Classification of South Africa map*, s.l.: Hydrological Services - Groundwater Information.
- DWAF, 1996b. *Water Quality Guidelines - Volume 1: Domestic Use*, s.l.: s.n.
- DWAF, 1996c. *South African Water Quality Guidelines (2nd Edition). Volume 5: Livestock Watering*, s.l.: s.n.
- DWAF, 1996d. *Water Quality Guidelines Volume 7: Aquatic Ecosystems*, s.l.: DWAF.
- DWAF, 1996e. *Water Quality Guidelines Volume 2: Recreational Use*, s.l.: DWAF.
- DWAF, 1996f. *Water Quality Guidelines Volume 3: Industrial Use*, s.l.: DWAF.
- DWAF, 2006. *Groundwater Resource Assessment II*, s.l.: s.n.
- DWAF, 2007. *Best Practice Guidelines - G3: Water Monitoring Systems*, s.l.: DWS.
- DWAF, 2008. *Best Practice Guidelines: Impact Prediction (G4)*, s.l.: DWS.
- DWS, 2011. *The Groundwater Dictionary - A Comprehensive Reference of Groundwater Related Terminology. 2nd Edition.*, s.l.: s.n.
- DWS, 2016. *New Water Management Areas*, South Africa: Government Gazette No. 40279.
- EPA, 1994. *U.S. Technical Document: Acid Mine Drainage Prediction. Environmental Protection Agency. EPA530-R-94-036. Retrieved from: <http://water.epa.gov/polwaste/nps/upload/amd.pdf>*, s.l.: s.n.
- Eyring, V. B. S. M. G. A. S. C. A. S. B. S. R. J. a. T. K. E., 2016. *Overview of the Coupled Model Intercomparison Project Phase 6 (CMIP6) experimental design and organization*, *Geosci. Model Dev.*, 9, 1937-1958, doi:10.5194/gmd-9-1937-2016. s.l.:s.n.
- Fourie, J., 2014. *Graphical representation of ABA and NAG screening results [telephonic correspondence]*. 11 September 2014., s.l.: s.n.
- GRIP, 2016. *Groundwater Resource Information Project*, s.l.: s.n.
- Harbaugh, A., B. E., Hill, M. & McDonald, M., 2000. *Modflow-200, the U.S. Geological Survey Modular Ground-Water Model - User Guide to Modularization Concepts and the Ground-Water Flow Process*. Open-File Report 00-92, s.l.: s.n.
- Hill, M. & Tiedeman, C., 2005. *Effective Groundwater Model Calibration: With analysis of Data, Sensitivities, and Uncertainty*. Wiley Press. ISBN-13: 978-0-471-77636-9, s.l.: s.n.
- Hughes, D., 2004. *Three decades of hydrological modelling research in South Africa*. *South African journal of science*, 100(11 & 12):638-642.. s.l.:s.n.



- INAP, 2022. *International Network for Acid Prevention. GARD guide: Chapter 2 Acid Rock Drainage Process.* c [http://www.gardguide.com/index.php?title=Chapter\\_2.](http://www.gardguide.com/index.php?title=Chapter_2.), s.l.: s.n.
- King, G., Maritz, E. & Jonck, F., 1998. 2730 Vryheid - 1:500 000 Hydrogeological map series of the Republic of South Africa., s.l.: s.n.
- King, G., Maritz, E. & Jonck, F., 1998. 2829 Durban - 1:500 000 Hydrological Map Series of the Republic of South Africa, s.l.: s.n.
- Kottek, M. et al., 2006. *World Map of the Köppen-Geiger climate classification updated.* Meteorol. Z. 15, 259-263. doi:10.1127/0941-2948/2006/0130. s.l.:s.n.
- Kresic, N., 2007. *Hydrogeology and Groundwater Modeling. 2nd Edition.* CRC Press. ISBN - 978 084 966 3484, s.l.: s.n.
- Lapakko, K. & Lawrence, R. W., 1993. *Modification of the net acid production (NAP) test. Proceedings of the 17th Annual British Columbia Mine Reclamation Symposium in Port Hardy, BC, 1993. The Technical and Research Committee on Reclamation,* s.l.: s.n.
- Lourens, P., 2013. *The relationship between South African geology and geohydrology,* s.l.: IGS, University of the Free State, Bloemfontein. Masters Dissertation.
- Lynch, S., 2004. *Development of a Raster Database of Annual, Monthly and Daily Rainfall for Southern Africa,* WRC Report No. 1156/1/04, Pretoria: Water Research Commission.
- Meteoblue, 2022. *Climate Data.* s.l.:<https://www.meteoblue.com>.
- Meteoblue, 2022. *Climate Data.* s.l.:<https://www.meteoblue.com>.
- Miller, S., Robertson, A. & Donahue, T., 1997. *Advances in Acid Drainage Prediction using the Net Acid Generation (NAG) Test. Proc. 4th International Conference on Acid Rock Drainage, Vancouver, BC, 0533-549,* s.l.: s.n.
- NGA, 2019. *National Groundwater Archive.* [Online]  
Available at: <https://www3.dwa.gov.za/NGANet/Security/WebLoginForm.aspx>
- NWA, 1999. *National Water Act, Government Gazette No. 20526, 8 October 1999. Wastewater limit values applicable to discharge of wastewater into a water resource,* s.l.: s.n.
- Parsons, R., 1995. *A South African Aquifer System Management Classification,* s.l.: Water Research Commission Report No. KV 7795.
- Price, W., 1997. *Guidelines and Recommended Methods for the prediction of metal leaching and Acid Rock Drainage at Minesites in British Columbia. British Columbia Ministry of Employment and Investment, Energy and Minerals Division, Smithers, BC, p.143,* s.l.: s.n.
- SADC GIP, 2022. *SADC Groundwater Information Portal (SADC GIP).* s.l.:s.n.
- Schulze, R., 1997. *South African Atlas of Agrohydrology and Climatology. WRC Report No. TT85/96,* Pretoria: Water Research Commission.
- Soregaroli, B. A. & Lawrence, R. W., 1998. *Update on waste characterization studies. In Mine Design, Operations and Closure Conference. Polson, Montana.,* s.l.: s.n.
- Van Deventer, H. S.-A. L. M. N. P. C. S. A. C. N. G. M. J. N. L. M. O. D. S. P. S. E. & S. K., 2018. *NBA2018 National Wetland Map 5.* s.l.:s.n.
- Vegter, J., 1995. *An explanation of a set of National Groundwater Maps. Water Research Commission. Report No TT 74/95..* s.l.:s.n.
- Woodford, A. V. T. G. T. A. T. G. R. P. G. M. O. R. V. D. a. E. C., 2013. *Karoo Groundwater Atlas Volume 2,* s.l.: Karoo Groundwater Expert Group (KGEG).
- WRC, 2015. <http://www.waterresourceswr2012.co.za/resource-centre/>. [Online].





**APPENDIX A: PHOTOGRAPHIC LOG**

FB7	<b>Date:</b> 19-10-2022	
<b>Direction Photo Taken:</b> North		
<b>Description</b>  The borehole is situated at Driefontein Community Health Centre.		
FB8	<b>Date:</b> 19-10-2022	
<b>Direction Photo Taken:</b> South		
<b>Description</b>  The borehole is situated southwest of the Health Centre on the edge of the wetland.		





FB9	Date: 21-10-2022	
Direction Photo Taken:  South		
Description  The borehole is situated downstream of the existing discard dump. The borehole is excessively deep with no signs of water.		
FB10	Date: 21-10-2022	
Direction Photo Taken:  South		
Description  The borehole is situated downstream of the existing discard dump and approx. 85 m upstream of FB9.		
FB12	Date: 20-10-2022	
Direction Photo Taken:		



South		
<div>Description</div> <p>The borehole is situated west and upgradient of Maqwasa West Shaft.</p>		
MQW1	<div>Date:</div> <p>21-10-2022</p>	
<div>Direction Photo Taken:</div> <p>North</p>		
<div>Description</div> <p>The borehole is situated west and upgradient of Maqwasa West Shaft.</p>		



MBH3	Date: 20-10-2022	
Direction Photo Taken: West		
<p><b>Description</b></p> <p>The borehole is situated on the eastern boundary upstream of the proposed co-disposal discard dump.</p>		
MBH4	Date: 20-10-2022	
Direction Photo Taken: North		
<p><b>Description</b></p> <p>The borehole is situated on the northern boundary upstream of the proposed co-disposal discard dump.</p>		
MBH5	Date: 20-10-2022	

<b>Direction Photo Taken:</b>  East	
<b>Description</b>  The borehole is situated on the western boundary downstream of the proposed co-disposal discard dump.	



---

## APPENDIX B: GEOPHYSICAL INVESTIGATION

The geophysical system used in this investigation was a Geonics G5-proton precession magnetometer (Mag). The aim was to identify if there are dolerite intrusive rock or contact areas in the area, extrapolate the likely spatial spread of these structures, and site future monitoring boreholes.

The presence of magnetic minerals in rocks causes deviations in the earth's magnetic field. The proton precision magnetometer measures the remnant magnetic field strength of these rocks. The instrument measures the magnetic field strength in Nano Tesla (nT). Rock associated with magmatic intrusions, such as dolerite sills and dykes, have more magnetic minerals than the surrounding sedimentary rocks or metamorphic rocks. The zone between the intruding rocks is known as the baked zone (a zone that is weathered and cracked due to intruding magmatic rock heat and pressure) and is known to be associated with preferential flow paths of groundwater. It is these structures that are primarily targeted in Karoo aquifer systems for groundwater development and as potential pollution transmitters/boundaries. Hence, the purpose of the survey was to identify structures that may/may not promote groundwater flow.

### 1. Survey orientation and spacing length

Seven (7) Mag profiles were completed. The Mag traverse varied from approximately 200 m in length. Mag readings were taken at 5 m intervals. Moreover, each spacing was recorded with a handheld GPS.

### 2. Potential inference

Mag lines were shifted and oriented to best avoid and compensate for the interference sources identified in the project area (i.e., power lines and fences).

### 3. Data analyses

The data obtained from the magnetic survey was analysed as follows:

- All magnetic data was captured in Microsoft Excel®, and profile trend graphs for the profile lines walked were constructed. A 3-point average algorithm was applied to smooth the data. The magnetic anomalies observed were then interpreted based on the magnetic field strength observed along the profile lines.

## LINE 1

Project:	Kangra Maquasa	Traverse Number:	Line1
Project Number:	22-0161	Traverse Direction:	NNE-SSW
Survey Area:	Maquasa East	Station Spacing:	10 m
Date of Survey:	06 October 2022	Operator:	Shuaib Dustay

Station	Station Coordinates		Mag		Comments
Station	Latitude (y)	Longitude (x)	Mag	Mag (Mov Average)	
0	30° 22' 44.7420" E	27° 01' 25.4640" S	28555	28555	
10	30° 22' 44.9076" E	27° 01' 25.1364" S	28554	28555	
20	30° 22' 45.0480" E	27° 01' 24.8592" S	28556	28554	
40	30° 22' 45.2064" E	27° 01' 24.5820" S	28554	28552	
50	30° 22' 45.3108" E	27° 01' 24.3012" S	28552	28553	
60	30° 22' 45.4440" E	27° 01' 24.0528" S	28551	28556	
70	30° 22' 45.5628" E	27° 01' 23.7324" S	28556	28562	
80	30° 22' 45.6564" E	27° 01' 23.4120" S	28561	28565	
90	30° 22' 45.7248" E	27° 01' 23.1348" S	28568	28185	
100	30° 22' 46.0344" E	27° 01' 22.7064" S	28561	27426	
110	30° 22' 46.2000" E	27° 01' 22.3032" S	27051	27043	Power line
120	30° 22' 46.3116" E	27° 01' 22.0152" S	27040	27405	Power line
130	30° 22' 46.4952" E	27° 01' 21.6840" S	27040	28121	Power line
140	30° 22' 46.5564" E	27° 01' 21.4104" S	28500	28480	
150	30° 22' 46.6860" E	27° 01' 21.1476" S	28442	28529	
160	30° 22' 46.7148" E	27° 01' 20.8740" S	28535	28582	
170	30° 22' 46.9200" E	27° 01' 20.5608" S	28603	28595	
180	30° 22' 47.0712" E	27° 01' 20.2368" S	28586	28599	
190	30° 22' 47.2368" E	27° 01' 19.8912" S	28604	28600	
200	30° 22' 47.3484" E	27° 01' 19.6104" S	28602	28594	
210	30° 22' 47.5104" E	27° 01' 19.3152" S	28592	28591	
220	30° 22' 47.5752" E	27° 01' 19.0308" S	28590	28589	
230	30° 22' 47.6976" E	27° 01' 18.7320" S	28592	28585	
240	30° 22' 47.8164" E	27° 01' 18.4404" S	28583	28585	
250	30° 22' 47.9496" E	27° 01' 18.1380" S	28583	28585	
260	30° 22' 48.0756" E	27° 01' 17.7996" S	28591	28584	
270	30° 22' 48.2304" E	27° 01' 17.5008" S	28575	28589	
280	30° 22' 48.3276" E	27° 01' 17.1768" S	28596	28588	
290	30° 22' 48.4680" E	27° 01' 16.8672" S	28588	28606	
300	30° 22' 48.5652" E	27° 01' 16.5720" S	28579	28629	
310	30° 22' 48.6696" E	27° 01' 16.2660" S	28679	28604	
320	30° 22' 48.7812" E	27° 01' 15.9600" S	28577	28581	
330	30° 22' 48.9036" E	27° 01' 15.6864" S	28583	28581	
340	30° 22' 49.0332" E	27° 01' 15.3624" S	28580	28578	
350	30° 22' 49.1664" E	27° 01' 15.0492" S	28579	28573	
360	30° 22' 49.2096" E	27° 01' 14.8188" S	28573	28567	
370	30° 22' 49.3680" E	27° 01' 14.5236" S	28565	28561	
380	30° 22' 49.4868" E	27° 01' 14.2716" S	28564	28555	
390	30° 22' 49.6056" E	27° 01' 13.9620" S	28551	28556	
400	30° 22' 49.7028" E	27° 01' 13.6956" S	28553	28570	
410	30° 22' 49.8864" E	27° 01' 13.4148" S	28568	28575	
420	30° 22' 49.9584" E	27° 01' 13.1556" S	28590	28560	
430	30° 22' 50.0448" E	27° 01' 12.8856" S	28553	28544	

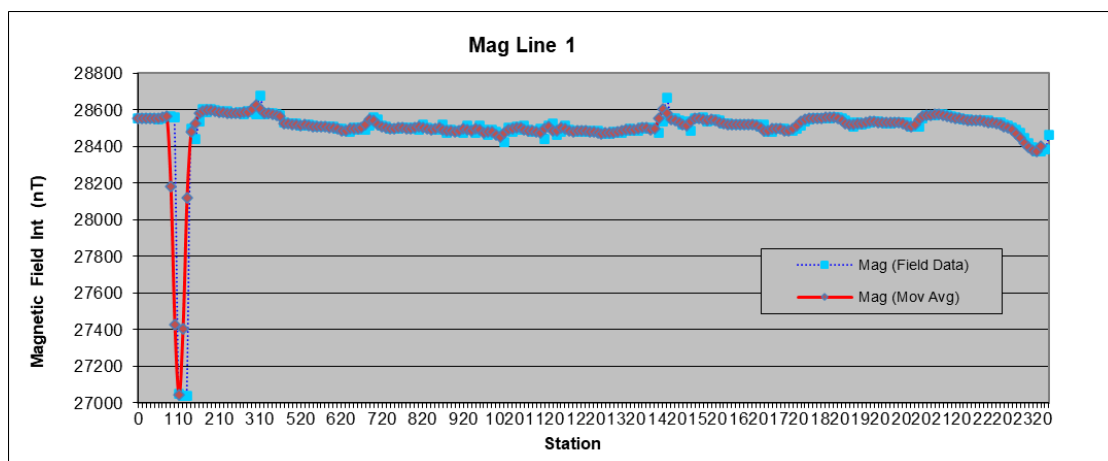
440	30° 22' 50.1672" E	27° 01' 12.5652" S	28543	28539	
450	30° 22' 50.2752" E	27° 01' 12.2844" S	28538	28538	
460	30° 22' 50.3544" E	27° 01' 11.9676" S	28536	28537	
470	30° 22' 50.4444" E	27° 01' 11.6580" S	28540	28533	
480	30° 22' 50.5452" E	27° 01' 11.3268" S	28532	28528	
490	30° 22' 50.6316" E	27° 01' 11.0568" S	28527	28525	
500	30° 22' 50.7432" E	27° 01' 10.7328" S	28525	28523	
510	30° 22' 50.8548" E	27° 01' 10.4700" S	28524	28519	
520	30° 22' 50.9160" E	27° 01' 10.1604" S	28517	28518	
530	30° 22' 51.0276" E	27° 01' 09.8580" S	28517	28519	
540	30° 22' 51.0924" E	27° 01' 09.5556" S	28520	28516	
550	30° 22' 51.2076" E	27° 01' 09.2244" S	28517	28511	
560	30° 22' 51.2940" E	27° 01' 08.9436" S	28509	28508	
570	30° 22' 51.4020" E	27° 01' 08.6304" S	28507	28507	
580	30° 22' 51.4776" E	27° 01' 08.3568" S	28507	28508	
590	30° 22' 51.5892" E	27° 01' 08.0400" S	28508	28506	
600	30° 22' 51.6648" E	27° 01' 07.7520" S	28509	28501	
610	30° 22' 51.7620" E	27° 01' 07.4208" S	28499	28496	
620	30° 22' 51.8520" E	27° 01' 07.1328" S	28498	28489	
630	30° 22' 51.8988" E	27° 01' 06.8160" S	28488	28489	
640	30° 22' 51.9816" E	27° 01' 06.4668" S	28482	28496	
650	30° 22' 52.0320" E	27° 01' 06.1896" S	28504	28500	
660	30° 22' 52.0860" E	27° 01' 05.8728" S	28495	28500	
670	30° 22' 52.1004" E	27° 01' 05.5380" S	28504	28502	
680	30° 22' 52.0896" E	27° 01' 05.2392" S	28495	28521	
690	30° 22' 52.1472" E	27° 01' 04.9404" S	28514	28547	
700	30° 22' 52.2768" E	27° 01' 04.6092" S	28562	28544	
710	30° 22' 52.3632" E	27° 01' 04.3032" S	28549	28523	
720	30° 22' 52.4208" E	27° 01' 03.9864" S	28516	28510	
730	30° 22' 52.5108" E	27° 01' 03.6948" S	28511	28502	
740	30° 22' 52.7304" E	27° 01' 03.4464" S	28500	28498	
750	30° 22' 52.8600" E	27° 01' 03.1116" S	28496	28500	
760	30° 22' 53.0724" E	27° 01' 02.7984" S	28500	28503	
770	30° 22' 53.3064" E	27° 01' 02.5860" S	28504	28502	
780	30° 22' 53.5908" E	27° 01' 02.2908" S	28504	28500	
790	30° 22' 53.8284" E	27° 01' 02.0244" S	28497	28499	
800	30° 22' 54.0120" E	27° 01' 01.7364" S	28502	28503	
810	30° 22' 54.1920" E	27° 01' 01.4376" S	28495	28509	
820	30° 22' 54.3360" E	27° 01' 01.0884" S	28520	28506	
830	30° 22' 54.4728" E	27° 01' 00.8040" S	28502	28497	
840	30° 22' 54.6168" E	27° 01' 00.4980" S	28498	28493	
850	30° 22' 54.8364" E	27° 01' 00.2568" S	28491	28498	
860	30° 22' 55.0416" E	27° 01' 00.0048" S	28490	28502	
870	30° 22' 55.2288" E	27° 00' 59.7348" S	28522	28491	
880	30° 22' 55.3548" E	27° 00' 59.4396" S	28475	28486	
890	30° 22' 55.4232" E	27° 00' 59.1336" S	28490	28486	
900	30° 22' 55.5024" E	27° 00' 58.8204" S	28487	28482	
910	30° 22' 55.5780" E	27° 00' 58.5216" S	28481	28487	
920	30° 22' 55.6824" E	27° 00' 58.2336" S	28477	28499	
930	30° 22' 55.7904" E	27° 00' 57.9384" S	28513	28493	
940	30° 22' 55.9200" E	27° 00' 57.6468" S	28491	28490	
950	30° 22' 56.0028" E	27° 00' 57.3516" S	28477	28499	
960	30° 22' 56.1288" E	27° 00' 57.0168" S	28513	28490	

970	30° 22' 56.2728" E	27° 00' 56.7036" S	28491	28478	
980	30° 22' 56.3736" E	27° 00' 56.4264" S	28465	28483	
990	30° 22' 56.5140" E	27° 00' 56.2032" S	28492	28482	
1000	30° 22' 56.6040" E	27° 00' 55.9044" S	28482	28462	
1010	30° 22' 56.6868" E	27° 00' 55.6488" S	28470	28456	
1020	30° 22' 56.7732" E	27° 00' 55.3824" S	28425	28478	
1030	30° 22' 56.8740" E	27° 00' 55.1232" S	28502	28495	
1040	30° 22' 56.9892" E	27° 00' 54.8244" S	28483	28500	
1050	30° 22' 57.1080" E	27° 00' 54.5616" S	28512	28503	
1060	30° 22' 57.2232" E	27° 00' 54.2664" S	28494	28503	
1070	30° 22' 57.3456" E	27° 00' 53.9892" S	28513	28494	
1080	30° 22' 57.4464" E	27° 00' 53.7120" S	28490	28485	
1090	30° 22' 57.6012" E	27° 00' 53.4348" S	28482	28488	
1100	30° 22' 57.7452" E	27° 00' 53.1468" S	28486	28481	
1110	30° 22' 57.9000" E	27° 00' 52.9092" S	28498	28474	
1120	30° 22' 58.0476" E	27° 00' 52.6896" S	28442	28500	
1130	30° 22' 58.1988" E	27° 00' 52.3656" S	28514	28509	
1140	30° 22' 58.3356" E	27° 00' 52.0848" S	28529	28486	
1150	30° 22' 58.3968" E	27° 00' 51.8184" S	28465	28488	
1160	30° 22' 58.5048" E	27° 00' 51.5484" S	28484	28503	
1170	30° 22' 58.6272" E	27° 00' 51.2784" S	28517	28497	
1180	30° 22' 58.7208" E	27° 00' 51.0120" S	28492	28486	
1190	30° 22' 58.9116" E	27° 00' 50.7096" S	28487	28483	
1200	30° 22' 58.9980" E	27° 00' 50.4216" S	28479	28485	
1210	30° 22' 59.0880" E	27° 00' 50.1480" S	28488	28486	
1220	30° 22' 59.1996" E	27° 00' 49.8960" S	28484	28484	
1230	30° 22' 59.3112" E	27° 00' 49.6332" S	28487	28483	
1240	30° 22' 59.4300" E	27° 00' 49.2984" S	28479	28482	
1250	30° 22' 59.5524" E	27° 00' 49.0212" S	28487	28477	
1260	30° 22' 59.6532" E	27° 00' 48.7440" S	28474	28472	
1270	30° 22' 59.7900" E	27° 00' 48.4812" S	28471	28474	
1280	30° 22' 59.9016" E	27° 00' 48.1860" S	28471	28477	
1290	30° 22' 59.9700" E	27° 00' 47.8980" S	28482	28477	
1300	30° 23' 00.0420" E	27° 00' 47.5992" S	28474	28479	
1310	30° 23' 00.0852" E	27° 00' 47.3004" S	28476	28488	
1320	30° 23' 00.1572" E	27° 00' 47.0124" S	28489	28493	
1330	30° 23' 00.2292" E	27° 00' 46.6992" S	28496	28491	
1340	30° 23' 00.3804" E	27° 00' 46.3968" S	28489	28493	
1350	30° 23' 00.4272" E	27° 00' 46.1268" S	28489	28499	
1360	30° 23' 00.7008" E	27° 00' 45.5724" S	28504	28502	
1370	30° 23' 00.8196" E	27° 00' 45.2880" S	28500	28502	
1380	30° 23' 00.9456" E	27° 00' 44.9928" S	28504	28494	
1390	30° 23' 01.0392" E	27° 00' 44.7300" S	28499	28496	
1400	30° 23' 01.2408" E	27° 00' 44.4420" S	28474	28553	
1410	30° 23' 01.3128" E	27° 00' 44.1036" S	28537	28605	
1420	30° 23' 01.4172" E	27° 00' 43.8012" S	28665	28581	
1430	30° 23' 01.6008" E	27° 00' 43.5744" S	28553	28551	
1440	30° 23' 01.8060" E	27° 00' 43.3368" S	28553	28541	
1450	30° 23' 01.9032" E	27° 00' 43.0812" S	28544	28531	
1460	30° 23' 02.0220" E	27° 00' 42.8148" S	28522	28521	
1470	30° 23' 02.1552" E	27° 00' 42.5160" S	28536	28516	
1480	30° 23' 02.3280" E	27° 00' 42.2892" S	28488	28537	
1490	30° 23' 02.4540" E	27° 00' 41.9724" S	28553	28556	

1500	30° 23' 02.5800" E	27° 00' 41.6736" S	28553	28555	
1510	30° 23' 02.7276" E	27° 00' 41.3856" S	28563	28547	
1520	30° 23' 02.9292" E	27° 00' 41.1696" S	28540	28545	
1530	30° 23' 03.0912" E	27° 00' 40.8564" S	28546	28547	
1540	30° 23' 03.2352" E	27° 00' 40.5576" S	28549	28541	
1550	30° 23' 03.3972" E	27° 00' 40.2732" S	28543	28532	
1560	30° 23' 03.4908" E	27° 00' 39.9312" S	28528	28526	
1570	30° 23' 03.5880" E	27° 00' 39.6216" S	28527	28522	
1580	30° 23' 03.6672" E	27° 00' 39.3552" S	28520	28520	
1590	30° 23' 03.7428" E	27° 00' 39.1176" S	28520	28520	
1600	30° 23' 03.8328" E	27° 00' 38.8404" S	28520	28521	
1610	30° 23' 03.9408" E	27° 00' 38.5668" S	28521	28522	
1620	30° 23' 04.0524" E	27° 00' 38.2752" S	28522	28523	
1630	30° 23' 04.1640" E	27° 00' 38.0160" S	28523	28519	
1640	30° 23' 04.2576" E	27° 00' 37.7280" S	28522	28515	
1650	30° 23' 04.3224" E	27° 00' 37.4328" S	28510	28507	
1660	30° 23' 04.3908" E	27° 00' 37.1556" S	28518	28490	
1670	30° 23' 04.4844" E	27° 00' 36.8496" S	28480	28485	
1680	30° 23' 04.5708" E	27° 00' 36.5904" S	28480	28496	
1690	30° 23' 04.7400" E	27° 00' 36.3024" S	28501	28500	
1700	30° 23' 04.9092" E	27° 00' 36.0000" S	28501	28496	
1710	30° 23' 05.0496" E	27° 00' 35.7408" S	28497	28490	
1720	30° 23' 05.1612" E	27° 00' 35.4312" S	28487	28490	
1730	30° 23' 05.3196" E	27° 00' 35.1468" S	28487	28499	
1740	30° 23' 05.4672" E	27° 00' 34.8660" S	28498	28516	
1750	30° 23' 05.6364" E	27° 00' 34.5816" S	28514	28535	
1760	30° 23' 05.7912" E	27° 00' 34.2900" S	28539	28547	
1770	30° 23' 05.9532" E	27° 00' 34.0056" S	28548	28553	
1780	30° 23' 06.0864" E	27° 00' 33.7572" S	28554	28555	
1790	30° 23' 06.1980" E	27° 00' 33.4368" S	28555	28555	
1800	30° 23' 06.3204" E	27° 00' 33.1272" S	28554	28555	
1810	30° 23' 06.3996" E	27° 00' 32.8536" S	28555	28558	
1820	30° 23' 06.5184" E	27° 00' 32.5440" S	28557	28560	
1830	30° 23' 06.6552" E	27° 00' 32.2704" S	28561	28560	
1840	30° 23' 06.7596" E	27° 00' 32.0220" S	28561	28555	
1850	30° 23' 06.8568" E	27° 00' 31.7376" S	28557	28543	
1860	30° 23' 06.9612" E	27° 00' 31.4568" S	28543	28528	
1870	30° 23' 07.1268" E	27° 00' 31.1868" S	28530	28520	
1880	30° 23' 07.2492" E	27° 00' 30.9168" S	28510	28523	
1890	30° 23' 07.3284" E	27° 00' 30.6360" S	28530	28524	
1900	30° 23' 07.4580" E	27° 00' 30.3516" S	28520	28526	
1910	30° 23' 07.5840" E	27° 00' 29.9628" S	28526	28532	
1920	30° 23' 07.6488" E	27° 00' 29.7288" S	28532	28537	
1930	30° 23' 07.7460" E	27° 00' 29.4768" S	28539	28538	
1940	30° 23' 07.8252" E	27° 00' 29.1528" S	28539	28534	
1950	30° 23' 07.9260" E	27° 00' 28.8972" S	28533	28530	
1960	30° 23' 08.0520" E	27° 00' 28.6452" S	28529	28530	
1970	30° 23' 08.1816" E	27° 00' 28.3536" S	28529	28531	
1980	30° 23' 08.2860" E	27° 00' 28.0476" S	28531	28533	
1990	30° 23' 08.4048" E	27° 00' 27.7524" S	28533	28533	
2000	30° 23' 08.5092" E	27° 00' 27.4644" S	28533	28527	
2010	30° 23' 08.6496" E	27° 00' 27.1548" S	28533	28515	
2020	30° 23' 08.8116" E	27° 00' 26.8488" S	28510	28508	



2030	30° 23' 08.9340" E	27° 00' 26.5644" S	28507	28519	
2040	30° 23' 09.0456" E	27° 00' 26.2692" S	28507	28546	
2050	30° 23' 09.1932" E	27° 00' 25.9344" S	28553	28567	
2060	30° 23' 09.2976" E	27° 00' 25.6788" S	28572	28572	
2070	30° 23' 09.4164" E	27° 00' 25.3800" S	28572	28574	
2080	30° 23' 09.5244" E	27° 00' 25.1028" S	28572	28577	
2090	30° 23' 09.6936" E	27° 00' 24.8148" S	28578	28577	
2100	30° 23' 09.7872" E	27° 00' 24.5268" S	28578	28572	
2110	30° 23' 09.9204" E	27° 00' 24.2352" S	28573	28565	
2120	30° 23' 10.0464" E	27° 00' 23.9364" S	28564	28560	
2130	30° 23' 10.1364" E	27° 00' 23.6268" S	28560	28555	
2140	30° 23' 10.2660" E	27° 00' 23.3244" S	28555	28552	
2150	30° 23' 10.4352" E	27° 00' 23.0220" S	28551	28549	
2160	30° 23' 10.5324" E	27° 00' 22.7268" S	28551	28544	
2170	30° 23' 10.6512" E	27° 00' 22.3920" S	28542	28542	
2180	30° 23' 10.7772" E	27° 00' 22.0968" S	28542	28543	
2190	30° 23' 10.8960" E	27° 00' 21.8124" S	28543	28543	
2200	30° 23' 11.0400" E	27° 00' 21.4992" S	28543	28540	
2210	30° 23' 11.1588" E	27° 00' 21.1968" S	28542	28535	
2220	30° 23' 11.2848" E	27° 00' 20.8872" S	28533	28531	
2230	30° 23' 11.3820" E	27° 00' 20.5632" S	28531	28528	
2240	30° 23' 11.5260" E	27° 00' 20.2176" S	28530	28521	
2250	30° 23' 11.6556" E	27° 00' 19.9152" S	28520	28512	
2260	30° 23' 11.7672" E	27° 00' 19.6164" S	28513	28503	
2270	30° 23' 11.9112" E	27° 00' 19.3032" S	28503	28490	
2280	30° 23' 12.0516" E	27° 00' 18.9936" S	28491	28473	
2290	30° 23' 12.1272" E	27° 00' 18.6948" S	28476	28448	
2300	30° 23' 12.2748" E	27° 00' 18.3960" S	28448	28421	
2310	30° 23' 12.4296" E	27° 00' 18.0648" S	28419	28397	
2320	30° 23' 12.5124" E	27° 00' 17.7876" S	28398	28379	
2330	30° 23' 12.6168" E	27° 00' 17.4672" S	28373	28376	
2340	30° 23' 12.6816" E	27° 00' 17.1720" S	28373	28400	
2350	30° 23' 12.7752" E	27° 00' 16.8948" S	28383	21327	
2360	30° 23' 12.9192" E	27° 00' 16.5780" S	28462	7116	



## LINE 2

Project:	Kangra Maquasa	Traverse Number:	Line2
Project Number:	22-0161	Traverse Direction:	NNE-SSW
Survey Area:	Maquasa East	Station Spacing:	10 m
Date of Survey:	10 October 2022	Operator:	Shuaib Dustay & Martin Ngubana

Station	Station Coordinates		Mag		Comments
Station	Latitude (y)	Longitude (x)	Mag	Mag (Mov Average)	
0	30° 23' 28.3380" E	27° 00' 18.5688" S	28406	28409	
10	30° 23' 28.2444" E	27° 00' 18.8028" S	28406	28416	
20	30° 23' 28.0932" E	27° 00' 19.0620" S	28418	28421.25	
30	30° 23' 27.8916" E	27° 00' 19.2996" S	28422	28422.75	
40	30° 23' 27.7008" E	27° 00' 19.5624" S	28423	28423	
50	30° 23' 27.5568" E	27° 00' 19.8396" S	28423	28422.75	
60	30° 23' 27.4272" E	27° 00' 20.0952" S	28423	28423.75	
70	30° 23' 27.2976" E	27° 00' 20.3940" S	28422	28426.75	
80	30° 23' 27.1536" E	27° 00' 20.6928" S	28428	28428.75	
90	30° 23' 27.0348" E	27° 00' 20.9952" S	28429	28428.75	
100	30° 23' 26.9124" E	27° 00' 21.2868" S	28429	28426.25	
110	30° 23' 26.7972" E	27° 00' 21.5784" S	28428	28422	
120	30° 23' 26.6820" E	27° 00' 21.8952" S	28420	28418.5	
130	30° 23' 26.5452" E	27° 00' 22.1364" S	28420	28414.5	
140	30° 23' 26.4084" E	27° 00' 22.4424" S	28414	28411	
150	30° 23' 26.2932" E	27° 00' 22.7088" S	28410	28410	
160	30° 23' 26.1888" E	27° 00' 22.9608" S	28410	28410.25	
170	30° 23' 26.0772" E	27° 00' 23.2488" S	28410	28413	
180	30° 23' 25.9116" E	27° 00' 23.5440" S	28411	28417.75	
190	30° 23' 25.7352" E	27° 00' 23.8284" S	28420	28420.25	
200	30° 23' 25.5876" E	27° 00' 24.1020" S	28420	28420.75	
210	30° 23' 25.4436" E	27° 00' 24.3936" S	28421	28421.25	
220	30° 23' 25.2852" E	27° 00' 24.6708" S	28421	28422.25	
230	30° 23' 25.1448" E	27° 00' 24.9408" S	28422	28423.5	
240	30° 23' 24.9936" E	27° 00' 25.2252" S	28424	28427	
250	30° 23' 24.8316" E	27° 00' 25.5060" S	28424	28438.5	
260	30° 23' 24.7128" E	27° 00' 25.8120" S	28436	28452.5	
270	30° 23' 24.6120" E	27° 00' 26.0928" S	28458	28448.75	
280	30° 23' 24.5508" E	27° 00' 26.4024" S	28458	28429.75	
290	30° 23' 24.3852" E	27° 00' 26.6940" S	28421	28419.5	
300	30° 23' 24.2160" E	27° 00' 26.9532" S	28419	28419	
310	30° 23' 24.0576" E	27° 00' 27.2052" S	28419	28417	
320	30° 23' 23.8956" E	27° 00' 27.4824" S	28419	28413	
330	30° 23' 23.7012" E	27° 00' 27.7488" S	28411	28411	
340	30° 23' 23.5500" E	27° 00' 28.0296" S	28411	28411.5	
350	30° 23' 23.3700" E	27° 00' 28.2888" S	28411	28412.5	
360	30° 23' 23.1972" E	27° 00' 28.5372" S	28413	28413.25	
370	30° 23' 22.9920" E	27° 00' 28.8288" S	28413	28413.75	
380	30° 23' 22.8156" E	27° 00' 29.0988" S	28414	28414	
390	30° 23' 22.6752" E	27° 00' 29.3472" S	28414	28414.25	
400	30° 23' 22.4880" E	27° 00' 29.6424" S	28414	28414	
410	30° 23' 22.3224" E	27° 00' 29.9340" S	28415	28414.5	
420	30° 23' 22.1172" E	27° 00' 30.2040" S	28412	28415.5	

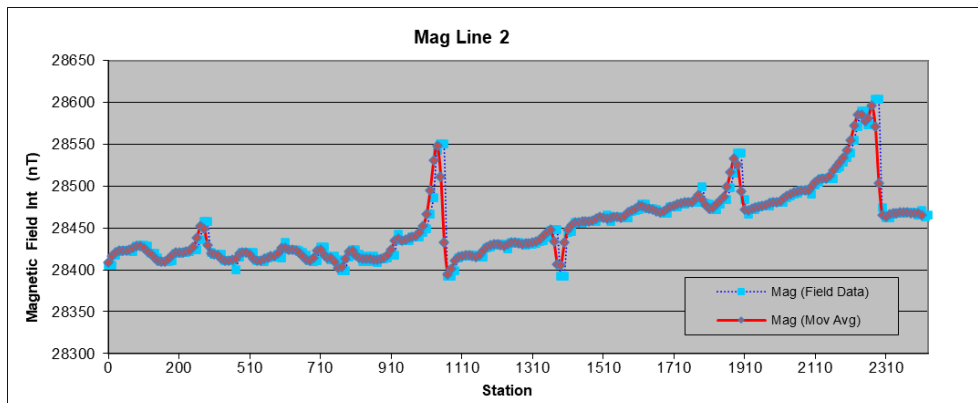
430	30° 23' 21.9084" E	27° 00' 30.4560" S	28419	28413	
440	30° 23' 21.7140" E	27° 00' 30.7368" S	28412	28407.5	
450	30° 23' 21.5376" E	27° 00' 31.0392" S	28409	28402.25	
460	30° 23' 21.3540" E	27° 00' 31.3128" S	28400	28403.75	
470	30° 23' 21.2172" E	27° 00' 31.5864" S	28400	28412.75	
480	30° 23' 21.0768" E	27° 00' 31.8744" S	28415	28419.5	
490	30° 23' 20.9508" E	27° 00' 32.1732" S	28421	28421	
500	30° 23' 20.8176" E	27° 00' 32.4756" S	28421	28421	
510	30° 23' 20.7528" E	27° 00' 32.8140" S	28421	28418.5	
520	30° 23' 20.6052" E	27° 00' 33.1128" S	28421	28413.5	
530	30° 23' 20.4900" E	27° 00' 33.3612" S	28411	28410.75	
540	30° 23' 20.3352" E	27° 00' 33.6924" S	28411	28411.25	
550	30° 23' 20.2200" E	27° 00' 33.9516" S	28410	28413.25	
560	30° 23' 20.0832" E	27° 00' 34.2252" S	28414	28414.75	
570	30° 23' 19.9428" E	27° 00' 34.4880" S	28415	28416	
580	30° 23' 19.8024" E	27° 00' 34.7724" S	28415	28416.75	
590	30° 23' 19.6440" E	27° 00' 35.0676" S	28419	28420	
600	30° 23' 19.5576" E	27° 00' 35.3736" S	28414	28426	
610	30° 23' 19.4100" E	27° 00' 35.6796" S	28433	28426.25	
620	30° 23' 19.2156" E	27° 00' 35.9244" S	28424	28424	
630	30° 23' 19.0680" E	27° 00' 36.1836" S	28424	28423.75	
640	30° 23' 18.9420" E	27° 00' 36.4860" S	28424	28422.75	
650	30° 23' 18.8448" E	27° 00' 36.7524" S	28423	28420.5	
660	30° 23' 18.7440" E	27° 00' 37.0260" S	28421	28416.5	
670	30° 23' 18.6144" E	27° 00' 37.3212" S	28417	28412.25	
680	30° 23' 18.4812" E	27° 00' 37.6164" S	28411	28410.5	
690	30° 23' 18.3588" E	27° 00' 37.9008" S	28410	28414.75	
700	30° 23' 18.2724" E	27° 00' 38.1924" S	28411	28423	
710	30° 23' 18.0816" E	27° 00' 38.5164" S	28427	28424.25	
720	30° 23' 17.9340" E	27° 00' 38.8008" S	28427	28417.75	
730	30° 23' 17.7072" E	27° 00' 39.0312" S	28416	28414	
740	30° 23' 17.5236" E	27° 00' 39.3084" S	28412	28414	
750	30° 23' 17.3652" E	27° 00' 39.5892" S	28416	28409.75	
760	30° 23' 17.1996" E	27° 00' 39.8772" S	28412	28402.25	
770	30° 23' 17.0196" E	27° 00' 40.1436" S	28399	28403	
780	30° 23' 16.8072" E	27° 00' 40.4388" S	28399	28413.25	
790	30° 23' 16.6452" E	27° 00' 40.7268" S	28415	28421.75	
800	30° 23' 16.4832" E	27° 00' 41.0256" S	28424	28422.75	
810	30° 23' 16.2816" E	27° 00' 41.3100" S	28424	28418	
820	30° 23' 16.1160" E	27° 00' 41.6052" S	28419	28413.75	
830	30° 23' 15.9180" E	27° 00' 41.8896" S	28410	28413	
840	30° 23' 15.7668" E	27° 00' 42.2172" S	28416	28413	
850	30° 23' 15.5724" E	27° 00' 42.4836" S	28410	28412.75	
860	30° 23' 15.3816" E	27° 00' 42.7320" S	28416	28411.75	
870	30° 23' 15.1548" E	27° 00' 43.0236" S	28409	28412	
880	30° 23' 14.8704" E	27° 00' 43.2648" S	28413	28413.25	
890	30° 23' 14.6508" E	27° 00' 43.5312" S	28413	28414.75	
900	30° 23' 14.4348" E	27° 00' 43.8012" S	28414	28417	
910	30° 23' 14.1864" E	27° 00' 44.0496" S	28418	28424.25	
920	30° 23' 13.9560" E	27° 00' 44.2548" S	28418	28434.75	
930	30° 23' 13.7472" E	27° 00' 44.4888" S	28443	28437	
940	30° 23' 13.5600" E	27° 00' 44.7372" S	28435	28435	
950	30° 23' 13.4232" E	27° 00' 44.9928" S	28435	28436	

960	30° 23' 13.3584" E	27° 00' 45.2916" S	28435	28438	
970	30° 23' 13.3116" E	27° 00' 45.5148" S	28439	28439	
980	30° 23' 13.1712" E	27° 00' 45.8316" S	28439	28440.5	
990	30° 23' 13.0344" E	27° 00' 46.1484" S	28439	28444.5	
1000	30° 23' 12.9156" E	27° 00' 46.3896" S	28445	28452.25	
1010	30° 23' 12.7752" E	27° 00' 46.6344" S	28449	28466.75	
1020	30° 23' 12.6492" E	27° 00' 46.8828" S	28466	28495.25	
1030	30° 23' 12.5124" E	27° 00' 47.1240" S	28486	28530.5	
1040	30° 23' 12.3720" E	27° 00' 47.4228" S	28543	28548.25	
1050	30° 23' 12.1884" E	27° 00' 47.6640" S	28550	28510.75	
1060	30° 23' 12.0768" E	27° 00' 47.8944" S	28550	28432.25	
1070	30° 23' 11.8860" E	27° 00' 48.1212" S	28393	28394.5	
1080	30° 23' 11.7456" E	27° 00' 48.3840" S	28393	28401.25	
1090	30° 23' 11.5908" E	27° 00' 48.6360" S	28399	28410.75	
1100	30° 23' 11.4288" E	27° 00' 48.8916" S	28414	28415.5	
1110	30° 23' 11.2236" E	27° 00' 49.1544" S	28416	28416.25	
1120	30° 23' 11.0616" E	27° 00' 49.3884" S	28416	28417	
1130	30° 23' 10.8960" E	27° 00' 49.6620" S	28417	28417.5	
1140	30° 23' 10.7340" E	27° 00' 49.9752" S	28418	28416.75	
1150	30° 23' 10.6296" E	27° 00' 50.2272" S	28417	28415.5	
1160	30° 23' 10.4604" E	27° 00' 50.4864" S	28415	28417.75	
1170	30° 23' 10.2768" E	27° 00' 50.7456" S	28415	28423.5	
1180	30° 23' 10.1220" E	27° 00' 51.0192" S	28426	28427.25	
1190	30° 23' 09.9744" E	27° 00' 51.2964" S	28427	28429	
1200	30° 23' 09.8160" E	27° 00' 51.5556" S	28429	28430.5	
1210	30° 23' 09.6396" E	27° 00' 51.8328" S	28431	28431	
1220	30° 23' 09.5208" E	27° 00' 52.1100" S	28431	28429.5	
1230	30° 23' 09.3552" E	27° 00' 52.3980" S	28431	28428.5	
1240	30° 23' 09.2364" E	27° 00' 52.6644" S	28425	28430.75	
1250	30° 23' 09.0924" E	27° 00' 52.9416" S	28433	28432.5	
1260	30° 23' 08.9664" E	27° 00' 53.2224" S	28432	28432.5	
1270	30° 23' 08.8800" E	27° 00' 53.4600" S	28433	28431.75	
1280	30° 23' 08.7792" E	27° 00' 53.7156" S	28432	28431	
1290	30° 23' 08.7180" E	27° 00' 53.9676" S	28430	28431.25	
1300	30° 23' 08.5344" E	27° 00' 54.2304" S	28432	28431.5	
1310	30° 23' 08.3724" E	27° 00' 54.4752" S	28431	28432.25	
1320	30° 23' 08.2860" E	27° 00' 54.6480" S	28432	28433.75	
1330	30° 23' 08.1636" E	27° 00' 54.9468" S	28434	28435.75	
1340	30° 23' 08.0124" E	27° 00' 55.2312" S	28435	28440	
1350	30° 23' 07.8684" E	27° 00' 55.4652" S	28439	28445.25	
1360	30° 23' 07.6956" E	27° 00' 55.7352" S	28447	28447.75	
1370	30° 23' 07.5372" E	27° 00' 56.0196" S	28448	28434.25	
1380	30° 23' 07.4256" E	27° 00' 56.2248" S	28448	28406.75	
1390	30° 23' 07.3284" E	27° 00' 56.5416" S	28393	28406	
1400	30° 23' 07.1916" E	27° 00' 56.8188" S	28393	28432.25	
1410	30° 23' 07.0944" E	27° 00' 57.0960" S	28445	28448.5	
1420	30° 23' 06.9792" E	27° 00' 57.3804" S	28446	28454	
1430	30° 23' 06.8532" E	27° 00' 57.6468" S	28457	28456.25	
1440	30° 23' 06.7344" E	27° 00' 57.9312" S	28456	28456.5	
1450	30° 23' 06.6336" E	27° 00' 58.2156" S	28456	28457.5	
1460	30° 23' 06.4716" E	27° 00' 58.4928" S	28458	28458	
1470	30° 23' 06.3420" E	27° 00' 58.7268" S	28458	28458	
1480	30° 23' 06.1944" E	27° 00' 59.0148" S	28458	28459	

1490	30° 23' 06.0720" E	27° 00' 59.2920" S	28458	28461	
1500	30° 23' 05.9676" E	27° 00' 59.5548" S	28462	28462.75	
1510	30° 23' 05.8128" E	27° 00' 59.8392" S	28462	28462.5	
1520	30° 23' 05.6904" E	27° 01' 00.0912" S	28465	28461	
1530	30° 23' 05.5428" E	27° 01' 00.3576" S	28458	28461.75	
1540	30° 23' 05.4096" E	27° 01' 00.6492" S	28463	28463	
1550	30° 23' 05.2440" E	27° 01' 00.8832" S	28463	28462.75	
1560	30° 23' 05.1720" E	27° 01' 01.1604" S	28463	28462.25	
1570	30° 23' 05.1072" E	27° 01' 01.4232" S	28462	28464	
1580	30° 23' 04.9632" E	27° 01' 01.6824" S	28462	28468.25	
1590	30° 23' 04.7976" E	27° 01' 01.9452" S	28470	28471	
1600	30° 23' 04.6860" E	27° 01' 02.2008" S	28471	28473.25	
1610	30° 23' 04.5456" E	27° 01' 02.4960" S	28472	28476.5	
1620	30° 23' 04.4232" E	27° 01' 02.7660" S	28478	28476.75	
1630	30° 23' 04.2936" E	27° 01' 03.0288" S	28478	28474.25	
1640	30° 23' 04.1496" E	27° 01' 03.3060" S	28473	28472.75	
1650	30° 23' 03.9840" E	27° 01' 03.5544" S	28473	28471.75	
1660	30° 23' 03.8508" E	27° 01' 03.8244" S	28472	28470	
1670	30° 23' 03.7284" E	27° 01' 04.0980" S	28470	28468.5	
1680	30° 23' 03.6024" E	27° 01' 04.3608" S	28468	28469.75	
1690	30° 23' 03.4620" E	27° 01' 04.6344" S	28468	28473.25	
1700	30° 23' 03.3108" E	27° 01' 04.8936" S	28475	28475	
1710	30° 23' 03.1920" E	27° 01' 05.1636" S	28475	28476	
1720	30° 23' 03.0840" E	27° 01' 05.4228" S	28475	28478	
1730	30° 23' 02.9364" E	27° 01' 05.6856" S	28479	28479.5	
1740	30° 23' 02.8104" E	27° 01' 05.9664" S	28479	28480.5	
1750	30° 23' 02.6664" E	27° 01' 06.2184" S	28481	28481	
1760	30° 23' 02.4900" E	27° 01' 06.4344" S	28481	28481	
1770	30° 23' 02.3460" E	27° 01' 06.7116" S	28481	28485.5	
1780	30° 23' 02.2308" E	27° 01' 06.9780" S	28481	28489.75	
1790	30° 23' 02.1084" E	27° 01' 07.2300" S	28499	28484.25	
1800	30° 23' 01.9860" E	27° 01' 07.4892" S	28480	28477	
1810	30° 23' 01.8132" E	27° 01' 07.7592" S	28478	28473.5	
1820	30° 23' 01.6476" E	27° 01' 08.0220" S	28472	28473.75	
1830	30° 23' 01.4784" E	27° 01' 08.2776" S	28472	28478.5	
1840	30° 23' 01.3272" E	27° 01' 08.5224" S	28479	28482.75	
1850	30° 23' 01.1400" E	27° 01' 08.7636" S	28484	28487.5	
1860	30° 23' 00.9492" E	27° 01' 08.9976" S	28484	28498.75	
1870	30° 23' 00.8088" E	27° 01' 09.2712" S	28498	28516.75	
1880	30° 23' 00.6180" E	27° 01' 09.5232" S	28515	28533	
1890	30° 23' 00.4884" E	27° 01' 09.7680" S	28539	28525.25	
1900	30° 23' 00.3408" E	27° 01' 10.0596" S	28539	28493.25	
1910	30° 23' 00.2076" E	27° 01' 10.3188" S	28484	28472	
1920	30° 23' 00.0852" E	27° 01' 10.5348" S	28466	28470.5	
1930	30° 22' 59.9736" E	27° 01' 10.7904" S	28472	28472.75	
1940	30° 22' 59.8332" E	27° 01' 11.0496" S	28472	28474.5	
1950	30° 22' 59.6820" E	27° 01' 11.3088" S	28475	28475.75	
1960	30° 22' 59.5452" E	27° 01' 11.5608" S	28476	28476	
1970	30° 22' 59.4264" E	27° 01' 11.8164" S	28476	28477.25	
1980	30° 22' 59.3148" E	27° 01' 12.0648" S	28476	28479.75	
1990	30° 22' 59.1672" E	27° 01' 12.3240" S	28481	28481	
2000	30° 22' 59.0124" E	27° 01' 12.5760" S	28481	28481	
2010	30° 22' 58.8684" E	27° 01' 12.8352" S	28481	28482.25	



2020	30° 22' 58.7172" E	27° 01' 13.0908" S	28481	28485.25	
2030	30° 22' 58.5552" E	27° 01' 13.3464" S	28486	28488	
2040	30° 22' 58.4004" E	27° 01' 13.5948" S	28488	28490	
2050	30° 22' 58.2384" E	27° 01' 13.8396" S	28490	28492.25	
2060	30° 22' 58.0656" E	27° 01' 14.0844" S	28492	28494.25	
2070	30° 22' 57.8892" E	27° 01' 14.2932" S	28495	28495.25	
2080	30° 22' 57.6984" E	27° 01' 14.5416" S	28495	28494.5	
2090	30° 22' 57.5652" E	27° 01' 14.7864" S	28496	28494.75	
2100	30° 22' 57.3852" E	27° 01' 15.0132" S	28491	28499.5	
2110	30° 22' 57.2052" E	27° 01' 15.2508" S	28501	28505	
2120	30° 22' 57.0504" E	27° 01' 15.4920" S	28505	28508	
2130	30° 22' 56.9172" E	27° 01' 15.7440" S	28509	28509	
2140	30° 22' 56.7084" E	27° 01' 15.9744" S	28509	28509	
2150	30° 22' 56.5140" E	27° 01' 16.2048" S	28509	28512	
2160	30° 22' 56.3160" E	27° 01' 16.4568" S	28509	28518.5	
2170	30° 22' 56.1684" E	27° 01' 16.7268" S	28521	28524	
2180	30° 22' 55.9848" E	27° 01' 16.9680" S	28523	28528.75	
2190	30° 22' 55.8228" E	27° 01' 17.2236" S	28529	28534.25	
2200	30° 22' 55.6824" E	27° 01' 17.4828" S	28534	28542.25	
2210	30° 22' 55.5024" E	27° 01' 17.7312" S	28540	28555.25	
2220	30° 22' 55.3260" E	27° 01' 17.9724" S	28555	28571.75	
2230	30° 22' 55.1460" E	27° 01' 18.1992" S	28571	28585.25	
2240	30° 22' 54.9804" E	27° 01' 18.4404" S	28590	28585.75	
2250	30° 22' 54.8328" E	27° 01' 18.6852" S	28590	28577.25	
2260	30° 22' 54.6744" E	27° 01' 18.8976" S	28573	28580.75	
2270	30° 22' 54.5088" E	27° 01' 19.1496" S	28573	28596.25	
2280	30° 22' 54.3360" E	27° 01' 19.4016" S	28604	28571.5	
2290	30° 22' 54.1704" E	27° 01' 19.6536" S	28604	28503.5	
2300	30° 22' 53.9616" E	27° 01' 19.9308" S	28474	28465	
2310	30° 22' 53.8140" E	27° 01' 20.1720" S	28462	28463.25	
2320	30° 22' 53.6592" E	27° 01' 20.4240" S	28462	28466	
2330	30° 22' 53.5224" E	27° 01' 20.6652" S	28467	28467.75	
2340	30° 22' 53.3244" E	27° 01' 20.9028" S	28468	28468	
2350	30° 22' 53.1444" E	27° 01' 21.1440" S	28468	28468.25	
2360	30° 22' 52.9644" E	27° 01' 21.3888" S	28468	28468.75	
2370	30° 22' 52.8744" E	27° 01' 21.6480" S	28469	28469	
2380	30° 22' 52.7448" E	27° 01' 21.9216" S	28469	28468	
2390	30° 22' 52.6332" E	27° 01' 22.2024" S	28469	28467.5	
2400	30° 22' 52.4928" E	27° 01' 22.4616" S	28465	28467.5	
2410	30° 22' 52.3596" E	27° 01' 22.7532" S	28471	28465.5	
2420	30° 22' 52.2264" E	27° 01' 22.9908" S	28463	21348.25	

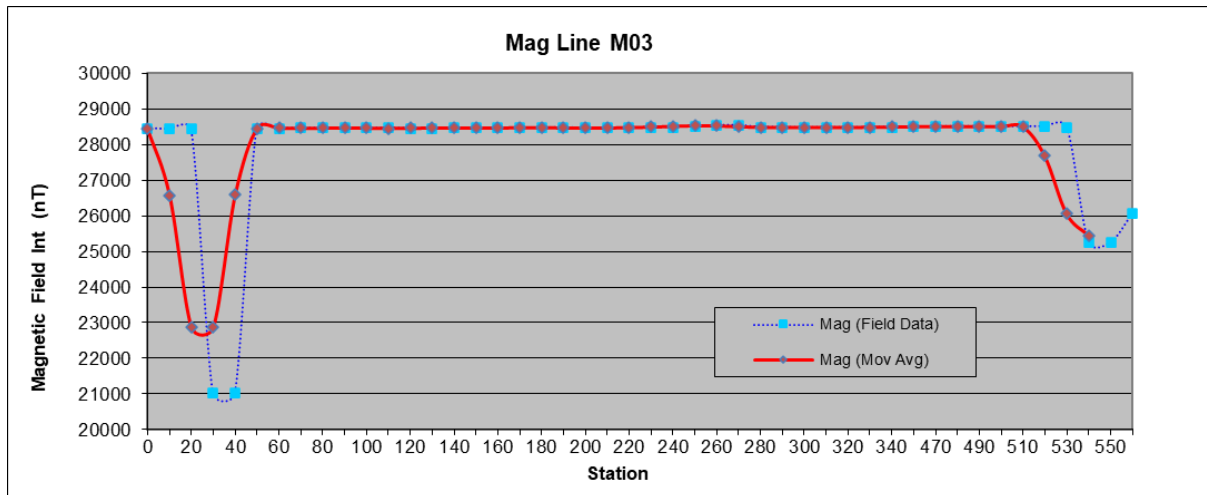


## LINE 3

Project:	Kangra Maquasa	Traverse Number:	Line3
Project Number:	22-0161	Traverse Direction:	SE-NW
Survey Area:	Maquasa East	Station Spacing:	10 m
Date of Survey:	10 October 2022	Operator:	Shuaib Dustay & Martin Ngubana

Station	Station Coordinates		Mag		Comments
Station	Latitude (y)	Longitude (x)	Mag	Mag (Moving Average)	
0	30° 22' 59.4408" E	27° 01' 25.4172" S	28463	28442	
10	30° 22' 59.1420" E	27° 01' 25.3452" S	28436	26578.25	
20	30° 22' 58.7604" E	27° 01' 25.2444" S	28433	22866.5	
30	30° 22' 58.4256" E	27° 01' 25.1436" S	21011	22872.5	
40	30° 22' 58.0656" E	27° 01' 25.0428" S	21011	26596.75	
50	30° 22' 57.7164" E	27° 01' 24.9528" S	28457	28461.75	
60	30° 22' 57.3636" E	27° 01' 24.8484" S	28462	28465	
70	30° 22' 57.0324" E	27° 01' 24.7296" S	28466	28467	
80	30° 22' 56.7012" E	27° 01' 24.6288" S	28466	28469.25	
90	30° 22' 56.3484" E	27° 01' 24.5208" S	28470	28470.75	
100	30° 22' 55.9992" E	27° 01' 24.3840" S	28471	28468.75	
110	30° 22' 55.6788" E	27° 01' 24.2436" S	28471	28464.25	
120	30° 22' 55.3800" E	27° 01' 24.1356" S	28462	28465.5	
130	30° 22' 55.0416" E	27° 01' 23.9484" S	28462	28472.5	
140	30° 22' 54.7140" E	27° 01' 23.7972" S	28476	28476	
150	30° 22' 54.4224" E	27° 01' 23.6640" S	28476	28476	
160	30° 22' 54.0840" E	27° 01' 23.5020" S	28476	28476	
170	30° 22' 53.7780" E	27° 01' 23.3832" S	28476	28478.5	
180	30° 22' 53.4396" E	27° 01' 23.2140" S	28476	28480.5	
190	30° 22' 53.1264" E	27° 01' 23.0340" S	28486	28475.75	
200	30° 22' 52.8024" E	27° 01' 22.8792" S	28474	28470.25	
210	30° 22' 52.4640" E	27° 01' 22.7676" S	28469	28473	
220	30° 22' 52.1328" E	27° 01' 22.6272" S	28469	28483.5	
230	30° 22' 51.8160" E	27° 01' 22.4796" S	28485	28497.75	
240	30° 22' 51.5316" E	27° 01' 22.3032" S	28495	28518.25	
250	30° 22' 51.2472" E	27° 01' 22.1232" S	28516	28538.5	
260	30° 22' 50.9484" E	27° 01' 21.9468" S	28546	28533.25	
270	30° 22' 50.6136" E	27° 01' 21.7920" S	28546	28507.75	
280	30° 22' 50.3220" E	27° 01' 21.6660" S	28495	28491.25	
290	30° 22' 49.9620" E	27° 01' 21.5148" S	28495	28486.75	
300	30° 22' 49.6884" E	27° 01' 21.3492" S	28480	28486	
310	30° 22' 49.4076" E	27° 01' 21.2340" S	28492	28486	
320	30° 22' 49.0800" E	27° 01' 21.0684" S	28480	28489.25	
330	30° 22' 48.7848" E	27° 01' 20.9172" S	28492	28494.25	
340	30° 22' 48.4752" E	27° 01' 20.8308" S	28493	28500.5	
350	30° 22' 48.1584" E	27° 01' 20.7192" S	28499	28508	
360	30° 22' 47.8488" E	27° 01' 20.5644" S	28511	28513.5	
370	30° 22' 47.5356" E	27° 01' 20.4204" S	28511	28521.5	
380	30° 22' 47.2080" E	27° 01' 20.2692" S	28521	28530.25	
390	30° 22' 46.8984" E	27° 01' 20.1540" S	28533	28533.75	
400	30° 22' 46.5672" E	27° 01' 20.0100" S	28534	28536	
410	30° 22' 46.2720" E	27° 01' 19.8552" S	28534	28541.5	
420	30° 22' 45.9696" E	27° 01' 19.6968" S	28542	28545	
430	30° 22' 45.7032" E	27° 01' 19.5456" S	28548	28541.75	
440	30° 22' 45.4008" E	27° 01' 19.3836" S	28542	28532.5	
450	30° 22' 45.1128" E	27° 01' 19.2036" S	28535	28521.25	
460	30° 22' 44.8572" E	27° 01' 19.0740" S	28518	28515	

470	30° 22' 44.5368" E	27° 01' 18.9012" S	28514	28514	
480	30° 22' 44.2452" E	27° 01' 18.7500" S	28514	28513.25	
490	30° 22' 43.9680" E	27° 01' 18.6312" S	28514	28511.75	
500	30° 22' 43.6944" E	27° 01' 18.4728" S	28511	28511	
510	30° 22' 43.4316" E	27° 01' 18.2928" S	28511	28506.75	
520	30° 22' 43.1148" E	27° 01' 18.1092" S	28511	27686.25	
530	30° 22' 42.8628" E	27° 01' 17.9472" S	28494	26058	
540	30° 22' 42.5604" E	27° 01' 17.8176" S	25246	25449	
550	30° 22' 42.3012" E	27° 01' 17.6736" S	25246	19340.5	
560	30° 22' 42.0312" E	27° 01' 17.4936" S	26058	6514.5	

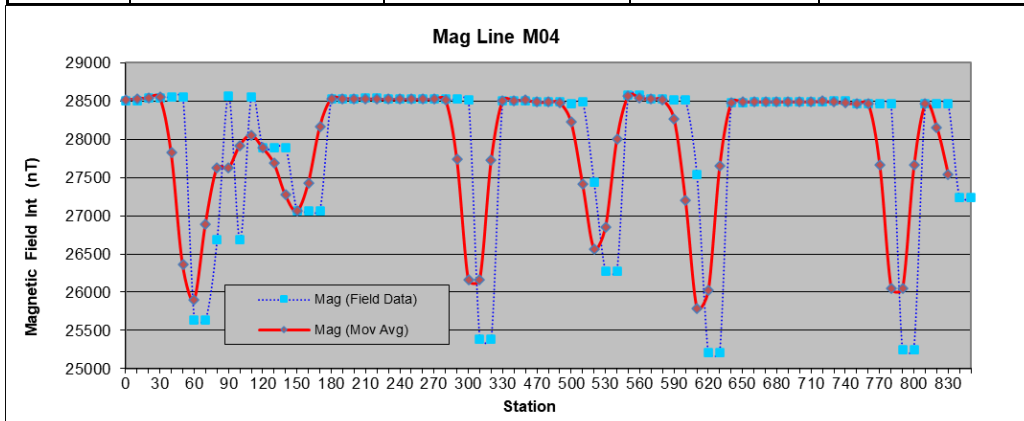


## LINE 4

<b>Project:</b>	Kangra Maquasa	<b>Traverse Number:</b>	Line4
<b>Project Number:</b>	22-0161	<b>Traverse Direction:</b>	SSW-NNE
<b>Survey Area:</b>	Maquasa East	<b>Station Spacing:</b>	10 m
<b>Date of Survey:</b>	11 October 2022	<b>Operator:</b>	Shuaib Dustay & Martin Ngubana

Station	Station Coordinates		Mag		Comments
Station	Latitude (y)	Longitude (x)	Mag	Mag (Moving Average)	
0	30° 22' 42.5928" E	27° 01' 18.0120" S	28509	28517.75	
10	30° 22' 42.7872" E	27° 01' 17.7096" S	28509	28535.25	
20	30° 22' 42.8988" E	27° 01' 17.3676" S	28544	28547.25	
30	30° 22' 42.9888" E	27° 01' 17.0940" S	28544	28553.75	
40	30° 22' 43.0572" E	27° 01' 16.7700" S	28557	27826	
50	30° 22' 43.1904" E	27° 01' 16.4892" S	28557	26364	
60	30° 22' 43.3092" E	27° 01' 16.1868" S	25633	25895.75	
70	30° 22' 43.3956" E	27° 01' 15.8808" S	25633	26891.75	
80	30° 22' 43.4856" E	27° 01' 15.5784" S	26684	27625	
90	30° 22' 43.6044" E	27° 01' 15.2904" S	28566	27622.25	
100	30° 22' 43.7376" E	27° 01' 14.9988" S	26684	27921.75	
110	30° 22' 43.8780" E	27° 01' 14.7036" S	28555	28058.5	
120	30° 22' 43.9824" E	27° 01' 14.4408" S	27893	27893	
130	30° 22' 44.0724" E	27° 01' 14.1168" S	27893	27686	
140	30° 22' 44.2020" E	27° 01' 13.8468" S	27893	27272	
150	30° 22' 44.3388" E	27° 01' 13.5552" S	27065	27065	
160	30° 22' 44.4468" E	27° 01' 13.2636" S	27065	27432	
170	30° 22' 44.5404" E	27° 01' 12.9756" S	27065	28166	
180	30° 22' 44.6052" E	27° 01' 12.7344" S	28533	28533	
190	30° 22' 44.7240" E	27° 01' 12.4356" S	28533	28534	
200	30° 22' 44.8356" E	27° 01' 12.1296" S	28533	28536	
210	30° 22' 44.9328" E	27° 01' 11.8524" S	28537	28534	
220	30° 22' 45.0048" E	27° 01' 11.5788" S	28537	28528	
230	30° 22' 45.0876" E	27° 01' 11.3160" S	28525	28525	
240	30° 22' 45.1668" E	27° 01' 11.0208" S	28525	28525	
250	30° 22' 45.2280" E	27° 01' 10.6968" S	28525	28525	
260	30° 22' 45.2964" E	27° 01' 10.3836" S	28525	28525	
270	30° 22' 45.4188" E	27° 01' 10.0740" S	28525	28524.75	
280	30° 22' 45.5160" E	27° 01' 09.7932" S	28525	28523	
290	30° 22' 45.6240" E	27° 01' 09.4764" S	28524	27736.25	
300	30° 22' 45.7140" E	27° 01' 09.1668" S	28519	26167	
310	30° 22' 45.8364" E	27° 01' 08.8176" S	25383	26164.5	
320	30° 22' 45.9372" E	27° 01' 08.5008" S	25383	27727.5	
330	30° 22' 46.0164" E	27° 01' 08.1912" S	28509	28509.25	
340	30° 22' 46.1208" E	27° 01' 07.9176" S	28509	28510.5	
350	30° 22' 46.3656" E	27° 01' 07.4568" S	28510	28512.5	
360	30° 22' 46.5492" E	27° 01' 07.1616" S	28513	28513.5	
370	30° 22' 46.6284" E	27° 01' 06.8736" S	28514	28513.25	
380	30° 22' 46.7364" E	27° 01' 06.6036" S	28513	28511.75	
390	30° 22' 46.8660" E	27° 01' 06.2796" S	28513	28506.5	
400	30° 22' 46.9848" E	27° 01' 05.9952" S	28508	28498.75	
410	30° 22' 47.0892" E	27° 01' 05.7144" S	28497	28493.75	
420	30° 22' 47.2116" E	27° 01' 05.4192" S	28493	27964	
430	30° 22' 47.2584" E	27° 01' 05.1384" S	28492	26907.25	

440	30° 22' 47.3844" E	27° 01' 04.8540" S	26379	26904.25	
450	30° 22' 47.4888" E	27° 01' 04.5696" S	26379	27957.5	
460	30° 22' 47.6076" E	27° 01' 04.2852" S	28480	28488.25	
470	30° 22' 47.6940" E	27° 01' 03.9756" S	28491	28491	
480	30° 22' 47.8200" E	27° 01' 03.6876" S	28491	28486.5	
490	30° 22' 47.9208" E	27° 01' 03.4104" S	28491	28481.75	
500	30° 22' 48.0324" E	27° 01' 03.1260" S	28473	28224.5	
510	30° 22' 48.1188" E	27° 01' 02.8668" S	28490	27413.75	
520	30° 22' 48.2592" E	27° 01' 02.5572" S	27445	26567.5	
530	30° 22' 48.3600" E	27° 01' 02.3124" S	26275	26852.5	
540	30° 22' 48.4284" E	27° 01' 01.9956" S	26275	28007.5	
550	30° 22' 48.4932" E	27° 01' 01.7220" S	28585	28572.75	
560	30° 22' 48.6012" E	27° 01' 01.4268" S	28585	28545.5	
570	30° 22' 48.7056" E	27° 01' 01.1568" S	28536	28525.5	
580	30° 22' 48.7920" E	27° 01' 00.8580" S	28525	28518	
590	30° 22' 48.9144" E	27° 01' 00.5448" S	28516	28272.75	
600	30° 22' 49.0296" E	27° 01' 00.2676" S	28515	27202.25	
610	30° 22' 49.1268" E	27° 00' 59.9544" S	27545	25789.25	
620	30° 22' 49.2132" E	27° 00' 59.6844" S	25204	26021.75	
630	30° 22' 49.2708" E	27° 00' 59.3820" S	25204	27658.5	
640	30° 22' 49.3248" E	27° 00' 59.0832" S	28475	28482.5	
650	30° 22' 49.4292" E	27° 00' 58.7664" S	28480	28491.25	
660	30° 22' 49.5012" E	27° 00' 58.4928" S	28495	28495	
670	30° 22' 49.5804" E	27° 00' 58.2048" S	28495	28494.25	
680	30° 22' 49.6884" E	27° 00' 57.9456" S	28495	28492.75	
690	30° 22' 49.8432" E	27° 00' 57.7008" S	28492	28492	
700	30° 22' 50.0088" E	27° 00' 57.4452" S	28492	28492.5	
710	30° 22' 50.1636" E	27° 00' 57.1824" S	28492	28495	
720	30° 22' 50.2968" E	27° 00' 56.8800" S	28494	28498.5	
730	30° 22' 50.4372" E	27° 00' 56.5884" S	28500	28492	
740	30° 22' 50.5272" E	27° 00' 56.2860" S	28500	28476	
750	30° 22' 50.6028" E	27° 00' 55.9800" S	28468	28467.25	
760	30° 22' 50.6640" E	27° 00' 55.6848" S	28468	28465.75	
770	30° 22' 50.6784" E	27° 00' 55.3464" S	28465	27661.25	
780	30° 22' 50.6820" E	27° 00' 55.0440" S	28465	26053.75	
790	30° 22' 50.6856" E	27° 00' 54.7524" S	25250	26053.5	
800	30° 22' 50.7288" E	27° 00' 54.4428" S	25250	27661.5	
810	30° 22' 50.7900" E	27° 00' 54.1404" S	28464	28466	
820	30° 22' 50.9232" E	27° 00' 53.8416" S	28468	28157.75	
830	30° 22' 50.9844" E	27° 00' 53.5716" S	28464	27542.25	
840	30° 22' 51.0780" E	27° 00' 53.2548" S	27235	20426.25	
850	30° 22' 51.1428" E	27° 00' 52.9668" S	27235	6808.75	



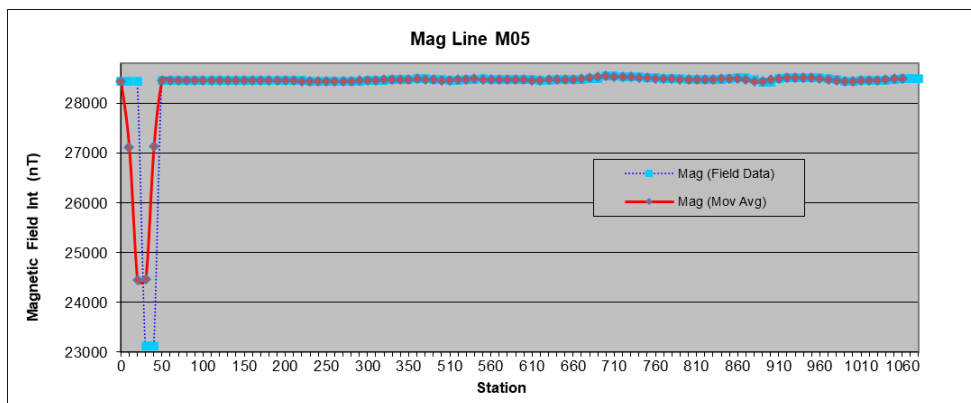


## LINE 5

Project:	Kangra Maquasa	Traverse Number:	Line 5
Project Number:	22-0161	Traverse Direction:	NNE-SSW
Survey Area:	Maquasa East	Station Spacing:	10 m
Date of Survey:	11 October 2022	Operator:	Shuaib Dustay & Martin Ngubana

Station	Station Coordinates		Mag	Mag (Moving Average)	Comments
	Latitude (y)	Longitude (x)			
0	30° 22' 52.3884" E	27° 00' 53.8632" S	28454	28451	
10	30° 22' 52.4172" E	27° 00' 53.6220" S	28450	27118.25	
20	30° 22' 52.5576" E	27° 00' 53.3448" S	28450	24454.75	
30	30° 22' 52.7196" E	27° 00' 53.0640" S	23123	24458.25	
40	30° 22' 52.8996" E	27° 00' 52.8120" S	23123	27129.75	
50	30° 22' 53.0616" E	27° 00' 52.5636" S	28464	28466.5	
60	30° 22' 53.2560" E	27° 00' 52.2972" S	28468	28466.5	
70	30° 22' 53.3712" E	27° 00' 52.0092" S	28466	28466	
80	30° 22' 53.4864" E	27° 00' 51.7248" S	28466	28464	
90	30° 22' 53.6340" E	27° 00' 51.4296" S	28466	28462.5	
100	30° 22' 53.7132" E	27° 00' 51.1488" S	28458	28463	
110	30° 22' 53.8068" E	27° 00' 50.8788" S	28468	28461.75	
120	30° 22' 53.9040" E	27° 00' 50.5692" S	28458	28461.75	
130	30° 22' 54.0048" E	27° 00' 50.3280" S	28463	28463	
140	30° 22' 54.1056" E	27° 00' 49.9968" S	28463	28463	
150	30° 22' 54.1884" E	27° 00' 49.7340" S	28463	28461.25	
160	30° 22' 54.2892" E	27° 00' 49.4352" S	28463	28457.75	
170	30° 22' 54.3864" E	27° 00' 49.1544" S	28456	28456.5	
180	30° 22' 54.4872" E	27° 00' 48.8772" S	28456	28459	
190	30° 22' 54.6024" E	27° 00' 48.6072" S	28458	28462.5	
200	30° 22' 54.7428" E	27° 00' 48.3408" S	28464	28464	
210	30° 22' 54.8796" E	27° 00' 48.0708" S	28464	28460.5	
220	30° 22' 54.9336" E	27° 00' 47.7684" S	28464	28451.25	
230	30° 22' 55.0596" E	27° 00' 47.4804" S	28450	28443.25	
240	30° 22' 55.1748" E	27° 00' 47.2176" S	28441	28440.5	
250	30° 22' 55.2648" E	27° 00' 46.9008" S	28441	28439.5	
260	30° 22' 55.3620" E	27° 00' 46.6380" S	28439	28439	
270	30° 22' 55.4916" E	27° 00' 46.3392" S	28439	28440.5	
280	30° 22' 55.6032" E	27° 00' 46.0512" S	28439	28448.5	
290	30° 22' 55.7436" E	27° 00' 45.7560" S	28445	28461.75	
300	30° 22' 55.8408" E	27° 00' 45.5292" S	28465	28468.75	
310	30° 22' 55.9632" E	27° 00' 45.2160" S	28472	28469.25	
320	30° 22' 56.1216" E	27° 00' 44.9136" S	28466	28472.5	
330	30° 22' 56.2296" E	27° 00' 44.6436" S	28473	28476.75	
340	30° 22' 56.3592" E	27° 00' 44.3664" S	28478	28478	
350	30° 22' 56.4348" E	27° 00' 44.0820" S	28478	28477.25	
360	30° 22' 56.5572" E	27° 00' 43.7904" S	28478	28483	
370	30° 22' 56.6760" E	27° 00' 43.5132" S	28475	28485.25	
380	30° 22' 56.7732" E	27° 00' 43.2036" S	28504	28456.25	
390	30° 22' 56.8812" E	27° 00' 42.9300" S	28458	28418	
400	30° 22' 56.9640" E	27° 00' 42.6420" S	28405	28404.25	
410	30° 22' 57.0720" E	27° 00' 42.3216" S	28404	28420.75	
420	30° 22' 57.1836" E	27° 00' 42.0192" S	28404	28497	
430	30° 22' 57.2844" E	27° 00' 41.7312" S	28471	28599.25	
440	30° 22' 57.4032" E	27° 00' 41.4612" S	28642	28611.5	
450	30° 22' 57.4680" E	27° 00' 41.1588" S	28642	28544.25	
460	30° 22' 57.5796" E	27° 00' 40.8996" S	28520	28501.25	
470	30° 22' 57.7020" E	27° 00' 40.6440" S	28495	28493.75	
480	30° 22' 57.8136" E	27° 00' 40.3200" S	28495	28489.5	
490	30° 22' 57.9360" E	27° 00' 40.0536" S	28490	28480.5	
500	30° 22' 58.0404" E	27° 00' 39.7728" S	28483	28470.25	
510	30° 22' 58.1520" E	27° 00' 39.5388" S	28466	28471	
520	30° 22' 58.3788" E	27° 00' 39.3048" S	28466	28481	
530	30° 22' 58.5768" E	27° 00' 39.0780" S	28486	28488	
540	30° 22' 58.7496" E	27° 00' 38.8260" S	28486	28490.75	
550	30° 22' 58.9548" E	27° 00' 38.5992" S	28494	28490.25	
560	30° 22' 59.1852" E	27° 00' 38.3904" S	28489	28487.5	
570	30° 22' 59.3652" E	27° 00' 38.1780" S	28489	28484.5	
580	30° 22' 59.5488" E	27° 00' 37.9440" S	28483	28483	

590	30° 22' 59.7180" E	27° 00' 37.6884" S	28483	28482	
600	30° 22' 59.9196" E	27° 00' 37.4508" S	28483	28475.25	
610	30° 23' 00.1104" E	27° 00' 37.2564" S	28479	28464.75	
620	30° 23' 00.3012" E	27° 00' 37.0044" S	28460	28464.75	
630	30° 23' 00.4704" E	27° 00' 36.7164" S	28460	28475.5	
640	30° 23' 00.6216" E	27° 00' 36.4968" S	28479	28482.75	
650	30° 23' 00.7800" E	27° 00' 36.2592" S	28484	28484	
660	30° 23' 00.9312" E	27° 00' 35.9928" S	28484	28487	
670	30° 23' 01.0860" E	27° 00' 35.7120" S	28484	28495.75	
680	30° 23' 01.2480" E	27° 00' 35.4204" S	28496	28514	
690	30° 23' 01.3884" E	27° 00' 35.1576" S	28507	28536.25	
700	30° 23' 01.5504" E	27° 00' 34.8804" S	28546	28545.5	
710	30° 23' 01.7016" E	27° 00' 34.6176" S	28546	28542	
720	30° 23' 01.8240" E	27° 00' 34.3260" S	28544	28534.75	
730	30° 23' 01.9788" E	27° 00' 34.0524" S	28534	28527.5	
740	30° 23' 02.1120" E	27° 00' 33.7752" S	28527	28521.75	
750	30° 23' 02.2452" E	27° 00' 33.5196" S	28522	28515.25	
760	30° 23' 02.3640" E	27° 00' 33.2280" S	28516	28508.5	
770	30° 23' 02.4864" E	27° 00' 32.9328" S	28507	28504	
780	30° 23' 02.6772" E	27° 00' 32.6412" S	28504	28498.25	
790	30° 23' 02.7924" E	27° 00' 32.3568" S	28501	28490.5	
800	30° 23' 02.9220" E	27° 00' 32.0832" S	28487	28487.5	
810	30° 23' 03.0948" E	27° 00' 31.8312" S	28487	28488.5	
820	30° 23' 03.2496" E	27° 00' 31.5288" S	28489	28489	
830	30° 23' 03.3792" E	27° 00' 31.2408" S	28489	28490.5	
840	30° 23' 03.5232" E	27° 00' 30.9492" S	28489	28497.5	
850	30° 23' 03.7176" E	27° 00' 30.7008" S	28495	28507	
860	30° 23' 03.8940" E	27° 00' 30.4092" S	28511	28503.25	
870	30° 23' 04.0740" E	27° 00' 30.1068" S	28511	28473.75	
880	30° 23' 04.2360" E	27° 00' 29.8368" S	28480	28438	
890	30° 23' 04.3620" E	27° 00' 29.5812" S	28424	28441.25	
900	30° 23' 04.4952" E	27° 00' 29.2356" S	28424	28480	
910	30° 23' 04.6392" E	27° 00' 28.9728" S	28493	28507.5	
920	30° 23' 04.7544" E	27° 00' 28.6812" S	28510	28515.25	
930	30° 23' 04.8552" E	27° 00' 28.3428" S	28517	28517	
940	30° 23' 04.9308" E	27° 00' 28.0476" S	28517	28517	
950	30° 23' 05.0496" E	27° 00' 27.8028" S	28517	28511.25	
960	30° 23' 05.1936" E	27° 00' 27.5076" S	28517	28497.5	
970	30° 23' 05.3268" E	27° 00' 27.2520" S	28494	28477.75	
980	30° 23' 05.4564" E	27° 00' 26.9460" S	28485	28456.5	
990	30° 23' 05.5608" E	27° 00' 26.6580" S	28447	28449	
1000	30° 23' 05.6616" E	27° 00' 26.3628" S	28447	28453.25	
1010	30° 23' 05.8092" E	27° 00' 26.0748" S	28455	28455.75	
1020	30° 23' 05.9424" E	27° 00' 25.8300" S	28456	28456	
1030	30° 23' 06.1332" E	27° 00' 25.5492" S	28456	28464.5	
1040	30° 23' 06.2700" E	27° 00' 25.2468" S	28456	28482	
1050	30° 23' 06.4284" E	27° 00' 24.9516" S	28490	28495	
1060	30° 23' 06.5724" E	27° 00' 24.6672" S	28492	28502.5	
1070	30° 23' 06.7236" E	27° 00' 24.3900" S	28506	21379.5	
1080	30° 23' 06.8712" E	27° 00' 24.1380" S	28506	7126.5	

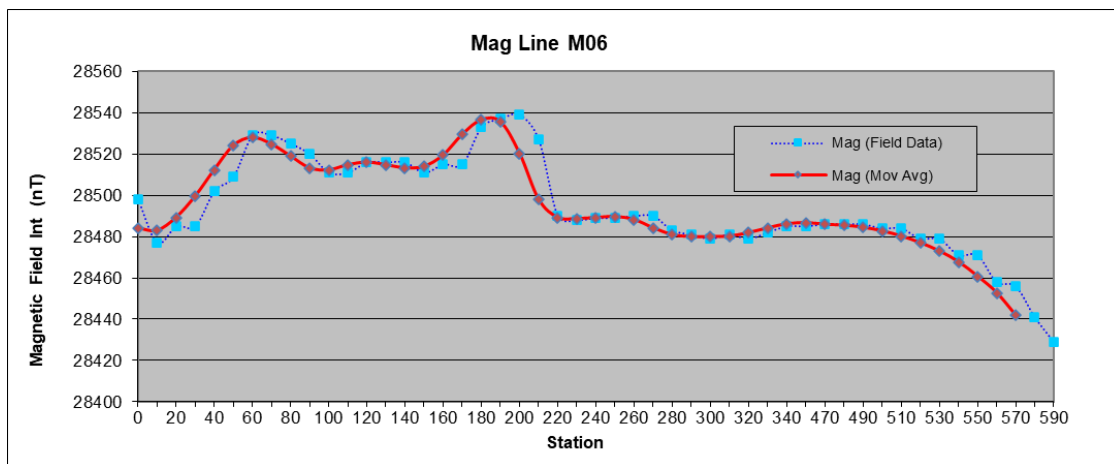


## LINE 6

Project:	Kangra Maquasa	Traverse Number:	Line 6
Project Number:	22-0161	Traverse Direction:	W-E
Survey Area:	Maquasa East	Station Spacing:	10 m
Date of Survey:	11 October 2022	Operator:	Shuaib Dustay & Martin Ngubana

Station	Station Coordinates		Mag		Comments
Station	Latitude (y)	Longitude (x)	Mag	Mag (Moving Average)	
0	30° 23' 08.1708" E	27° 00' 21.3516" S	28498	28484.25	
10	30° 23' 08.4948" E	27° 00' 21.4776" S	28477	28483	
20	30° 23' 08.8584" E	27° 00' 21.5352" S	28485	28489.25	
30	30° 23' 09.2148" E	27° 00' 21.4740" S	28485	28499.5	
40	30° 23' 09.5568" E	27° 00' 21.4560" S	28502	28512.25	
50	30° 23' 09.8736" E	27° 00' 21.3804" S	28509	28524	
60	30° 23' 10.1904" E	27° 00' 21.2544" S	28529	28528	
70	30° 23' 10.5324" E	27° 00' 21.0960" S	28529	28524.75	
80	30° 23' 10.8312" E	27° 00' 20.9484" S	28525	28519	
90	30° 23' 11.1336" E	27° 00' 20.8224" S	28520	28513.25	
100	30° 23' 11.4648" E	27° 00' 20.7036" S	28511	28512.25	
110	30° 23' 11.7456" E	27° 00' 20.5092" S	28511	28514.75	
120	30° 23' 12.0696" E	27° 00' 20.3796" S	28516	28516	
130	30° 23' 12.3936" E	27° 00' 20.2608" S	28516	28514.75	
140	30° 23' 12.6960" E	27° 00' 20.1636" S	28516	28513.25	
150	30° 23' 13.0308" E	27° 00' 20.1456" S	28511	28514	
160	30° 23' 13.3404" E	27° 00' 20.0700" S	28515	28519.5	
170	30° 23' 13.6860" E	27° 00' 20.0340" S	28515	28529.5	
180	30° 23' 14.0496" E	27° 00' 19.9800" S	28533	28536.5	
190	30° 23' 14.3808" E	27° 00' 19.8756" S	28537	28535.5	
200	30° 23' 14.7264" E	27° 00' 19.7892" S	28539	28520.25	
210	30° 23' 15.0756" E	27° 00' 19.6956" S	28527	28498	
220	30° 23' 15.4320" E	27° 00' 19.6704" S	28490	28489.25	
230	30° 23' 15.7740" E	27° 00' 19.6128" S	28488	28488.75	
240	30° 23' 16.1088" E	27° 00' 19.5444" S	28489	28489.25	
250	30° 23' 16.4508" E	27° 00' 19.4760" S	28489	28489.75	
260	30° 23' 16.7676" E	27° 00' 19.3968" S	28490	28488.25	
270	30° 23' 17.1024" E	27° 00' 19.3068" S	28490	28484.25	
280	30° 23' 17.4516" E	27° 00' 19.2024" S	28483	28481	
290	30° 23' 17.7684" E	27° 00' 19.1268" S	28481	28480	
300	30° 23' 18.1032" E	27° 00' 19.0152" S	28479	28480	
310	30° 23' 18.4092" E	27° 00' 18.9648" S	28481	28480.25	
320	30° 23' 18.7800" E	27° 00' 18.8712" S	28479	28482	
330	30° 23' 19.0716" E	27° 00' 18.7488" S	28482	28484.25	
340	30° 23' 19.3380" E	27° 00' 18.6084" S	28485	28486.25	
350	30° 23' 19.6224" E	27° 00' 18.5112" S	28485	28486.75	
360	30° 23' 19.9248" E	27° 00' 18.4932" S	28490	28482.75	
370	30° 23' 20.2380" E	27° 00' 18.4572" S	28482	28477	
380	30° 23' 20.5656" E	27° 00' 18.4104" S	28477	28473.25	
390	30° 23' 20.9040" E	27° 00' 18.3636" S	28472	28474.25	
400	30° 23' 21.2208" E	27° 00' 18.2880" S	28472	28479.25	
410	30° 23' 21.5556" E	27° 00' 18.2592" S	28481	28482.5	
420	30° 23' 21.8328" E	27° 00' 18.1764" S	28483	28484.25	
430	30° 23' 22.1136" E	27° 00' 18.0612" S	28483	28486.75	
440	30° 23' 22.4340" E	27° 00' 18.0324" S	28488	28488	
450	30° 23' 22.7544" E	27° 00' 18.0108" S	28488	28487.5	

460	30° 23' 23.0820" E	27° 00' 18.0000" S	28488	28486.5	
470	30° 23' 23.3952" E	27° 00' 17.9604" S	28486	28486	
480	30° 23' 23.7228" E	27° 00' 17.8776" S	28486	28485.5	
490	30° 23' 24.0216" E	27° 00' 17.8416" S	28486	28484.5	
500	30° 23' 24.2952" E	27° 00' 17.6904" S	28484	28482.75	
510	30° 23' 24.5652" E	27° 00' 17.5752" S	28484	28480.25	
520	30° 23' 24.7524" E	27° 00' 17.4132" S	28479	28477	
530	30° 23' 25.0188" E	27° 00' 17.3088" S	28479	28473	
540	30° 23' 25.3572" E	27° 00' 17.2368" S	28471	28467.75	
550	30° 23' 25.6776" E	27° 00' 17.1648" S	28471	28460.75	
560	30° 23' 25.9908" E	27° 00' 17.0784" S	28458	28452.75	
570	30° 23' 26.3112" E	27° 00' 16.9776" S	28456	28441.75	
580	30° 23' 26.6892" E	27° 00' 16.8552" S	28441	21324.75	
590	30° 23' 26.9772" E	27° 00' 16.7832" S	28429	7107.25	



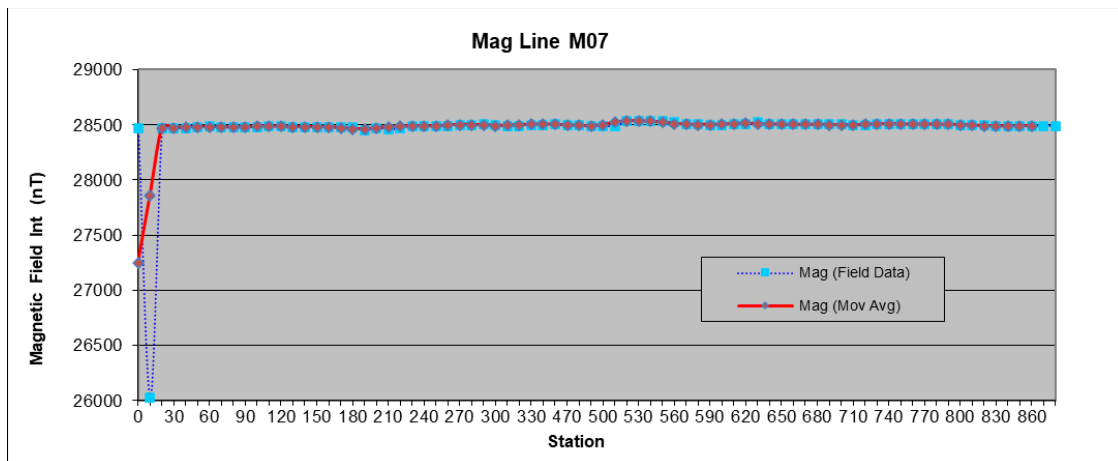
## LINE 7

Project:	Kangra Maquasa	Traverse Number:	Line 6
Project Number:	22-0161	Traverse Direction:	SW-NE
Survey Area:	Maquasa East	Station Spacing:	10 m
Date of Survey:	11 October 2022	Operator:	Shuaib Dustay & Martin Ngubana

Station	Station Coordinates		Mag		Comments
Station	Latitude (y)	Longitude (x)	Mag	Mag (Moving Average)	
0	30° 22' 58.5660" E	27° 01' 25.6908" S	28467	27248.5	
10	30° 22' 58.8432" E	27° 01' 25.5684" S	26030	27858.25	
20	30° 22' 59.0772" E	27° 01' 25.4568" S	28467	28468.5	
30	30° 22' 59.3796" E	27° 01' 25.2300" S	28469	28472	
40	30° 22' 59.6100" E	27° 01' 25.1472" S	28469	28478.75	
50	30° 22' 59.8152" E	27° 01' 24.9636" S	28481	28482.5	
60	30° 23' 00.0528" E	27° 01' 24.8412" S	28484	28481	
70	30° 23' 00.3624" E	27° 01' 24.6648" S	28481	28477.75	
80	30° 23' 00.6288" E	27° 01' 24.4956" S	28478	28476	
90	30° 23' 00.9168" E	27° 01' 24.3444" S	28474	28479.75	
100	30° 23' 01.1616" E	27° 01' 24.1932" S	28478	28486.25	
110	30° 23' 01.4568" E	27° 01' 24.0276" S	28489	28487.25	
120	30° 23' 01.7304" E	27° 01' 23.8548" S	28489	28483	
130	30° 23' 01.9896" E	27° 01' 23.7036" S	28482	28479.75	
140	30° 23' 02.2884" E	27° 01' 23.5560" S	28479	28479	
150	30° 23' 02.5116" E	27° 01' 23.3796" S	28479	28479	
160	30° 23' 02.7312" E	27° 01' 23.2896" S	28479	28479.25	
170	30° 23' 02.9832" E	27° 01' 23.1600" S	28479	28471.5	
180	30° 23' 03.2244" E	27° 01' 23.0016" S	28480	28461	
190	30° 23' 03.4836" E	27° 01' 22.8720" S	28447	28460.75	
200	30° 23' 03.7392" E	27° 01' 22.7244" S	28470	28468.25	
210	30° 23' 03.9732" E	27° 01' 22.5516" S	28456	28482.25	
220	30° 23' 04.2900" E	27° 01' 22.3680" S	28470	28484	
230	30° 23' 04.5600" E	27° 01' 22.1952" S	28491	28489.25	
240	30° 23' 04.8516" E	27° 01' 22.0188" S	28491	28485.75	
250	30° 23' 05.1000" E	27° 01' 21.8712" S	28484	28488	
260	30° 23' 05.3772" E	27° 01' 21.7056" S	28484	28496	
270	30° 23' 05.6256" E	27° 01' 21.5328" S	28500	28500.5	
280	30° 23' 05.9064" E	27° 01' 21.3492" S	28500	28500	
290	30° 23' 06.2196" E	27° 01' 21.2052" S	28502	28496	
300	30° 23' 06.5292" E	27° 01' 21.0360" S	28496	28491.5	
310	30° 23' 06.8100" E	27° 01' 20.8704" S	28490	28492.75	
320	30° 23' 07.0656" E	27° 01' 20.7048" S	28490	28498.25	
330	30° 23' 07.3608" E	27° 01' 20.5392" S	28501	28502.25	
340	30° 23' 07.6128" E	27° 01' 20.3880" S	28501	28504.25	
350	30° 23' 07.8900" E	27° 01' 20.2044" S	28506	28504.5	
360	30° 23' 08.0880" E	27° 01' 19.9884" S	28504	28503.5	
370	30° 23' 08.3904" E	27° 01' 19.8696" S	28504	28502.25	
380	30° 23' 08.6676" E	27° 01' 19.7400" S	28502	28501.25	
390	30° 23' 08.9700" E	27° 01' 19.5708" S	28501	28498.5	
400	30° 23' 09.2724" E	27° 01' 19.4304" S	28501	28493.5	
410	30° 23' 09.5244" E	27° 01' 19.2576" S	28491	28491.25	
420	30° 23' 09.8376" E	27° 01' 19.0884" S	28491	28491.75	
430	30° 23' 10.1184" E	27° 01' 18.9552" S	28492	28491.5	
440	30° 23' 10.4136" E	27° 01' 18.8220" S	28492	28490.5	
450	30° 23' 10.7304" E	27° 01' 18.6708" S	28490	28491.25	
460	30° 23' 11.0040" E	27° 01' 18.4944" S	28490	28493.75	
470	30° 23' 11.2776" E	27° 01' 18.3000" S	28495	28494.25	
480	30° 23' 11.5800" E	27° 01' 18.1416" S	28495	28492.75	
490	30° 23' 11.8212" E	27° 01' 17.9580" S	28492	28490.25	
500	30° 23' 12.0624" E	27° 01' 17.7816" S	28492	28498.75	
510	30° 23' 12.3576" E	27° 01' 17.5800" S	28485	28521	
520	30° 23' 12.5952" E	27° 01' 17.4540" S	28533	28533	
530	30° 23' 12.8868" E	27° 01' 17.2776" S	28533	28533	
540	30° 23' 13.1532" E	27° 01' 17.1300" S	28533	28530	
550	30° 23' 13.4268" E	27° 01' 16.9428" S	28533	28521	
560	30° 23' 13.6860" E	27° 01' 16.7556" S	28521	28510.25	
570	30° 23' 13.9632" E	27° 01' 16.6116" S	28509	28503.25	



580	30° 23' 14.2548" E	27° 01' 16.4532" S	28502	28500.5	
590	30° 23' 14.5248" E	27° 01' 16.2768" S	28500	28500.75	
600	30° 23' 14.7768" E	27° 01' 16.1328" S	28500	28502.25	
610	30° 23' 15.0792" E	27° 01' 15.9708" S	28503	28507.5	
620	30° 23' 15.3564" E	27° 01' 15.8304" S	28503	28511.75	
630	30° 23' 15.6408" E	27° 01' 15.6900" S	28521	28507	
640	30° 23' 15.9288" E	27° 01' 15.5316" S	28502	28502.5	
650	30° 23' 16.1844" E	27° 01' 15.3696" S	28503	28502.25	
660	30° 23' 16.4292" E	27° 01' 15.1896" S	28502	28502	
670	30° 23' 16.6956" E	27° 01' 15.0132" S	28502	28502	
680	30° 23' 16.9656" E	27° 01' 14.8476" S	28502	28502	
690	30° 23' 17.2356" E	27° 01' 14.7108" S	28502	28500	
700	30° 23' 17.5632" E	27° 01' 14.5344" S	28502	28496	
710	30° 23' 17.8656" E	27° 01' 14.4444" S	28494	28497	
720	30° 23' 18.1536" E	27° 01' 14.2788" S	28494	28503	
730	30° 23' 18.3984" E	27° 01' 14.0916" S	28506	28505.75	
740	30° 23' 18.6324" E	27° 01' 13.9332" S	28506	28505.25	
750	30° 23' 18.8952" E	27° 01' 13.7496" S	28505	28504.75	
760	30° 23' 19.1616" E	27° 01' 13.5912" S	28505	28504.25	
770	30° 23' 19.2948" E	27° 01' 13.3464" S	28504	28504	
780	30° 23' 19.5576" E	27° 01' 13.1700" S	28504	28503.25	
790	30° 23' 19.7268" E	27° 01' 12.9612" S	28504	28501.75	
800	30° 23' 19.9752" E	27° 01' 12.7992" S	28501	28499	
810	30° 23' 20.2848" E	27° 01' 12.6876" S	28501	28494.25	
820	30° 23' 20.6340" E	27° 01' 12.6120" S	28493	28490.25	
830	30° 23' 20.7600" E	27° 01' 12.3744" S	28490	28488.5	
840	30° 23' 20.9904" E	27° 01' 12.1908" S	28488	28488	
850	30° 23' 21.2712" E	27° 01' 12.0432" S	28488	28488.25	
860	30° 23' 21.5376" E	27° 01' 11.8884" S	28488	28488.75	
870	30° 23' 21.7860" E	27° 01' 11.7192" S	28489	21366.75	
880	30° 23' 22.0236" E	27° 01' 11.6004" S	28489	7122.25	



## APPENDIX C: LABORATORY CERTIFICATES



## Test Report

Page 1 of 1

**Client:** Groundwater Consulting Services (GCS)  
**Address:** 63 Wessel Road, Woodmead, 2191  
**Report no:** 137167  
**Project:** Kangra

**Date of report:** 19 October 2022  
**Date accepted:** 10 October 2022  
**Date completed:** 19 October 2022  
**Date received:** 10 October 2022

<b>Lab no:</b>	185437	185438
<b>Date sampled:</b>	10-Oct-22	10-Oct-22
<b>Aquatico sampled:</b>	No	No
<b>Sample type:</b>	Geochem	Geochem
<b>Locality description:</b>	KSLURRY1	KDISCARD
<b>Analyses</b>		
	<b>Unit</b>	<b>Method</b>
N Paste pH (1:2)	pH	Geochem
N Net acid generation (NAG)	H2SO4 kg/t	Geochem
N NAGpH	pH	Geochem
N Total Sulphur	%	Geochem
N Sulphate Sulphur	%	Geochem
N Acid Potential based Total Sulphur	CaCO3 kg/t	Geochem
N Acid Potential based Sulphide Sulphur	CaCO3 kg/t	Geochem
N Neutralization Potential (NP)	CaCO3 kg/t	Geochem
N Net Neutralization Potential (NNP)	CaCO3 kg/t	Geochem
N NP / AP (TS)	-	Geochem
N NP / AP (SS)	-	Geochem
N Geo - Milling 75um	-	Geochem
N Sulphide Sulphur	%	Geochem

Sub = Sub-contracted NR = Not requested RTF = Results to follow NATD = Not able to determine ATR = Alternative test report  
 Results relate only to the items sampled and tested ; Results reported against the limit of detection.  
 The report shall not be reproduced except in full without approval of the laboratory  
 The results apply to the sample received.

M. Swanepoel  
 Technical Signatory

www.aquatico.co.za

89 Regency Drive, R21 Corporate Park, Centurion, South Africa

Tel: +27 12 450 3800 Fax: +27 12 450 3851



## Test Report

Page 1 of 2

**Client:** Groundwater Consulting Services (GCS)  
**Address:** 63 Wessel Road, Woodmead, 2191  
**Report no:** 137169  
**Project:** Kangra

**Date of report:** 17 October 2022  
**Date accepted:** 10 October 2022  
**Date completed:** 17 October 2022  
**Date received:** 10 October 2022

Lab no:	185451	185452
Date sampled:	10-Oct-22	10-Oct-22
Aquatico sampled:	No	No
Sample type:	Geochem	Geochem
Locality description:	KDISCARD	KSLURRY1
Analyses		
	Unit	Method
N Geo - Reagent water Leach 1:20	-	Geochem
A pH @ 25°C	pH	ALM 20
A Electrical conductivity (EC) @ 25°C	mS/m	ALM 20
A Total Alkalinity	mg CaCO <sub>3</sub> /l	ALM 01
A Chloride (Cl)	mg/l	ALM 02
A Sulphate (SO <sub>4</sub> )	mg/l	ALM 03
A Orthophosphate (PO <sub>4</sub> ) as P	mg/l	ALM 04
A Nitrate (NO <sub>3</sub> ) as N	mg/l	ALM 06
A Calcium (Ca)	mg/l	ALM 30
A Magnesium (Mg)	mg/l	ALM 30
A Sodium (Na)	mg/l	ALM 30
A Potassium (K)	mg/l	ALM 30
A Aluminium (Al)	mg/l	ALM 31
A Iron (Fe)	mg/l	ALM 31
A Manganese (Mn)	mg/l	ALM 31
A Cadmium (Cd)	mg/l	ALM 31
A Cobalt (Co)	mg/l	ALM 31
A Chromium (Cr)	mg/l	ALM 31
A Copper (Cu)	mg/l	ALM 31
A Nickel (Ni)	mg/l	ALM 31
A Lead (Pb)	mg/l	ALM 31
A Zinc (Zn)	mg/l	ALM 31
A Boron (B)	mg/l	ALM 33
A Barium (Ba)	mg/l	ALM 33
A Beryllium (Be)	mg/l	ALM 33
A Vanadium (V)	mg/l	ALM 33
N Bismuth (Bi)	mg/l	ALM 32
N Silver (Ag)	mg/l	ALM 32

A = Accredited N = Non accredited Sub = Sub-contracted NR = Not requested RTF = Results to follow NATD = Not able to determine ATR = Alternative P = Pretoria K = K test report ; Results relate only to the items sampled and tested ; Results reported against the limit of detection; Results marked 'Non SANAS Accredited' in this report are not included in the SANAS Schedule of Accreditation for this laboratory; Uncertainty of measurement available on request for all methods included in the SANAS Schedule of Accreditation; The report shall not be reproduced except in full without approval of the laboratory

*M. Swanepoel*  
 Technical Signatory



## Test Report

Page 2 of 2

**Client:** Groundwater Consulting Services (GCS)  
**Address:** 63 Wessel Road, Woodmead, 2191  
**Report no:** 137169  
**Project:** Kangra

**Date of report:** 17 October 2022  
**Date accepted:** 10 October 2022  
**Date completed:** 17 October 2022  
**Date received:** 10 October 2022

Lab no:			185451	185452
Date sampled:			10-Oct-22	10-Oct-22
Aquatico sampled:			No	No
Sample type:			Geochem	Geochem
Locality description:			KDISCARD	KSLURRY1
Analyses				
	Unit	Method		
N Gallium (Ga)	mg/l	ALM 32	0.002	0.002
N Lithium (Li)	mg/l	ALM 32	0.006	0.009
A Molybdenum (Mo)	mg/l	ALM 33	0.039	0.052
N Rubidium (Rb)	mg/l	ALM 32	0.010	0.011
A Strontium (Sr)	mg/l	ALM 33	1.35	2.65
N Tellurium (Te)	mg/l	ALM 32	<0.001	<0.001
N Thallium (Tl)	mg/l	ALM 32	<0.037	<0.037
A Total oxidised nitrogen as N	mg/l	ALM 06	<0.194	<0.194

A = Accredited N = Non accredited Sub = Sub-contracted NR = Not requested RTF = Results to follow NATD = Not able to determine ATR = Alternative P = Pretoria K = K test report ; Results relate only to the items sampled and tested ; Results reported against the limit of detection; Results marked 'Non SANAS Accredited' in this report are not included in the SANAS Schedule of Accreditation for this laboratory; Uncertainty of measurement available on request for all methods included in the SANAS Schedule of Accreditation; The report shall not be reproduced except in full without approval of the laboratory

Authenticated signature on first page

www.aquatico.co.za

89 Regency Drive, R21 Corporate Park, Centurion, South Africa

Tel: +27 12 450 3800 Fax: +27 12 450 3851



leaders in environmental monitoring

address: 89 Regency drive, R21 Corporate Park, Centurion  
postal: P.O. Box 905008, Garsfontein, 0042  
web: www.aquatico.co.za  
office: 012 450 3800 • fax: 012 450 3851

63 WESSEL ROAD  
WOODMEAD  
2191

ATTENTION: GROUNDWATER CONSULTING SERVICES (GCS)  
17 OCTOBER 2022

**Kangra**  
**(TEST REPORT 137170)**

**Qualitative and quantitative XRD results**

Geochem samples (2) were submitted to Aquatico Laboratories on **10 October 2022** for Rietveld analysis.

The material was milled and prepared for XRD analysis using a front-loading preparation method.

The samples were analysed with a PANalytical Empyrean diffractometer with X'Celerator detector and fixed slits with a Cu-K $\alpha$  radiation.

The phases were identified by using X'Pert Highscore plus software.

**Comments:**

- If the results in this report do not correspond to results of other analytical techniques, please contact us for further review of the XRD results.
- The mineral names in this report may not reflect the specific mineral identified, but rather the mineral group.
- Due to preferred orientation and crystallite size effects as well as small sample amounts, results may not be as accurate as shown.
- Small amounts of additional phases may be present.
- **It may be advisable to confirm results using alternative analytical techniques.**
- Amorphous phases, if present, were not taken into account during quantification.

If you have any further queries, please contact the laboratory.

Analyst  
Paula Aucamp  
BSc (Hons) Geology

***Samples will be stored for 1 month after which it will be discarded***



directors: R. Erdmann (CEO) • P.J. Naudé • T.B. Sefolo • L.E. Kolobe.  
company registration number: 2006/028605/07. vat no: 4360195723.

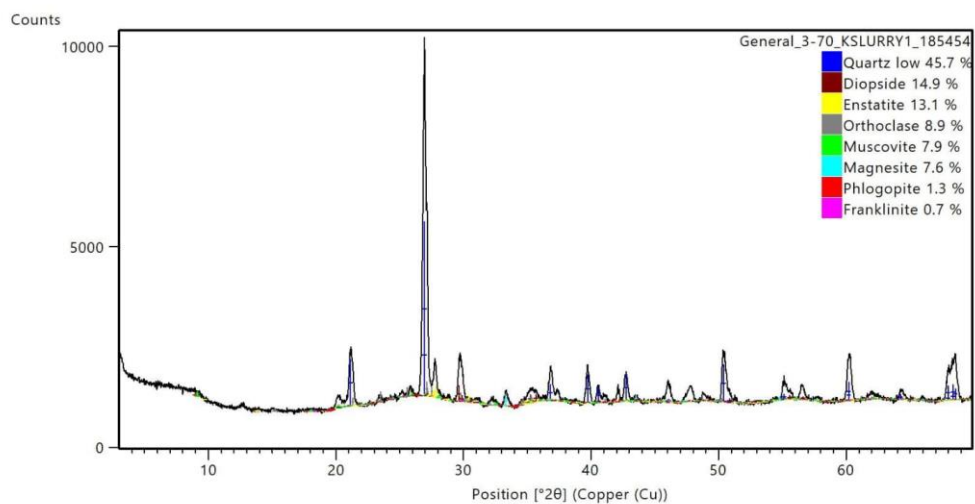
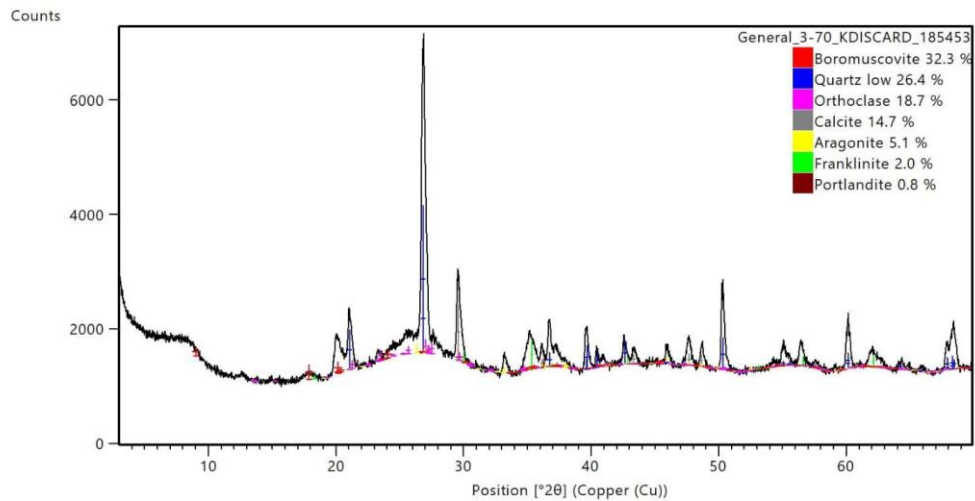




leaders in environmental monitoring

address: 89 Regency drive, R21 Corporate Park, Centurion  
 postal: P.O. Box 905008, Garsfontein, 0042  
 web: www.aquatico.co.za  
 office: 012 450 3800 • fax: 012 450 3851

### Results:



directors: R. Erdmann (CEO) • P.J. Naudé • T.B. Sefolo • L.E. Kolobe.  
 company registration number: 2006/028605/07. vat no: 4360195723.


**leaders in environmental monitoring**

address: 89 Regency drive, R21 Corporate Park, Centurion  
 postal: P.O. Box 905008, Garsfontein, 0042  
 web: www.aquatico.co.za  
 office: 012 450 3800 • fax: 012 450 3851

**Mineral description:**

Mineral	Chemical formula	Description
Aragonite	$\text{CaCO}_3$	Aragonite is a polymorph of the carbonate mineral calcite (i.e., the minerals have the same chemical formula but different crystal structures). Aragonite is stable under higher pressure conditions compared to calcite.
Calcite	$\text{CaCO}_3$	Calcite is a carbonate mineral and one of the most common minerals in sedimentary, igneous and metamorphic rocks. Calcite is usually white in colour.
Diopside	$\text{MgCaSi}_2\text{O}_6$	Diopside is a pyroxene mineral and belongs to the clinopyroxene sub-group. It is an important rock-forming mineral in mafic igneous rocks and can also be found in metamorphic rocks.
Enstatite	$\text{Mg}_2\text{Si}_2\text{O}_6$	Enstatite is part of the pyroxene group of minerals and is a common rock forming mineral in ultramafic-mafic igneous rocks and metamorphic rocks. Enstatite belongs to the orthopyroxene subgroup and typically occurs as grey to greenish brown crystals.
Franklinite	$\text{ZnFe}_2\text{O}_4$	Franklinite is a zinc iron oxide which is part of the spinel group of minerals. Similar to magnetite, franklinite can contain both ferric ( $\text{Fe}^{3+}$ ) and ferrous ( $\text{Fe}^{2+}$ ) iron with manganese commonly occurring together with zinc.
Magnesite	$\text{MgCO}_3$	Magnesite is a whitish, brittle, magnesium carbonate mineral that is typically formed through the carbonation of ultramafic magnesium-rich rocks such as peridotite.
Muscovite	$\text{KAl}_2(\text{AlSi}_3\text{O}_{10})(\text{OH})_2$	Muscovite is a hydrated phyllosilicate mineral containing aluminium and potassium. It has a perfect basal cleavage yielding remarkably thin laminae (sheets) which are often highly elastic.
Orthoclase	$\text{KAlSi}_3\text{O}_8$	Orthoclase is a potassium bearing feldspar. It has similar chemical composition to microcline. It commonly forms large well-shaped crystals in pegmatites, where it is associated with quartz, mica and other feldspars such as microcline and albite.
Phlogopite	$\text{KMg}_3\text{AlSi}_3\text{O}_{10}(\text{OH})_2$	Phlogopite is the magnesium-rich endmember of biotite. This micaceous mineral is typically found in ultra-mafic igneous rocks and metamorphosed clayey rocks like shale and mudstone.
Portlandite	$\text{Ca}(\text{OH})_2$	Portlandite is a calcium hydroxide mineral. This mineral is typically formed during the alteration of calcium silicate minerals in contact metamorphic zones and can also be found in burning coal measures.
Quartz	$\text{SiO}_2$	Quartz is one of the most common minerals on Earth, and is present in many sedimentary, igneous and metamorphic rocks.



directors: R. Erdmann (CEO) • P.J. Naudé • T.B. Sefolo • L.E. Kolobe.  
 company registration number: 2006/028605/07. uat no: 4360195723.

**leaders in environmental monitoring**

address: 89 Regency drive, R21 Corporate Park, Centurion  
postal: P.O. Box 905008, Garsfontein, 0042  
web: [www.aquatico.co.za](http://www.aquatico.co.za)  
office: 012 450 3800 • fax: 012 450 3851

**References:**

1. Cairncross, B., 2004. Field Guide to Rocks and Minerals of South Africa. South Africa, Struik Nature.
2. Dutrow, B., & Klein, C., 2007. The Manual of Minerals Science. 23<sup>rd</sup> Edition, United States of America, Jay O'Callaghan.



directors: R. Erdmann (CEO) • P.J. Naudé • T.B. Sefolo • L.E. Kolobe.  
company registration number: 2006/028605/07. uat no: 4360195723.



## Test Report

Page 1 of 1

**Client:** Groundwater Consulting Services (GCS)  
**Address:** 63 Wessel Road, Woodmead, 2191  
**Report no:** 137172  
**Project:** Kangra

**Date of report:** 14 October 2022  
**Date accepted:** 10 October 2022  
**Date completed:** 14 October 2022  
**Date received:** 10 October 2022

Lab no:			185457
Date sampled:			10-Oct-22
Aquatico sampled:			No
Sample type:			Water
Locality description:			EG1
Analyses			
	Unit	Method	
A pH @ 25°C	pH	ALM 20	7.57
A Electrical conductivity (EC) @ 25°C	mS/m	ALM 20	15.3
A Total dissolved solids (TDS)	mg/l	ALM 26	110
A Total Alkalinity	mg CaCO3/l	ALM 01	63.4
A Chloride (Cl)	mg/l	ALM 02	11.2
A Sulphate (SO4)	mg/l	ALM 03	22.2
A Nitrate (NO3) as N	mg/l	ALM 06	<0.194
A Nitrite (NO2) as N	mg/l	ALM 07	0.075
A Fluoride (F)	mg/l	ALM 08	<0.263
A Calcium (Ca)	mg/l	ALM 30	9.90
A Magnesium (Mg)	mg/l	ALM 30	8.34
A Sodium (Na)	mg/l	ALM 30	12.1
A Potassium (K)	mg/l	ALM 30	7.47
A Aluminium (Al)	mg/l	ALM 31	0.034
A Iron (Fe)	mg/l	ALM 31	<0.004
A Manganese (Mn)	mg/l	ALM 31	<0.001
A Bicarbonate alkalinity	mg CaCO3/l	ALM 26	63.2
A Total oxidised nitrogen as N	mg/l	ALM 06	<0.194

A = Accredited N = Non accredited Sub = Sub-contracted NR = Not requested RTF = Results to follow NATD = Not able to determine ATR = Alternative P = Pretoria K = K test report ; Results relate only to the items sampled and tested ; Results reported against the limit of detection; Results marked 'Non SANAS Accredited' in this report are not included in the SANAS Schedule of Accreditation for this laboratory; Uncertainty of measurement available on request for all methods included in the SANAS Schedule of Accreditation; The report shall not be reproduced except in full without approval of the laboratory

*M. Swanepoel*  
**Technical Signatory**



## Test Report

Page 1 of 1

**Client:** Groundwater Consulting Services (GCS)  
**Address:** 63 Wessel Road, Woodmead, 2191  
**Report no:** 137244  
**Project:** Kangra

**Date of report:** 19 October 2022  
**Date accepted:** 11 October 2022  
**Date completed:** 19 October 2022  
**Date received:** 11 October 2022

Lab no:				185786
Date sampled:				11-Oct-22
Aquatico sampled:				No
Sample type:				Geochem
Locality description:				KDISCARD 1
Analyses				
	Unit	Method		
N Paste pH (1:2)	pH	Geochem		7.54
N Net acid generation (NAG)	H2SO4 kg/t	Geochem		53.3
N NAGpH	pH	Geochem		2.56
N Total Sulphur	%	Geochem		4.51
N Sulphate Sulphur	%	Geochem		3.00
N Acid Potential based Total Sulphur	CaCO3 kg/t	Geochem		141
N Acid Potential based Sulphide Sulphur	CaCO3 kg/t	Geochem		47.2
N Neutralization Potential (NP)	CaCO3 kg/t	Geochem		44.5
N Net Neutralization Potential (NNP)	CaCO3 kg/t	Geochem		0
N NP / AP (TS)	-	Geochem		0.316
N NP / AP (SS)	-	Geochem		0.943
N Geo - Milling 75um	-	Geochem		Yes
N Sulphide Sulphur	%	Geochem		1.51

Sub = Sub-contracted NR = Not requested RTF = Results to follow NATD = Not able to determine ATR = Alternative test report  
 Results relate only to the items sampled and tested ; Results reported against the limit of detection.  
 The report shall not be reproduced except in full without approval of the laboratory  
 The results apply to the sample received.

*M. Swanepoel*  
 Technical Signatory





## Test Report

Page 1 of 2

**Client:** Groundwater Consulting Services (GCS)  
**Address:** 63 Wessel Road, Woodmead, 2191  
**Report no:** 137245  
**Project:** Kangra

**Date of report:** 18 October 2022  
**Date accepted:** 11 October 2022  
**Date completed:** 18 October 2022  
**Date received:** 11 October 2022

Lab no:			185787
Date sampled:			11-Oct-22
Aquatico sampled:			No
Sample type:			Geochem
Locality description:			KDISCARD 1
Analyses			
	Unit	Method	
N Geo - Reagent water Leach 1:20	-	Geochem	Yes
A pH @ 25°C	pH	ALM 20	8.23
A Electrical conductivity (EC) @ 25°C	mS/m	ALM 20	30.8
A Total Alkalinity	mg CaCO3/l	ALM 01	42.3
A Chloride (Cl)	mg/l	ALM 02	1.79
A Sulphate (SO4)	mg/l	ALM 03	86.1
A Orthophosphate (PO4) as P	mg/l	ALM 04	<0.005
A Nitrate (NO3) as N	mg/l	ALM 06	<0.194
A Calcium (Ca)	mg/l	ALM 30	40.9
A Magnesium (Mg)	mg/l	ALM 30	5.39
A Sodium (Na)	mg/l	ALM 30	5.73
A Potassium (K)	mg/l	ALM 30	6.48
A Aluminium (Al)	mg/l	ALM 31	0.017
A Iron (Fe)	mg/l	ALM 31	0.006
A Manganese (Mn)	mg/l	ALM 31	0.022
A Cadmium (Cd)	mg/l	ALM 31	<0.002
A Cobalt (Co)	mg/l	ALM 31	<0.003
A Chromium (Cr)	mg/l	ALM 31	<0.003
A Copper (Cu)	mg/l	ALM 31	0.004
A Nickel (Ni)	mg/l	ALM 31	<0.002
A Lead (Pb)	mg/l	ALM 31	<0.004
A Zinc (Zn)	mg/l	ALM 31	<0.002
A Boron (B)	mg/l	ALM 33	<0.013
A Barium (Ba)	mg/l	ALM 33	0.095
A Beryllium (Be)	mg/l	ALM 33	<0.005
A Vanadium (V)	mg/l	ALM 33	<0.001
N Bismuth (Bi)	mg/l	ALM 32	<0.004
N Silver (Ag)	mg/l	ALM 32	<0.001

A = Accredited N = Non accredited Sub = Sub-contracted NR = Not requested RTF = Results to follow NATD = Not able to determine ATR = Alternative P = Pretoria K = K test report ; Results relate only to the items sampled and tested ; Results reported against the limit of detection; Results marked 'Non SANAS Accredited' in this report are not included in the SANAS Schedule of Accreditation for this laboratory; Uncertainty of measurement available on request for all methods included in the SANAS Schedule of Accreditation; The report shall not be reproduced except in full without approval of the laboratory

*M. Swanepoel*  
 Technical Signatory



## Test Report

Page 2 of 2

**Client:** Groundwater Consulting Services (GCS)  
**Address:** 63 Wessel Road, Woodmead, 2191  
**Report no:** 137245  
**Project:** Kangra

**Date of report:** 18 October 2022  
**Date accepted:** 11 October 2022  
**Date completed:** 18 October 2022  
**Date received:** 11 October 2022

Lab no:				185787
Date sampled:				11-Oct-22
Aquatico sampled:				No
Sample type:				Geochem
Locality description:				KDISCARD 1
Analyses				
		Unit	Method	
N Gallium (Ga)		mg/l	ALM 32	0.002
N Lithium (Li)		mg/l	ALM 32	0.005
A Molybdenum (Mo)		mg/l	ALM 33	0.029
N Rubidium (Rb)		mg/l	ALM 32	0.011
A Strontium (Sr)		mg/l	ALM 33	0.842
N Tellurium (Te)		mg/l	ALM 32	<0.001
N Thallium (Tl)		mg/l	ALM 32	<0.037
A Total oxidised nitrogen as N		mg/l	ALM 06	<0.194

A = Accredited N = Non accredited Sub = Sub-contracted NR = Not requested RTF = Results to follow NATD = Not able to determine ATR = Alternative P = Pretoria K = K test report ; Results relate only to the items sampled and tested ; Results reported against the limit of detection; Results marked 'Non SANAS Accredited' in this report are not included in the SANAS Schedule of Accreditation for this laboratory; Uncertainty of measurement available on request for all methods included in the SANAS Schedule of Accreditation; The report shall not be reproduced except in full without approval of the laboratory

Authenticated signature on first page

www.aquatico.co.za

89 Regency Drive, R21 Corporate Park, Centurion, South Africa

Tel: +27 12 450 3800 Fax: +27 12 450 3851



## Test Report

Page 1 of 1

<b>Client:</b>	Groundwater Consulting Services (GCS)	<b>Date of report:</b>	19 October 2022
<b>Address:</b>	63 Wessel Road, Woodmead, 2191	<b>Date accepted:</b>	11 October 2022
<b>Report no:</b>	137247	<b>Date completed:</b>	19 October 2022
<b>Project:</b>	Kangra	<b>Date received:</b>	11 October 2022

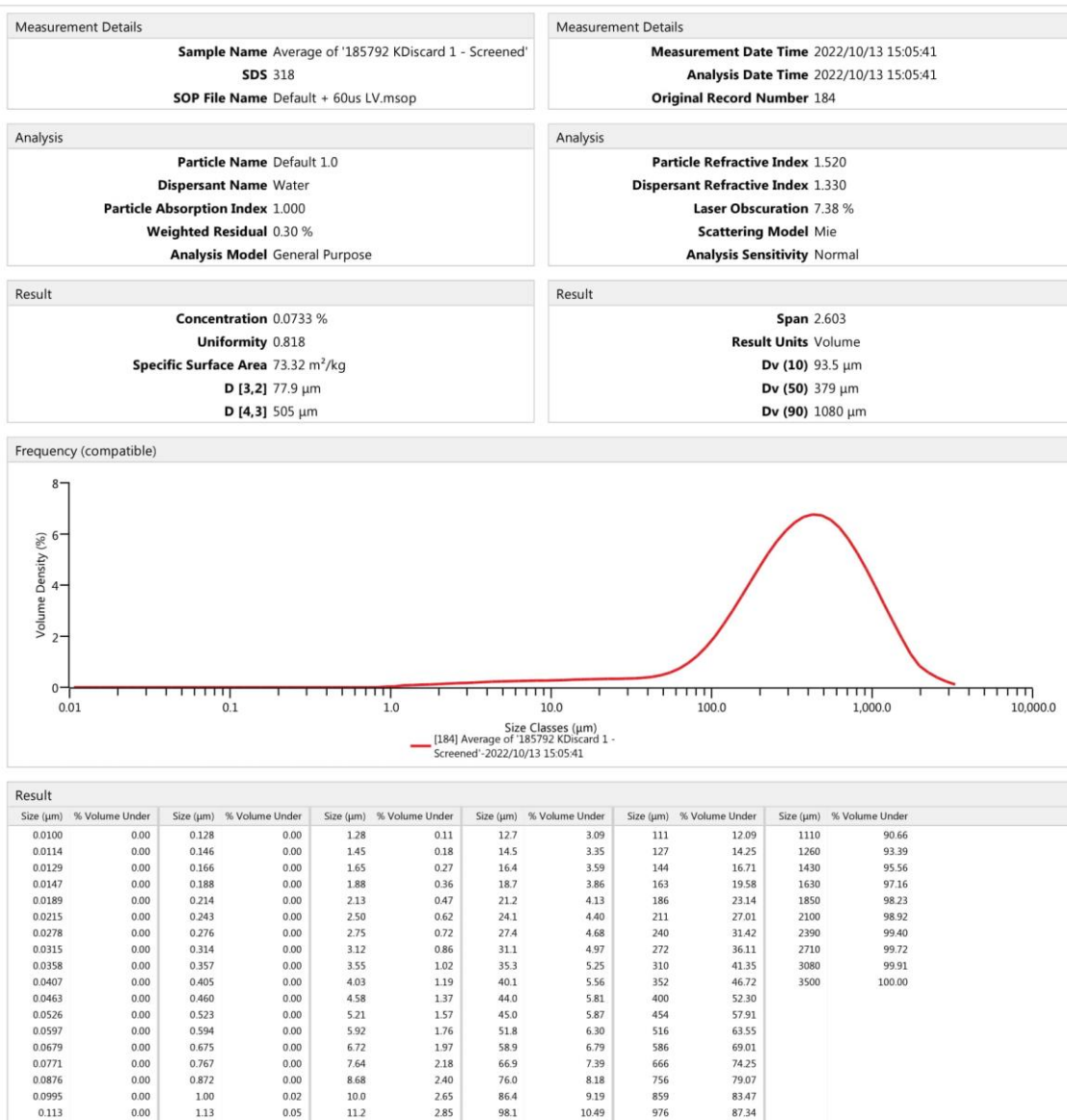
Lab no:	185791		
Date sampled:	11-Oct-22		
Aquatiko sampled:	No		
Sample type:	Geochem		
Locality description:	KDISCARD 1		
Analyses	Unit	Method	
N XRD Quantitative	%	XRD	Yes

Sub = Sub-contracted NR = Not requested RTF = Results to follow NATD = Not able to determine ATR = Alternative test report  
 Results relate only to the items sampled and tested ; Results reported against the limit of detection.  
 The report shall not be reproduced except in full without approval of the laboratory  
 The results apply to the sample received.

*M. Swanepoel*  
 Technical Signatory

## Particle size distribution

Malvern Instruments



Malvern Instruments Ltd.  
www.malvern.com

Mastersizer - v3.81  
Page 1 of 1

Aquatico

Created: 2014/09/01  
Printed: 2022/10/13 15:12

## APPENDIX D: RISK ASSESSMENT METHODOLOGY

Due to the hydrological assessment forming part of a larger risk assessment for the study area, the potential impacts and the determination of impact significance were assessed. The process of assessing the potential impacts of the project encompasses the following four activities:

1. Identification and assessment of potential impacts;
2. Prediction of the nature, magnitude, extent, and duration of potentially significant impacts;
3. Identification of mitigation measures that could be implemented to reduce the severity or significance of the impacts of the activity; and
4. Evaluation of the significance of the impact after the mitigation measures have been implemented i.e. the significance of the residual impact.

Per GNR 982 of the EIA Regulations (2014), the significance of potential impacts was assessed in terms of the following criteria:

- I. Cumulative impacts;
- II. Nature of the impact;
- III. The extent of the impact;
- IV. Probability of the impact occurring;
- V. The degree to which the impact can be reversed;
- VI. The degree to which the impact may cause irreplaceable loss of resources; and
- VII. The degree to which the impact can be mitigated.

Table 11-1 provides a summary of the criteria used to assess the significance of the potential impacts identified. An explanation of these impact criteria is provided in Table 11-2.

The net consequence is established by the following equation:

$$\text{Consequence} = (\text{Duration} + \text{Extent} + \text{Irreplaceability of resource}) \times \text{Severity}$$

And the environmental significance of an impact was determined by multiplying consequence by probability.

**Table 11-1: Proposed Criteria and Rating Scales to be used in the Assessment of the Potential Impacts**

Criteria	Rating Scales	Notes
Nature	Positive (+)	An evaluation of the effect of the impact related to the proposed development.
	Negative (-)	
Extent	Footprint (1)	The impact only affects the area in which the proposed activity will occur.



Criteria	Rating Scales	Notes
	Site (2)	The impact will affect only the development area.
	Local (3)	The impact affects the development area and adjacent properties.
	Regional (4)	The effect of the impact extends beyond municipal boundaries.
	National (5)	The effect of the impact extends beyond more than 2 regional/ provincial boundaries.
	International (6)	The effect of the impact extends beyond country borders.
Duration	Temporary (1)	The duration of the activity associated with the impact will last 0-6 months.
	Short-term (2)	The duration of the activity associated with the impact will last 6-18 months.
	Medium-term (3)	The duration of the activity associated with the impact will last 18 months-5 or years.
	Long-term (4)	The duration of the activity associated with the impact will last more than 5 years.
Severity	Low (1)	Where the impact affects the environment in such a way that natural, cultural and social functions and processes are minimally affected.
	Moderate (2)	Where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way; and valued, important, sensitive, or vulnerable systems or communities are negatively affected.
	High (3)	Where natural, cultural, or social functions and processes are altered to the extent that the natural process will temporarily or permanently cease; and valued, important, sensitive, or vulnerable systems or communities are substantially affected.
Potential for impact on irreplaceable resources	No (0)	No irreplaceable resources will be impacted.
	Yes (1)	Irreplaceable resources will be impacted.
Consequence	Extremely detrimental (-25 to -33)	A combination of extent, duration, intensity, and the potential for impact on irreplaceable resources.
	Highly detrimental (-19 to -24)	
	Moderately detrimental (-13 to -18)	
	Slightly detrimental (-7 to -12)	
	Negligible (-6 to 0)	
	Slightly beneficial (0 to 6)	

Criteria	Rating Scales	Notes
	Moderately beneficial (13 to 18)	
	Highly beneficial (19 to 24)	
	Extremely beneficial (25 to 33)	
Probability (the likelihood of the impact occurring)	Improbable (0)	It is highly unlikely or less than 50 % likely that an impact will occur.
	Probable (1)	It is between 50 and 70 % certain that the impact will occur.
	Definite (2)	It is more than 75 % certain that the impact will occur or it is definite that the impact will occur.
Significance	Very high - negative (-49 to -66)	A function of Consequence and Probability.
	High - negative (-37 to -48)	
	Moderate - negative (-25 to -36)	
	Low - negative (-13 to -24)	
	Very low (0 to -12)	
	Low-positive (0 to 12)	
	Moderate-positive (13 to 24)	
	High-positive (37 to 48)	
	Very high - positive (49 to 66)	

Table 11-2: Explanation of Assessment Criteria

Criteria	Explanation
Nature	This is an evaluation of the type of effect the construction, operation, and management of the proposed development would have on the affected environment. Will the impact of change on the environment be positive, negative, or neutral?
Extent or Scale	This refers to the spatial scale at which the impact will occur. The extent of the impact is described as footprint (affecting only the footprint of the development), site (limited to the site), and regional (limited to the immediate surroundings and closest towns to the site). The extent of scale refers to the actual physical footprint of the impact, not to the spatial significance. It is acknowledged that some impacts, even though they may be of a small extent, are of very high importance, e.g. impacts on species of very restricted range. To avoid “double counting, specialists have been requested to indicate spatial significance under “intensity” or “impact on irreplaceable resources” but not under “extent” as well.
Duration	The lifespan of the impact is indicated as temporary, short, medium, and long-term.
Severity	This is a relative evaluation within the context of all the activities and the other impacts within the framework of the project. Does the activity destroy the impacted environment, alter its functioning, or render it slightly altered?

Criteria	Explanation
Impact on irreplaceable resources	This refers to the potential for an environmental resource to be replaced, should it be impacted. A resource could be replaced by natural processes (e.g. by natural colonization from surrounding areas), through artificial means (e.g. by reseeding disturbed areas or replanting rescued species) or by providing a substitute resource, in certain cases. In natural systems, providing substitute resources is usually not possible, but in social systems, substitutes are often possible (e.g. by constructing new social facilities for those that are lost). Should it not be possible to replace a resource, the resource is essentially irreplaceable e.g. red data species that are restricted to a particular site or habitat to a very limited extent.
Consequence	The consequence of the potential impacts is a summation of the above criteria, namely the extent, duration, intensity, and impact on irreplaceable resources.
Probability of occurrence	The probability of the impact occurring is based on the professional experience of the specialist with environments of a similar nature to the site and/or with similar projects. It is important to distinguish between the probability of the impact occurring and the probability that the activity causing a potential impact will occur. Probability is defined as the probability of the impact occurring, not as the probability of the activities that may result in the impact.
Significance	Impact significance is defined to be a combination of the consequence (as described below) and the probability of the impact occurring. The relationship between consequence and probability highlights that the risk (or impact significance) must be evaluated in terms of the seriousness (consequence) of the impact, weighted by the probability of the impact occurring.  In simple terms, if the consequence and probability of an impact are high, then the impact will have a high significance. The significance defines the level to which the impact will influence the proposed development and/or environment. It determines whether mitigation measures need to be identified and implemented and whether the impact is important for decision-making.
Degree of confidence in predictions	Specialists and the EIR team were required to indicate the degree of confidence (low, medium, or high) that there is in the predictions made for each impact, based on the available information and their level of knowledge and expertise. The degree of confidence is not taken into account in the determination of consequence or probability.
Mitigation measures	Mitigation measures are designed to reduce the consequence or probability of an impact or to reduce both consequence and probability. The significance of impacts has been assessed both with mitigation and without mitigation.

## APPENDIX E: MODEL CONFIDENCE MATRIX

In the development of the numerical model, a detailed data review was conducted. Data confidence and data availability dictate model confidence. A summary of the required data versus the data available is outlined below; 3: indicates sufficient data availability, 2: indicates moderate availability, and 1: indicates limited or no availability.

As indicated in the table below, limited data required for the development of a medium-high confidence model is available. These data gaps will be required to be filled before updating the model and producing a higher confidence model suitable for defensible predictive modelling.

**Table 1: Model Data Confidence (1: low, 2: moderate, 3: high)**

Data types	Confidence
Spatial and temporal distribution of groundwater head observations is required to adequately define groundwater behaviour, especially in areas of greatest interest and where outcomes are to be reported.	3
The spatial distribution of bore logs and associated stratigraphic interpretations clearly define aquifer geometry.	3
Reliable metered groundwater extraction and injection data are available.	2
Rainfall and evaporation data is available.	2
Aquifer-testing data to define key parameters.	3
Streamflow and stage measurements are available with reliable base flow estimates at several points.	1
Reliable land-use and soil mapping data available.	2
Good quality and adequate spatial coverage of digital elevation model to define ground surface elevation.	3
The geometry of the existing mine workings.	2
Geometry and temporal plan of future mine workings/development activities.	3
The geometry of existing mine residue disposal/storage areas and proposed facilities.	3
Transport model calibration points and confidence of constant sampling data	2
Aquifer dewatering rates / verified estimates	2
<i>Model Data Confidence Rating</i>	<i>Class 2</i>
<i>Class 1: Low Confidence Model</i>	<i>Score &lt;21 (50%)</i>
<i>Class 2: Intermediate Confidence Model</i>	<i>Score 21 - 31 (50-80%)</i>
<i>Class 3: High Confidence Model</i>	<i>Score &gt;31 (80 - 100%)</i>

---

**APPENDIX F: DISCLAIMER**

The opinions expressed in this Report have been based on site /project information supplied to GCS (Pty) Ltd (GCS) by Kangra Coal and are based on public domain data, field data and data supplied to GCS by the client. GCS has acted and undertaken this assessment objectively and independently.

GCS has exercised all due care in reviewing the supplied information. Whilst GCS has compared key supplied data with expected values, the accuracy of the results and conclusions are entirely reliant on the accuracy and completeness of the supplied data. GCS does not accept responsibility for any errors or omissions in the supplied information and does not accept any consequential liability arising from commercial decisions or actions resulting from them.

The boreholes that were sited in this investigation are sited according to scientific principles which relate to sub-surface hydrogeological signatures/structures which may act as preferential groundwater flow paths. It should be noted that in some cases (3 out of 10 boreholes) the hydrogeological signatures may indicate high water potential, however, during drilling low yields are observed. For this reason, GCS recommends that a hydrogeological specialist supervises the drilling to ensure that drilling is stopped, or the method is adapted if hydrogeology differs from desktop and sitting data. Even with such oversight and scientific recommendations, a high-yielding borehole is not guaranteed, and GCS cannot be held responsible or liable for dry or low-yielding boreholes or for any hydrogeological or any other condition which may affect the yield volume or yield water quality.

Opinions presented in this report, apply to the site conditions, and features as they existed at the time of GCS's investigations, and those reasonably foreseeable. These opinions do not necessarily apply to conditions and features that may arise after the date of this report, about which GCS had no prior knowledge nor had the opportunity to evaluate.



## APPENDIX G: DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

### PROJECT TITLE

Geohydrological Assessment, Numerical Flow & Transport Model Development for the Amatikulu Sugar Mill

### SPECIALIST INFORMATION

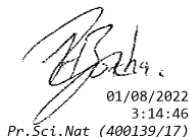
Specialist Company Name:	GCS Water SA Pty Ltd		
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	2	Percentage Procurement Recognition
Specialist name:	Hendrik Botha		
Specialist Qualifications:	MSc Environmental Sciences (Geohydrology & Geochemistry) BSc Hons. Environmental Sciences (Hydrology) BSc. Chemistry & Geology		
Professional affiliation/registration:	PR SCI NAT 400139/17		
Physical address:	1 Karbochem Road, Newcastle, KZN		
Postal address:			
Postal code:	2940	Cell:	
Telephone:	071 102 3819	Fax:	
E-mail:	hendrikb@gcs-sa.biz		

---

DECLARATION BY THE SPECIALIST

I, Hendrik Botha, declare that -

- I act as the independent specialist in this application.
- I will perform the work relating to the application objectively, 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 concerning 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 realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.



01/08/2022  
3:14:46  
Pr.Sci.Nat (400139/17)

---

Signature of the Specialist

---

GCS

---

Name of Company:

---

17 November 2023

---

Date

## APPENDIX H: CV OF SPECIALIST



Hendrik Botha

**Technical Director**

LinkedIn:

**CORE SKILLS**

- Project management
- Analytical and numerical groundwater modelling
- Geochemical assessments and geochemical modelling
- Hydrogeology, hydrological assessments & yield assessments
- Hydrology, floodline modelling & storm water management
- Groundwater vulnerability, impact, and risk assessments
- Technical report writing
- GIS and mapping

**DETAILS****Qualifications**

- BSc Chemistry and Geology (Environmental Sciences) (2012)
- BSc Hons Hydrology (Environmental Sciences) (2013)
- MSc Geohydrology and Hydrology (Environmental Sciences) (2014-2016)

**Membership**

- Groundwater Division of GSSA
- Groundwater Association of KwaZulu Natal Member
- International Mine Water Association (IMWA)

**Languages**

- Afrikaans - Speak, read, write.
- English - Speak, read, write.

**Projects undertaken in**

- South Africa
- Nigeria
- Namibia
- Liberia

**PROFILE**

Hendrik (Henri) Botha is currently the manager of the GCS Newcastle Office and occupies the role of principal hydrogeologist. Groundwater, geochemistry and surface hydrology, as well as knowledge of water chemistry together with GIS, and analytical and numerical modelling skills, are some of his sought-after expertise. General and applied logical knowledge are his key elements in problem-solving.

**Professional Affiliations:**

SACNASP Professional Natural Scientist (400139/17)

**Areas of Expertise:**

- Waste classification and Impact Assessments
- Aquifer vulnerability assessments
- Geochemical sampling, data interpretation and modelling
- Geophysical surveys and data interpretation
- GIS
- Water quality sampling and data interpretation
- Groundwater impact and risk assessments
- Numerical and Conceptual Visual Modelling (Visual Modflow, ModflowFLEX, Voxler, RockWorks, Surfer and Excel)
- Hydrogeology (Hydrological Soil Types) & Soils Assessments
- Floodline Modelling (HEC-RAS)
- Stormwater Management Systems and Modelling
- Surface Water Yield Assessments
- Water and Salt Balances



Page 1 of 8

## **APPENDIX E-5: HYDROPEDOLOGICAL ASSESSMENT**

# Hydropedology Assessment for the Proposed Co-Disposal Facility & Water Treatment Plant at Kangra Maquasa East Operations

## Report

Version - Final 1

17 November 2023

Kangra Coal

GCS Project Number: 22-0161\_PED

Client Reference: 111862





## Hydropedology Assessment for the Proposed Co-Disposal Facility & Water Treatment Plant at Kangra Maquasa East Operations

Report  
Version - Final 1

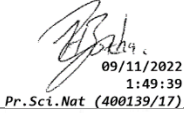

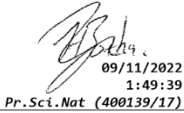


17 November 2023

Kangra Coal

22-0161\_PED

### DOCUMENT ISSUE STATUS

Report Issue	Final 1		
GCS Reference Number	GCS Ref - 22-0161_PED		
Client Reference	111862		
Title	Hydropedology Assessment for the Proposed Co-Disposal Facility & Water Treatment Plant at Kangra Maquasa East Operations		
	Name	Signature	Date
Author	Hendrik Botha (MSc, PriSciNat)	 09/11/2022 1:49:39 Pr.Sci.Nat (400139/17)	17 November 2023
Proof-reader	Lisa Botha (BSc. Hons)		17 November 2023
Director	Hendrik Botha (MSc, PriSciNat)	 09/11/2022 1:49:39 Pr.Sci.Nat (400139/17)	17 November 2023

### LEGAL NOTICE

This report or any proportion thereof and any associated documentation remain the property of GCS until the mandator effects payment of all fees and disbursements due to GCS in terms of the GCS Conditions of Contract and Project Acceptance Form. Notwithstanding the aforesaid, any reproduction, duplication, copying, adaptation, editing, change, disclosure, publication, distribution, incorporation, modification, lending, transfer, sending, delivering, serving or broadcasting must be authorised in writing by GCS.

**DECLARATION OF INDEPENDENCE**

GCS (Pty) Ltd was appointed to conduct this specialist study and to act as the independent hydrogeological specialist. GCS objectively performed the work, even if this results in views and findings that are not favourable. GCS has the expertise in conducting the specialist investigation and does not have a conflict of interest in the undertaking of this study. This report presents the findings of the investigations which include the activities set out in the scope of work.

## APPENDIX 6 OF THE EIA REGULATION - CHECKLIST AND REFERENCE FOR THIS REPORT

**Table 1 - Requirements from Appendix 6 of GN 326 EIA Regulation 2017**

Requirements from Appendix 6 of GN 326 EIA Regulation 2017	Chapter
(a) Details of: (i) The specialist who prepare the reports; and (ii) the expertise of that specialist to compile a specialist report including a curriculum vitae	Page ii
(b) Declaration that the specialist is independent in a form as may be specialities by the competent authority	Appendix E.
(c) Indication of the scope of, and purpose for which, the report was prepared	Page ii
(cA) Indication of the quality and age of base data used for the specialist report	Appendix B.
(cB) A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 1.
(d) Duration, Date and seasons of the site investigation and the relevance of the season to the outcome of the assessment	Sections 1, 2 and 3.
(e) Description of the methodology adopted in preparing the report or carrying out the specialised process include of equipment and modelling used	Section 4.
(f) Details of an assessment of the specifically identified sensitivity of the site related to the proposed activity or activities and its associate's structures and infrastructure, inclusive of a site plan identifying alternative	Section 1.3.
(g) Identification of any areas to be avoided, including buffers	Section 1.2
(h) Map superimposing the activity and associated structures and infrastructure on environmental sensitivities of the site including areas to be avoided, including buffers	Sections 1, 2, 3 and 4
(i) Description of any assumptions made and uncertainties or gaps in knowledge	Section 5.1
(j) A description of the findings and potential implications of such findings on the impact of the proposed activity including identified alternatives on the environment or activities	Sections 1, 2 and 3
(k) Mitigation measures for inclusion in the EMPr	Sections 2, 4, and 5.
(l) Conditions for inclusion in the environmental authorisation	Executive summary, Section 5.
(m) Monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 5.
(n) Reasoned opinion - (i) as to whether the proposed activity, activities or portions thereof should be authorised. (iA) regarding the acceptability of the proposed activity or activities; and (ii) if the opinion is that the proposed activity, activities or portions thereof should be authorised, and avoidance, management, and mitigation measures should be included in the EMPr, and where applicable, the closure plan	Refer to Section 5.3
(o) <i>Description of any consultation process that was undertaken during preparing the specialist report</i>	None required.
(p) <i>A summary and copies of any comments received during any consultation process and where applicable all responses thereto</i>	None required.
(q) <i>Any other information requested by the competent authority</i>	None required.

## CONTENTS PAGE

DECLARATION of Independence .....	3
Appendix 6 of the EIA Regulation - CHECKLIST and Reference for this Report .....	4
CONTENTS PAGE.....	v
List of Figures.....	vi
List of Tables.....	vi
List of Appendices .....	vii
LIST OF ACRONYMS .....	viii
<b>1 Introduction .....</b>	<b>1</b>
1.1 Project background .....	1
1.1.1 Water Treatment Plant:.....	1
1.1.2 Co-Disposal Facility.....	2
1.2 The focus of this study .....	3
1.3 Study objectives and methodology .....	4
1.4 Legislative considerations.....	5
1.5 Study relevance to the season in which it was undertaken .....	5
1.6 Scope of Work .....	5
1.7 Gaps and limitations .....	6
<b>2 Site overview .....</b>	<b>8</b>
2.1 Sub-catchments/hydrological response units (HRUs) .....	8
2.2 Land cover & slope rise .....	8
2.3 Local geology & soils.....	8
2.4 Climate .....	12
2.4.1 Temperature .....	12
2.4.2 Wind speed and direction .....	13
2.4.3 Rainfall and evaporation .....	13
2.4.4 Runoff.....	15
2.5 Surface water and groundwater users in the study area .....	15
2.6 Depth to groundwater .....	16
2.7 Wetland areas .....	17
2.8 Present ecological state (PES) and environmental sensitivity and ecological importance (EIS) - quaternary scale .....	17
2.9 Land morphology and soils .....	18
2.9.1 Site-specific .....	20
2.10 Soil permeability .....	21
<b>3 Hydropedological assessment .....</b>	<b>25</b>
3.1 Hydrological Soil Types (HST) .....	25
3.2 Hillslopes and hillslope hydrology.....	26
3.3 Conceptual hydrological flow processes .....	26
3.3.1 Hillslope 1.....	26
3.3.2 Hillslope 2.....	27
3.3.3 Hillslope 3.....	29
3.3.4 Hillslope 4.....	30
<b>4 Flow driver assessment &amp; Risks .....</b>	<b>33</b>
4.1 Flow driver loss calculation/impact estimation .....	35
4.1.1 Assumptions.....	36
4.1.2 Calculations.....	37
4.2 Estimated flow losses and risk rating.....	38
4.3 Hydrogeology risk assessment .....	40
4.3.1 Impacts on the soil interflow processes, soil structure and land capability.....	40

4.3.2	Reduced hydropedological flow to surface water (perennial & non-perennial streams and wetlands) as well as impacts on soil and water quality .....	42
4.4	Cumulative impacts and impacts on the hydrological cycle .....	43
5	Conclusions .....	47
5.1	Avoidance areas .....	48
5.2	Mitigation measures for inclusion in the EMPr .....	48
5.3	Reasoned opinion on whether the activity should be authorized .....	48
6	Bibliography .....	49

## LIST OF FIGURES

Figure 1-1:	Proposed WTP and possible brine evaporation pond.....	2
Figure 1-2:	Proposed Co-Disposal Facility (Phase 1 already approved, Phase 2 & 3 will be co-disposal) .....	3
Figure 1-3:	Typical soil genesis .....	4
Figure 1-4:	Site locality and drainage .....	7
Figure 2-1:	Sub-catchments and land cover types .....	9
Figure 2-2:	Sub-catchments and surface slope rise %.....	10
Figure 2-3:	Local geology.....	11
Figure 2-4:	Average yearly temperatures (Meteoblue, 2022) .....	12
Figure 2-5:	Wind rose (Meteoblue, 2022).....	13
Figure 2-6:	Average rainfall for Station 0407639W & WR2012 evaporation .....	14
Figure 2-7:	Simulated natural (unmodified) runoff for W51B .....	15
Figure 2-8:	Groundwater elevation vs topography elevation - correlation (Kangra Monitoring Holes) .....	16
Figure 2-9:	Groundwater base-flow concept (DWS, 2011) .....	17
Figure 2-10:	Land morphology concept (Almond, 2016) .....	18
Figure 2-11:	Bb62.....	19
Figure 2-12:	Land types associated with the project area .....	23
Figure 2-13:	Estimated soil distribution for sub-catchments associated with the project .....	24
Figure 3-1:	Hillslope 1 - conceptual hydropedology flow regimes .....	27
Figure 3-2:	Hillslope 2 - conceptual hydropedology flow regimes .....	28
Figure 3-3:	Hillslope 3 - conceptual hydropedology flow regimes .....	29
Figure 3-4:	Hillslope 4 - conceptual hydropedology flow regimes .....	30
Figure 3-5:	Hydrological soil types in the study area and soil flow paths .....	31
Figure 3-6:	Conceptualisation of hydrological soil flow paths.....	32
Figure 4-1:	Natural flow drivers .....	33
Figure 4-2:	Altered flow drivers - built-up area for a lines TSF/Landfill .....	34

## LIST OF TABLES

Table 2-1:	MAP of nearest rainfall stations .....	13
Table 2-2:	Groundwater users within a 2.5 km radius of the site.....	15
Table 2-3:	Summary of PES and EIS for the Quaternary Catchment .....	17
Table 2-4:	Summary of soil classes identified .....	21
Table 2-5:	Soil permeability classes for agriculture and conservation (Food and Agriculture Organization (FAO, 1980).....	21
Table 2-6:	DWS range of hydraulic conductivities in different soil types (DWS, 2011) ...	22
Table 3-1:	Hydrological soil types .....	25
Table 4-1:	Flow driver calculations .....	37
Table 4-2:	Estimated % Loss rating for micro-catchments (hillslopes) .....	39



Table 4-3: Risk rating scale.....	40
Table 4-4: Construction phase hydropedology risks.....	44
Table 4-5: Operational phase hydropedological risks.....	45
Table 4-6: Closure phase hydropedology risks .....	46
Table 5-1: Proposed Criteria and Rating Scales to be used in the Assessment of the Potential Impacts .....	72
Table 5-2: Explanation of Assessment Criteria .....	73

## LIST OF APPENDICES

Appendix A: Soil Profile Data & Field Observations.....	51
Appendix B: Soil particle distribution lab certificates .....	55
Appendix C: Hydropedology risk assessment methodology .....	72
Appendix D: Disclaimer and deceleration of independence .....	75
Appendix E: details of the specialist, declaration of interest and undertaking under oath .....	76
Appendix F: CV of Specialist .....	78

## LIST OF ACRONYMS

Acronym	Description
A	Diagnostic A horizon
A/B	Interflow soil type A/B
A/Bedrock	Interflow soil type A/Bedrock
B (B1, B2, B3 etc.)	Diagnostic B horizon
BA	Basic Assessment
BOD	Biological oxygen demand
COD	Chemical oxygen demand
CSWMP	A conceptual stormwater management plan
CVB	channel valley bottom wetland
CVB	Channelled valley bottom wetland
DEM	Digital Elevation Model
DWS	Department of Water and Sanitation
E	Diagnostic E horizon
G	G Horizon/soil
GCS	GCS Water and Environment (Pty) Ltd.
GN704	General Notice 704
ha	Hectare
HOSASH	Hydrology of South African Soils and Hillslopes
HRU	Hydrological Response Unit
HST	Hydrological Soil Type
IWULA	Integrated Water Use Licence Application
m <sup>3</sup>	Cubic Metres
MAE	Mean annual evaporation
MAR	Mean Annual Runoff
MIPI	Midgley and Pitman
NEMA	National Environmental Management Agency
n-Value	Manning's Roughness Coefficients
NWA	National Water Act, 1998 (Act No. 36 of 1998)
O	Orthic Horizon/soil
PCD	Pollution Control Dam
PFD	Process flow diagram
RP	Riparian zone/wetland
S	Seepage wetland
SDF	Standard design flood
SW	Surface Water
TDS	Total dissolved solids
TIN	Triangulated Irregular Network
UCVB	Unchanneled valley bottom wetland
UVB	un-channelled valley bottom
V	Vertic Horizon/soil
WMA	Water Management Area
WR2012	Water Resources of South Africa 2012
WTW	Water Treatment Works
PES	Present Ecological State
EIS	Ecological importance and Sensitivity

## 1 INTRODUCTION

GCS Water and Environment (Pty) Ltd (GCS) was appointed by Kangra Coal (Pty) Ltd to undertake a hydrogeology assessment for the proposed development of a Co-Disposal Facility and Water Treatment Plant (WTP) at Maquasa East operations, near Driefontein, Mpumalanga Province (refer to Figure 1-4). The project falls in quaternary catchment W51B of the Pongola to Mtamvuna Water Management Area (WMA) (DWS, 2016).

### 1.1 Project background

Kangra Coal is an existing coal mine located in Driefontein, near Piet Retief, in the Mkhondo Local Municipality within the Gert Sibande District Municipality. The Maquasa East (MQE) operations include the historical opencast and underground operations. Kangra is proposing to construct a water treatment plant as well as a co-disposal facility at their Maquasa East operations. The treatment plant will be used to treat water from the existing decant point as well as any surplus water within the mining operations.

#### 1.1.1 Water Treatment Plant:

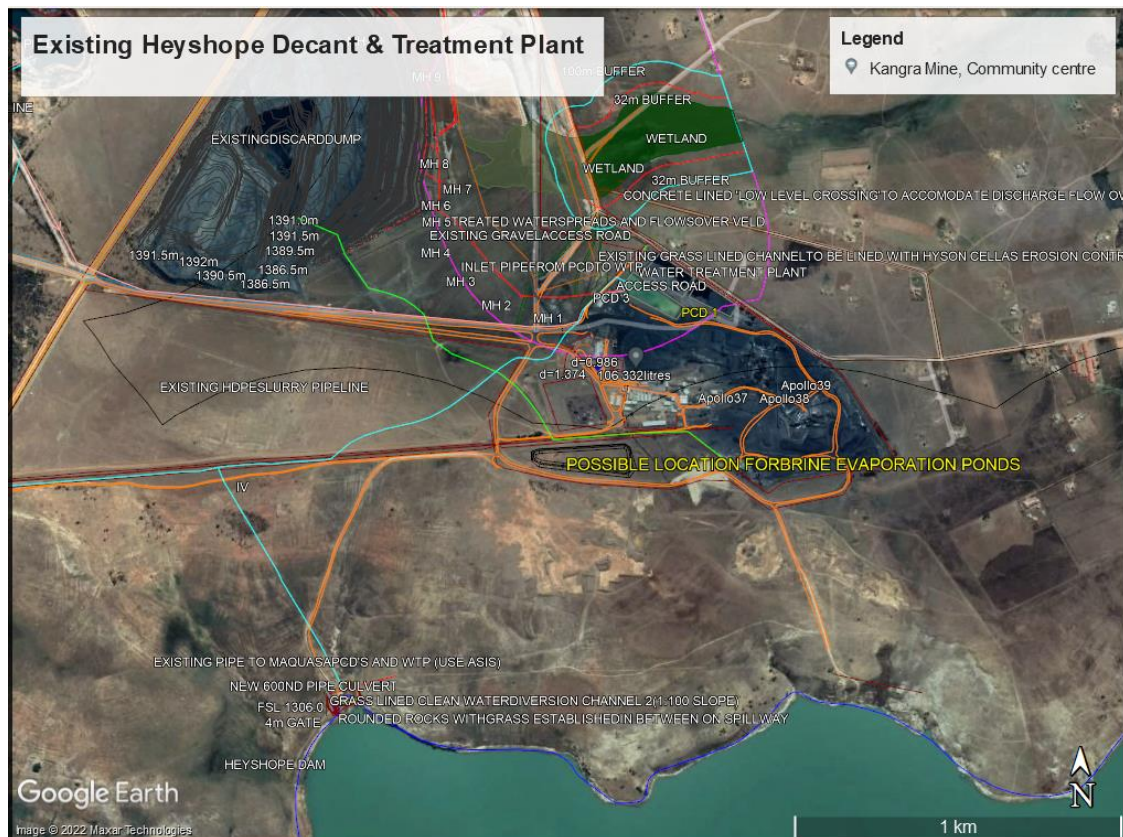
Decant is currently observed in the form of clear groundwater discharge emanating from the old underground workings at MQE close to the Heyshope Dam. This decant is observed at an elevation range of approx. 1303 to 1306 mamsl and is contained in an unlined contamination dam. This excess decant is currently pumped from the unlined dam back to the MQE PCDs. Based on available data from previous studies undertaken at the mine decant observed emanating from the old workings occurs at a rate ranging from 1 220 to 2 700 m<sup>3</sup>/d (average 1 800 m<sup>3</sup>/d), depending on the rainfall season.

Kangra intends to upgrade the current contamination dam with a correctly lined dam as approved by the Department of Water and Sanitation to prevent any seepages onto the Heyshope Dam. The decant will be pumped into the proposed wastewater treatment plant that will be situated close to the Maquasa East PCDs. Construction and operation of the discussed infrastructure will trigger listed activities that will require authorisation.

The master layout plan associated with the proposed water treatment plant and brine storage facilities proposed (and existing PCDs) is shown in Figure 1-1.

It should also be noted that Kangra is investigating the possibility of storing brine on the discard dump/co-disposal that will come from the water treatment plant. This is one of the two options, with the other being dedicated brine evaporation ponds. GCS has not yet received confirmation as to which option Kangra are opting for, thus impacts relating to both are considered in this assessment.

Treated water will be discharged into the Heyshope dam at the existing decant rate at pristine water quality (in line with GA limits for treated effluent discharge), and therefore will likely not have a negative impact on water quantity or quality. Compared to the active decant water quality, the proposed activity is predicted to improve the Heyshope water quality. Proposed discharge will take place at an existing abstraction point west of Driefontein, that is no longer in use.



**Figure 1-1: Proposed WTP and possible brine evaporation pond**

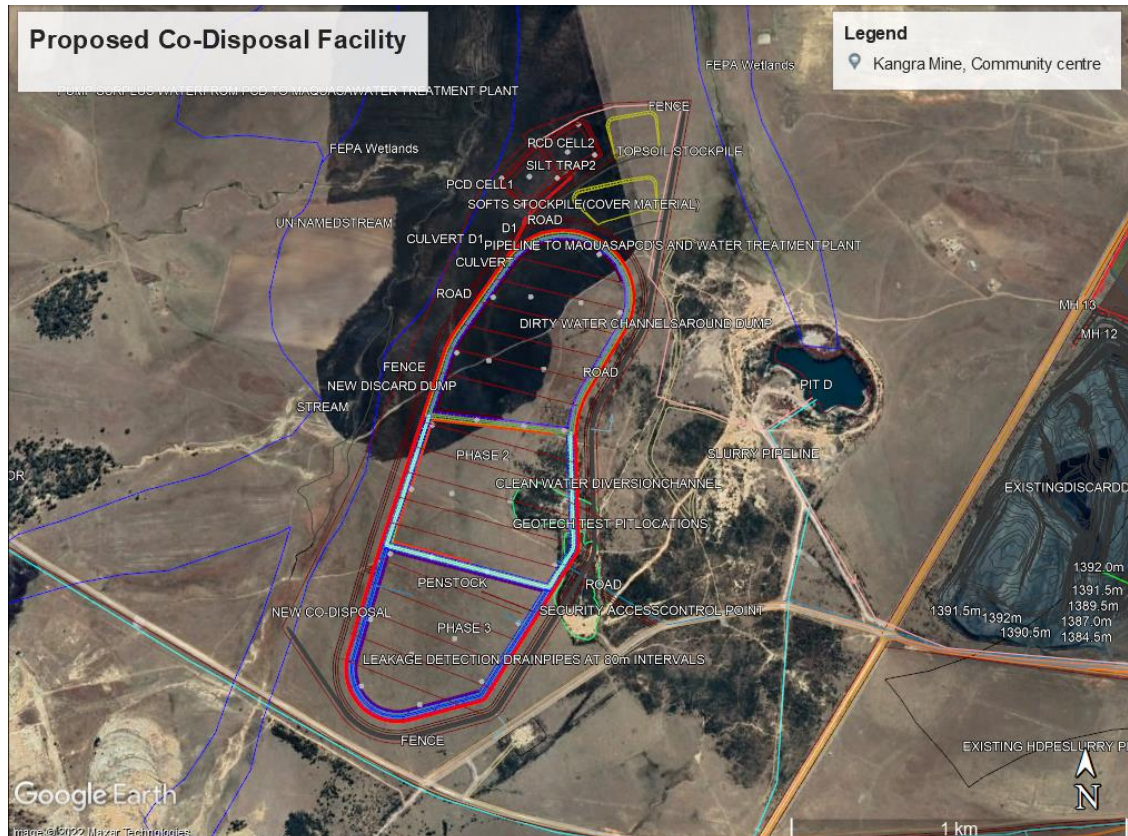
### 1.1.2 Co-Disposal Facility

The discard dump at MQE has an approved environmental authorisation and a water use license. As a result of changing operational requirements, there is now a need for a co-disposal facility at MQE, this co-disposal facility is not authorised.

- The co-disposal facility will be located within the MQE operation on the remaining (RE) portion of the farm Rooikop 18 HT. The co-disposal facility will accommodate discarded produced from the benefaction plant located at Maquasa East, which currently washes and processes coal from the surrounding Kangra Coal operations and will receive coal from future expansion areas.
- This discard dump was originally designed as a three-compartment side hill-type dump with a footprint of approximately 65ha. The three-compartment layout allows for a modular implementation approach with the benefit of delaying capital expenditure. The implementation of this project will be done in two phases:

- Phase 1 will entail the use of the approved discard dump, and
- Phases 2 and 3 will entail the use of a co-disposal facility that requires authorisations.

In the phases, the plan is to build the full waste dump over 20 years. Phase 1 (7 years capacity), Phase 2 (7 years capacity), and Phase 3 (6 years capacity). GFK are undertaking detailed designs of the dump, as well as stormwater sizing. The facility will be lined with an impermeable barrier. The layout plan for the co-disposal facility is shown in Figure 1-2.



**Figure 1-2: Proposed Co-Disposal Facility (Phase 1 already approved, Phase 2 & 3 will be co-disposal)**

## 1.2 The focus of this study

This hydrogeology assessment focuses on the proposed co-disposal facility and probable impacts on the hydrogeological flow drivers if the co-disposal facility is constructed. The proposed WTP and the brine pond are situated in an already impacted area (near and in the beneficiation area). As such, there may have already been an impact on hydrogeology since mining started in 1996. Considering scaling, the co-disposal facility has a higher potential to impact hydrogeology flow drivers, as opposed to the small WTP and brine pond.

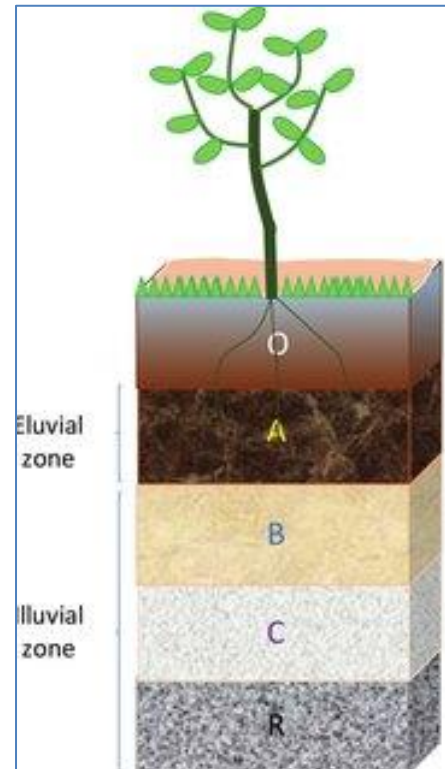


### 1.3 Study objectives and methodology

Soils develop over time under the influence of chemical, physical, and biological processes (refer to Figure 1-3). Soils are predominantly the result of in-situ weathering of the host rock (i.e. has characteristics associated with the parent geological occurrence/rock). Soil has an interactive relationship with hydrology (i.e. climate, rainfall duration, runoff patterns, groundwater contribution to baseflow, evaporation etc.). It is a product of water-related processes (physical and chemical) and a first-order control of the destination of rainwater. Though hydrological processes change seasonally, soil characteristics and water transfer capabilities remain similar throughout the year. A once-off study was undertaken.

The objectives of this hydropedological assessment were to:

1. Evaluate the soils in the study area:
  - Soils were classified per the taxonomic system for South Africa (Department of Agricultural Development, 1991); (SCWG, 2018)
  - Soil permeability was estimated based on available data (i.e. field characterised textures and public soil data) and according to best practice guidelines (FAO, 1980); and (DWS, 2011).
2. Derive hydropedological flow regimes and interaction areas:
  - In the determination of Hydrological Soil
  - Types (HST), soils were divided into classes based on their expected hydrological responses (Van Tol, et al., 2013).
3. Quantification of the hydropedological fluxes using a spreadsheet-based water balance model:
  - A simple spreadsheet-based water balance model was used to illustrate unsaturated zone fluxes/water balances.
4. Conceptualise the water flow dynamics and derive hydropedological flow buffer areas (if required) for wetlands identified in the area.
  - Hydrological processes were perceived from traceable signatures in the soil matrix resulting from the soil's ability to transmit, store and react with water (Le Roux, et al., 2011).



**Figure 1-3: Typical soil genesis**

5. Identify potential hydropedological impacts per standard DWS & EIA impact criteria and risk rating (refer to **Appendix B**).

#### **1.4 Legislative considerations**

The study scope of works and objectives coincide with DWS guidelines for Hydropedology Studies (Van Tol; Bouwer, J.J, 2021). Based on the proposed activities, the scope of this study, the budget allocated to this study and time frames during this study, a “Step 1 to Step 4” type study could be completed, which entails:

1. Identification of dominant hillslopes.
2. Conceptualising hillslope hydropedological responses.
3. Quantification of hydraulic properties and flow rates.
4. Quantification of hydropedological fluxes.

#### **1.5 Study relevance to the season in which it was undertaken**

This study was undertaken as a once-off study and relies on historical hydrological and climate data for the site; as well as recognized hydrological and water resource databases for South Africa. Data generated during the time of this study is not seasonally bound as average yearly data was applied where required and as scientifically acceptable.

#### **1.6 Scope of Work**

The scope of work completed was as follows:

1. **Desktop study:**
  - a. All available reports (which were provided by the client) relating to the site were assessed.
  - b. Evaluation of soil occurrences in the study area, based on available South African databases.
2. **Field investigation:**
  - a. Several auger holes were drilled in the project area, in pre-determined hillslope areas.
  - b. The soils identified in the study area were screened per the Soil Classification guidelines for South Africa (Department of Agricultural Development, 1991) and (SCWG, 2018) to derive hydropedological flow regimes.
3. **Hydropedological assessment:**
  - a. Meteorological evaluation.
  - b. Catchment delineation.

- c. Estimation of soil permeability and soil flow processes based on field observation and desktop data.
- d. HOSASH (Hydrology of South African Soils and Hillslopes) index.

#### **4. Water balance and flow modelling:**

- a. A simple spreadsheet-based water balance model was used to illustrate unsaturated zone fluxes/water balances.
- b. The total water loss during a development phase concerning the natural water processes in a sub-catchment was estimated. This was used in conjunction with the water balance flow model to determine the natural stream loss % for a sub-catchment and associated hillslopes.

#### **5. Risk assessment:**

- a. The risk and impact criteria (refer to **Appendix B**) were applied to the study area, to evaluate hydropedological risks.
- b. Natural flow losses were estimated, using a spreadsheet water balance developed for the site.

#### **6. Mapping and report:**

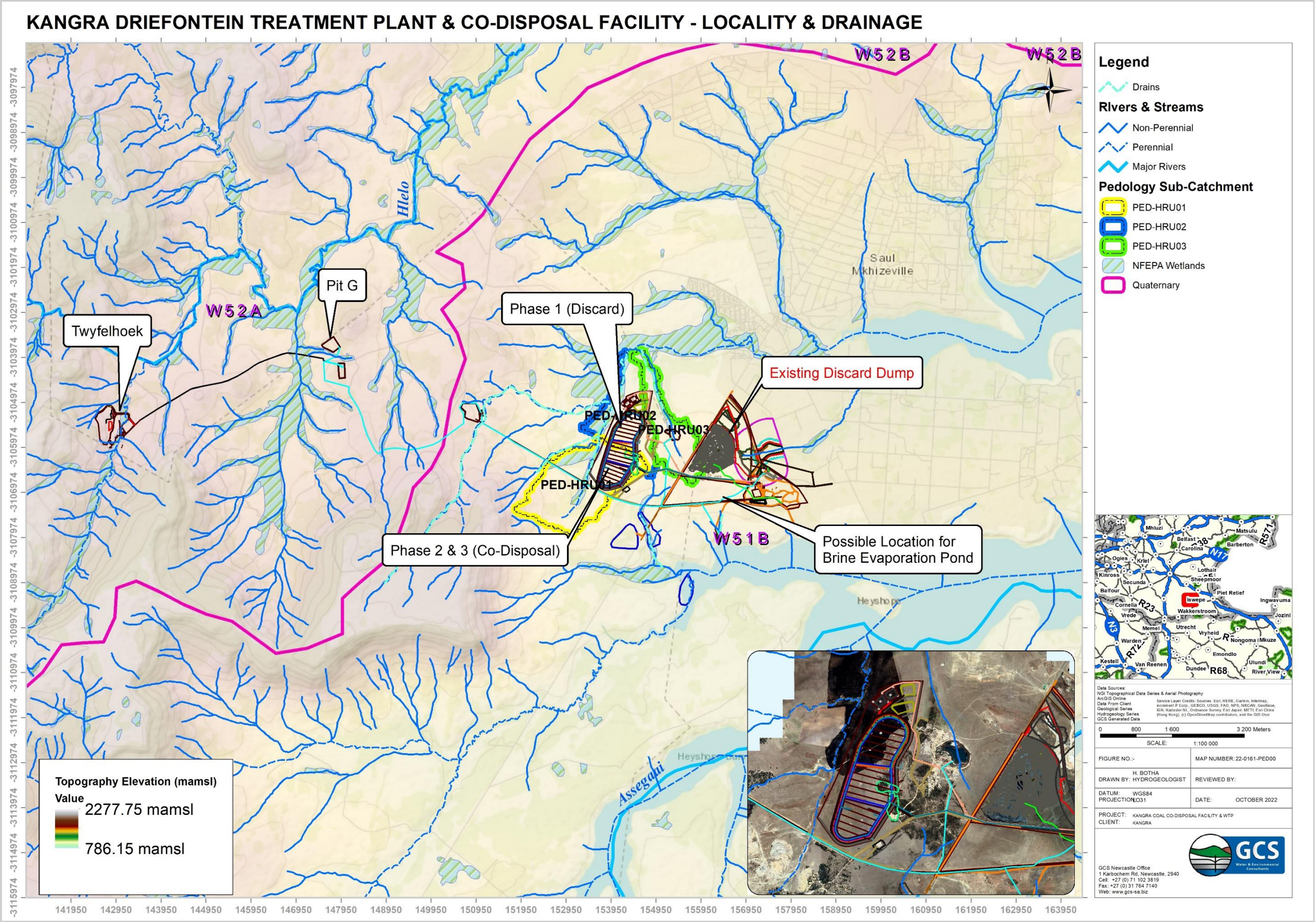
- a. Several hydrological hillslope profiles, soil distribution and hydrological soil type maps were produced; and
- b. This report was compiled.

### **1.7 Gaps and limitations**

The following study limitations are recognised:

- The concepts presented are simplifications of the temporal variability of water transfer functions. Realistically, water transfer functions, such as throughflow and groundwater sources, may take a few months up to several years to recharge streams (Le Roux, et al., 2011) However, hydropedology hillslopes have been effectively applied to simulate runoff response mechanisms (Van Tol, et al., 2013).
- Per minimum requirements for hydropedology studies published by DWS (Van Tol, J.J., Bouwer, D. & Le Roux, P.A.L., 2021), this “Level 3” study was undertaken (field investigation, conceptualisation of hillslopes and soil flow suppression). No numerical unsaturated flow modelling was undertaken, but simple analytical spreadsheet water balance/flux modelling.
- It is understood that all gaps and data limitations noted during this investigation will be committed to as future works. This report can therefore be considered a work-in-progress document, which can be updated as the project changes from planning to the closure phase.







---

## 2 SITE OVERVIEW

As mentioned previously, the project falls in quaternary catchment W51B of the Pongola to Mtamvuna Water Management Area (WMA) (DWS, 2016). Elevations on the site typically range from 1 300 to 1 600 meters above mean sea level (mamsl).

### 2.1 Sub-catchments/hydrological response units (HRUs)

Three (3) hydrological response unit (HRUs) describes the natural drainage and hydropedology flow boundaries associated with the site (using a 1:1 000 stream count and 30 m DTM fill) - refer to Figure 1-4 and Figure 2-1. The sub-catchment relates well to desktop-delineated drainage lines for the project area, as well as verified streams associated with the project area.

Primary drainage from the position of the proposed co-disposal site, and much of the MQE area is towards the northeast, to the perennial Egude River, which makes up the bottom inflow of the Heyshope Dam. Drainage from the southern portions of the MQE area, and Maquassa West (MQW) is towards the south, via several perennial and non-perennial drainage lines, towards the southern inflow of the Heyshope Dam. The Heyshope Dam is therefore the end received of any surface water-related pollution that may take place at the MQE operations.

### 2.2 Land cover & slope rise

The dominant land types associated with the sub-catchment are shown in Figure 2-1 (DEA, 2019), and is observed to be natural grasslands. The slope % rise for the general area is shown in Figure 2-2. Slope rise % was used to characterise the sub-catchment slope, hydropedology flow fields and general drainage.

### 2.3 Local geology & soils

According to the 1:250 000 geological series (2730 Vryheid), the local surface geology is characterised by occurrences of dolerite, and sediments associated with the Vryheid Formation, of the Eccu Group, of the Karoo Sequence (DMEA, 1998g) - refer to Figure 2-3.



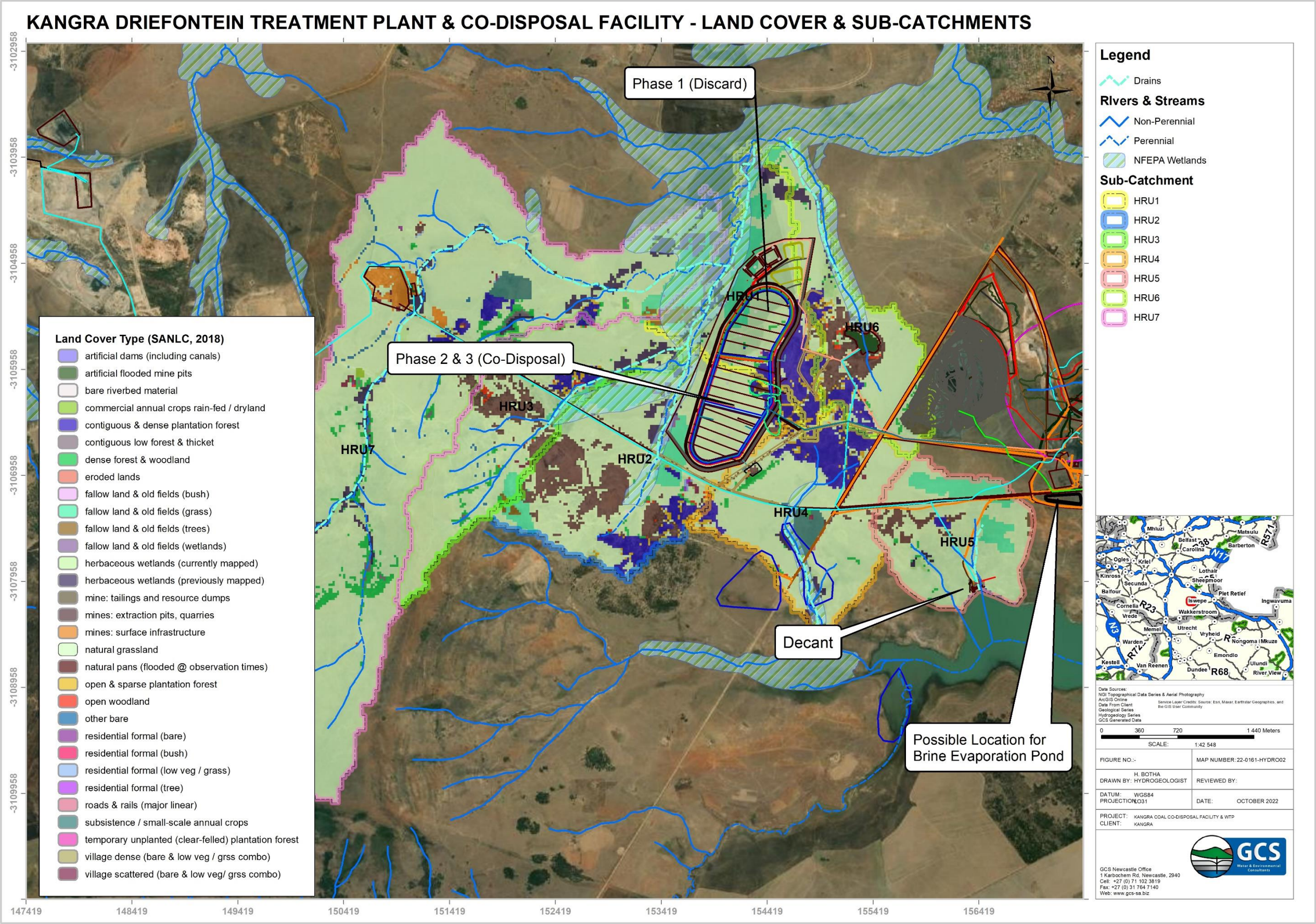


Figure 2-1: Sub-catchments and land cover types



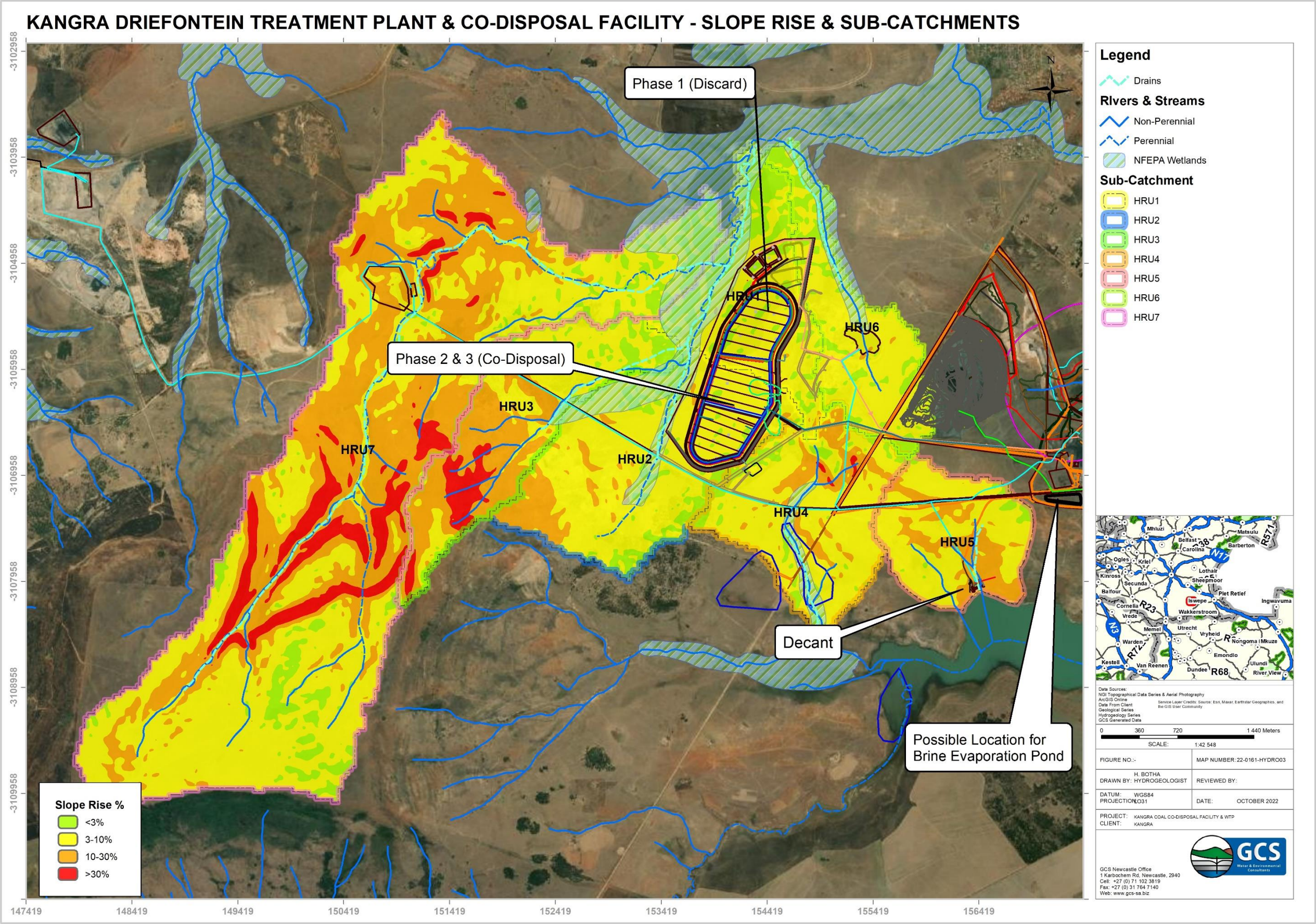


Figure 2-2: Sub-catchments and surface slope rise %



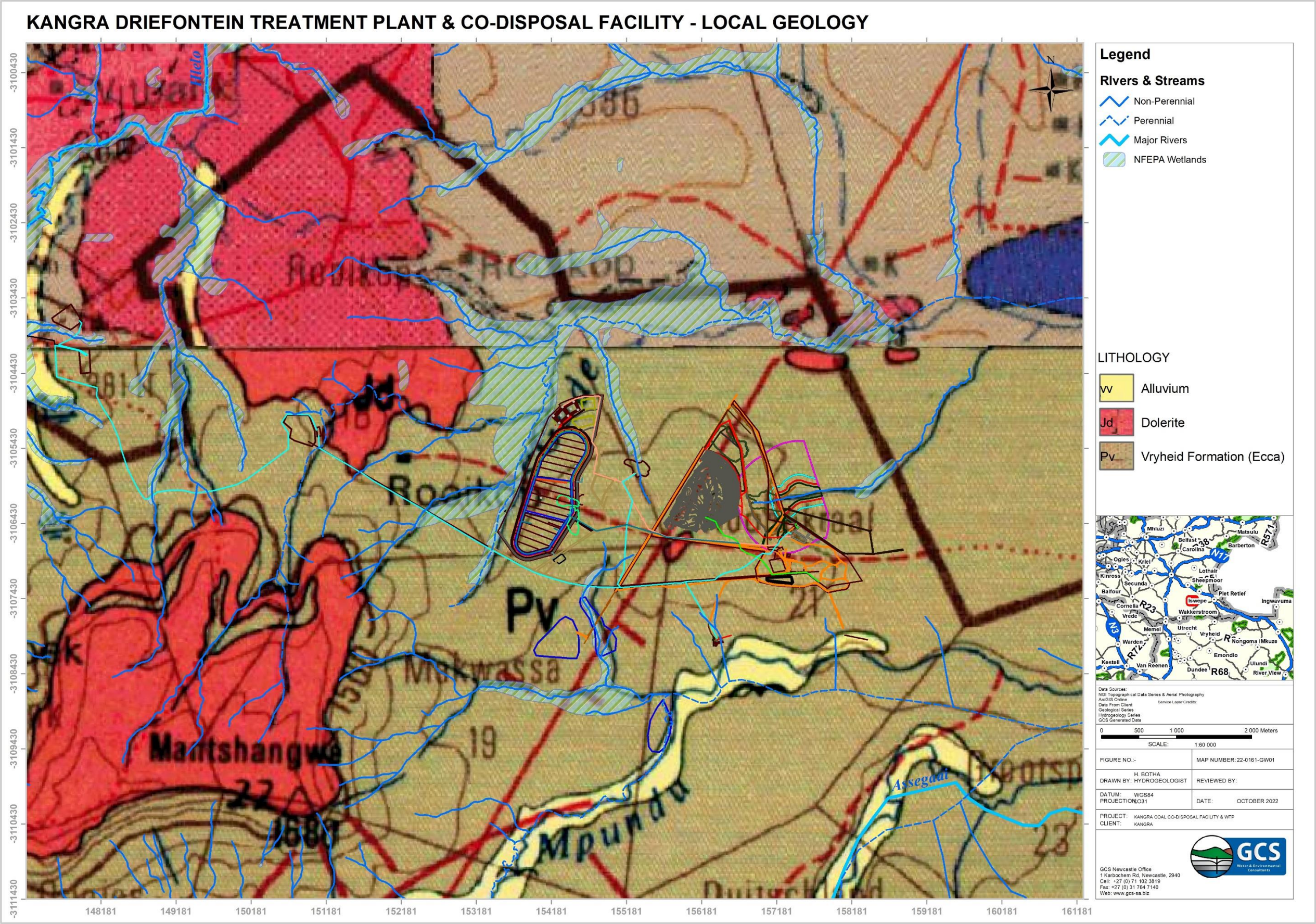


Figure 2-3: Local geology



## 2.4 Climate

Climate, amongst other factors, influences soil-water processes. The most influential climatic parameter is rainfall. Rainfall intensity, duration, evaporative demand and runoff were considered in this study to indicate rainfall partitioning within the project area.

### 2.4.1 Temperature

The average yearly temperature (refer to Figure 2-4) for the project area ranges from 25 to 33°C (high) and -4 to -2°C (Low). The study area is situated in a subtropical highland climate or temperate oceanic climate with dry winters (Cwb) area, as per the Köppen Climate Classification (Kottek, et al., 2006). The project area receives summer rainfall.

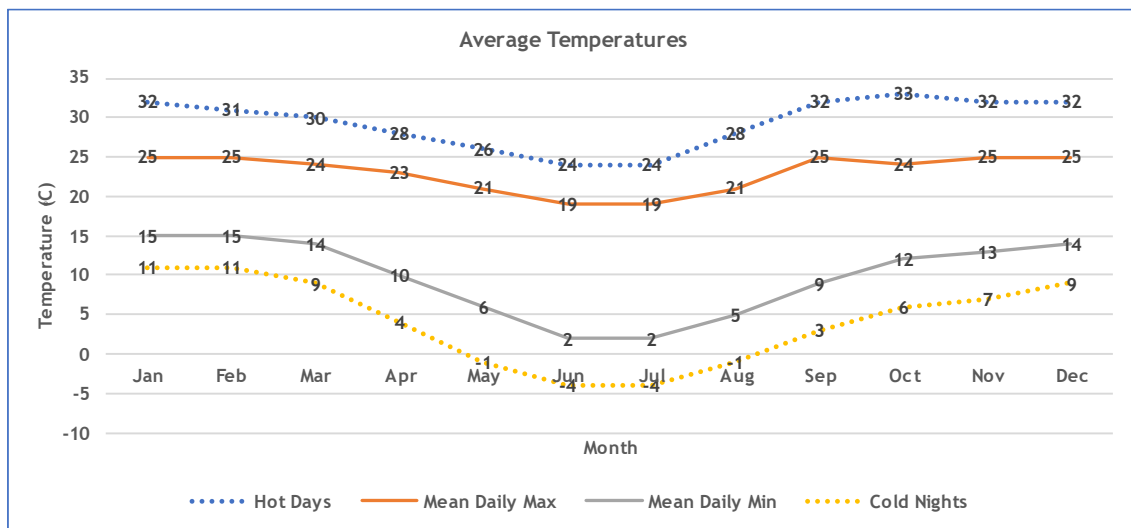


Figure 2-4: Average yearly temperatures (Meteoblue, 2022)

### 2.4.2 Wind speed and direction

Figure 2-5 shows the wind rose for the project area (Vryheid used as reference) and presents the number of hours per year the wind blows from the indicated direction. The wind blows from WW, ENE and E more often, at velocities ranging from 1 km/hr to 28 km/hr; and from other directions but less frequently and at lower velocities (< 19 km/hr).



Figure 2-5: Wind rose (Meteoblue, 2022)

### 2.4.3 Rainfall and evaporation

The project area is situated in rainfall zone W5A. The mean annual precipitation (MAP) measured at several rainfall stations that fall close to the site is summarised in Table 2-1, below.

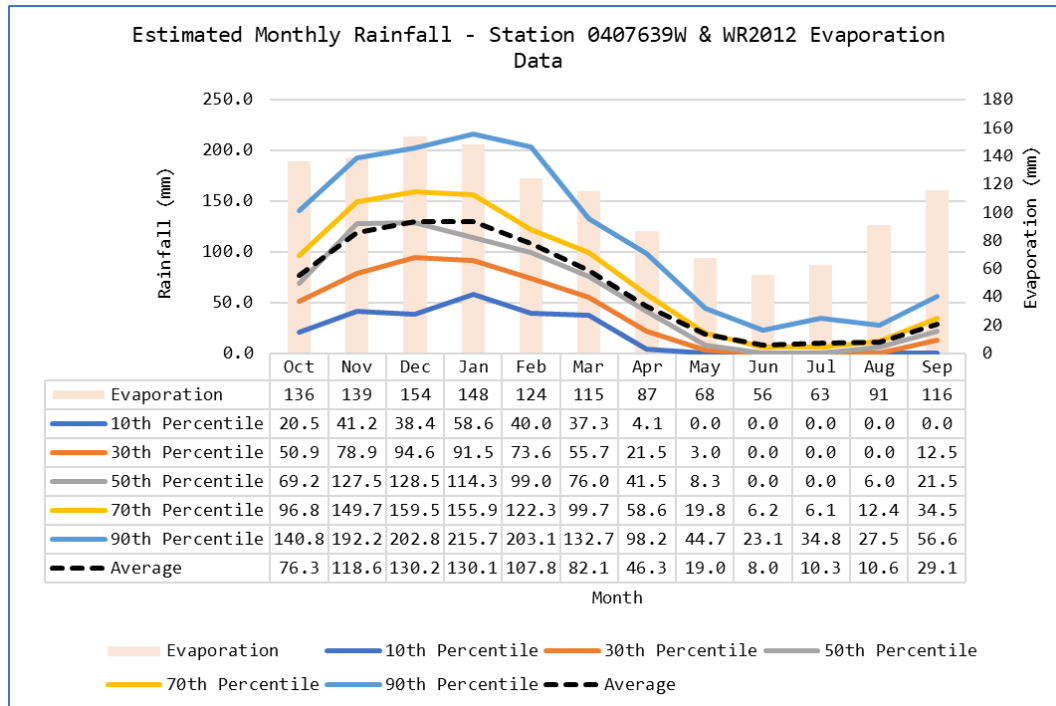
Table 2-1: MAP of nearest rainfall stations

Station Name	ID	MAP (mm/yr)
GROOT RIETVLEI	0407639_W	770
DIRKIESDORP (POL)	0407730_W	681
SPITSKOP	0407397_W	800
BRERETON PARK	0443807_W	900
Average		787.75

The monthly rainfall data used to calculate MAP was obtained from rainfall station 0407639W (Grootvlei). The rainfall record is for the period 1929 to 2003 (74 years). Monthly rainfall for the site is likely to be distributed as shown in Figure 2-6, below.



Available rainfall data suggest a MAP ranging from 482 (30<sup>th</sup> percentile) to 1372 (90<sup>th</sup> percentile) mm/yr. The average rainfall is in the order of 768 mm/yr. The project area falls within evaporation zone 13A, of which Mean Annual Evaporation (MAE) ranges from 1 200 to 1 300 mm/yr. The MAE far exceeds the MAP for the site, which implies greater evaporative losses when compared to incident rainfall. Monthly evapotranspiration for the site is likely to be distributed as shown in Figure 2-6, below.



**Figure 2-6: Average rainfall for Station 0407639W & WR2012 evaporation**

#### 2.4.4 Runoff

Runoff from natural (unmodified) catchments for quaternary catchment W51B is simulated in WR2012 (WRC, 2015) as being equivalent to 103.5 mm/yr (or 13% of the MAP). This is approximately 51.369 Mm<sup>3</sup>/yr NMAR for the surface area of W51B.

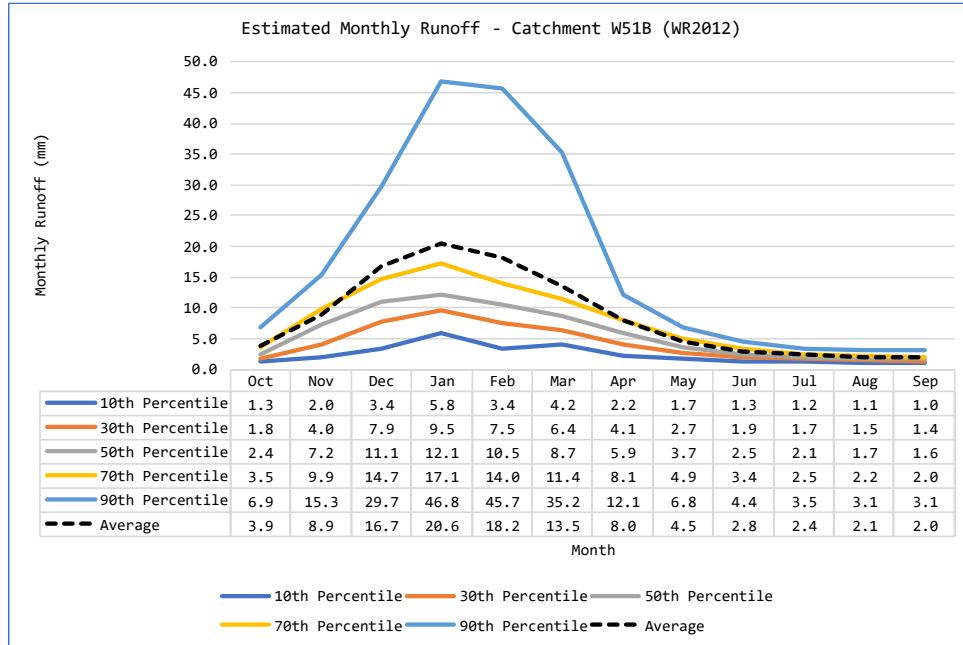


Figure 2-7: Simulated natural (unmodified) runoff for W51B

#### 2.5 Surface water and groundwater users in the study area

According to Water Allocation Registration Management System (WARMS, 2019), there are no WARMS water users within a 5 km radius of the proposed activity. According to SADAC GIP and National Groundwater Activities (NGA) data, there are at least 3 registered boreholes within a 5 km radius of the proposed activities (refer to Figure 1-4 and Table 2-2).

Table 2-2: Groundwater users within a 2.5 km radius of the site

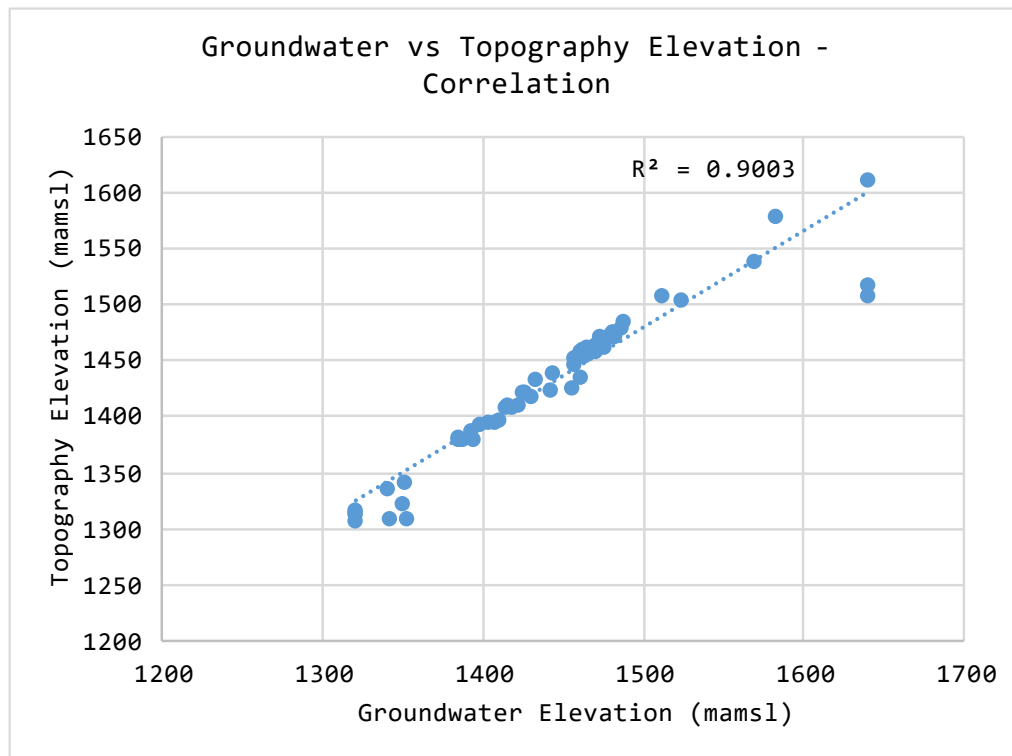
ID	Source	Latitude (WGS84) Decimal Degrees	Longitude (WGS84) Decimal Degrees	Elevation (mamsl)	Water Level (mbgl)
736675	SADAC GIP / NGA 2022	-27.06383	30.39031	1322	2.1
736687	SADAC GIP / NGA 2023	-27.02717	30.41504	1351	15
611988	SADAC GIP / NGA 2024	-26.974167	30.400833	1351	No Data

GCS (2022) identified two (2) groundwater boreholes within a 5 km radius of the proposed co-disposal facility (namely FB7 and FB8) that are used for groundwater supply. The boreholes are used by Kangra to supply water to the Community Health Centre.

## 2.6 Depth to groundwater

According to (Vegter, 1995) and (DWAF, 2006), the groundwater levels within the region are expected to range from 15 to 30 mbgl (meters below ground level). Available monitoring boreholes data for Kangra suggest a water level range from 1.28 to 131 mbgl (nearing the MQW underground workings in the mountains), with an average water level in the order of 12.4 mbgl for the MQE area.

Available water level data for boreholes in the area suggest there is a good correlation between the surface topography and the groundwater table (refer to Figure 2-8,  $R = 90\%$ ). The groundwater table is expected to mimic the topography and be shallower closer to perennial streams (i.e. these are prominent groundwater contributions to base-flow areas or areas where groundwater seepage from the resource into the aquifer units may take place).



**Figure 2-8: Groundwater elevation vs topography elevation - correlation (Kangra Monitoring Holes)**

## 2.7 Wetland areas

Based on available National Wetland Freshwater Ecosystem Priority Areas (NFEPA) (Van Deventer, 2018) the non-perennial and perennial drainage areas situated downstream of the proposed co-disposal facility are classified as channelled valley bottom (CVB) wetland areas of the Mesic Highveld Grassland Bioregion (refer to Figure 1-4).

In terms of wetland geo-hydrology, base flow is considered the most important contributor to wetland health. Base flow (refer to Figure 2-9) is a non-process-related term to signify low amplitude high-frequency flow in a river during dry or fair-weather periods. Base flow is not a measure of the volume of groundwater discharged into a river or wetland, but it is recognised that groundwater contributes to the base-flow component of river or wetland flow.

Available literature (WRC, 2015; DWAF, 2006) suggests groundwater contribution to baseflow ranges from 9.8 mm/yr (PITMAN MODEL) to 43.45 mm/yr (HUGHES MODEL). This relates to approximately 2% to 6% of rainfall.

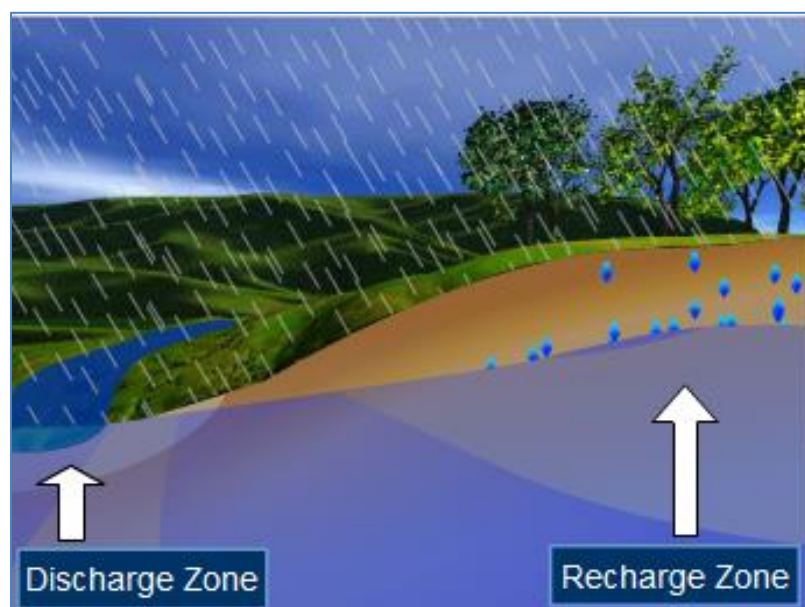


Figure 2-9: Groundwater base-flow concept (DWS, 2011)

## 2.8 Present ecological state (PES) and environmental sensitivity and ecological importance (EIS) - quaternary scale

Table 2-3 provides a summary of the PES and EIS for the quaternary catchment associated with the project area (WRC, 2015). It is recommended that the resource management objectives (RMO) for wetlands in the project area need to maintain the current PES and EIS post development

Table 2-3: Summary of PES and EIS for the Quaternary Catchment

Quat	PES	EIS
W51B	Class B: Largely Natural	High

## 2.9 Land morphology and soils

Different soil types are encountered within shoulder, mid-slope and valley positions of the project area (referred to as soil hillslope) and are mainly due to sub-surface geology, products of weathering, degree of saturation, soil texture and slope position (refer to Figure 2-10). The terrain in the project area is slightly sloping to flat (due to undulating hills), with soil depths ranging from 600 mm to 1200 mm generally with clay content ranging from 15 to 60%.

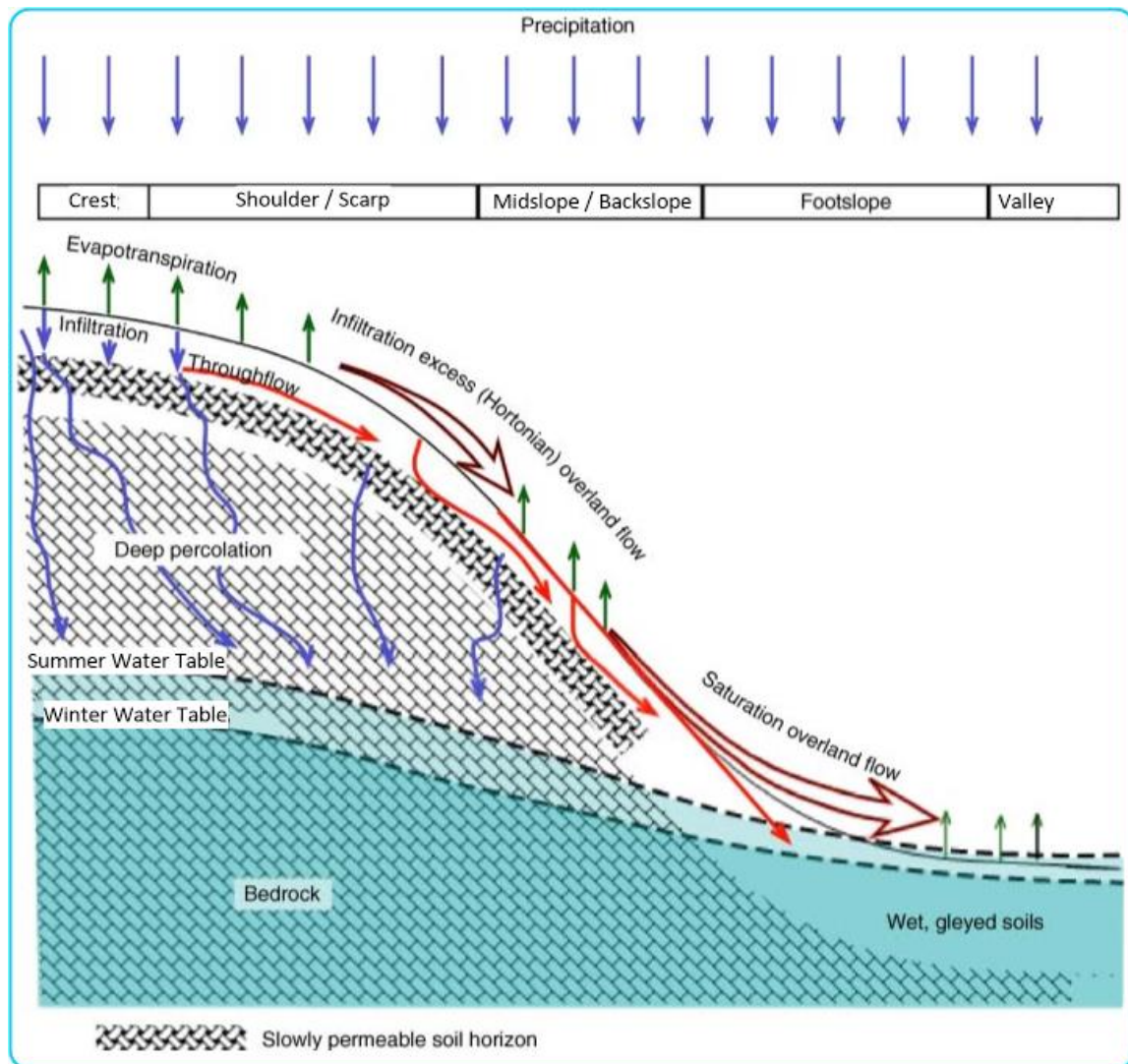


Figure 2-10: Land morphology concept (Almond, 2016)



According to the Land types of South Africa databases (Land Type Survey Staff, 1972 - 2006c), the soils in the area typically conform to land types of the Bb62 group, which entail duplex soils typically red and yellow, dystrophic/mesotrophic, apedal soils with plinthic subsoils (plinthic soils comprise > 10% of land type, red soils comprise < 33% of land type). According to WR2012 soil data for the area, the erodibility of the soils for the area can be considered medium (WRC, 2015). Typical soil types on hillslopes associated with this landform are shown in Figure 2-11 and Figure 2-12 shows the soil land types associated with the greater project area.

Duplex soils are characterised by a distinct difference in saturated and unsaturated hydraulic conductivity between the coarser overlying and higher clay content structured underlying horizons. In this regard, the coarser materials can accommodate more distinct lateral flows of water with its associated redox morphology in the form of bleaching and removal of sesquioxides. The structured subsoil horizon may exhibit a certain degree of redox morphology expression (redox depletions and redox accumulations) that can, in its maximal expression, lead to the classification of a G horizon in the lower parts of the landscape. Wetlands are often identified in areas with E horizons and shallow lateral seepage due to the perching of the water on the structured subsoil.

Distinct water accumulation and lateral flows may also occur beneath the structured horizons in unconsolidated materials or fractured and weathering rock. In these cases, the redox morphology is consistent with the criteria used for wetland identification except for the depth criteria that preclude it from formal wetland identification (Der Waals, 2019).

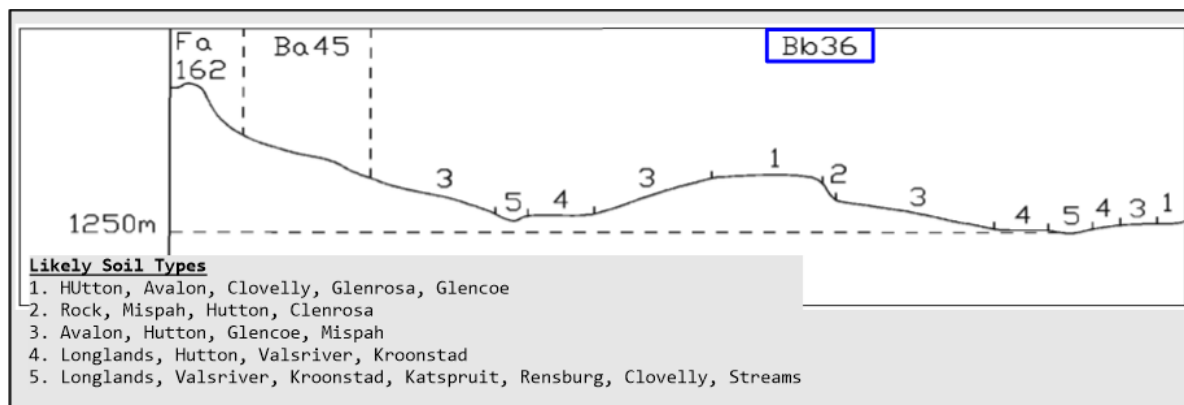


Figure 2-11: Bb62

### 2.9.1 *Site-specific*

GCS undertook a soil survey to evaluate the soil types, and to derive the hydropedological soil types. The auger hole positions are indicated in Figure 2-13 and soil profiles are available in **Appendix A**. Four (4) dominant hillslopes define the site and soil hydrological processes (from the position of the proposed co-disposal facility).

From the soil survey undertaken, the following is noted:

- The majority of the co-disposal facility footprint area is characterised by shallow soils classified as the Glencoe soil type. The soil type was observed to have relatively shallow orthic A (topsoil) horizons, followed by a yellow-brown apedal B horizon with evidence of Fe and Mn concretions, clay matter (more than in the A horizon) that gradually transitions into very hard plinthic rock (horizon). The presence of clay matter and weathered plinth will likely cause temporary perched water tables, during prolonged rainfall events/storm events. Stagnant flow along the hard plinthic / soil interface is expected in a lateral direction. The Glencoe soil form was observed in 42% of the test auger holes.
- Towards the southeast side of the site (crest/hilltop) very shallow soils were encountered off the Mispah soil type. Augering in these areas hit refusal at depths <0.1m. The Mispah soil form was encountered in 28% of the test auger holes. It was noted that the area southeast of the proposed co-disposal facility gradually extends into backfilled material used to rehabilitate the old opencast pit associated with the area. The Mispah soil form occurred in areas that appear to be associated with the high wall of the old pit.
- Towards the northeastern side of the site, soils of the Hutton soil type were observed. These soil are signified by deeply weathered soils, having a distinct A horizon, followed by thick yellow-brown apedal B horizons. Deeper in the profile, weathered zone material was observed, with signs of wetness. The soils lacked pedological features which would classify this layer as soft plinthic B. The Hutton soil form was encountered in 14% of the auger test holes.
- Towards the northeast and northwest of the site, near the drainage line areas in depression areas or areas where stagnant water was observed, soils of the Katspruit and Rensburg soil forms were encountered. The presence of a saturated G horizon, with mottling and gleying, suggests long-term saturated conditions. These soil types were inferred to the greater project area, based on their position of the hillslopes. The Katspruit and Rensburg soil forms were encountered in 16% of the auger test holes.
- The estimated soil distribution at the site is presented in Figure 2-13.

## 2.10 Soil permeability

Several soil samples were taken from both A and B horizons and subjected to particle size distribution (PSD) tests. The laboratory test results are available in **Appendix B** and soil texture classes are summarized in Table 2-4. Based on available soil data for the project area, it is anticipated that the area is characterized by sandy loam to sandy clay loam soil types. As such, the anticipated permeability of the soils is estimated at 1.3 cm/hr to  $4.1 \times 10^{-3}$  cm/hr.

**Table 2-4: Summary of soil classes identified**

Lab ID	Sample ID	Media
189388	A11 0-0.3M	Sandy Loam
189389	A11 1-1.3M	Sandy Clay Loam
189390	A12 0-0.3M	Loamy Sand
189391	A12 1.2-1.5M	Sandy Clay Loam
189392	A14 0.4-0.6M	Sandy Loam
189393	A14 0-0.4M	Sandy Clay Loam
189394	A15 Composite	Sandy Clay Loam
189395	A16 0.3M	Sandy Clay Loam
189396	A16 0-0.2M	Sandy Clay Loam
189397	A17 0.0.3M	Sandy Clay Loam
189398	A17 1.3-1.5M	Sandy Loam
189399	A6 0-0.03M	Sandy Loam
189400	A6 1.3-1.5M	Sandy Loam
189401	A7 0.7-0.9M	Loamy Sand
189402	A7 0-0.2M	Sandy Loam
189403	A8 0-0.3M	Loamy Sand
189404	A8 1.2-1.5M	Sandy Loam

**Table 2-5: Soil permeability classes for agriculture and conservation (Food and Agriculture Organization (FAO, 1980))**

Soil Texture	Permeability (cm/hour)
Sand	<u>5</u>
Sandy Loam	2.5
Loam	<u>1.3</u>
Clay Loam	0.8
Silty Clay	0.25
Clay	0.05

**Table 2-6: DWS range of hydraulic conductivities in different soil types (DWS, 2011)**

Type	Saturated Hydraulic Conductivity, $K_s$ (cm/s)
Gravel	$3 \times 10^{-2} - 3$
Coarse Sand	$9 \times 10^{-5} - 6 \times 10^{-1}$
Medium Sand	$9 \times 10^{-5} - 5 \times 10^{-2}$
Fine Sand	$2 \times 10^{-5} - 2 \times 10^{-2}$
Loamy Sand	<u><math>4.1 \times 10^{-3}</math></u>
Sandy Loam	<u><math>1.2 \times 10^{-3}</math></u>
Loam	$2.9 \times 10^{-4}$
Silt, Loess	$1 \times 10^{-7} - 2 \times 10^{-3}$
Silt Loam	$1.2 \times 10^{-4}$
Till	$1 \times 10^{-10} - 2 \times 10^{-4}$
Clay	$1 \times 10^{-9} - 4.7 \times 10^{-7}$
Sandy Clay Loam	$3.6 \times 10^{-4}$
Silty Clay Loam	$1.9 \times 10^{-5}$
Clay Loam	$7.2 \times 10^{-5}$
Sandy Clay	$3.3 \times 10^{-5}$
Silty Clay	$5.6 \times 10^{-6}$
Un-weathered marine clay	$8 \times 10^{-11} - 2 \times 10^{-7}$



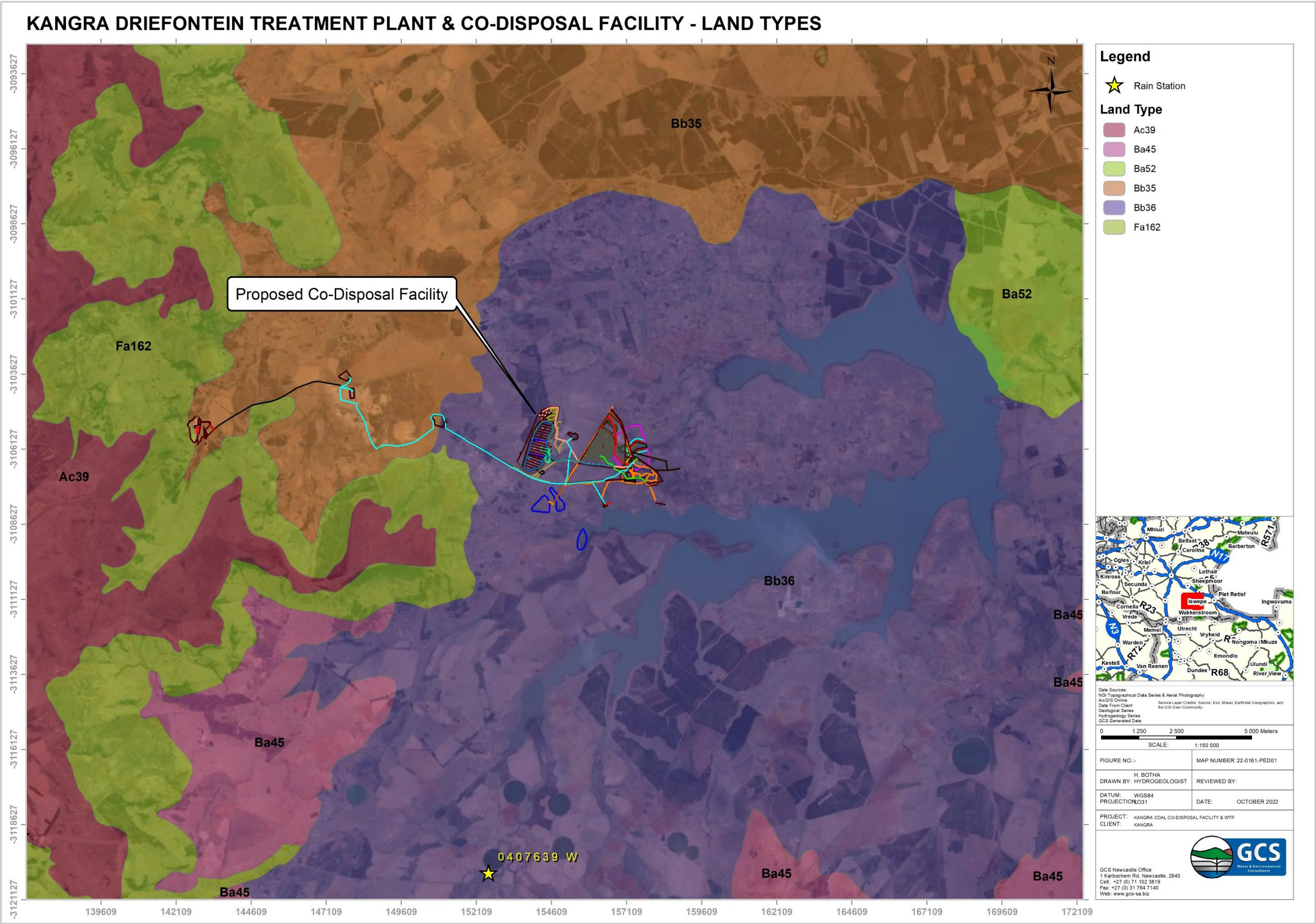
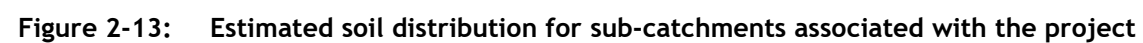


Figure 2-12: Land types associated with the project area







### 3 HYDROPEDOLOGICAL ASSESSMENT

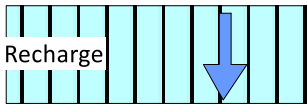
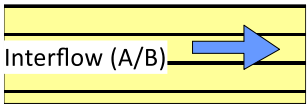
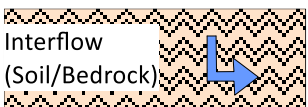
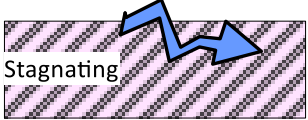
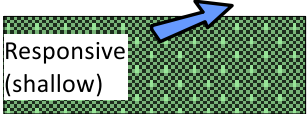
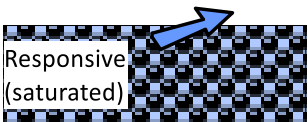
Soil genesis is influenced by physical and chemical water-related processes and soils are, therefore, the first-order control of hydrological processes. The water transfer function of soils varies on several factors including soil properties, topography, and climate.

Characteristic soil properties make it possible to conceptualise hillslope hydrological responses within catchments. The approach followed in this study includes the classification of hillslopes for the site, and the development of a soil map (refer to Section 2.9.1), which were used to determine the HST. Finally, a conceptualization of hydrological processes that occur on the various hillslopes, based on HST was undertaken.

#### 3.1 Hydrological Soil Types (HST)

In the determination of Hydrological Soil Types (HST), soils were divided into classes based on their expected hydrological responses (Van Tol, et al., 2013). Hydrological processes were perceived from traceable signatures in the soil matrix resulting from the soil's ability to transmit, store and react with water (Le Roux, et al., 2011). The HST descriptions and representative symbols are presented in Table 3-1, below.

**Table 3-1: Hydrological soil types**

Hydrological soil type	Description	Symbol
Recharge	The soils do not have any morphological indication of saturation. Vertical flow through and out of the profile into the underlying bedrock is the dominant flow path. These soils are deep and freely drained and are experiencing the leaching of nutrients to underlying soil horizons.	
Interflow (A/B)	The soils have a textural discontinuity which facilitates the build-up of water in the topsoil, the water that sits on the upper layer then flows laterally into the stream on the A/B horizon interface. The flow path is predominantly downslope in a lateral direction.	
Interflow (Soil/Bedrock) Or Interflow (A/ Bedrock)	Soils overlying relatively impermeable bedrock. Hydromorphic properties signify the temporal build of water on the soil/bedrock interface and slow discharge in a predominantly lateral direction.	
Stagnating	Stagnating soils tend to act like interflow (soil/bedrock) soil types, however, due to the presence of abundant clays lateral discharge is slow. A build-up of water content in the soil, profile leads to temporary perched groundwater after high rainfall events.	
Responsive (Shallow)	The soils are shallow, and they are over a relatively less permeable weathered rock or bedrock. They have limited storage capacity which results in the generation of overland flow after rainfall events.	
Responsive (Saturated)	Soils with morphological evidence of long periods of saturation. These soils are close to saturation during rainy seasons and promote the generation of overland flow due to saturation.	

\*Adapted from (Van Tol, et al., 2013)

### 3.2 Hillslopes and hillslope hydrology

Hillslopes and preferential soil flow paths were evaluated based on a 30 m ALOS digital terrain model (DTM) (JAXA, 2022), and can be seen in Figure 3-5. The hillslopes generally feed into responsive soil types or streams/rivers.

### 3.3 Conceptual hydrological flow processes

The hydrological processes associated with the land types and soil types in the project area are discussed concerning the numbered arrows in Figure 3-1 to Figure 3-4, and the hillslope positions are indicated in Figure 3-6. The following provides a summary of the likely soil flow paths and the HSTs.

#### 3.3.1 Hillslope 1

##### Crest to midslope/backslope:

On the crest to midslope position of the hillslope, stagnating soils of the Glencoe soil types were encountered.

2. a. Stagnating soils tend to act like interflow (soil/bedrock) soil types, however, due to the presence of abundant clays lateral discharge is slow. Slow discharge in a predominantly lateral direction is expected for water that can make it to the plinthic interface. A build-up of water content in the soil, profile leads to temporary perched groundwater after high rainfall events.
2. b. Deep percolation into the sub-soils/hard rock and subsequent aquifers towards the lower topography areas is expected.

##### Footslope:

On the footslope position of the hillslope, deep/shallow recharge soils of the Hutton soil types were encountered.

- 1.a. Shallow and deep vertical recharge to sub-soils are expected, as well as some lateral movement where sub-soils turn to hard rock/plinthic material (as per greater site context).
1. b. Deep percolation into the sub-soils/hard rock and subsequent aquifers towards the lower topography areas is expected. This deep percolation water contributes to surface water streams as groundwater baseflow.

##### Valley bottom:

On the valley positions of the hillslope, responsive (saturated) soils occur.

- 4.a. b. In responsive soils, the build-up of water is expected in the B and upper A horizons after rain and overland discharge and minor lateral seepage are expected (due to saturation excess). Secondary vertical seepage to deeper soil zones from the saturated B horizon is expected. At the transition from one soil type to the other (upstream to downstream) overland flow may take place during wet seasons.

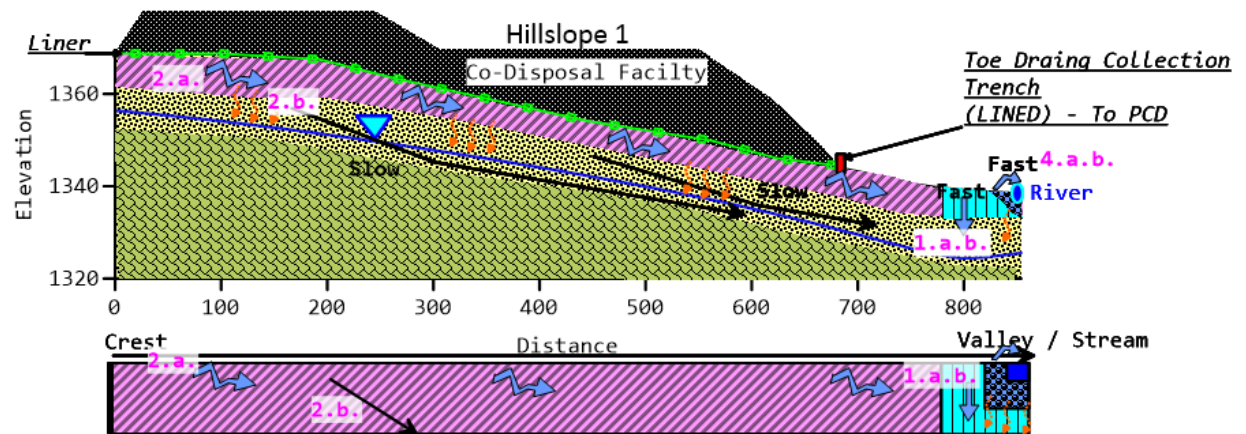


Figure 3-1: Hillslope 1 - conceptual hydrogeology flow regimes

### 3.3.2 Hillslope 2

#### Crest:

On the crest position of the hillslope, the rehabilitated opencast associated with the area will act as anthropogenic recharge soils.

1.a. Shallow and deep vertical recharge to sub-soils are expected, as well as some lateral movement where sub-soils turn to hard rock/plinthic material (as per greater site context).

1. b. Deep percolation into the sub-soils/hard rock and subsequent aquifers towards the lower topography areas is expected. This deep percolation water contributes to surface water streams as groundwater baseflow.

#### Shoulder to midslope:

On the shoulder to midslope position of the hillslope, interflow (soil/bedrock) soils of the Mispah type were encountered.

3.a. Shallow hard rock or soft plinthic B horizons will signify a temporal build of water on the soil/bedrock interface and slow discharge in a predominantly lateral direction will occur.

3. b. In areas where bedrock has been subjected to fracturing secondary flow paths towards the groundwater table could exist. Water in the fractured zone will likely seep vertically down into the groundwater table.

#### Footslope:

On the footslope position of the hillslope, deep/shallow recharge soils of the Hutton soil types were encountered.

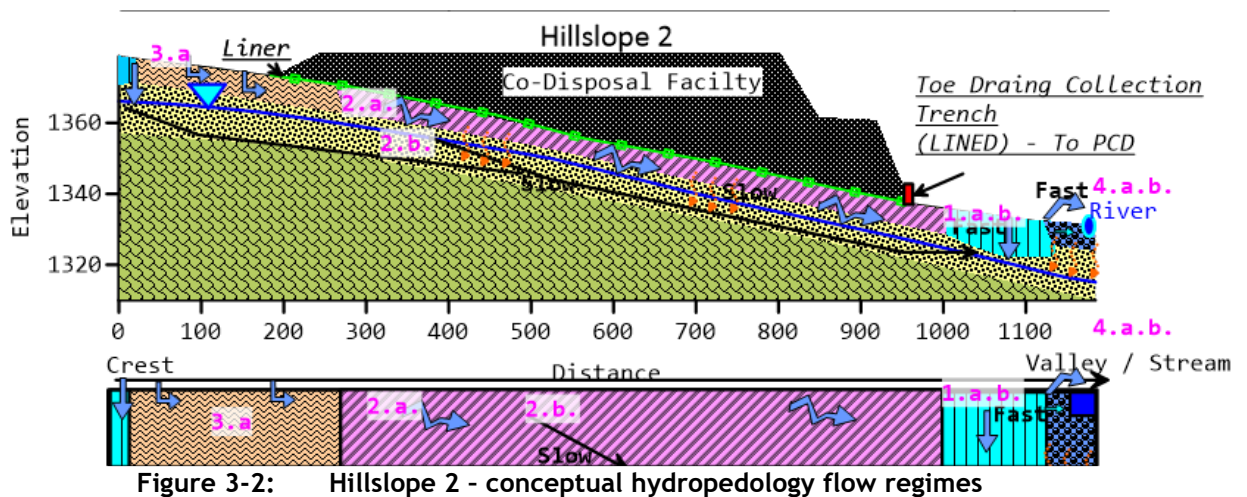
1.a. Shallow and deep vertical recharge to sub-soils are expected, as well as some lateral movement where sub-soils turn to hard rock/plinthic material (as per greater site context).

1. b. Deep percolation into the sub-soils/hard rock and subsequent aquifers towards the lower topography areas is expected. This deep percolation water contributes to surface water streams as groundwater baseflow.

**Valley bottom:**

On the valley positions of the hillslope, responsive (saturated) soils occur.

4.a. b. In responsive soils, the build-up of water is expected in the B and upper A horizons after rain and overland discharge and minor lateral seepage are expected (due to saturation excess). Secondary vertical seepage to deeper soil zones from the saturated B horizon is expected. At the transition from one soil type to the other (upstream to downstream) overland flow may take place during wet seasons.





### 3.3.3 Hillslope 3

#### Crest to midslope

On the crest to midslope position of the hillslope, interflow (soil/bedrock) soils of the Mispah type were encountered.

3.a. Shallow hard rock or soft plinthic B horizons will signify a temporal build of water on the soil/bedrock interface and slow discharge in a predominantly lateral direction will occur.

3. b. In areas where bedrock has been subjected to fracturing secondary flow paths towards the groundwater table could exist. Water in the fractured zone will likely seep vertically down into the groundwater table.

#### Footslope to the valley bottom

On the valley positions of the hillslope, responsive (saturated) soils occur.

4.a. b. In responsive soils, the build-up of water is expected in the B and upper A horizons after rain and overland discharge and minor lateral seepage are expected (due to saturation excess). Secondary vertical seepage to deeper soil zones from the saturated B horizon is expected. At the transition from one soil type to the other (upstream to downstream) overland flow may take place during wet seasons.

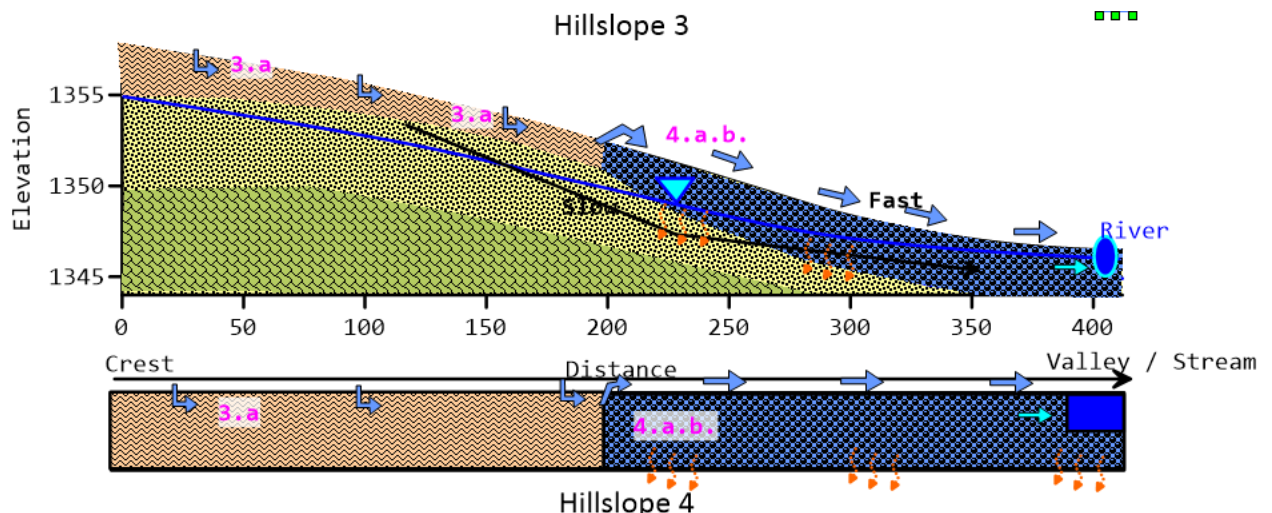


Figure 3-3: Hillslope 3 - conceptual hydrogeology flow regimes

### 3.3.4 Hillslope 4

#### Crest

On the crest position of the hillslope, deep/shallow recharge soils of the Hutton soil types were encountered.

1.a. Shallow and deep vertical recharge to sub-soils are expected, as well as some lateral movement where sub-soils turn to hard rock/plinthic material (as per greater site context).

1. b. Deep percolation into the sub-soils/hard rock and subsequent aquifers towards the lower topography areas is expected. This deep percolation water contributes to surface water streams as groundwater baseflow.

#### Scarp to footslope

On the scarp to footslope position of the hillslope, stagnating soils of the Glencoe soil types were encountered.

2. a. Stagnating soils tend to act like interflow (soil/bedrock) soil types, however, due to the presence of abundant clays lateral discharge is slow. Slow discharge in a predominantly lateral direction is expected for water that can make it to the plinthic interface. A build-up of water content in the soil, profile leads to temporary perched groundwater after high rainfall events.

2. b. Deep percolation into the sub-soils/hard rock and subsequent aquifers towards the lower topography areas is expected.

#### Valley bottom

On the valley positions of the hillslope, responsive (saturated) soils occur.

4.a. b. In responsive soils, the build-up of water is expected in the B and upper A horizons after rain and overland discharge and minor lateral seepage are expected (due to saturation excess). Secondary vertical seepage to deeper soil zones from the saturated B horizon is expected. At the transition from one soil type to the other (upstream to downstream) overland flow may take place during wet seasons.

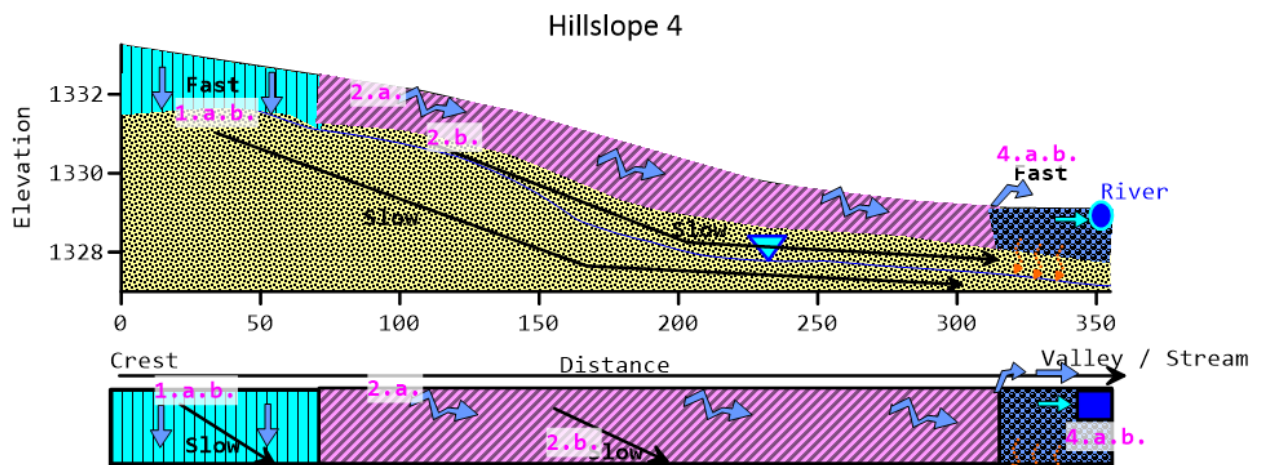


Figure 3-4: Hillslope 4 - conceptual hydrogeology flow regimes



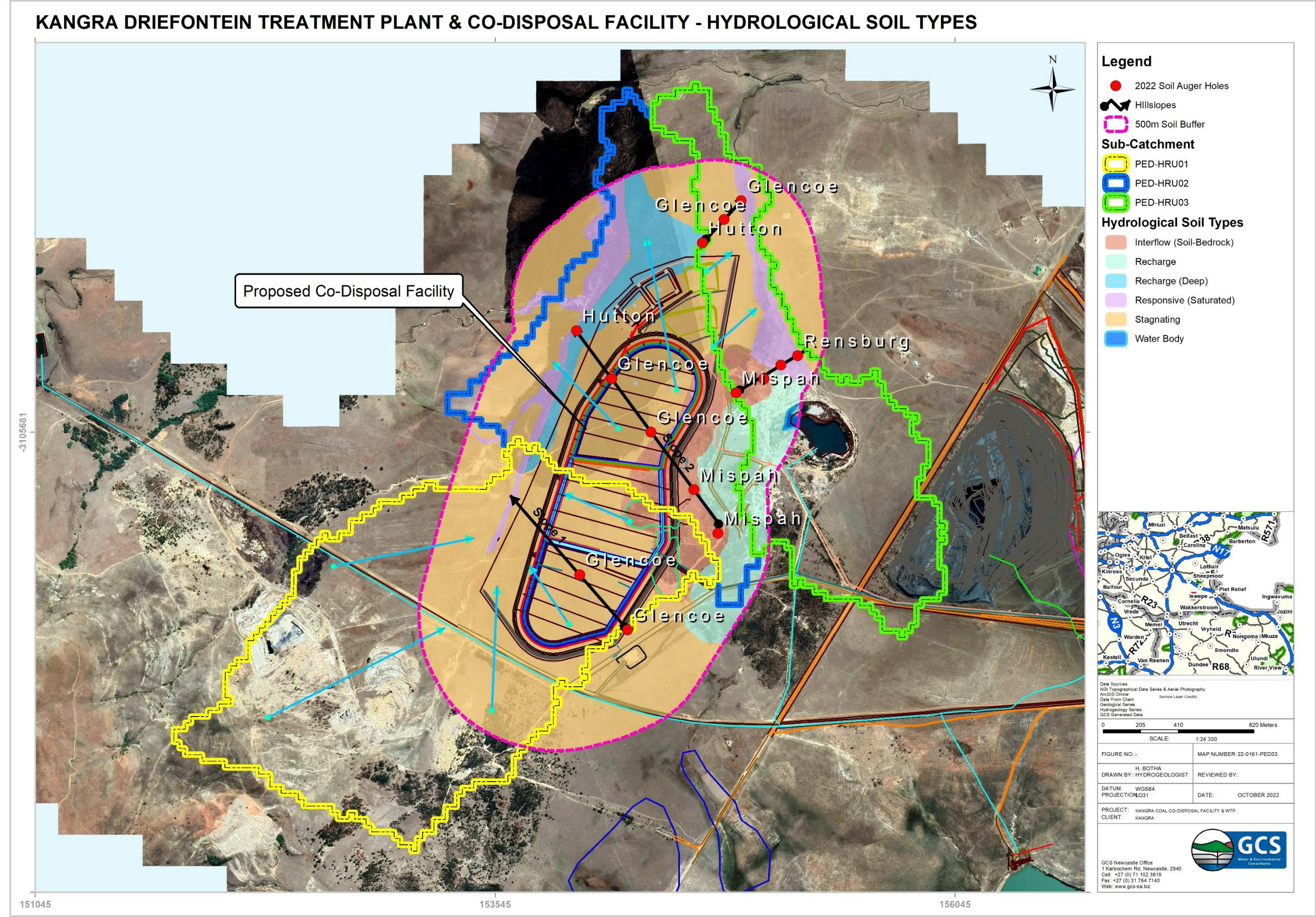


Figure 3-5: Hydrological soil types in the study area and soil flow paths



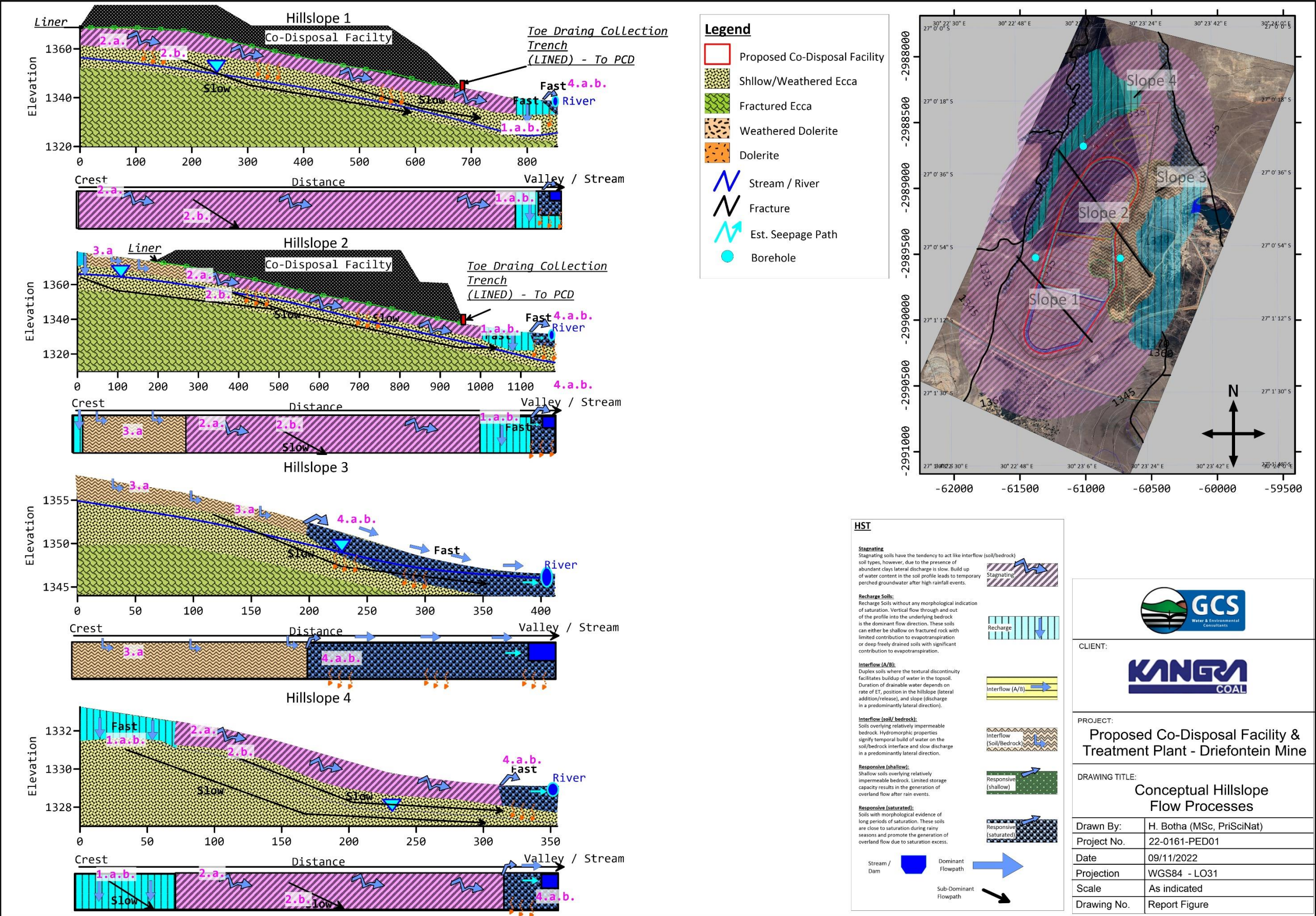


Figure 3-6: Conceptualisation of hydrological soil flow paths



#### 4 FLOW DRIVER ASSESSMENT & RISKS

The impact on the hydrogeological functions is founded on basic principles of geo-hydrology (Harbaugh, et al., 2000) and hydrogeology (Job & le Roux, 2019; Job, et al., 2019; Le Roux, et al., 2011). The general hydrogeological flow drivers, and coupled geohydrological processes, for a natural setting are presented in Figure 4-1, below.

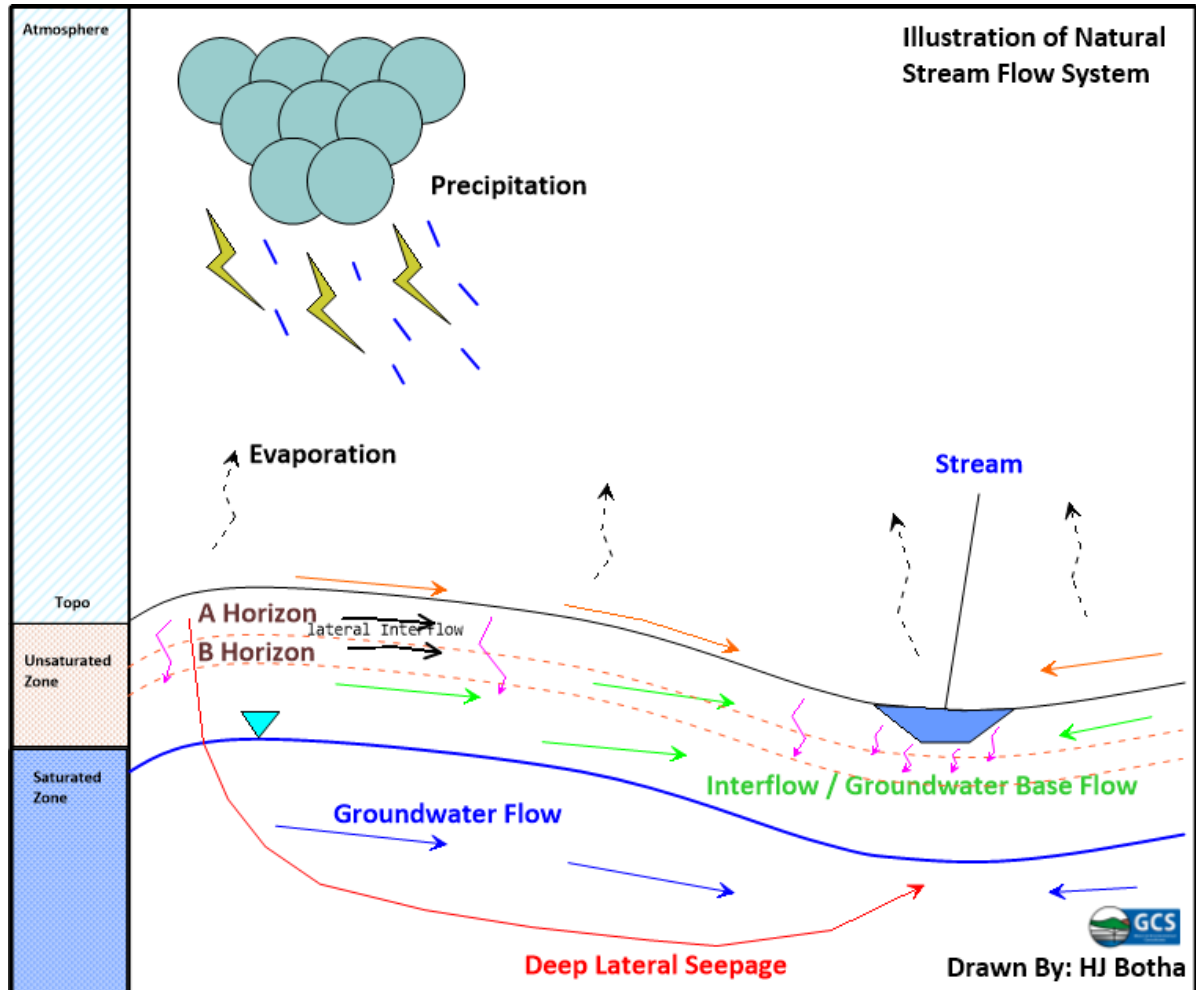


Figure 4-1: Natural flow drivers

It can be seen that the main hydrological processes in a non-mining setting are:

- Atmospheric zone:
  - Precipitation;
  - Runoff; and
  - Evaporation.
- Unsaturated zone:
  - Infiltration;
  - Interflow (soil capillary rise, percolation, vertical soil water flow); and



- Groundwater baseflow (lateral soil water possibly saturated lateral groundwater flow - in areas where shallow groundwater levels occur).
- Saturated zone:
  - Deep lateral seepage; and
  - Groundwater flow (baseflow and aquifer flow).

For the proposed development (built-up areas, that make the land surface impervious) the hydrological process will be altered and is presented in Figure 4-2, below.

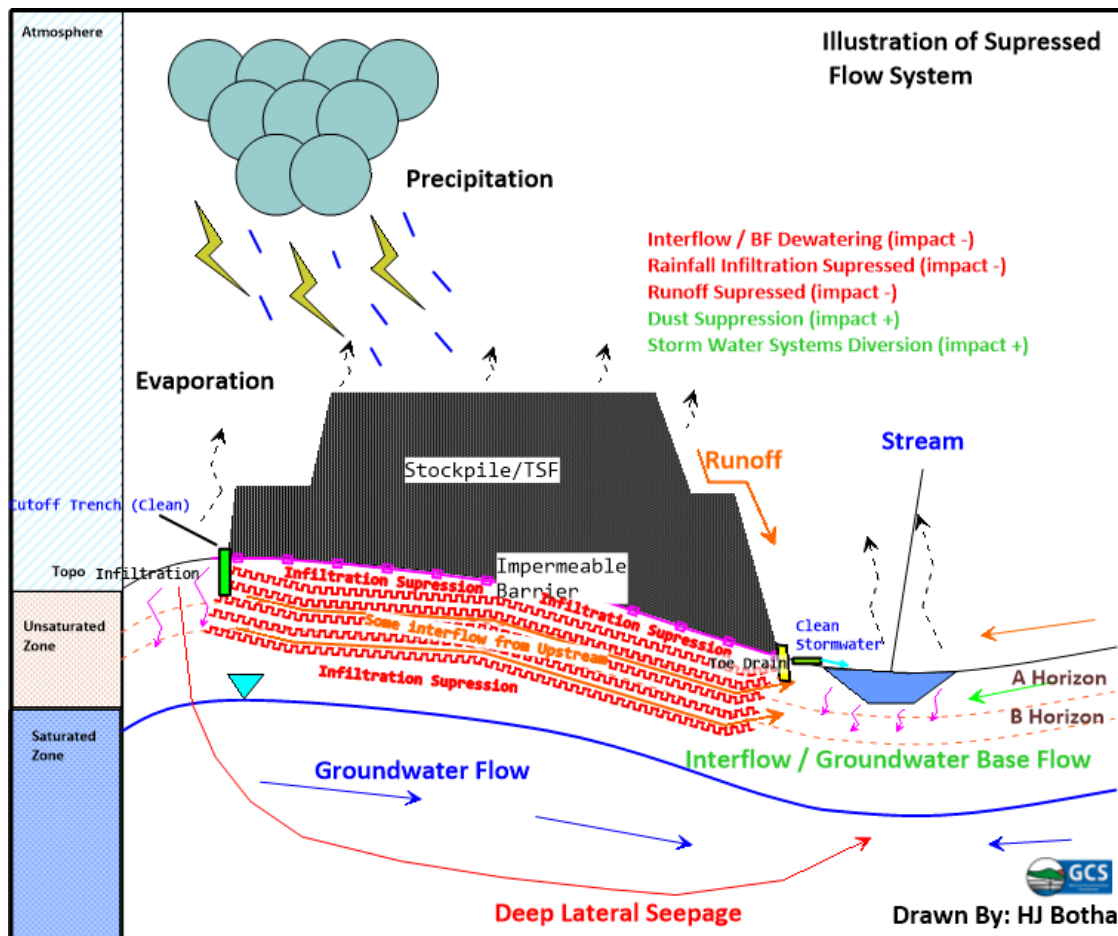


Figure 4-2: Altered flow drivers - built-up area for a lined TSF/Landfill

The following components will highly likely be impacted and will depend on the geomorphology and HSTs of a specific sub-catchment and associated hillslopes, namely:

- Natural runoff towards the valley areas will be disturbed. All runoff from the co-disposal facility will collect in the toe drain systems and report to the PCDs.
- Infiltration over the surface area that is disturbed will be suppressed/removed completely, and no longer be available to add to soil interflow and deep percolation soil functions.
- Interflow (vertical or lateral or both) will be intercepted by the upstream cut-off trench, acting as a clean water diversion system.
- Runoff from the upper reaches of the sub-catchment will be intercepted and removed (if not diverted).

#### 4.1 Flow driver loss calculation/impact estimation

A water balance approach was adopted to estimate the potential impacts on the flow drivers. The equation used was as follows:

$$\text{Flow Loss \%} = \frac{FN \text{ (m}^3\text{/yr.)}}{WT \text{ (m}^3\text{/yr.)}} \times 100 \text{ (convert to \%)} \quad \text{Equation 1}$$

##### Where:

- FN = Sum of Total Negative flow driver impacts in a given sub-catchment.
- WT = Total water in the system.

##### And:

$$FN = RRI + GBR + AII + NRF \quad \text{Equation 2}$$

- RRI = Est. direct rainfall runoff intercepted by the development (m<sup>3</sup>/yr.).
- GBR = Est. reduced groundwater contribution to flow drivers / GW dewatering (m<sup>3</sup>/yr.).
- AII = Est. aquifer and soil interflow intercepted by the development/activity (m<sup>3</sup>/yr.); and
- NRF = Est. surface runoff intercepted which would naturally flow from upper catchments to the downstream environment (m<sup>3</sup>/yr.) - estimated at 80% of the MAP.

Adding positive water releases to the flow driver system (i.e. diverting rainwater to the environment via stormwater systems) may offset the negative. The equation used, was as follows:

$$\text{Net Flow loss impact (\%)} = \left[ \Sigma \text{Total Negative flow driver impacts (m}^3/\text{yr.)} - \text{Positive Adjustments (m}^3/\text{yr.)} \right] / \text{Total water in the system (m}^3/\text{yr.)} \times 100 \text{ (convert to \%)} \quad \text{Equation 3}$$

Where:

The Sum of Positive Adjustments (m<sup>3</sup>/yr.) are:

- Est. positive flow releases previously impacted (m<sup>3</sup>/yr.); and
- Est. new positive flow releases not impacted on (m<sup>3</sup>/yr.).

#### 4.1.1 Assumptions

The following assumptions were made:

- Constant evaporation is assumed for the sub-catchments - sink in the water balance model.
- No groundwater dewatering takes place.
- Groundwater contribution to baseflow is assumed to be in the order of 43.4 mm/yr. (DWAF, 2006) - Hughes Model.
- Upstream interception along the length of the proposed clean water diversion trench up to a maximum depth of 3m is assumed.
- No artificial recharge, other than in the case of a mitigation measure (i.e. attenuated stormwater releases to wetlands/streams/drainage lines), is accounted for. Artificial recharge from dams is not considered.
- The existing setting and activities proposed are evaluated. The co-disposal facilities and PCDs will be lined, and hence are assessed as being impermeable or no-flow boundaries. This was done to evaluate the likely impacts of PES/EIS.
- The above-mentioned assumptions were made to give a worst-case overview of the likely impacts on the hydrogeological flow water balance, as a result of the activities at the site.

#### 4.1.2 Calculations

The calculations for impact on the hydrogeological flow drivers, pre- and post-mitigation, are shown in Table 4-1.

**Table 4-1: Flow driver calculations**

		Rainfall	HRU1	HRU2	HRU3
		mm/yr	768.4413333	768.441333	768.441333
		GW Recharge - DEEP	HRU1	HRU2	HRU3
		%	5	5	5
		mm/yr	38.42206667	38.4220667	38.4220667
		BF - SHALLOW	HRU1	HRU2	HRU3
		mm/yr	43.45	43.45	43.45
		Runoff	HRU1	HRU2	HRU3
		Stormwater factor (%)	90%	90%	90%
		Runoff Factor (%)	80%	80%	80%
		Sub-Catch Area	HRU1	HRU2	HRU3
Drivers	Status	km <sup>2</sup>	2.608994	1.548668	1.35857
Natural Water Processes					
	+	Total Rain Volume (m <sup>3</sup> /yr)	2004858.83	1190060.50	1043981.34
	-	Runoff (m <sup>3</sup> /yr)	1603887.06	952048.40	835185.07
	+	Re AQ - Deep / Shallow Percolation (m <sup>3</sup> /yr)	100242.94	59503.03	52199.07
	+	BF - Shallow Soil Interflow (m <sup>3</sup> /yr)	113360.79	67289.62	59029.87
	-	Evap (m <sup>3</sup> /yr)	187368.03	111219.45	97567.33
		Balance	0	0	0
Description		Development	HRU1	HRU2	HRU3
The area that becomes impermeable or altered.		Est. Disturbance Area (km <sup>2</sup> ) - Above Ground / Impermeable	0.4780	0.3930	0.0400
		Est. Disturbance Area (km <sup>2</sup> ) - Soil Removal	0.0048	0.0039	0.0004
		Est. Disturbance Area (km <sup>2</sup> ) - Under Ground	0.0000	0.0000	0.0000
		Est. Intercepted Flow Area (m <sup>2</sup> )	3027	2334	1443
		Est. Groundwater Dewatering (l/sec)	0	0	0
		Est. Dewater/Decant Rate	HRU1	HRU2	HRU3
		m <sup>3</sup> /day			
Drivers	Status				
Impacted Processes	-	Rainfall Intercepted (m <sup>3</sup> /yr)	367314.96	301997.44	30737.65
	-	Soil Zone Water Loss (m <sup>3</sup> /yr)	207.69	170.76	17.38
	-	Deeper Zone Water Loss (under soils) (m <sup>3</sup> /yr)	0.00	0.00	0.00
	-	Deeper Vadose Zone & Water Table - DEWATER (m <sup>3</sup> /yr)	0.00	0.00	0.00
	-	Horizontal Interflow Removed (m <sup>3</sup> /day)	9.57	9.08	3.91
	+	Storm Water (m <sup>3</sup> /yr)	330583.46	241597.96	24590.12
		Potential Negative Impacts	367532.21	302177.28	30758.94
		% Impact on Natural Flow System	18.33%	25.39%	2.95%
		% After Storm Water Convey	1.84%	5.09%	0.59%

## 4.2 Flow driver Impact categories

Table 4-2 summarises the criteria used for the hydropedological flow driver impact assessment.

The flow driver impact assessment aims to characterise the likely impacts on the hydropedological flow drivers (i.e. what are the likely impacts of the development on the hydropedological flow drives sustaining a wetland or stream after the development has taken place).

**Table 4-2: Impact categories for describing the impact on the wetlands and associated hydropedological drivers**

Severity	Flow Driver Reduction	Change Class	Description
No Impact	0 - 2.5%	No change	The hydropedological process is predicted to be unmodified and the functionality of the wetland will remain unchanged
Low	2.5 - 5%	No Significant change	A small effect on the hydropedological process is predicted, however, the functionality of the wetland remains unchanged and no change in resource class is expected.
Low to Moderate	5 - 10%	Limited change with a change in the PES category is possible	A slight change in hydropedological processes is predicted and a small change in the wetland may have taken place but is changed to the (present ecological state) PES, EIS (ecological importance and sensitivity) or wetland functionality and eco service provision is limited with no more than one PES class predicted.
Moderate	10 - 15%	A significant change with a change in PES Category definite and possibly a change of more than one category	A moderate change in the hydropedological processes is predicted to occur, the change in PES may exceed one category but no change in EIS takes place. No loss of important eco-services is predicted to occur
High	15 - 22.5%	A very significant change with a change in PES of more than two categories	Modifications have reached a very significant level and the hydropedological processes are predicted to be largely modified with a large change in the PES, and EIS of the wetland feature as well as a significant loss in eco service provision.
Very High	22.5 - 60%	Serious to Critical change with a change in PES of more than three categories or a permanent complete loss of wetland resource	Modifications have reached a serious level and the hydropedological processes have been seriously modified with an almost complete loss of wetland integrity, functionality, and service provision.



### 4.3 Estimated flow losses and risk rating

Based on the sub-catchments delineated and the proposed co-disposal facility and PCD footprints, the overall impacts on the sub-surface natural flow systems were estimated. Table 4-3 summarises the estimated % loss ratings for the sub-catchments - pre- and post-mitigation.

As the areas are mainly undeveloped, natural soil water processes are expected. The predicted impact on the wetlands and watercourses fed by the hydrogeological processes ranges from 2.95% (expected no impact) to 25.39% (expected high impact) for the hydrogeological sub-catchments.

It is assumed that wetlands that do exist in the area need to maintain the current PES and EIS post-development, as per the resource management objectives (RMO). The calculation suggests that the PES will likely change if the wetland units were only fed by the sub-catchments. However, considering the greater sub-catchment and drainage area, the severity decreases to low and moderate for HRU1 and HRU2.

The table below shows how the severity of a sub-catchment scale can further be improved by incorporating stormwater attenuation back into the environment. No defined hydrogeological buffer areas are recommended, however, it is proposed that stormwater attenuation from the development area back to the natural environment be considered. Wetland buffers should be at least 15m to 25 m, or as per the dedicated wetland assessment report for the site (refer to GCS, 2022 - wetland assessment report). Efforts should be made to maintain the current PES and EIS of the wetland units identified during the operational phase of the project, as well as during the closure phase.

**Table 4-3: Estimated % Loss rating for micro-catchments (hillslopes)**

Sub-Catchment	Est. Flow Driver Impact (No Mitigation)	Severity	Est. Flow Driver Impact (Mitigation)	Severity
Pedology - HRU01	18.33%	High	1.84%	No Impact
Pedology - HRU02	25.39%	Very High	5.09%	Low to Moderate
Pedology - HRU03	2.95%	Low	0.59%	No Impact

#### 4.4 Hydrogeology risk assessment

The anticipated hydrological risk concerning the operational phase of the construction, operational and closure phase of the proposed co-disposal facility and PCDs. The SPR model (DWAF, 2008) was used to evaluate potential pollution sources and primary receptors within the study area.

Risk assessment entails understanding the generation of a hazard, the probability that the hazard will occur, and the consequences if it should occur. The net consequence is established by the following equation:

$$\text{Consequence} = (\text{Duration} + \text{Extent} + \text{Irreplaceability of resource}) \times \text{Severity}$$

And the environmental significance of an impact was determined by multiplying consequence by probability. The risk significance rating is summarised in Table 4-4.

**Table 4-4: Risk rating scale**

Criteria	Rating Scales
Significance	Very high - negative (-49 to -66)
	High - negative (-37 to -48)
	Moderate - negative (-25 to -36)
	Low - negative (-13 to -24)
	Neutral - Very low (0 to -12)
	Low-positive (0 to 12)
	Moderate-positive (13 to 24)
	High-positive (24 to 48)
	Very high - positive (49 to 66)

The potential impacts identified and environmental significance for the construction, operational and closure phases of the project are captured in Table 4-5 to Table 4-7. Based on the available conceptual mine layout plans the following will likely contribute to impacts of hydrogeological flow drivers, and soil quality and may compromise surface water quality in the nearby watercourses.

##### 4.4.1 Impacts on the soil interflow processes, soil structure and land capability

There is potential to impact the soil interflow processes, namely:

- Alteration to natural hydrogeological flow paths by infilling or cut and fill activities.
- Suppression of rainfall infiltration as a result of the installation of an impermeable barrier and initial deposition of coal wastes onto the impermeable barrier.
- Impacts on the macro-soil structure.
- Impacts on the hydrogeological processes supporting the watercourses.

This will result in subsequent impacts on soil structure & land capability and could compromise soil quality. These impacts are expected from the preparation to the closure phase of the project. There is the potential for soil contamination and suppression of natural hydropedological flow drivers in areas associated with the proposed co-disposal facility and PCDs. Potential contaminants from the project are expected to include construction-related consumables, fuels, hydrocarbons, residues and hazardous wastes. A waste classification will be undertaken for the EIA as well as to inform the final design of the secured landfill facility and liner requirements. In the absence of mitigation, however, the intensity of unmitigated impacts would be high, particularly for the suppression of the natural hydropedological flow drivers and that relating to soil quality. In time, reduced soil water quality could be reversed, however, at this stage, the related period is not known. The related unmitigated significance is, therefore, moderate. Important to note is that the use or potential contamination of water resources is regulated through Water Use Licensing requirements of the DWS as the custodian of water resources in South Africa. Where the project plan takes into account the findings of specialist studies, applies the necessary mitigation to avoid, minimize or remedy impacts in line with the mitigation hierarchy and operates under a water use license, the significance of potential impacts can be reduced.

The following activities may contribute to these impacts:

- **Preparation phase:**
  - Site preparation, including placement of contractor laydown areas and storage (i.e. temporary stockpiles, bunded areas etc.) facilities.
  - Disturbing vadose zone during soil excavations/infilling activities.
  - In-situ placement of new soils, altering existing soil-flow processes (i.e. cut-and-fill areas).
  - Linear developments (pipelines, electrical pylons & transmission lines and roads associated with the project) will likely not have a major impact on hydropedology as these structures entail disturbing a very shallow or small surface area. However, soil compaction due to road and pipeline installations, and the movement of heavy vehicles and mining machinery is highly likely to occur.
  - Vegetation loss will likely decrease soil infiltration and increase runoff, which will likely increase erosion.
- **Operational phase:**
  - Surface water interception and reduced rainfall runoff to watercourses and drainage servitudes.
  - Decreased groundwater recharge due to interception of natural soil water occurrences and dewatering.

- **Closure / decommission phase**

- The activities will generally entail rehabilitation and site clean-ups, whereby the aim would be to restore natural flow processes. Similar impacts to those associated with the commissioning phase are anticipated but will be limited to areas that are further disturbed/rehabilitated.
- The following is anticipated and assumes that the co-disposal site will be rehabilitated and the area stabilised:
  - New hydrogeology flow regimes will form as a result of the rehabilitated co-disposal facility and PCDs, with liners that still prevent infiltration.

#### ***4.4.2 Reduced hydrogeological flow to surface water (perennial & non-perennial streams and wetlands) as well as impacts on soil and water quality***

There is potential to impact the water quality and quantity of watercourses/wetlands sustained by the hydrogeological flow, using suppression or alteration of the natural flow as a result of the proposed activities. Moreover, contamination of soils during the project may compromise water quality. The following is anticipated:

- **Preparation phase:**

- Soil & surface water contamination and sedimentation from the following activities:
  - Leakages from vehicles and mine machines, and seepage from mine materials (i.e. construction material for permanent facilities, cement, paint, etc.).
  - Erosion and sedimentation of watercourses as a result of mine preparation activities, stockpiling and initial mining phase due to unforeseen circumstances (i.e. bad weather); and
  - Alteration of natural drainage lines may lead to ponding or increased runoff patterns (i.e. may cause stagnant water levels or increase erosion).
- Vegetation loss will likely decrease soil infiltration and increase runoff, which will likely increase erosion.

- **Operational phase:**

- Surface water interception and reduced rainfall runoff to watercourses and drainage servitudes.
- Decreased groundwater recharge due to interception of natural soil water occurrences.

- 
- Soil pollution through nutrient leaching from the co-disposal facility and PCDs (though unlikely as the areas will be lined).
  - Soil quality could be compromised if oil & fuel spills from vehicles occur during the operational phase at the site.
  - **Closure / decommission phase:**
    - The activities will generally entail rehabilitation and site clean-ups, whereby the aim would be to restore natural flow processes. Similar impacts to those associated with the commissioning phase are anticipated but will be limited to areas that are further disturbed/rehabilitated.

#### **4.5 Cumulative impacts and impacts on the hydrological cycle**

As all activities will take place on the same property, there will be cumulative impacts. The risk tables considered cumulative risk about the site and existing activities at the mine.

Treated water will be discharged into the Heyshope dam at the existing decant rate at pristine water quality (in line with GA limits for treated effluent discharge), and therefore will likely not have a negative impact on water quantity or quality. Compared to the active decant water quality, the proposed activity is predicted to improve the Heyshope water quality. Proposed discharge will take place at an existing abstraction point west of Driefontein, that is no longer in use.



**Table 4-5: Construction phase hydrogeology risks**

Component being impacted	Activity Which May Cause the Impact	Activity	Pre-Mitigation							Recommended Mitigation Measures	Post Mitigation							Confidence
			Duration (D)	Extent (E)	Potential for impact on irreplaceable resources (I)	Severity (S)	Consequence (C)	Probability (P)	Significance		Duration (D)	Extent (E)	Potential for impact on irreplaceable resources (I)	Severity (S)	Consequence (C)	Probability (P)	Significance	
<p>Soil interflow processes:</p> <ul style="list-style-type: none"> <li>• Infilling of wetlands and watercourses inducing alternative flow paths (if infilling occurs).</li> <li>• Alteration to natural hydrogeological flow paths.</li> <li>• Impacts on the macro-soil structure.</li> <li>• Impacts on the hydrogeological processes supporting the watercourses.</li> </ul> <p>Soil structure &amp; land capability:</p> <ul style="list-style-type: none"> <li>• Exposure of soils, leading to increased runoff from cleared areas and erosion of the watercourses, thus increasing the potential for sedimentation of the watercourses.</li> <li>• Vegetation loss.</li> <li>• Soil compaction; and</li> <li>• Soil erosion.</li> </ul> <p>Soil quality:</p> <ul style="list-style-type: none"> <li>• Natural nutrient content decreases due to soil exposure.</li> <li>• Loss of natural bio-organisms essential to soil processes.</li> </ul>	Site preparation, including placement of contractor laydown areas and storage (i.e. temporary stockpiles, bunded areas etc.) facilities.	Earthworks	Short-term (2)	Site (2)	Yes (1)	Moderate (-2)	Slightly detrimental (-7 to -12) (-10)	Definite (2)	Low - negative (-13 to -24) (-20)	<ul style="list-style-type: none"> <li>• Only excavate areas applicable to the project area.</li> <li>• Backfill the material in the same order it was excavated to reduce contamination of deeper soils with shallow oxidised soils.</li> <li>• Cover excavated soils with a temporary liner to prevent contamination.</li> <li>• Keep the site clean of all general and domestic wastes. All development footprint areas are to remain as small as possible and vegetation clearing is to be limited to what is essential.</li> </ul>	Short-term (2)	Site (2)	Yes (1)	Low (-1)	Negligible (-6 to 0) (-5)	Definite (2)	Neutral - Very low (0 to -12) (-10)	Medium
	Disturbing vadose zone during soil excavations/infilling activities.	Earthworks	Short-term (2)	Site (2)	Yes (1)	High (-3)	Moderately detrimental (-13 to -18) (-15)	Definite (2)	Moderate - negative (-25 to -36) (-30)	<ul style="list-style-type: none"> <li>• Retain as much indigenous vegetation as possible.</li> <li>• Exposed soils are to be protected using a suitable covering or revegetating.</li> <li>• Existing roads should be used as far as practical to gain access to the site, and crossing watercourses in areas where no existing crossing is apparent should be unnecessary, but if it is essential crossings should be made at right angles.</li> </ul>	Short-term (2)	Site (2)	Yes (1)	Moderate (-2)	Slightly detrimental (-7 to -12) (-10))	Definite (2)	Low - negative (-13 to -24) (-20)	Medium
	Vegetation clearing & soil stockpiling.	Earthworks	Short-term (2)	Site (2)	Yes (1)	High (-3)	Moderately detrimental (-13 to -18) (-15)	Definite (2)	Moderate - negative (-25 to -36) (-30)	<ul style="list-style-type: none"> <li>• Have emergency fuel &amp; oil spill kits on site.</li> <li>• Soil quality monitoring &amp; visual assessments - monthly basis. If obvious pollution is noted (visually) then it is advised that soil screening be undertaken.</li> </ul>	Short-term (2)	Site (2)	Yes (1)	Moderate (-2)	Slightly detrimental (-7 to -12) (-10))	Definite (2)	Low - negative (-13 to -24) (-20)	Medium
Soil quality	Seepage/leakages/overland flow from the co-disposal facility and PCDs may cause soil degradation. Moreover, oil & fuel spills from vehicles parked at the site may compromise soil quality. Prolonged pollution may migrate to the nearby watercourse and/or percolate into the groundwater table.	Earthworks	Short-term (2)	Site (2)	Yes (1)	High (-3)	Moderately detrimental (-13 to -18) (-15)	Definite (2)	Moderate - negative (-25 to -36) (-30)	<ul style="list-style-type: none"> <li>• Routine visual inspections of infrastructure and parking areas for signs of soil contamination.</li> <li>• Have emergency fuel &amp; oil spill kits on site.</li> </ul>	Short-term (2)	Site (2)	Yes (1)	Negligible (0)	Negligible (0 to -6) (-0)	Probable (1)	Negligible (0 to -12) (0)	Medium

Component being impacted	Activity Which May Cause the Impact	Activity	Pre- Mitigation							Recommended Mitigation Measures	Post Mitigation							Confidence
			Duration (D)	Extent (E)	Potential for impact on irreplaceable resources (I)	Severity (S)	Consequence (C)	Probability (P)	Significance		Duration (D)	Extent (E)	Potential for impact on irreplaceable resources (I)	Severity (S)	Consequence (C)	Probability (P)	Significance	
Perched Water Table Dewatering	Temporary dewatering of perched groundwater (only expected during intense storm events and shortly thereafter).	Earthworks	Short-term (2)	Site (2)	Yes (1)	High (-3)	Moderately detrimental (-13 to -18) (-15)	Definite (2)	Moderate - negative (-25 to -36) (-30)	<ul style="list-style-type: none"> <li>Water quality monitoring and routine visual assessment for contamination.</li> <li>Discharge dewatered / rainwater collected into the nearby stream. May require authorisation. If water is contaminated, discharge to the closest greywater system (depending on the extent of contamination)</li> </ul>	Short-term (2)	Site (2)	Yes (1)	Negligible (0)	Negligible (0 to -6) (-0)	Probable (1)	Negligible (0 to -12) (0)	Medium

Table 4-6: Operational phase hydrogeological risks

Component being impacted	Activity Which May Cause the Impact	Activity	Pre- Mitigation							Recommended Mitigation Measures	Post Mitigation							Confidence
			Duration (D)	Extent (E)	Potential for impact on irreplaceable resources (I)	Severity (S)	Consequence (C)	Probability (P)	Significance		Duration (D)	Extent (E)	Potential for impact on irreplaceable resources (I)	Severity (S)	Consequence (C)	Probability (P)	Significance	
Soil interflow processes: <ul style="list-style-type: none"> <li>Alteration to natural hydrogeological flow paths.</li> <li>Impacts on the macro-soil structure.</li> <li>Impacts on the hydrogeological processes supporting the watercourses.</li> </ul>	<p>Disturbing the inner-soil architecture of the original soil profile will disturb natural flow processes (i.e. a result of infilling or cut-and-fill activities).</p> <p>Excavated soil will be placed in other areas (i.e. on top of other soils) and will have an impact on the flow dynamics of the soil it is dumped on top of. This may reduce rainfall infiltration and induce runoff.</p> <p>Impermeable areas will decrease rainfall infiltration into soils, and hence reduce interflow (A/B and A/bedrock) or lateral flow to downstream wetland areas.</p>	Site activities	long Term (4)	Site (2)	Yes (1)	Moderate (-2)	Moderately detrimental (-13 to -18) (-14)	Definite (2)	Moderate - negative (-25 to -36) (-30)	<ul style="list-style-type: none"> <li>Revegetate areas (with vegetation growing at the site) where heavy machinery movement takes place to prevent erosion.</li> <li>Ensure that clean stormwater is attenuated back to the natural environment, directly downstream of the development. The release of stormwater will offset the rainfall infiltration reduction impacts on soil interflow and may benefit downstream watercourses and wetland units.</li> </ul>	Long-term (4)	Site (2)	Yes (1)	Moderate (2)	Moderately beneficial (13 to 18) (14)	Definite (2)	High-positive (24 to 48) (28)	Medium
Soil quality	Seepage/leakages/overland flow from the co-disposal facility may impact soil quality.	Site activities	Long-term (4)	Site (2)	Yes (1)	Negligible (0)	Slightly detrimental (-7 to -12) (-7)	Definite (2)	Low (12 to -25) (-14)	<ul style="list-style-type: none"> <li>Have emergency fuel &amp; oil spill kits on site.</li> <li>Ensure PCDs are operated at levels that prevent overflow during 1-2 to 1:100-year flood events.</li> </ul>	Long-term (4)	Site (2)	Yes (1)	Negligible (0)	Negligible (0 to -6) (0)	Probable (1)	Negligible (0 to -12) (0)	Medium

**Table 4-7: Closure phase hydrogeology risks**

Component being impacted	Activity Which May Cause the Impact	Activity	Pre- Mitigation							Recommended Mitigation Measures	Post Mitigation							Confidence
			Duration (D)	Extent (E)	Potential for impact on irreplaceable resources (I)	Severity (S)	Consequence (C)	Probability (P)	Significance		Duration (D)	Extent (E)	Potential for impact on irreplaceable resources (I)	Severity (S)	Consequence (C)	Probability (P)	Significance	
Soil interflow processes: • Infilling of wetlands and watercourses inducing alternative flow paths (if infilling occurs). • Alteration to natural hydrogeological flow paths. • Impacts on the macro-soil structure. • Impacts on the hydrogeological processes supporting the watercourses.  Soil structure & land capability: • Exposure of soils, leading to increased runoff from cleared areas and erosion of the watercourses, thus increasing the potential for sedimentation of the watercourses. • Vegetation loss. • Soil compaction; and Soil erosion.  Soil quality: • Natural nutrient content decreases due to soil exposure. • Loss of natural bio-organisms essential to soil processes.	Decommissioning of non-essential infrastructure to rehabilitate and close the co-disposal facilities, and rehabilitate the PCD areas.	Rehabilitation	Long-term (4)	Site (2)	Yes (1)	Moderate (2)	Moderately beneficial (13 to 18) (14)	Definite (2)	High-positive (24 to 48) (28)	No mitigation is required. Rehabilitation will likely improve the impact of the development on the hydrogeology assessment.  General risks associated with the construction phase (refer to Table 4-4) will likely exist during earthworks and rehabilitation activities. Refer to mitigation measures for these activities in Table 4-4.								
	Re-Disturbing vadose zone during soil excavations/infilling activities.	Rehabilitation	Long-term (4)	Site (2)	Yes (1)	Moderate (2)	Moderately beneficial (13 to 18) (14)	Definite (2)	High-positive (24 to 48) (28)									
	Re-vegetation and rehabilitation.	Rehabilitation	Long-term (4)	Site (2)	Yes (1)	Moderate (2)	Moderately beneficial (13 to 18) (14)	Definite (2)	High-positive (24 to 48) (28)									
Soil interflow processes: • Alteration to natural hydrogeological flow paths. • Impacts on the macro-soil structure. • Impacts on the hydrogeological processes supporting the watercourses.	The presence of the co-disposal facility will have long-term implications in terms of altering the natural hydrogeological flow drivers of the subsoils, on which the facility is situated This applies to the proposed PCDs as well.	Site activities	long Term (4)	Site (2)	Yes (1)	Moderate (-2)	Moderately detrimental (-13 to -18) (-14)	Definite (2)	Moderate - negative (-25 to -36) (-30)	• Revegetate areas (with vegetation growing at the site) where heavy machinery movement takes place to prevent erosion.  • Ensure that clean stormwater is attenuated back to the natural environment, directly downstream of the development. The release of stormwater will offset the rainfall infiltration reduction impacts on soil interflow and may benefit downstream watercourses and wetland units.	Long-term (4)	Site (2)	Yes (1)	Moderate (2)	Moderately beneficial (13 to 18) (14)	Definite (2)	High-positive (24 to 48) (28)	Medium

## 5 CONCLUSIONS

Soil data were evaluated for the project area to produce a soil distribution map. The soil map was used to categorize the hydrological soil types (HST), into the following categories:

- Recharge.
- Responsive (shallow).
- Responsive (saturated).
- Stagnating.
- Interflow (A/B); and
- Interflow (soil/bedrock).

Three (3) sub-catchments and four (4) prominent hillslopes were defined for the proposed development area. Generally, recharge soils were observed on the crest and footslope positions of two (2) of the hillslopes, with the remainder of the hillslopes (and the majority of the site) being dominated by stagnating hydrological soil types. It was noted that the area southeast of the proposed co-disposal facility gradually extends into backfilled material used to rehabilitate the old opencast pit associated with the area. These soils were classified as interflow (soil/bedrock) type and occurred in areas that appear to be associated with the high wall of the old rehabilitated pit. The valley positions associated with the site, nearing perennial and non-perennial drainage lines, are dominated by responsive (saturated) soil types. In responsive soils, the build-up of water is expected in the B and upper A horizons after rain and overland discharge and minor lateral seepage are expected (due to saturation excess). Secondary vertical seepage to deeper soil zones from the saturated B horizon is expected. At the transition from one soil type to the other (upstream to downstream) overland flow may take place during wet seasons.

As the areas are mainly undeveloped, natural soil water processes are expected. The predicted impact on the wetlands and watercourses fed by the hydrological processes ranges from 2.95% (expected no impact) to 25.39% (expected high impact) for the hydrological sub-catchments.

It is assumed that wetlands that do exist in the area need to maintain the current PES and EIS post-development, as per the resource management objectives (RMO). The calculation suggests that the PES will likely change if the wetland units were only fed by the sub-catchments. However, considering the greater sub-catchment and drainage area, the severity decreases to low and moderate for HRU1 and HRU2. The severity of a flow driver suppression on a sub-catchment scale can further be improved by incorporating stormwater attenuation back into the environment.

### **5.1 Avoidance areas**

No defined hydrological buffer areas are recommended; however, it is proposed that stormwater attenuation from the development area back to the natural environment be considered. Wetland buffers should be at least 15 m to 25 m, or as per the dedicated wetland assessment report for the site (refer to GCS, 2022 - wetland assessment report). Efforts should be made to maintain the current PES and EIS of the wetland units identified during the operational phase of the project, as well as during the closure phase.

### **5.2 Mitigation measures for inclusion in the EMP**

The following mitigation measures can be considered as part of the EMP:

- Ensure clean stormwater is conveyed to the natural environment. An attenuation pond can be used to ensure steady seepage of accumulated stormwater into the soils upstream of wetland areas.
- Ensure fuel spill cleaning kits are on standby to mitigate any fuel/oil leakages which could compromise soil quality.
- Ensure that all mine infrastructure footprints are as small as possible, to prevent suppression of hydrological flow drivers.
- It is recommended that wetland buffers delineated by a wetland specialist be incorporated into the final designs of the co-disposal facility. These buffer areas should also be sufficient to further promote natural hydrological functions.
- It is recommended that mitigation measures, as described in Section 4.4 be implemented during the construction and operational phase of this project.

### **5.3 Reasoned opinion on whether the activity should be authorized**

This assessment cannot find any grounds or identify high hydrological risks that do not proceed with the development. This is grounded on the assumption that the proposed mitigation measures and EMP recommendations are implemented during the construction, operational and closure phases of the development.





## 6 BIBLIOGRAPHY


- Adamson, P., 1981. *Southern African Storm Rainfall: Technical Report TR102*, Pretoria: Department of Environmental Affairs.
- Alexander, J., 2002. The Standard Design Flood. *South African Institution of Engineers*, pp. 26-30.
- Almond, P. C. & M. J. L., 2016. *Soils on Slopes: Catenas. International Encyclopedia of Geography: People, the Earth, Environment and Technology: People, the Earth, Environment and Technology*, 1-12., s.l.: s.n.
- Bailey, A. & Pitman, W., 2015. *Water Resources of South Africa 2012 Study (WR2012): Executive Summary Version 1. WRC Report No. K5/2143/1*, Gezina, South Africa: Water Research Commission Report.
- Batsumi Consulting Engineers, 2021. *Mokopelane Waste Water Treatment Works Report. Civil Engineering Waste Water Treatment: Makopelane.*, s.l.: FETAKGOMO TUBATSE LOCAL MUNISIPALITY.
- Campbell, .. W. A. M. B., 1986. *Evaluation of flood estimation methods- Phase II: An evaluation of hydrological techniques for making flood estimations on small unguaged catchments*, Pretoria: Water Research Commission.
- CSIR, 2005. *GUIDELINES FOR HUMAN SETTLEMENT PLANNING AND DESIGN. Ecologically sound urban development*, s.l.: s.n.
- CSIR, 2005. *Guidelines for Human Settlement Planning and Design: Volume 2*, Pretoria: CSIR Building and Construction Technology, s.l.: s.n.
- DEA, 2019. *South African National Land-Cover (SANLC) 2018*, South Africa: DEA on 1st October 2019.
- Department of Agricultural Development, D., 1991. *Soil Classification - A Taxonomix System for South Africa*, s.l.: s.n.
- Der Waals, J. G. A. P. D., 2019. *DEVELOPING WETLAND DISTRIBUTION AND TRANSFER FUNCTIONS FROM LAND TYPE DATA AS A BASIS FOR THE CRITICAL EVALUATION OF WETLAND DELINEATION GUIDELINES BY INCLUSION OF SOIL WATER FLOW DYNAMICS IN CATCHMENT AREAS VOLUME 3. WRC Report No. 2461/3/18.* s.l.:s.n.
- DMEA, 1998g. *1:250 000 Geological Series - 2730 Vryheid*, s.l.: s.n.
- DWAF, 1996b. *Water Quality Guidelines - Volume 1: Domestic Use*, s.l.: s.n.
- DWAF, 2003. *1:500 000 Hydrogeological map series of the Republic of South Africa - 2722 Kimberly*, s.l.: s.n.
- DWAF, 2006. *Groundwater Resource Assessment II*, s.l.: s.n.
- DWAF, 2007. *Best Practice Guidelines - G3: Water Monitoring Systems*, s.l.: DWS.
- DWAF, 2008. *Best Practice Guidelines: Impact Prediction (G4)*, s.l.: DWS.
- DWS, 2011. *The Groundwater Dictionary - A Comprihensive Reference of Groundwater Related Terminology. 2nd Edition.*, s.l.: s.n.
- DWS, 2011. *The Groundwater Dictionary - A Comprihensive Reference of Groundwater Related Terminology. 2nd Edition.*, s.l.: s.n.
- DWS, 2016. *New Water Management Areas*, South Africa: Government Gazette No. 40279.
- ESRI, 2018. *ArcView10.5*, s.l.: Environmental Systems Research Institute, California.
- Eyring, V. B. S. M. G. A. S. C. A. S. B. S. R. J. a. T. K. E., 2016. *Overview of the Coupled Model Intercomparison Project Phase 6 (CMIP6) experimental design and organization*, *Geosci. Model Dev.*, 9, 1937-1958, doi:10.5194/gmd-9-1937-2016. s.l.:s.n.
- FAO, 1980. *Food and Agriculture Organization (FAO) - Drainage design factors*, s.l.: FAO Irrigation and Drainage Paper No. 38. Rome.
- GCS, August 2022. *Water Quality Monitoring Report for the Maquasa East, Maquasa West & Nooitgesien Operations: Second Quarter, 2022 Monitoring Period*, s.l.: s.n.
- GFK, 2022. *Engineering Designs and Master Layout Plan for Kangra Coal WTP & Co-Disposal Facility*, s.l.: GFK.
- Harbaugh, A., B. E., Hill, M. & McDonald, M., 2000. *Modflow-200, the U.S. Geological Survey Modular Ground-Water Model - User Guide to Modularization Concepts and the Ground-Water Flow Process. Open-File Report 00-92*, s.l.: s.n.
- JAXA, 2022. *Advanced Land Observation Satellite (ALOS) Global Digital Surface Model (DSM)*, Tokyo: Earth Observation Research Center (EORC), Japan Aerospace Exploration Agency (JAXA).


- JAXA, 2022. *Advanced Land Observation Satellite (ALOS) Global Digital Surface Model (DSM)*, Tokyo: Earth Observation Research Center (EORC), Japan Aerospace Exploration Agency (JAXA).
- Kindersley, 2012. *New Neighbourhood Design and Development Standards Manual. Section 6 Storm Water Drainage System*, s.l.: s.n.
- King, G., Maritz, E. & Jonck, F., 1998. *2726 Kroonstad - 1:500 000 Hydrological Map Series of the Republic of South Africa*, s.l.: s.n.
- Kottek, M. et al., 2006. *World Map of the Köppen-Geiger climate classification updated*. *Meteorol. Z.* 15, 259-263. doi:10.1127/0941-2948/2006/0130. s.l.:s.n.
- Le Roux, P. et al., 2011. *Hydropedological interpretation of the soils of selected catchments with the aim of improving efficiency of hydrological models*, s.l.: Pretoria: Water .
- Lynch, S., 2004. *Development of a Raster Database of Annual, Monthly and Daily Rainfall for Southern Africa*, WRC Report No. 1156/1/04, Pretoria: Water Research Commission.
- Meteoblue, 2022. *Climate Data*. s.l.:<https://www.meteoblue.com>.
- NWA, 1998. *The South African National Water Act*, s.l.: South Africa.
- SANRAL, 2013. *South African Drainage Manual*. Pretoria: South African National Road Agency.
- SANRAL, 2013. *South African Drainage Manual*, Pretoria: SANRAL.
- Schulze, R., 1997. *South African Atlas of Agrohydrology and Climatology*. WRC Report No. TT85/96, Pretoria: Water Research Commission.
- SCWG, 2018. *Soil Classification - A Natural and Anthropogenic System for South Africa*, s.l.: ARC LNR.
- Smithers, J. & Schulze, R., 2002. *Design Rainfall and Flood Estimation*, WRC Report No. K5/1060, Pretoria: Water Research Commission.
- US Army Corps of Engineers, 2016. *HEC RAS Hydraulic Modelling Software. Version 5.0*. California: s.n.
- Van Deventer, H. S.-A. L. M. N. P. C. S. A. C. N. G. M. J. N. L. M. O. D. S. P. S. E. & S. K., 2018. *NBA2018 National Wetland Map 5*. s.l.:s.n.
- Van Tol, J.J., Bouwer, D. & Le Roux, P.A.L., 2021. *Guideline for hydropedological Assessments and Minimum Requirements*, s.l.: DWS.
- Van Tol; Bouwer, J.J, 2021. *Guideline for Hydropedological Assessments and Minimum Requirements.*, s.l.: s.n.
- Van Tol, J., Le Roux, P. & Lorentz, S., 2013. *Hydropedological Classification of South African Hillslopes*, *Vadoze Zone Journal*, 2-10: s.n.
- Vegter, J., 1995. *An explanation of a set of National Groundwater Maps*. *Water Research Commission. Report No TT 74/95.* s.l.:s.n.
- WRC, 2015. <http://www.waterresourceswr2012.co.za/resource-centre/>. [Online].


## APPENDIX A: SOIL PROFILE DATA &amp; FIELD OBSERVATIONS


Auger hole logging data sheet				
	Hole ID:	A6	Latitude	-27.008447
	Project:	Maquasa	longitude	30.383301
	Project No:	22-0161	Elevation (m amsl)	1320.84192
	Province	Mpumalanga	Depth (m)	1.5
	Logged by	Shuaib and Martin	Water level (mbgl)	NA
	From (m)	To (m)	Soil form; Moisture; Colour; Consistency; Structure; Origin: Grain size	
	0	0.2	Orthic A; dry; brown; silty sand; fine	
	0.3	1	fine	
	1.1	1.5	Unspecified with wetness	
	Comment		Hole dug using hand auger (HA).	
	Soil form		Hutton	


Auger hole logging data sheet				
	Hole ID:	A7	Latitude	-27.01055
	Project:	Maquasa	longitude	30.385021
	Project No:	22-0161	Elevation (m amsl)	1338.33801
	Province	Mpumalanga	Depth (m)	0.9
	Logged by	Shuaib and Martin	Water level (mbgl)	NA
	From (m)	To (m)	Soil form; Moisture; Colour; Consistency; Structure; Origin: Grain size	
	0	0.2	Orthic A; dry; fine; sandy-silt	
	0.3	0.6	Yellow-brown Apedal B; moist; fine; silt	
	0.7	0.9	Red Apedal B; Moist; fine; silt	
	Comment		Hole dug using hand auger (HA).	
	Soil form		Glencoe	


Auger hole logging data sheet				
	Hole ID:	A8	Latitude	-27.012878
	Project:	Maquasa	longitude	30.38694
	Project No:	22-0161	Elevation (m amsl)	1349.69287
	Province	Mpumalanga	Depth (m)	1.5
	Logged by	Shuaib and Martin	Water level (mbgl)	NA
	From (m)	To (m)	Soil form; Moisture; Colour; Consistency; Structure; Origin: Grain size	
	0	0.3	Orthic A; dry; brown;	
	0.4	0.8	Yellow Apedal B; slightly moist; fine; silt	
	0.9	1.5	Red Apedal B; moist; fine; silt	
	Comment		Hole dug using hand auger (HA).	
	Soil form		Glencoe	

Auger hole logging data sheet				
	Hole ID:	A9	Latitude	-27.015398
	Project:	Maquasa	longitude	30.389029
	Project No:	22-0161	Elevation (m amsl)	1347.56812
	Province	Mpumalanga	Depth (m)	0.2
	Logged by	Shuaib and Martin	Water level (mbgl)	NA
	From (m)	To (m)	Soil form; Moisture; Colour; Consistency; Structure; Origin: Grain size	
	0	0.2	Orthic A; dry; brown; fine; silt	
	0.3		Hard Rock.	
	Comment		Hole dug using hand auger (HA).	
	Soil form		Mispha	


Auger hole logging data sheet				
	Hole ID:	A10	Latitude	-27.017306
	Project:	Maquasa	longitude	30.390213
	Project No:	22-0161	Elevation (m amsl)	1346.0944
	Province	Mpumalanga	Depth (m)	0.3
	Logged by	Shuaib and Martin	Water level (mbgl)	NA
	From (m)	To (m)	Soil form; Moisture; Colour; Consistency; Structure; Origin: Grain size	
	0	0.2	dry; yellow-brown; silt; fine	
	0.3	0.3	dry; blackish-red; silt; fine	
	0.4		Hard Rock	
	Comment		Hole dug using hand auger (HA).	
	Soil form		Mispah	


Auger hole logging data sheet				
	Hole ID:	A11	Latitude	-27.021531
	Project:	Maquasa	longitude	30.385789
	Project No:	22-0161	Elevation (m amsl)	1379.580078
	Province	Mpumalanga	Depth (m)	1.3
	Logged by	Shuaib and Martin	Water level (mbgl)	NA
	From (m)	To (m)	Soil form; Moisture; Colour; Consistency; Structure; Origin: Grain size	
	0	0.2	Orthic A; dry; brown; fine; silt	
	0.3	0.6	dry; brown; fine; silt with parent rock inclusions	
	0.7	1.3	dry; yellow-brown with red mottles; sandy-silt	
	1.4		Hard Plinthic B	
	Comment		Hole dug using hand auger (HA).	
	Soil form		Glencoe	


Auger hole logging data sheet				
	Hole ID:	A12	Latitude	-27.02332
	Project:	Maquasa	longitude	30.383438
	Project No:	22-0161	Elevation (m amsl)	1366
	Province	Mpumalanga	Depth (m)	1.5
	Logged by	Shuaib and Martin	Water level (mbgl)	NA
	From (m)	To (m)	Soil form; Moisture; Colour; Consistency; Structure; Origin: Grain size	
	0	0.3	Orthic A; dry; brown; fine; silt	
	0.4	0.5	yellow-brown Apedal B; dry; yellow-brown; fine; silt	
	0.6	1.5	Red Apedal B; moist; yellow-red; fine; silt	
	Comment		Hole dug using hand auger (HA).	
	Soil form		Glencoe	


Auger hole logging data sheet				
	Hole ID:	A16	Latitude	-27.004614
	Project:	Maquasa	longitude	30.389459
	Project No:	22-0161	Elevation (m amsl)	1328
	Province	Mpumalanga	Depth (m)	0.4
	Logged by	Shuaib and Martin	Water level (mbgl)	NA
	From (m)	To (m)	Soil form; Moisture; Colour; Consistency; Structure; Origin: Grain size	
	0.0	0.2	Orthic A; dry; grey-brown to brown; transported hillwash; very fine to fine silty SAND, with scattered gravels.	
	0.3	0.4	Yellow-brown Apeadal B; dry; yellow-brown with reddish inclusions; Reworked Residuum; very-fine to fine silty SAND, with scattered ferricrete nodules.	
	0.5		Hard Plinthic B	
	Comment		Hole dug using hand auger (HA).	
	Soil form		Glencoe	




Auger hole logging data sheet				
	Hole ID:	A15	Latitude	-27.003583
	Project:	Maquasa	longitude	30.390513
	Project No:	22-0161	Elevation (m amsl)	1325
	Province	Mpumalanga	Depth (m)	0.6
	Logged by	Shuaib and Martin	Water level (mbgl)	NA
	From (m)	To (m)	Soil form; Moisture; Colour; Consistency; Structure; Origin: Grain size	
	0	0.45	Orthic A; dry; grey-brown to brown; transported hillwash; very fine to fine silty SAND, with scattered gravels.	
	0.45	0.6	Yellow-brown Apeadal B; dry; yellow-brown with reddish inclusions; Reworked Residuum; very-fine to fine silty SAND ,with scattered ferricrete nodules.	
	0.7		Hard Plinthic B	
	Comment		Hole dug using hand auger (HA).	
	Soil form		Glencoe	


Auger hole logging data sheet				
	Hole ID:	A14	Latitude	-27.002759
	Project:	Maquasa	longitude	30.391342
	Project No:	22-0161	Elevation (m amsl)	1327
	Province	Mpumalanga	Depth (m)	0.7
	Logged by	Shuaib and Martin	Water level (mbgl)	NA
	From (m)	To (m)	Soil form; Moisture; Colour; Consistency; Structure; Origin: Grain size	
	0	0.4	Orthic A; dry; grey-brown to brown; transported hillwash; very fine to fine silty SAND, with scattered gravels.	
	0.5	0.7	Yellow-brown Apeadal B; dry; yellow-brown with reddish inclusions; Reworked Residuum; very-fine to fine silty SAND ,with scattered ferricrete nodules.	
	0.8		Unspecified	
	Comment		Hole dug using hand auger (HA).	
	Soil form		Hutton	

Auger hole logging data sheet				
	Hole ID:	A17	Latitude	-27.009542
	Project:	Maquasa	longitude	30.394108
	Project No:	22-0161	Elevation (m amsl)	1339
	Province	Mpumalanga	Depth (m)	1.5
	Logged by	Shuaib and Martin	Water level (mbgl)	1
	From (m)	To (m)	Soil form; Moisture; Colour; Consistency; Structure; Origin: Grain size	
	0	1	Dry - semi-dry becoming moist to very moist; dark gry to black speck orange; sandy silty clay; Alluvium (VERTIC)	
	1.1	1.5	Wet; dark-grey to black; clay; very fine; alluvium (G-Hor)	
	Comment		Hole dug using hand auger (HA). Soil very sticky from 1.2m	
	Soil form		Rensburg	

Auger hole logging data sheet				
	Hole ID:	A18	Latitude	-27.009948
	Project:	Maquasa	longitude	30.39329
	Project No:	22-0161	Elevation (m amsl)	1343
	Province	Mpumalanga	Depth (m)	1.5
	Logged by	Shuaib and Martin	Water level (mbgl)	0.7
	From (m)	To (m)	Soil form; Moisture; Colour; Consistency; Structure; Origin: Grain size	
	0	0.2	Orthic A; Semi-moist; light-brown to brown; silty clay; fine to very fine.	
	0.3	1.2	moist-wet, black, clay, very fine, alluvium	
	1.3	1.3	wet, grey, sandy-clay, fine to very-fine; alluvium	
	1.4	1.5	wet, reddish-brown, silty sand, fine, alluvium	
	Comment		Hole dug using hand auger (HA).	
	Soil form		Katspruit	



Auger hole logging data sheet				
	Hole ID:	A19	Latitude	-27.010557
	Project:	Maquasa	longitude	30.392456
	Project No:	22-0161	Elevation (m amsl)	1415
	Province	Mpumalanga	Depth (m)	0.05
	Logged by	Shuaib and Martin	Water level (mbgl)	NA
From (m)	To (m)	Soil form; Moisture; Colour; Consistency; Structure; Origin: Grain size		
0	0.1	Topsoil		
Comment		Hole dug using hand auger (HA).		
Soil form		Mispha		

Auger hole logging data sheet				
	Hole ID:	A20	Latitude	-27.011149
	Project:	Maquasa	longitude	30.391093
	Project No:	22-0161	Elevation (m amsl)	1353
	Province	Mpumalanga	Depth (m)	0
	Logged by	Shuaib and Martin	Water level (mbgl)	NA
From (m)	To (m)	Soil form; Moisture; Colour; Consistency; Structure; Origin: Grain size		
0	0.1	Topsoil		
Comment		Hole dug using hand auger (HA).		
Soil form		Mispha		

APPENDIX B: SOIL PARTICLE DISTRIBUTION LAB CERTIFICATES

Particle size distribution

Malvern Instruments



Measurement Details

Sample Name

Average of '189399 A6 0-0.03M - Screened'

SDS

421

SOP File Name

Default + 60us LV.msop

Analysis

Particle Name

Default 1.0

Dispersant Name

Water

Particle Absorption Index

1.000

Weighted Residual

0.18 %

Analysis Model

General Purpose

Result

Concentration

0.0333 %

Uniformity

0.865

Specific Surface Area

142.2 m<sup>2</sup>/kg

D [3,2]

40.2 μm

D [4,3]

188 μm

Measurement Details

Measurement Date Time

2022/10/21 11:45:27

Analysis Date Time

2022/10/21 11:45:27

Original Record Number

261

Analysis

Particle Refractive Index

1.520

Dispersant Refractive Index

1.330

Laser Obscuration

6.61 %

Scattering Model

Mie

Analysis Sensitivity

Normal

Result

Span

2.772

Result Units

Volume

Dv (10)

31.1 μm

Dv (50)

138 μm

Dv (90)

415 μm

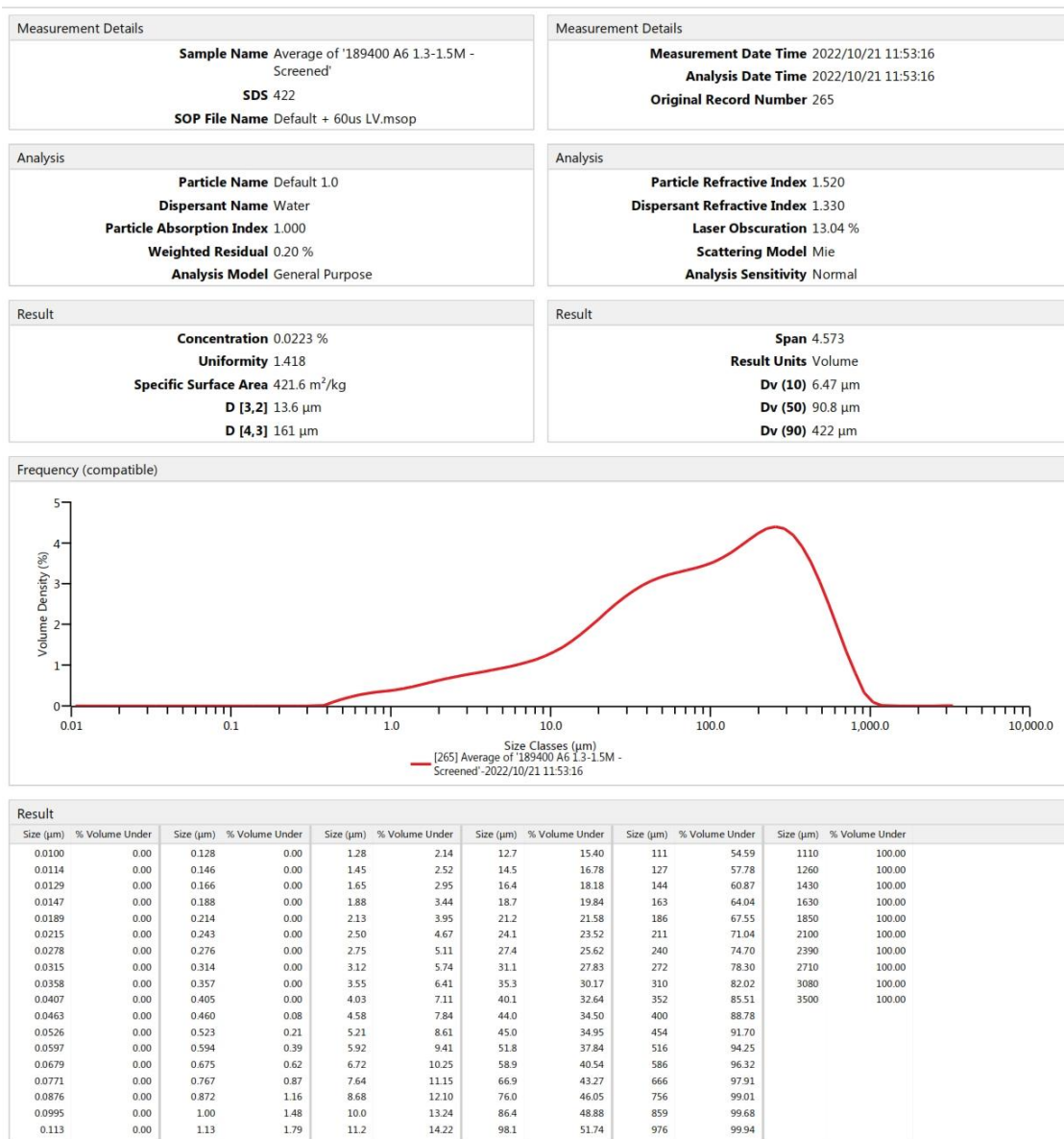
Frequency (compatible)

Result

Size (μm)	% Volume Under	Size (μm)	% Volume Under	Size (μm)	% Volume Under	Size (μm)	% Volume Under	Size (μm)	% Volume Under	Size (μm)	% Volume Under
0.0100	0.00	0.128	0.00	1.28	0.43	12.7	4.59	111	41.45	1110	99.92
0.0114	0.00	0.146	0.00	1.45	0.54	14.5	5.09	127	46.61	1260	99.98
0.0129	0.00	0.166	0.00	1.65	0.67	16.4	5.62	144	51.57	1430	100.00
0.0147	0.00	0.188	0.00	1.88	0.81	18.7	6.26	163	56.54	1630	100.00
0.0189	0.00	0.214	0.00	2.13	0.96	21.2	6.96	186	61.86	1850	100.00
0.0215	0.00	0.243	0.00	2.50	1.17	24.1	7.80	211	66.93	2100	100.00
0.0278	0.00	0.276	0.00	2.75	1.29	27.4	8.80	240	72.00	2390	100.00
0.0315	0.00	0.314	0.00	3.12	1.48	31.1	9.99	272	76.74	2710	100.00
0.0358	0.00	0.357	0.00	3.55	1.67	35.3	11.44	310	81.39	3080	100.00
0.0407	0.00	0.405	0.00	4.03	1.87	40.1	13.22	352	85.49	3500	100.00
0.0463	0.00	0.460	0.00	4.58	2.08	44.0	14.78	400	89.13		
0.0526	0.00	0.523	0.00	5.21	2.31	45.0	15.16	454	92.18		
0.0597	0.00	0.594	0.00	5.92	2.56	51.8	17.94	516	94.68		
0.0679	0.00	0.675	0.00	6.72	2.82	58.9	20.96	586	96.59		
0.0771	0.00	0.767	0.07	7.64	3.10	66.9	24.38	666	97.99		
0.0876	0.00	0.872	0.14	8.68	3.42	76.0	28.21	756	98.93		
0.0995	0.00	1.00	0.24	10.0	3.81	86.4	32.41	859	99.51		
0.113	0.00	1.13	0.33	11.2	4.16	98.1	36.88	976	99.78		

## Particle size distribution

Malvern Instruments



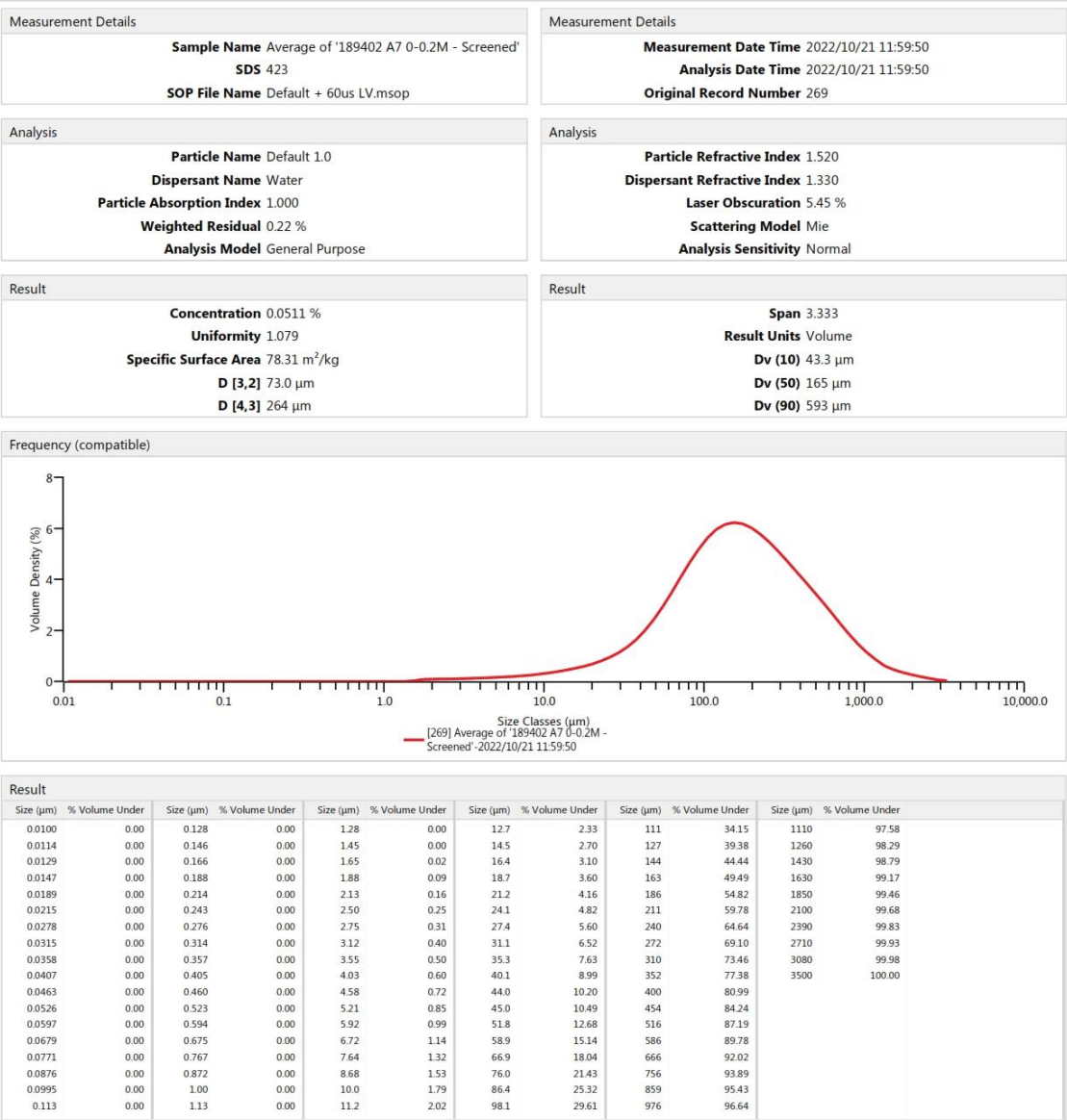
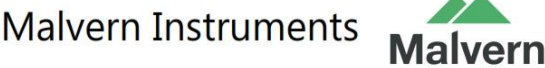
Malvern Instruments Ltd.  
www.malvern.com

Mastersizer - v3.81  
Page 1 of 1

Aquatico

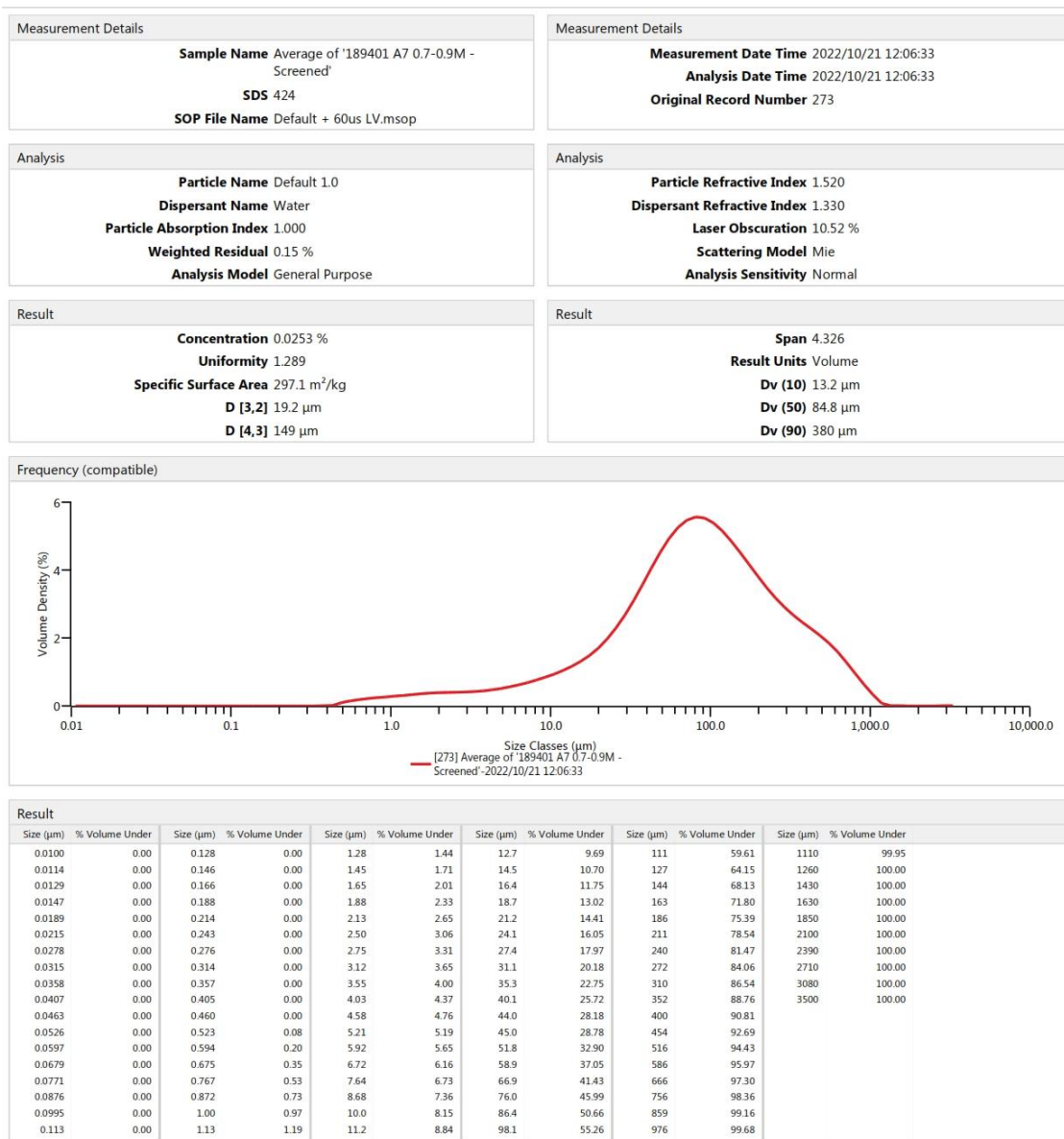
Created: 2014/09/01  
Printed: 2022/10/21 14:50

Particle size distribution



## Particle size distribution

Malvern Instruments



Malvern Instruments Ltd.  
www.malvern.com

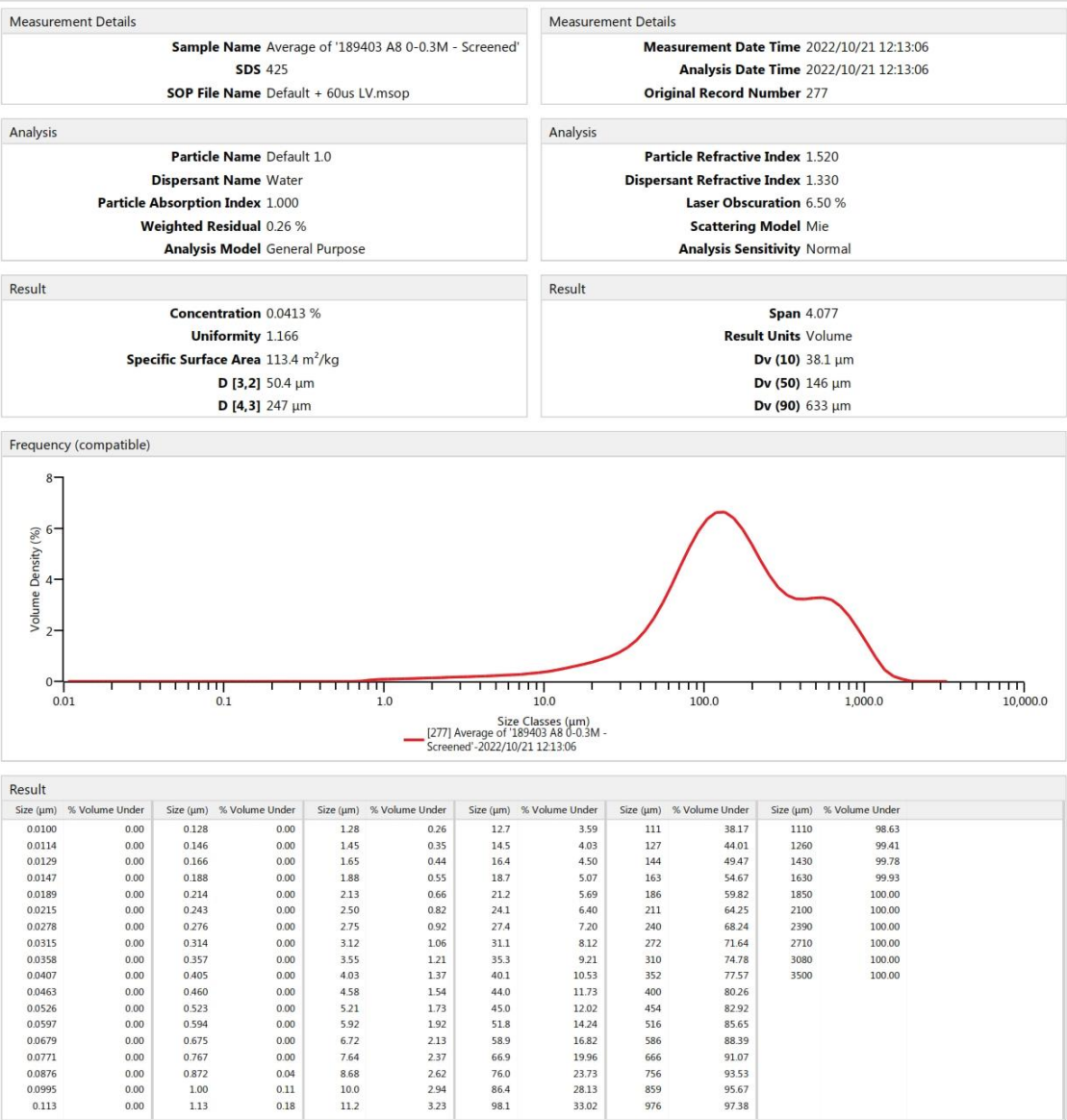
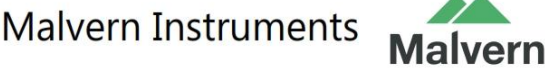
Mastersizer - v3.81  
Page 1 of 1

Aquatico

Created: 2014/09/01  
Printed: 2022/10/21 14:50

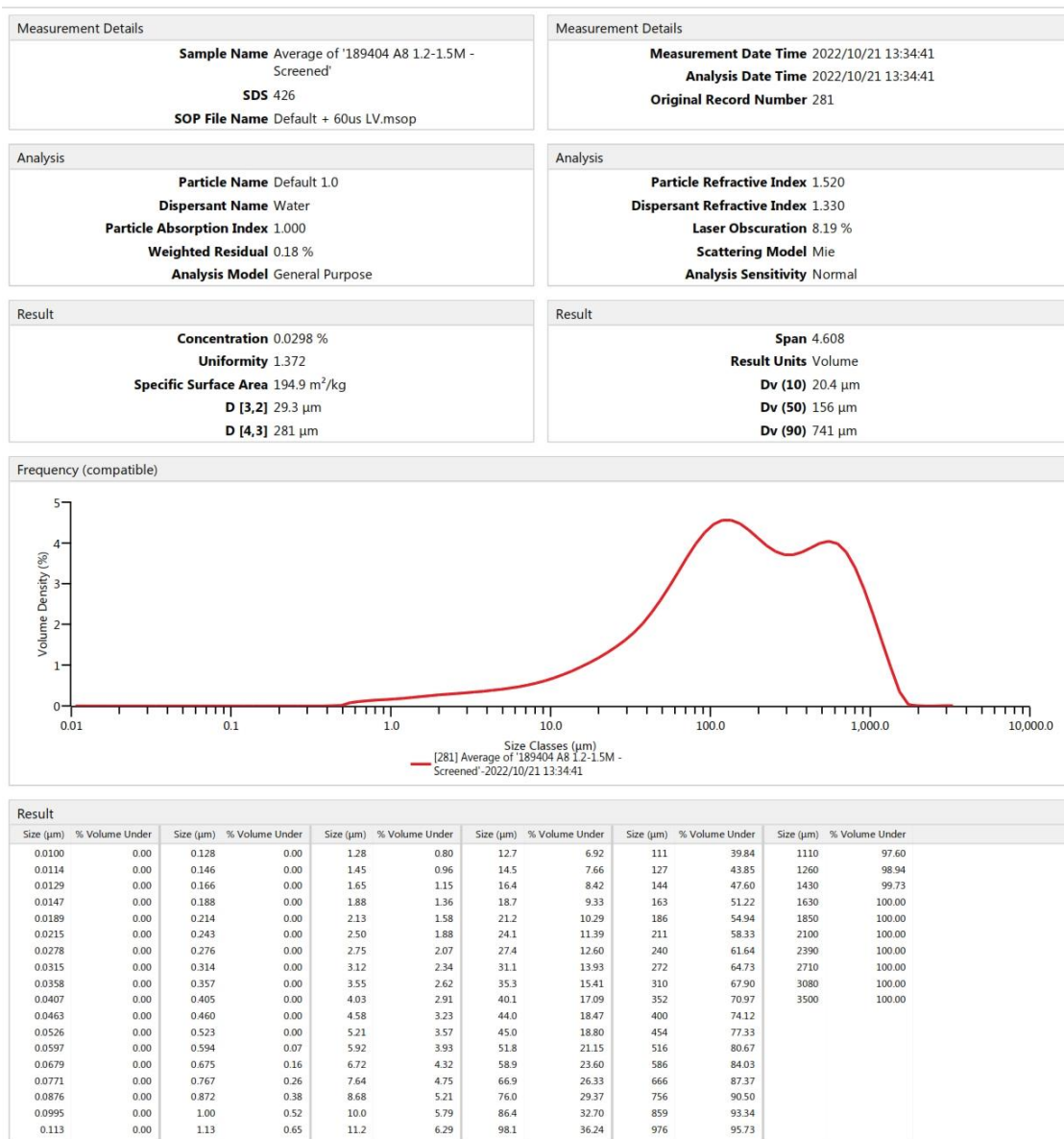


Particle size distribution



## Particle size distribution

Malvern Instruments



Malvern Instruments Ltd.  
www.malvern.com

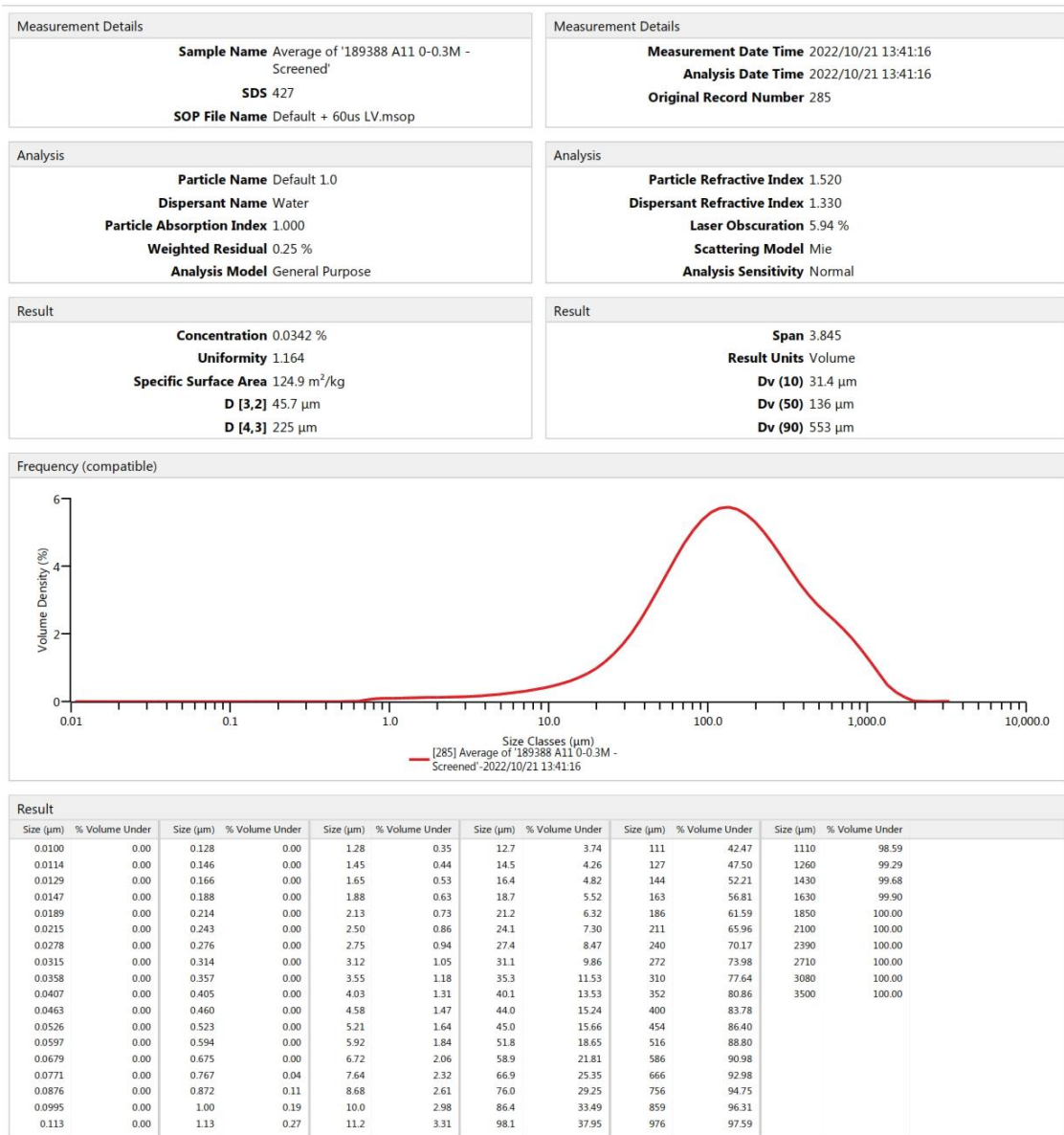
Mastersizer - v3.81  
Page 1 of 1

Aquatico

Created: 2014/09/01  
Printed: 2022/10/21 14:50

## Particle size distribution

Malvern Instruments



Malvern Instruments Ltd.  
www.malvern.com

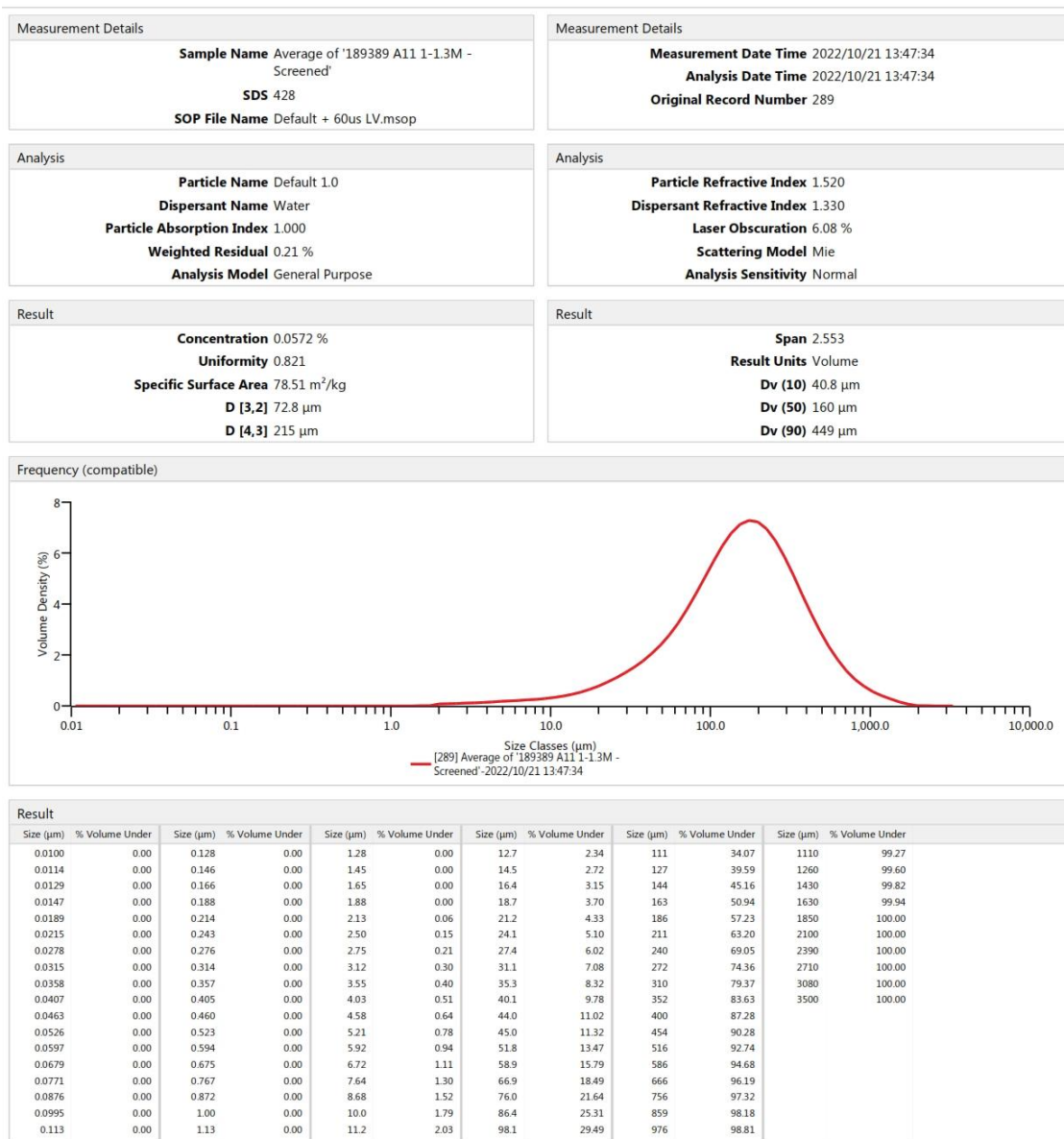
Mastersizer - v3.81  
Page 1 of 1

Aquatico

Created: 2014/09/01  
Printed: 2022/10/21 14:50

## Particle size distribution

Malvern Instruments



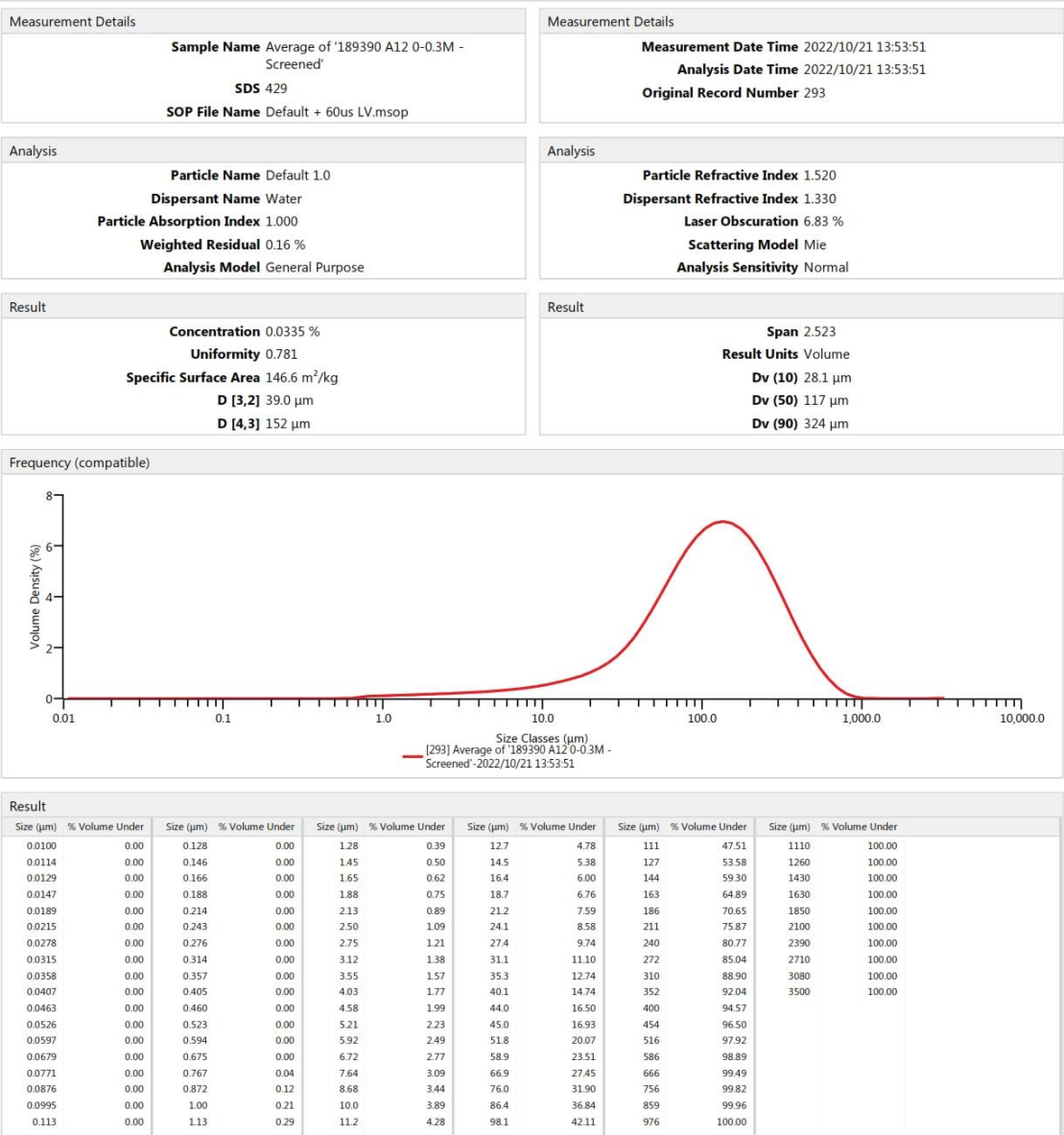
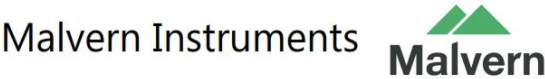
Malvern Instruments Ltd.  
www.malvern.com

Mastersizer - v3.81  
Page 1 of 1

Aquatico

Created: 2014/09/01  
Printed: 2022/10/21 14:50

Particle size distribution



Result

Concentration

0.0335 %

Uniformity

0.781

Specific Surface Area

146.6 m<sup>2</sup>/kg

D [3,2]

39.0 μm

D [4,3]

152 μm

Measurement Details

Measurement Date Time

2022/10/21 13:53:51

Analysis Date Time

2022/10/21 13:53:51

Original Record Number

293

Analysis

Particle Refractive Index

1.520

Dispersant Refractive Index

1.330

Laser Obscuration

6.83 %

Scattering Model

Mie

Analysis Sensitivity

Normal

Result

Span

2.523

Result Units

Volume

Dv (10)

28.1 μm

Dv (50)

117 μm

Dv (90)

324 μm

Frequency (compatible)

— [293] Average of '189390 A12 0-0.3M - Screened' - 2022/10/21 13:53:51

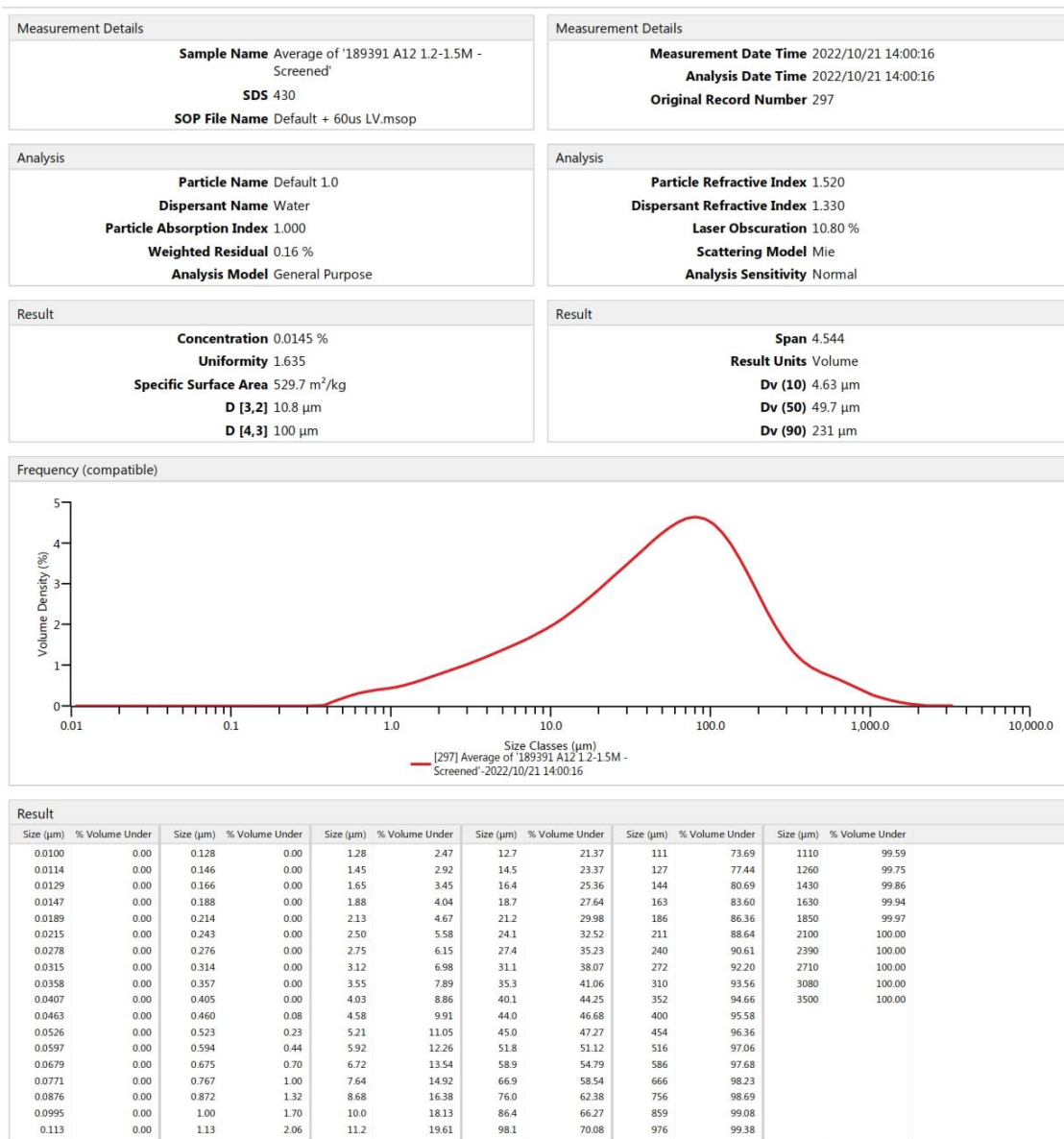
Result

Size (μm)	% Volume Under	Size (μm)	% Volume Under	Size (μm)	% Volume Under	Size (μm)	% Volume Under	Size (μm)	% Volume Under
0.0100	0.00	0.128	0.00	1.28	0.39	12.7	4.78	111	47.51
0.0114	0.00	0.146	0.00	1.45	0.50	14.5	5.38	127	53.58
0.0129	0.00	0.166	0.00	1.65	0.62	16.4	6.00	144	59.30
0.0147	0.00	0.188	0.00	1.88	0.75	18.7	6.76	163	64.89
0.0189	0.00	0.214	0.00	2.13	0.89	21.2	7.59	186	70.65
0.0215	0.00	0.243	0.00	2.50	1.09	24.1	8.58	211	75.87
0.0278	0.00	0.276	0.00	2.75	1.21	27.4	9.74	240	80.77
0.0315	0.00	0.314	0.00	3.12	1.38	31.1	11.10	272	85.04
0.0358	0.00	0.357	0.00	3.55	1.57	35.3	12.74	310	88.90
0.0407	0.00	0.405	0.00	4.03	1.77	40.1	14.74	352	92.04
0.0463	0.00	0.460	0.00	4.58	1.99	44.0	16.50	400	94.57
0.0526	0.00	0.523	0.00	5.21	2.23	45.0	16.93	454	96.50
0.0597	0.00	0.594	0.00	5.92	2.49	51.8	20.07	516	97.92
0.0679	0.00	0.675	0.00	6.72	2.77	58.9	23.51	586	98.89
0.0771	0.00	0.767	0.04	7.64	3.09	66.9	27.45	666	99.49
0.0876	0.00	0.872	0.12	8.68	3.44	76.0	31.90	756	99.82
0.0995	0.00	1.00	0.21	10.0	3.89	86.4	36.84	859	99.96
0.113	0.00	1.13	0.29	11.2	4.28	98.1	42.11	976	100.00



## Particle size distribution

Malvern Instruments



Malvern Instruments Ltd.  
www.malvern.com

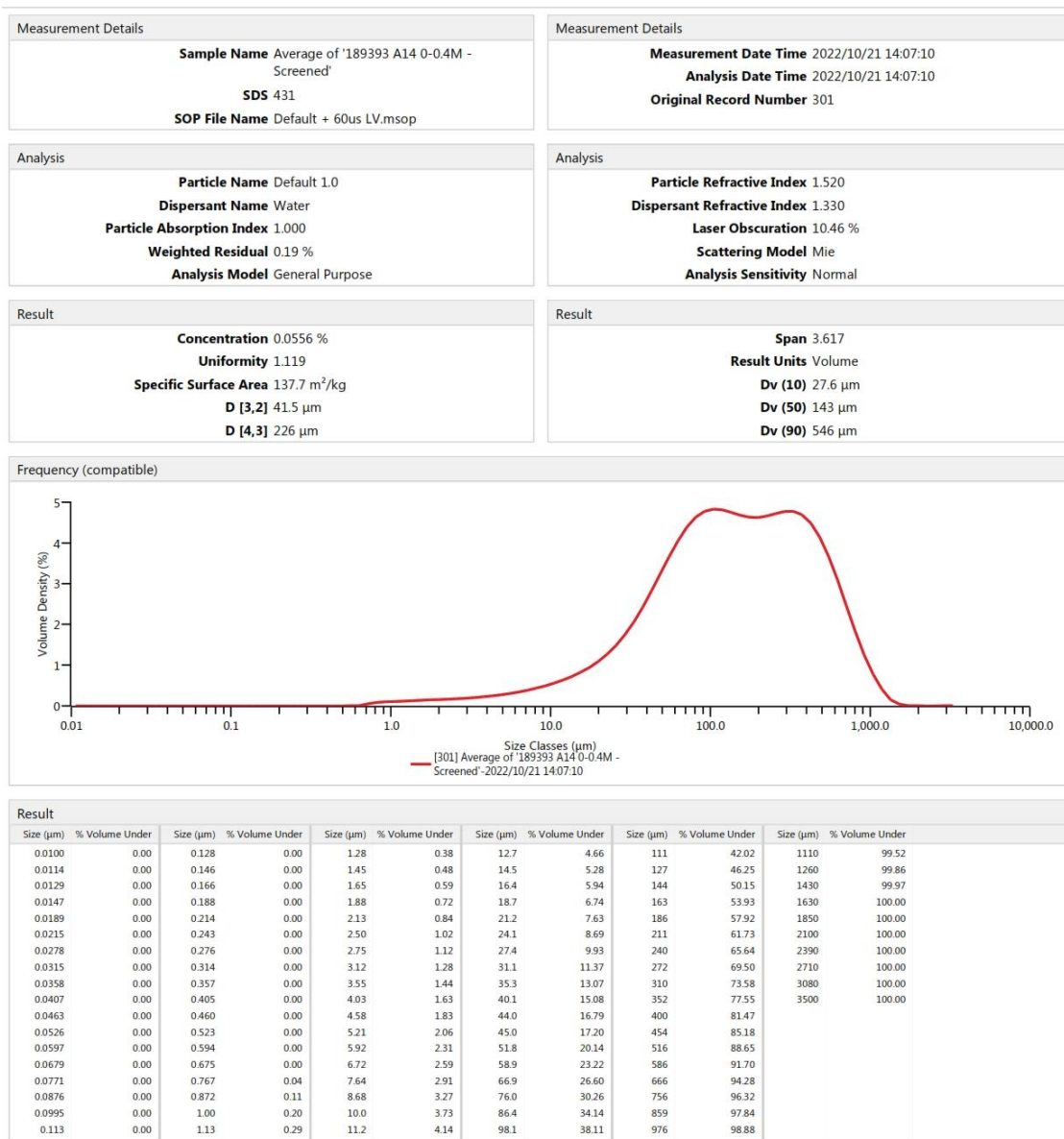
Mastersizer - v3.81  
Page 1 of 1

Aquatico

Created: 2014/09/01  
Printed: 2022/10/21 14:50

## Particle size distribution

Malvern Instruments



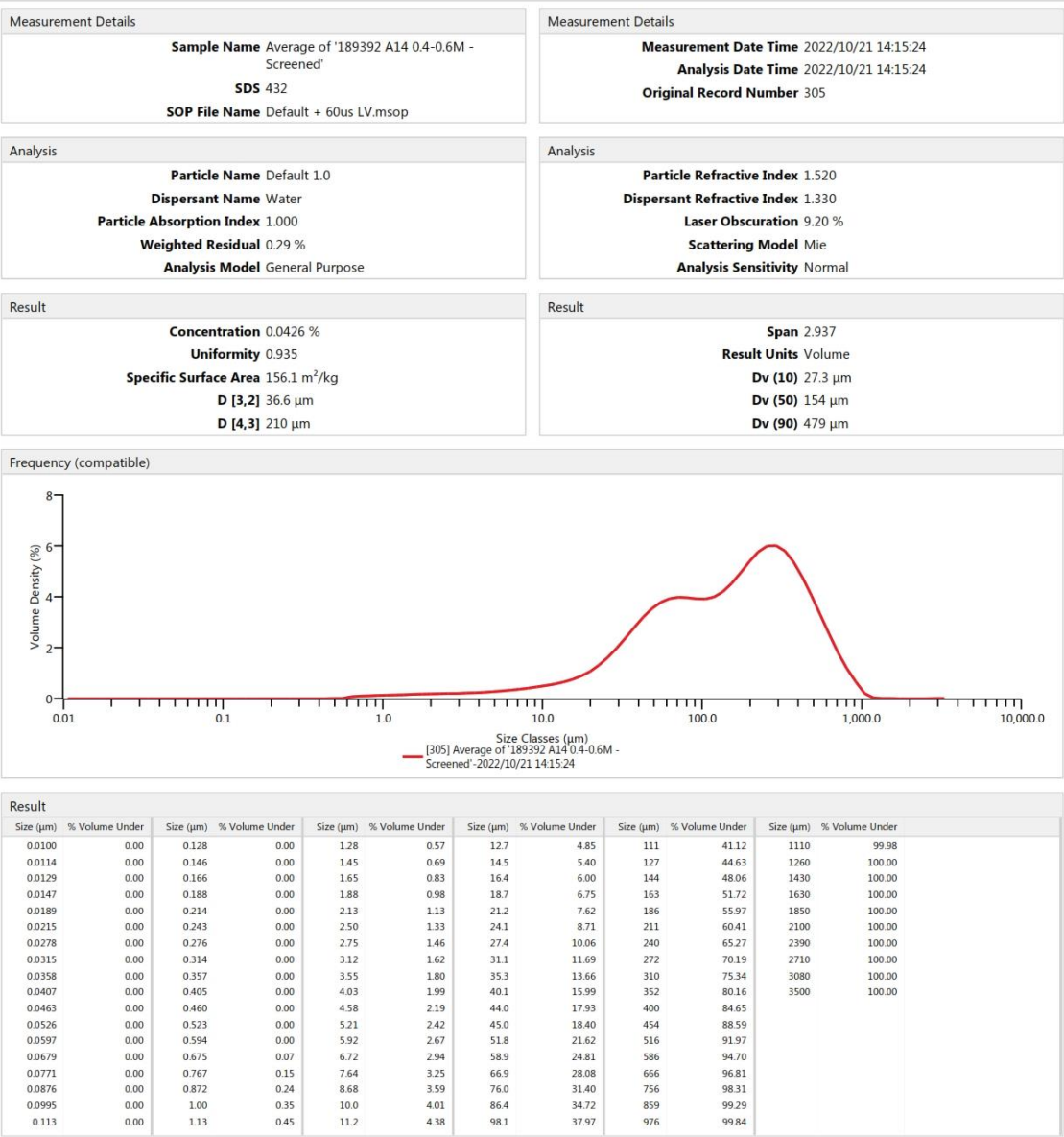
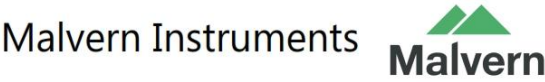
Malvern Instruments Ltd.  
www.malvern.com

Mastersizer - v3.81  
Page 1 of 1

Aquatico

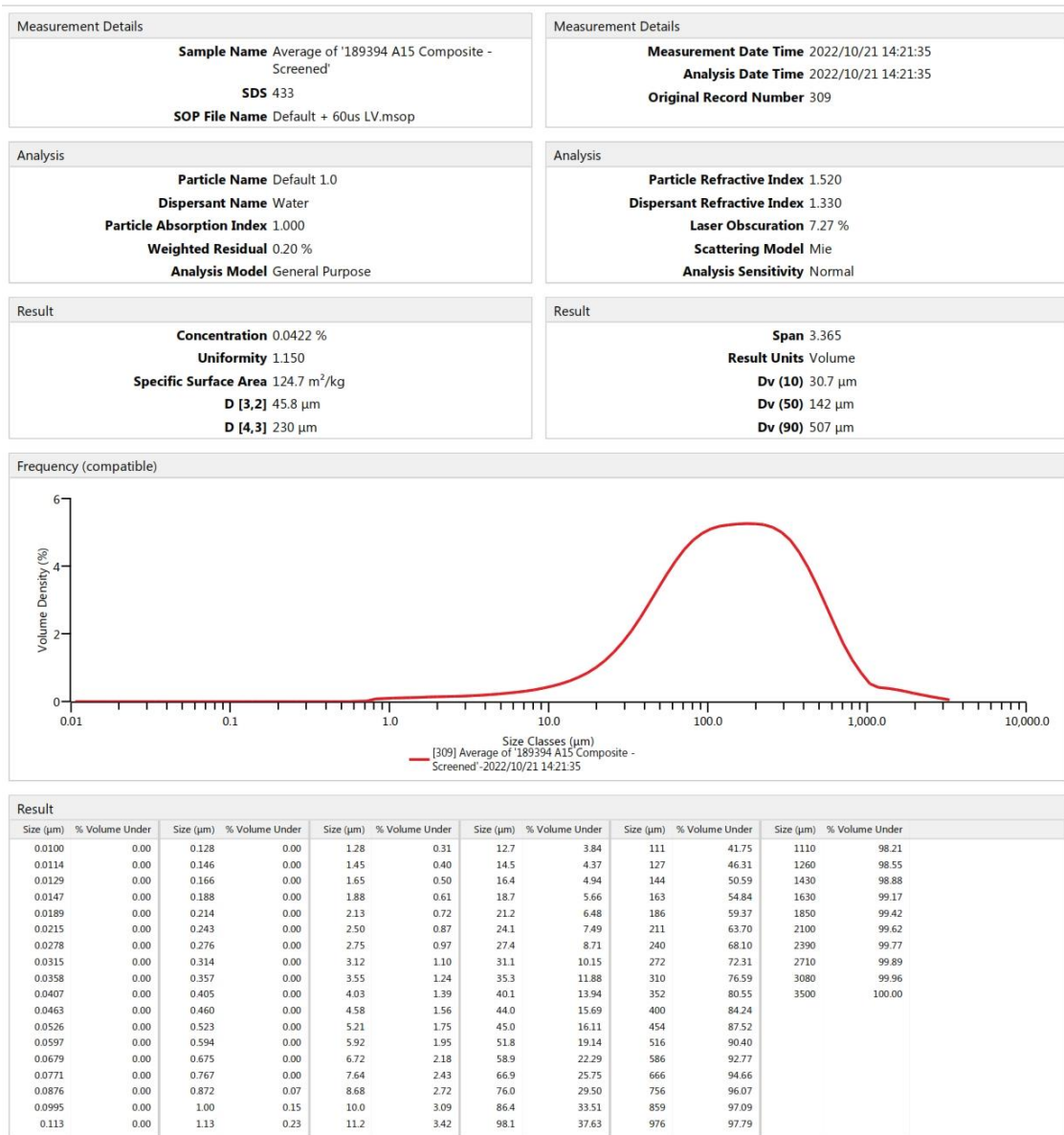
Created: 2014/09/01  
Printed: 2022/10/21 14:50

Particle size distribution



## Particle size distribution

Malvern Instruments



Malvern Instruments Ltd.  
www.malvern.com

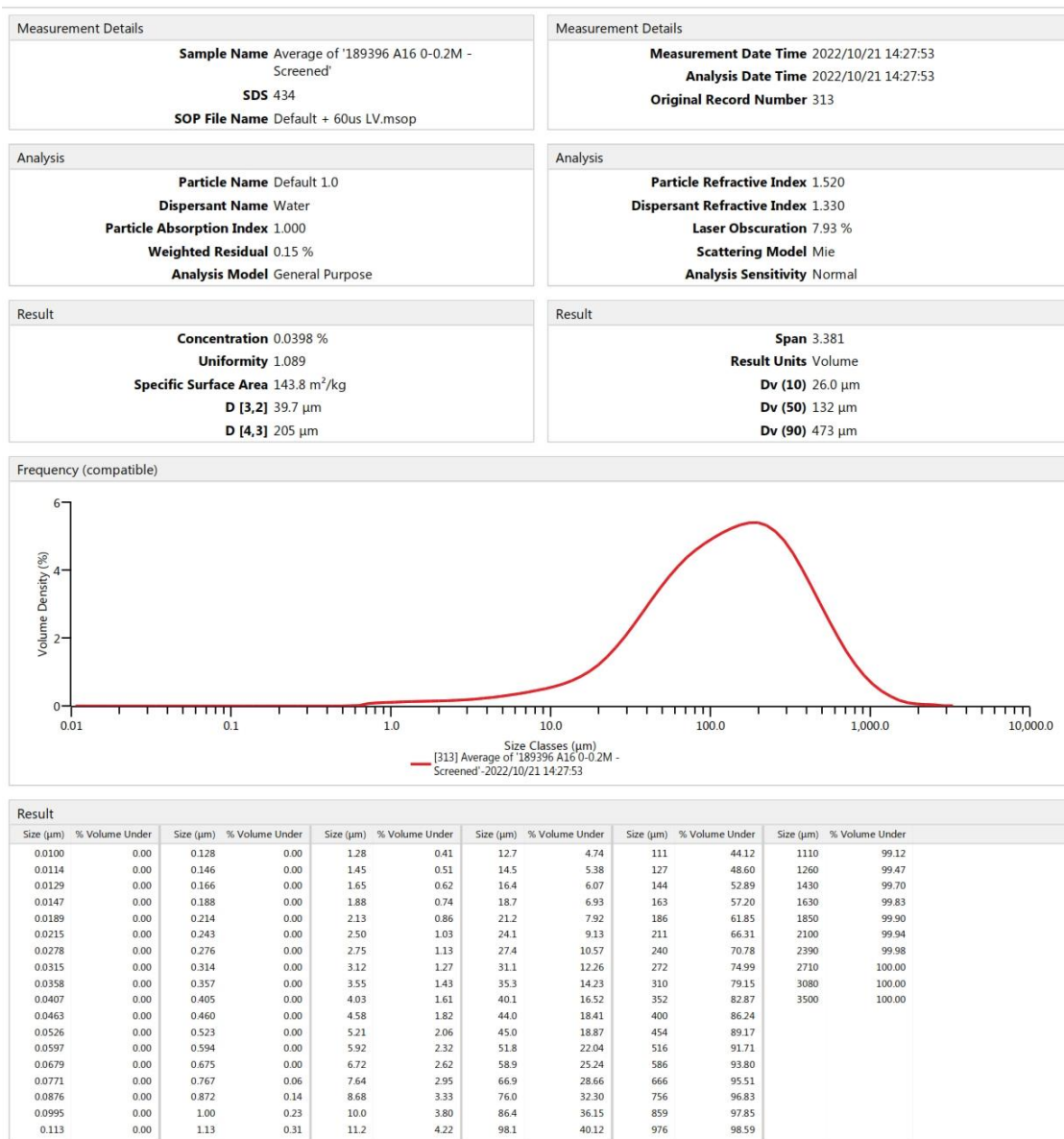
Mastersizer - v3.81  
Page 1 of 1

Aquatico

Created: 2014/09/01  
Printed: 2022/10/21 14:51

## Particle size distribution

Malvern Instruments



Malvern Instruments Ltd.  
www.malvern.com

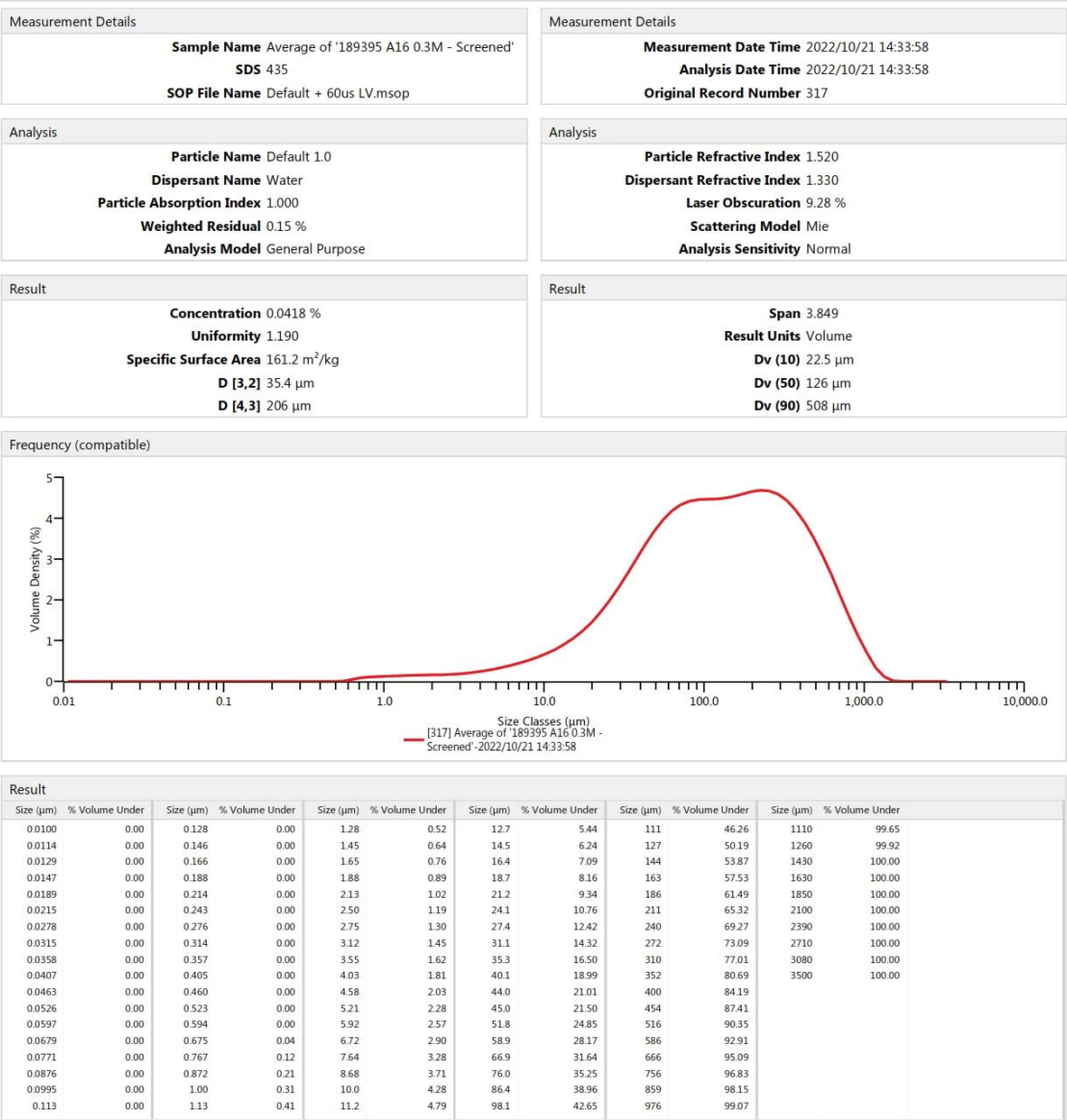
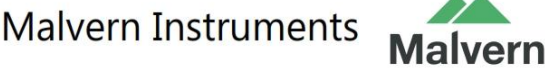
Mastersizer - v3.81  
Page 1 of 1

Aquatico

Created: 2014/09/01  
Printed: 2022/10/21 14:51

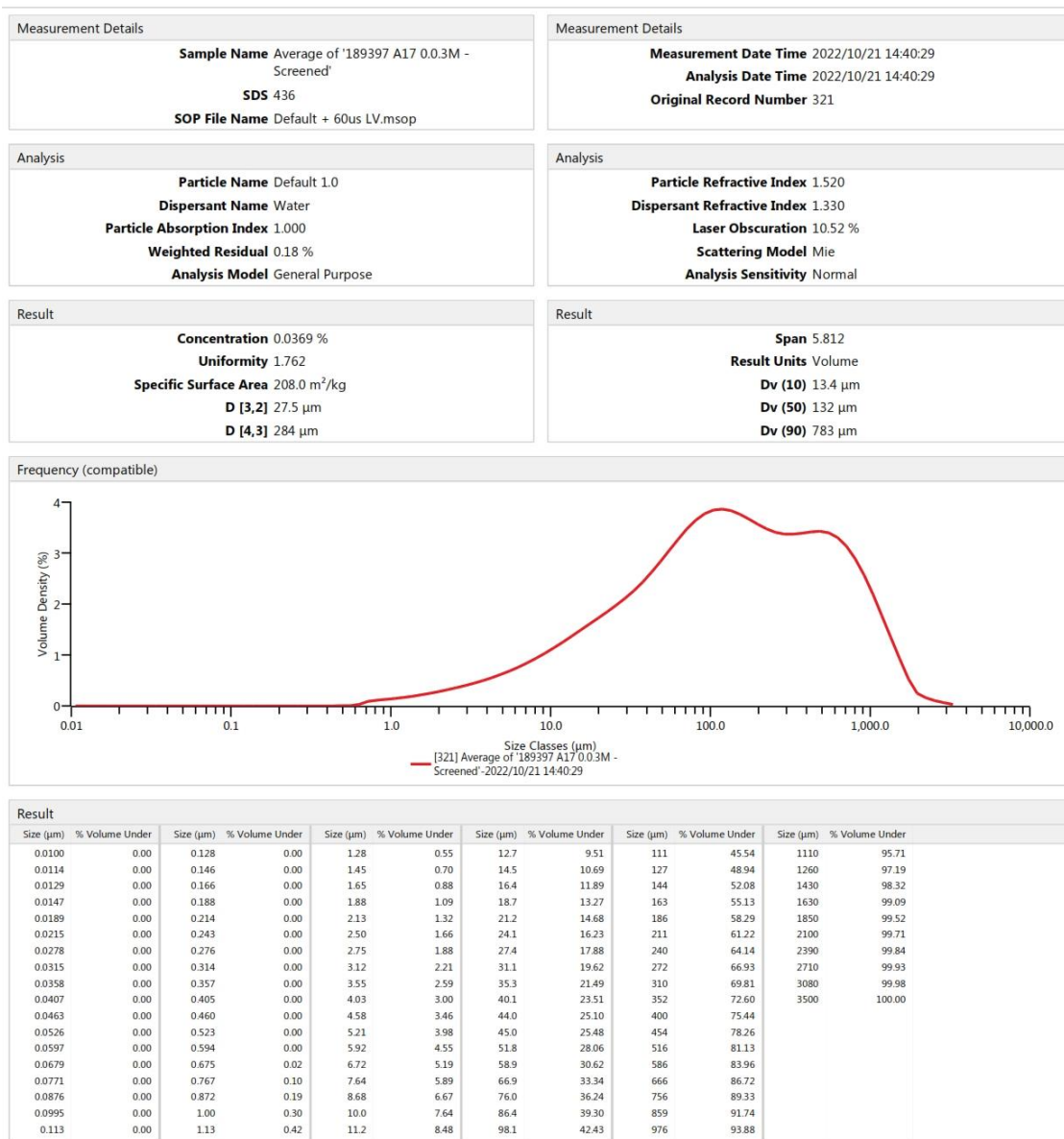


Particle size distribution



## Particle size distribution

Malvern Instruments



Malvern Instruments Ltd.  
www.malvern.com

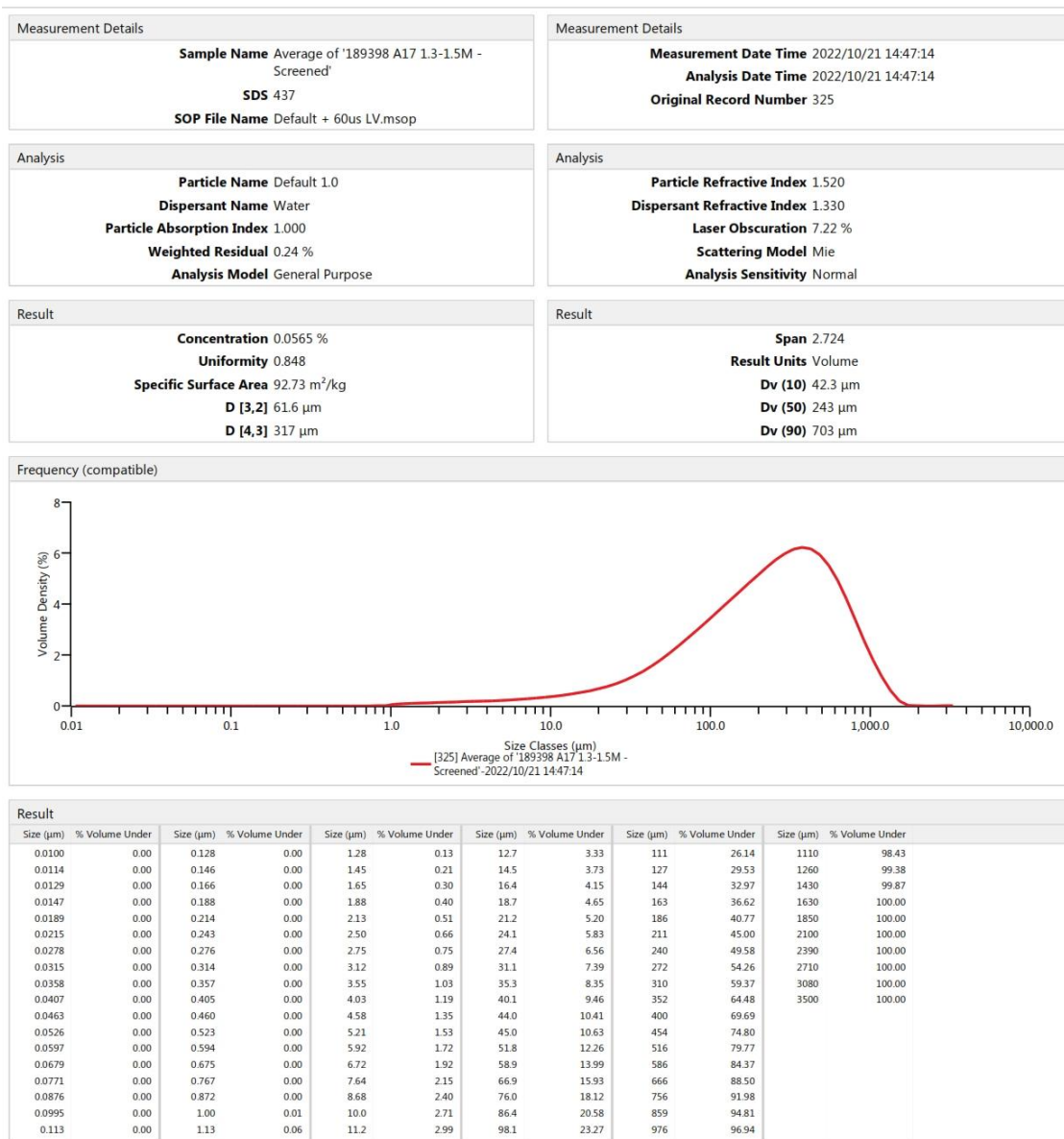
Mastersizer - v3.81  
Page 1 of 1

Aquatico

Created: 2014/09/01  
Printed: 2022/10/21 14:51

## Particle size distribution

Malvern Instruments



Malvern Instruments Ltd.  
www.malvern.com

Mastersizer - v3.81  
Page 1 of 1

Aquatico

Created: 2014/09/01  
Printed: 2022/10/21 14:51

## APPENDIX C: HYDROPEDOLOGY RISK ASSESSMENT METHODOLOGY

Due to the assessment forming part of a larger risk assessment for the study area, the potential impacts and the determination of impact significance were assessed. The process of assessing the potential impacts of the project encompasses the following four activities:

1. Identification and assessment of potential impacts.
2. Prediction of the nature, magnitude, extent, and duration of potentially significant impacts.
3. Identification of mitigation measures that could be implemented to reduce the severity or significance of the impacts of the activity; and
4. Evaluation of the significance of the impact after the mitigation measures have been implemented i.e., the significance of the residual impact.

Per GNR 982 of the EIA Regulations (2014), the significance of potential impacts was assessed in terms of the following criteria:

- I. Cumulative impacts.
- II. Nature of the impact.
- III. The extent of the impact.
- IV. Probability of the impact occurring.
- V. The degree to which the impact can be reversed.
- VI. The degree to which the impact may cause irreplaceable loss of resources; and
- VII. The degree to which the impact can be mitigated.

Table 6-1 provides a summary of the criteria used to assess the significance of the potential impacts identified. An explanation of these impact criteria is provided in Table 6-2.

$$\text{Consequence} = (\text{Duration} + \text{Extent} + \text{Irreplaceability of resource}) \times \text{Severity}$$

And the environmental significance of an impact was determined by multiplying consequence by probability.

**Table 6-1: Proposed Criteria and Rating Scales to be used in the Assessment of the Potential Impacts**

Criteria	Rating Scales	Notes
Nature	Positive (+)	An evaluation of the effect of the impact related to the proposed development.
	Negative (-)	
Extent	Footprint (1)	The impact only affects the area in which the proposed activity will occur.
	Site (2)	The impact will affect only the development area.
	Local (3)	The impact affects the development area and adjacent properties.
	Regional (4)	The effect of the impact extends beyond municipal boundaries.
	National (5)	The effect of the impact extends beyond more than 2 regional/provincial boundaries.
	International (6)	The effect of the impact extends beyond country borders.
Duration	Temporary (1)	The duration of the activity associated with the impact will last 0-6 months.
	Short-term (2)	The duration of the activity associated with the impact will last 6-18 months.

Criteria	Rating Scales	Notes
	Medium-term (3)	The duration of the activity associated with the impact will last 18 months-5 or years.
	Long-term (4)	The duration of the activity associated with the impact will last more than 5 years.
Severity	Low (1)	Where the impact affects the environment in such a way that natural, cultural and social functions and processes are minimally affected.
	Moderate (2)	Where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way; and valued, important, sensitive, or vulnerable systems or communities are negatively affected.
	High (3)	Where natural, cultural, or social functions and processes are altered to the extent that the natural process will temporarily or permanently cease; and valued, important, sensitive, or vulnerable systems or communities are substantially affected.
Potential for impact on irreplaceable resources	No (0)	No irreplaceable resources will be impacted.
	Yes (1)	Irreplaceable resources will be impacted.
Consequence	Extremely detrimental (-25 to -33)	A combination of extent, duration, intensity, and the potential for impact on irreplaceable resources.
	Highly detrimental (-19 to -24)	
	Moderately detrimental (-13 to -18)	
	Slightly detrimental (-7 to -12)	
	Negligible (-6 to 0)	
	Slightly beneficial (0 to 6)	
	Moderately beneficial (13 to 18)	
	Highly beneficial (19 to 24)	
Probability (the likelihood of the impact occurring)	Extremely beneficial (25 to 33)	It is highly unlikely or less than 50% likely that an impact will occur.
	Improbable (0)	
	Probable (1)	
Significance	Definite (2)	It is between 50 and 70% certain that the impact will occur.
	Very high - negative (-49 to -66)	A function of Consequence and Probability.
	High - negative (-37 to -48)	
	Moderate - negative (-25 to -36)	
	Low - negative (-13 to -24)	
	Neutral - Very low (0 to -12)	
	Low-positive (0 to 12)	
	Moderate-positive (13 to 24)	
	High-positive (24 to 48)	
	Very high - positive (49 to 66)	

Table 6-2: Explanation of Assessment Criteria

Criteria	Explanation
Nature	This is an evaluation of the type of effect the construction, operation, and management of the proposed development would have on the affected environment. Will the impact of change on the environment be positive, negative, or neutral?
Extent or Scale	This refers to the spatial scale at which the impact will occur. The extent of the impact is described as footprint (affecting only the footprint of the development), site (limited to the site), and regional (limited to the immediate surroundings and closest towns to the site). The extent of scale refers to the actual physical footprint of the impact, not to the spatial significance. It is acknowledged that some impacts, even though they may be of a small extent, are of very high importance, e.g., impacts on species of very restricted range. To avoid "double counting," specialists have been requested to indicate spatial significance under "intensity" or "impact on irreplaceable resources" but not under "extent" as well.
Duration	The lifespan of the impact is indicated as temporary, short, medium, and long-term.
Severity	This is a relative evaluation within the context of all the activities and the other impacts within the framework of the project. Does the activity destroy the impacted environment, alter its functioning, or render it slightly altered?
Impact on irreplaceable resources	This refers to the potential for an environmental resource to be replaced, should it be impacted. A resource could be replaced by natural processes (e.g., by natural colonization from surrounding areas), through artificial means (e.g., by reseeding disturbed areas or replanting rescued species) or by providing a substitute resource, in certain cases. In natural systems, providing substitute resources is usually not possible, but in social systems, substitutes are often possible (e.g., by constructing new social facilities for those that are lost). Should it not be possible to replace a resource, the resource is essentially irreplaceable e.g., red data species that are restricted to a particular site or habitat to a very limited extent.
Consequence	The consequence of the potential impacts is a summation of the above criteria, namely the extent, duration, intensity, and impact on irreplaceable resources.



Criteria	Explanation
Probability of occurrence	The probability of the impact occurring is based on the professional experience of the specialist with environments of a similar nature to the site and/or with similar projects. It is important to distinguish between the probability of the impact occurring and the probability that the activity causing a potential impact will occur. Probability is defined as the probability of the impact occurring, not as the probability of the activities that may result in the impact.
Significance	Impact significance is defined to be a combination of the consequence (as described below) and the probability of the impact occurring. The relationship between consequence and probability highlights that the risk (or impact significance) must be evaluated in terms of the seriousness (consequence) of the impact, weighted by the probability of the impact occurring. In simple terms, if the consequence and probability of an impact are high, then the impact will have a high significance. The significance defines the level to which the impact will influence the proposed development and/or environment. It determines whether mitigation measures need to be identified and implemented and whether the impact is important for decision-making.
Degree of confidence in predictions	Specialists and the EIR team were required to indicate the degree of confidence (low, medium, or high) that there is in the predictions made for each impact, based on the available information and their level of knowledge and expertise. The degree of confidence is not taken into account in the determination of consequence or probability.
Mitigation measures	Mitigation measures are designed to reduce the consequence or probability of an impact or to reduce both consequence and probability. The significance of impacts has been assessed both with mitigation and without mitigation.

---

**APPENDIX D: DISCLAIMER AND DECELERATION OF INDEPENDENCE**

The opinions expressed in this Report have been based on site/project information supplied to GCS (Pty) Ltd by Kangra Coal (Pty) Ltd and are based on public domain data, field data and data supplied to GCS by the client. GCS has acted and undertaken this assessment objectively and independently.

GCS has exercised all due care in reviewing the supplied information. Whilst GCS has compared key supplied data with expected values, the accuracy of the results and conclusions are entirely reliant on the accuracy and completeness of the supplied data. GCS does not accept responsibility for any errors or omissions in the supplied information and does not accept any consequential liability arising from commercial decisions or actions resulting from them.

Opinions presented in this report, apply to the site conditions, and features as they existed at the time of GCS's investigations, and those reasonably foreseeable. These opinions do not necessarily apply to conditions and features that may arise after the date of this report, about which GCS had no prior knowledge nor had the opportunity to evaluate.

## APPENDIX E: DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

### PROJECT TITLE

Hydropedology Assessment for the Proposed Co-Disposal Facility & Water Treatment Plant at Kangra Maquasa East Operations

### SPECIALIST INFORMATION

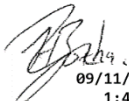
Specialist Company Name:	GCS Environmental SA		
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	2	Percentage Procurement Recognition
Specialist name:	Hendrik Botha		
Specialist Qualifications:	MSc Environmental Sciences (Geohydrology & Geochemistry) BSc Hons. Environmental Sciences (Hydrology) BSc. Geology and Chemistry		
Professional affiliation/registration:	PR SCI NAT 400139/17		
Physical address:	1 Karbochem Road, Newcastle, KZN		
Postal address:			
Postal code:	2940	Cell:	
Telephone:	071 102 3819	Fax:	
E-mail:	hendrikb@gcs-sa.biz		

---

DECLARATION BY THE SPECIALIST

I, Hendrik Botha, declare that –

- I act as the independent specialist in this application.
- I will perform the work relating to the application objectively, 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 concerning 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 realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

  
09/11/2022  
1:49:53  
Pr.Sci.Nat (400139/17)

---

Signature of the Specialist

GCS

---

Name of Company:

17 November 2023

---

Date

## APPENDIX F: CV OF SPECIALIST



Hendrik Botha

**Technical Director**

LinkedIn:

**CORE SKILLS**

- Project management
- Analytical and numerical groundwater modelling
- Geochemical assessments and geochemical modelling
- Hydropedology, hydrological assessments & yield assessments
- Hydrology, floodline modelling & storm water management
- Groundwater vulnerability, impact, and risk assessments
- Technical report writing
- GIS and mapping

**DETAILS****Qualifications**

- BSc Chemistry and Geology (Environmental Sciences) (2012)
- BSc Hons Hydrology (Environmental Sciences) (2013)
- MSc Geohydrology and Hydrology (Environmental Sciences) (2014-2016)

**Membership**

- Groundwater Division of GSSA
- Groundwater Association of KwaZulu Natal Member
- International Mine Water Association (IMWA)

**Languages**

- Afrikaans - Speak, read, write.
- English - Speak, read, write.

**Projects undertaken in**

- South Africa
- Nigeria
- Namibia
- Liberia

**PROFILE**

Hendrik (Henri) Botha is currently the manager of the GCS Newcastle Office and occupies the role of principal hydrogeologist. Groundwater, geochemistry and surface hydrology, as well as knowledge of water chemistry together with GIS, and analytical and numerical modelling skills, are some of his sought-after expertise. General and applied logical knowledge are his key elements in problem-solving.

**Professional Affiliations:**

SACNASP Professional Natural Scientist (400139/17)

**Areas of Expertise:**

- Waste classification and Impact Assessments
- Aquifer vulnerability assessments
- Geochemical sampling, data interpretation and modelling
- Geophysical surveys and data interpretation
- GIS
- Water quality sampling and data interpretation
- Groundwater impact and risk assessments
- Numerical and Conceptual Visual Modelling (Visual Modflow, ModflowFLEX, Voxler, RockWorks, Surfer and Excel)
- Hydropedology (Hydrological Soil Types) & Soils Assessments
- Floodline Modelling (HEC-RAS)
- Stormwater Management Systems and Modelling
- Surface Water Yield Assessments
- Water and Salt Balances



Page 1 of 8



## **APPENDIX E-6: HERITAGE ASSESSMENT**

**Prepared for:**

**Renee Janse van Rensburg & Jane Mahaba**

**Ground Water Consulting Services**

**PO Box 2597 Rivonia 2128**

**Tel 011 8035726 & Fax 0118035745**

**A PHASE I HERITAGE IMPACT ASSESSMENT STUDY FOR KANGRA  
COAL'S (PTY) LTD (KANGRA COAL) PROPOSED NEW MINING  
AREAS AND ROADS FOR THE MAQUASA EAST AND THE  
NOOITGESIEN OPEN CAST MINING OPERATIONS NEAR THE  
HEYSHOPE DAM BETWEEN ERMELO AND PIET RETIEF IN THE  
MPUMALANGA PROVINCE OF SOUTH AFRICA**

**Prepared by:**

**DR JULIUS CC PISTORIUS**

**Archaeologist & Heritage Consultant**

**Member ASAPA**

**Rosemary Street 352 Lynnwood 0082**

**PO Box 1522 Roodekuil Bela Bela 0480**

**Tel and fax 0147362115**

**Cell 0825545449**

**March 2013**

## EXECUTIVE SUMMARY

Kangra Coal (Pty) Ltd (Kangra Coal) intends to establish eight new open cast mining areas and haul roads in the Maquasa East and the proposed Nooitgesien Mining Areas to the west of the Heyshope Dam between Ermelo and Piet Retief along the escarp in the Mpumalanga Province of South Africa. The footprints of the proposed new open cast mining areas and haul roads are collectively referred to as the Project Area whilst the proposed mining development project is referred to as the Kangra Project.

The proposed Kangra Project may have an influence on any of the types and ranges of heritage resources which are outlined in Section 3 of the National Heritage Resources Act (No 25 of 1999). Consequently, a Phase I Heritage Impact Assessment (HIA) study was conducted for the Kangra Project as required by Section 38 of the National Heritage Resources Act (No 25 of 1999).

The aims with the Phase I HIA study were the following:

- To establish whether any of the types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act (No 25 of 1999) (see Box 1) (except paleontological remains) do occur in the Project Area and, if so, to determine the nature, the extent and the significance of these remains.
- To establish if any of these heritage resources will be affected by the proposed Kangra Project and, if so, to evaluate what appropriate mitigation measures must be taken if any of the types and ranges of heritage resources will be affected by the proposed mining project.

The Phase I HIA for the proposed Project Area revealed the following types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act (No 25 of 1999), namely:

- Remains from the historical period in and near the Project Area.
- Informal graveyards and graves in and near the Project Area.

No pre-historical remains were recorded. This study also did not provide for a paleontological study.

The graveyards and historical remains were geo-referenced and mapped (Figures 8, 9 & 20).

### **The significance of the heritage resources**

The historical remains and graveyards will be negatively affected when the proposed Kangra Project is implemented during the construction phase.

The significance of the heritage resources therefore has to be indicated as well as mitigation measures for those heritage resources which will be affected by the proposed Kangra Project.

The significance of the impacts on the heritage resources was determined using a ranking scale.

### **The historical remains**

All buildings and features older than sixty years are considered to be of historical significance and are protected by Section 34 and Section 38 of the National Heritage Resources Act (No 25 of 1999). The historical remains can be considered to be of low significance when considering criteria such as the following (Table 1):

- These remains are common across the Eastern Highveld (although being threatened on an increasing scale due to general development).
- These remains do not have any educational, research, aesthetical or any other significance which warrants their continued existence, conservation or even future use (e.g. as a historical site [open air museum]).
- The remains have been adequately documented for future reference during the Phase I HIA study.

### **The graveyards**

All graveyards and graves can be considered to be of high significance and are protected by various laws (Table 2). Legislation with regard to graves includes Section 36 of the National Heritage Resources Act (No 25 of 1999) whenever graves are older than sixty years. The act also distinguishes various categories of graves and burial grounds. Other legislation with regard to graves includes those which apply when graves are exhumed and relocated, namely the Ordinance on Exhumations (No 12 of 1980) and the Human Tissues Act (No 65 of 1983 as amended).

### **Possible impact on the heritage resources**

It is highly likely that historical remains DC03 to DC07 and graveyards GY05, GY07, GY09, GY0110 and GY11 will be directly affected (destroyed) by the Kangra Project whilst the historical remains DC01, DC02 and DC03 and graveyards GY01, GY02, GY03, G04, GY06 and GY08 may only be impacted indirectly by the Kangra Project.

The impact on the heritage resources will occur during the construction phase as the removing of top soil to commence with mining occur at the onset of the Kangra Project.

The significance of the impact on the heritage resources therefore has to be indicated.

### **The historical remains**

The significance of the impact on the historical remains is outlined in Tables 4(a) and 4(b).

### **The graveyards**

The significance of the impacts on the graveyards and graves is outlined in Tables 5(a) and 5(b).

### **Mitigating the heritage resources**

The following mitigation measures have to be applied to the historical remains and graveyards and graves which will be affected directly or indirectly during the construction phase for the proposed Kangra Project, namely:

#### **The historical remains**

These remains have low significance and have been described; geo-referenced; tabulated; mapped on a 1:50 000 topographical map and have been photographed, the evidence of which is provided in this report. These remains therefore have been adequately documented for future reference by any researcher or interested person seeking knowledge about the early occupation, life-ways, settlement patterns and traditions on the Eastern Highveld during the early twentieth century.

As these remains have been documented in this Phase I HIA study Kangra Coal needs not to apply for a demolishing permit from SAHRA for these remains that will be directly (destroyed) or indirectly affected in order to make way for the proposed Kangra Project.

#### **The graveyards**

It seems as if some or all of the graveyards and graves may hold graves which are older than sixty years. The graveyards and graves can be mitigated in two ways depending on whether they may be affected, directly or indirectly, namely:

- By means of exhumation and relocation when graveyards are affected directly (GY05, GY07, GY09, GY10 and GY11). The exhumation of human remains and the relocation of graveyards are regulated by various laws, regulations and administrative procedures. This task is undertaken by forensic archaeologists or by reputed



undertakers who are acquainted with all the administrative procedures and relevant legislation that have to be adhered to whenever human remains are exhumed and relocated. This process also includes social consultation with a 60 days statutory notice period for graves older than sixty years. Permission for the exhumation and relocation of human remains have to be obtained from the descendants of the deceased (if known), the National Department of Health, the Provincial Department of Health, the Premier of the Province and the local police.

- Graveyards can be demarcated with brick walls or with fences when they are affected indirectly and not in any physical way (GY01, GY02, GY03, G04, GY06, GY08). Conserving graveyards *in situ* in mining areas create the risk and responsibility that they may be damaged, accidentally, that the mine remains responsible for the graveyards' future unaffected existence, maintenance and that controlled access must exist for any relatives or friends who wish to visit the deceased. Safe corridors not less than 15m wide therefore must be maintained between graveyards and mining related activities and the graveyards and graves must be fenced-off. A Conservation Management Plan for the ongoing protection of these graveyards and graves must be included in the Environmental Management Plan for the mine.

#### General (general disclaimer)

It is possible that this Phase I HIA study may have missed heritage resources in the Project Area as heritage sites may occur in tall grass or in Blue Gum lots while others may lie below the surface of the earth and may only be exposed once development commences.

If any heritage resources of significance is exposed during the Kangra Project the South African Heritage Resources Authority (SAHRA) should be notified immediately, all development activities must be stopped and an archaeologist accredited with the Association for Southern African Professional Archaeologist (ASAPA) should be notify in order to determine appropriate mitigation measures for the discovered finds. This may include obtaining the necessary authorisation (permits) from SAHRA to conduct the mitigation measures.

## **CONTENTS**

<b>1</b>	<b>INTRODUCTION</b>	<b>9</b>
----------	---------------------	----------

<b>2</b>	<b>TERMS OF REFERENCE</b>	<b>11</b>
<b>3</b>	<b>THE PROJECT AREA</b>	<b>12</b>
3.1	Location	12
3.2	The nature of the Kangra Project Area	14
3.3	The nature of the Kangra Project	14
3.3.1	The Mining Areas	14
3.3.1.1	The Maquasa East Mining Area	14
	Block A	14
	Block B	16
	Block C	16
	Block D	17
3.3.1.2	The Nooitgesien Mining Area	17
	Block E	18
	Block F	18
	Block G	19
	Block H	19
3.3.2	The haul roads	19
<b>4</b>	<b>APPROACH AND METHODOLOGY</b>	<b>20</b>
4.1	Fieldwork	20
4.2	Databases, literature survey and maps	21
4.3	Assumptions and limitations	21
4.4	Some remarks on terminology	21
<b>5</b>	<b>CONTEXTUALISING THE PROJECT AREA</b>	<b>25</b>
5.1	Stone Age and rock art sites	25
5.2	Iron Age remains	27
5.3	The Historical Period	29
5.4	A coal mining heritage	29
5.5	A vernacular stone architectural heritage	30
<b>6</b>	<b>THE PHASE I HERITAGE IMPACT ASSESSMENT</b>	<b>32</b>
6.1	Types and ranges of heritage resources	32

6.2	Historical remains	34
6.2.1	Dwelling Complex 01	34
6.2.2	Dwelling Complex 02	37
6.2.3	Dwelling Complex 03	38
6.2.4	Dwelling Complex 04	39
6.2.5	Dwelling Complex 05	39
6.2.6	Dwelling Complex 06	40
6.2.7	Dwelling Complex 07	41
6.2.8	Possible historical coal mine	41
6.2.9	Tables	42
6.3	Graveyards	44
6.3.1	Graveyard 01	44
6.3.2	Graveyard 02	46
6.3.3	Graveyard 03	46
6.3.4	Grave 04	46
6.3.5	Graveyard 05	47
6.3.6	Graveyard 06	47
6.3.7	Grave 07	48
6.3.8	Graveyard 08	48
6.3.9	Graveyard 09	48
6.3.10	Graveyard 10	49
6.3.11	Graveyard 11	49
6.3.12	Graveyard 12	51
6.3.12	Tables	51

<b>7</b>	<b>THE SIGNIFICANCE, POSSIBLE IMPACT ON AND THE MITIGATION OF THE HERITAGE RESOURCES</b>	<b>53</b>
7.1	The significance of the heritage resources	53
7.1.1	The historical remains	54
7.1.2	The graveyards	55
7.2	Possible impact on the heritage resources	56
7.2.1	The historical remains	56
7.2.2	The graveyards	57
7.3	Mitigating the heritage resources	58

7.3.1	The historical remains	58
7.3.2	The graveyards	58
<b>8</b>	<b>CONCLUSION AND RECOMMENDATION</b>	<b>60</b>
<b>9</b>	<b>SELECT BIBLIOGRAPHY</b>	<b>64</b>
	<b>APPENDIX A: DETAILS OF THE SPECIALIST</b>	<b>68</b>

## **1 INTRODUCTION**

Kangra Coal (Pty) Ltd (hereafter referred to as Kangra Coal) intends to establish eight new open cast mining areas (Block A to Block G) and haul roads at the Maquasa East

and the Nooitgesien Mining Areas near the Heyshope dam between Ermelo and Piet Retief along the escarp in the Mpumalanga Province of South Africa. The footprints of the proposed new open cast mining areas and the haul roads are collectively referred to as the Project Area whilst the proposed mining project is referred to as the Kangra Project.

Focused archaeological research along the escarp in the Mpumalanga Province has indicated that this region has a rich heritage comprised of remains dating from the pre-historical and from the historical (or colonial) periods of South Africa. These pre-historical and historical remains form a record of the heritage of most groups living in South Africa today (see Box 1).

**Box 1: Types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act (No 25 of 1999).**

The National Heritage Resources Act (Act 25 of 1999, Section 3) outlines the following types and ranges of heritage resources that qualify as part of the national estate:

- a. Places, buildings structures and equipment of cultural significance;
- b. Places to which oral traditions are attached or which are associated with living heritage;
- c. Historical settlements and townscapes;
- d. Landscapes and natural features of cultural significance;
- e. Geological sites of scientific or cultural importance;
- f. Archaeological and palaeontological sites;
- g. Graves and burial grounds including



## **2 TERMS OF REFERENCE**

Kangra Coal's proposed mining project involves the establishment of eight new open cast pits and haul roads at the Maquasa East and Nooitgesien Mining Areas. The

Kangra Project may impact on any of the types and ranges of heritage resources ('national estate') which are outlined in Section 3 of the National Heritage Resources Act (No. 25 of 1999) (see Box 1). Consequently, Ground Water Consulting Services commissioned the author to undertake a Phase I HIA study for the proposed Project Area.

The aims with the Phase I HIA study were the following:

- To establish whether any of the types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act (No 25 of 1999) (see Box 1) (except paleontological remains) do occur in the Project Area and, if so, to determine the nature, the extent and the significance of these remains.
- To establish if any of these heritage resources will be affected by the proposed Kangra Project and, if so, to evaluate what appropriate mitigation measures must be taken if any of the types and ranges of heritage resources will be affected by the proposed mining project.

### **3 THE PROJECT AREA**

#### **3.1 Location**

Kangra Coal's Project Area is located on the farms Maquasa 19HT, Roodekraal 21HT and Rooikop 18HT which is part of a swath of land which stretches along an undulating grassland between the extensive Mantshangwe mountain range in the west and the village of Driefontein and the Heyshope Dam in the east. The Project Area is bisected from the north to the south by the Gude River with numerous small streams feeding into this river. Patches with agricultural fields occur across the Project Area.

The larger part of the Project Area is relatively pristine. Small, scattered villages occupied by Sotho and Swazi speaking communities with varying numbers of individuals which are sometimes associated with graveyards occur across the Project Area (2630 CD Panbult & 2730 Dirkiesdorp; 1:50 000 topographical map) (Figures 1-7).



**Figure 1- Kangra Coal's Project Area stretches from the extensive Mantshangwe mountain range in the west towards the village of Driefontein and the Heyshope dam in the east (above).**



## **3.2 The nature of the Kangra Project Area**

The Kangra Project Area is part of the Mpumalanga Escarpment and is characterised by extensive mountain ranges composed of sandstone with some dolerite outcrops and dykes which manifest as low kopjes and inconspicuous randjes. In between the massive sandstone mountains an outstretched grass veld runs across undulating plains. The larger project area is pristine and is characterised by the absence of any trees except for the occurrence of exotics such as Blue Gum plantations and dense stands with wattle trees. Scattered human settlements occur across the area. Agricultural fields are limited and small in extent whilst the only evidence for the large scale alteration of the environment is confined to abandoned coal mining activities as well as current coal mining operations.

## **3.3 The nature of the Kangra Project**

Kangra Coal intends to expand its opencast operations with the addition of eight new opencast pits and the construction of new haul roads. A proposed new conveyer route indicated in all figures is no longer part of this project (Figure 2).

### **3.3.1 The Mining Areas**

#### **3.3.1.1 The Maquasa East Mining Area**

The following open cast mines are planned in the Maquasa East Mining Area, namely (Figure 3):

#### **Block A**

Block A (Figure 3, bottom left) is located on the eastern end of Maquasa 19HT and the western edge of Roodekraal 21HT. The mine is located to the south of an existing conveyer belt and on the higher banks of the western end of the Heyshope Dam. The terrain is characterized by grass veld which slopes towards the Heyshope Dam in the south.





**Figures 3 & 4- Kangra Coal's proposed four open cast mining pits near the in the Maquasa East Mining Area (above). The proposed Block B on Roodekraal 19HT near the banks of the Heyshope Dam (below).**



## **Block B**

This proposed mine is located on Roodekraal 21HT near the northern banks of the Heyshope Dam and is wedged between the dam and the village of Driefontein (Figure 3, bottom right). Block B is located on a stretch of grass veld that slopes southwards into the dam. The southern sloping parts of the mining area is characterised by outcrops of ferricrete along the banks of the Heyshope dam.

## **Block C**

This proposed mining area is located on Roodekraal 21HT adjacent (north) of a waste dump (Figure 3, top right). It is situated on a level grass veld and is wedged between the waste dump and the road that runs to Kangra Coal's processing plant. This area has largely been disturbed as a result of earth moving activities and the dumping of soil in the past.



**Figure 5- Kangra Coal's proposed Block C is a disturbed area where quarrying is taking place next to a dump (above)**

## Block D

This proposed mining area is located on Rooikop 18HT on a piece of grass veld and a stretch of land which has been mined in the past. Block D is situated between two dirt roads, one in the north and the other in the south (Figure 3, top left). This mining area slopes towards the Gude stream in the west. Block D is disturbed as a result of earlier mining activities. Wattle bush encroachment occurs along the northern edge of this piece of land.

### 3.3.1.2 The Nooitgesien Mining Area

The following open cast mines are planned in the Nooitgesien Mining Area, namely:



**Figure 6- Kangra Coal's proposed four open cast mine pits in the Nooitgesien Mining Area which is located to the western of the Maquasa Mining Area (above).**

## Block E

This proposed mining area is situated near one of Kangra's operating shafts on Rooikop 18HT (Figure 5, top right). This piece of land stretches around the southern and western base a low rise which slopes towards the south and the west.

### **Block F**

Block F is located on Rooikop 18HT and is situated on an outstretched piece of grass veld that slopes towards the west and towards Block G (Figure 5, bottom east). This piece of land is characterised by grass veldt with a small Blue Gum lot where a village occupied by a few families and their homesteads occur.



**Figure 7- Block G on Rooikop 18HT stretches towards a low rise in the north-west where Block H is located above the Hlelo River (above).**

### **Block G**

Block G is situated on Rooikop 18HT in an area that is generally lower than the surrounding landscape. Stands with Blue Gum trees occur towards the central part of this piece of land (Figure 5, bottom west).

## **Block H**

This proposed open cast mining area is located in grass veld along the southern and western slope of a low rise on Rooikop 18HT. The proposed new mine is located above the Hlelo River in close proximity of earlier abandoned mining activities (Figure 5, north).

### **3.3.2 The haul roads**

At least five new haul roads are planned, namely (Figure 2):

- Road 1 (bright blue): Runs from Pit D (Maquasa West) to Dump 3 (Nooitgesien).
- Road 2 (pink & white): Runs from Pit D (Maquasa West) to Pit G1 (Nooitgesien).
- Road 3 (pink & white): Runs between Pit D (Maquasa East) to the existing Road north of Dump 4 (Nooitgesien).
- Road 4 (pink & white): Runs between the point where the new conveyor route starts (red line) to the existing dirt road north of Dump 4 (Nooitgesien).
- Road 5 (pink & white): Runs between Road 3 (Nooitgesien) to Pit G2 (Nooitgesien).

These haul roads are not illuminated with photographs as the majority cross landscape close to the open cast pits which are illustrated in Figures 3-7.

## **4 APPROACH AND METHODOLOGY**

This Phase I HIA study was conducted by means of the following:



#### 4.1 Fieldwork

The larger Project Area was surveyed with a vehicle considering the size and extent of the area. The aim with the survey was to geo-reference, describe and photograph heritage resources whenever they existed. Not all Blue Gum plantations or disturbed parts of the Project Area were traversed or surveyed on foot. Disturbed areas included Block C and Block D of Maquasa East of which the latter was not accessible as mining relating activities are taking place.



**Figure 00- The main track pathway which was followed during the survey and which was recorded with a mounted GPS. Smaller detailed pedestrian surveys were conducted from the main track route (above).**

A GPS track pathway was registered with a mounted GPS instrument which outlines the main track for the survey. More detailed pedestrian surveys were conducted from this main track. All the open cast mining areas were traversed on foot. The pedestrian survey also included stretches of the new haul roads. Parts of the Project Area were also surveyed on at least two occasions in the past (Pistorius 2008, 2012). Tracks of land around the Project Area was also surveyed by the author (Pistorius 2011).

Photographs illuminate the characteristic features of the Project Area (see Part 3.2 'The nature of the Kangra Project', Figures 3 –7).

#### **4.2 Databases, literature survey and maps**

Literature relating to the pre-historical and the historical unfolding of the Eastern Highveld was reviewed. This review focused primarily on the pre-history as well as the Historical Period on the Eastern Highveld. It also provided a broad outline of the coal mining history of the region as well as its indigenous architecture. The literature research contextualises the pre-historical and historical background of the Eastern Highveld which again contributes to a better understanding of the identity and meaning of heritage sites which occur in and near the Project Area.

The desktop study also involved consulting heritage data banks maintained at institutions such as the Mpumalanga Provincial Heritage Resources Agency in Barberton, the Archaeological Data Recording Centre at the National Flagship Institute (Museum Africa) in Pretoria and the national heritage resources register at the South African Heritage Resources Agency (SAHRIS) in Cape Town.

In addition, the Project Area was studied by means of maps on which it appears (2630 CD Panbult & 2730 Dirkiesdorp; 1:50 000 topographical maps & 2628 East Rand 1: 250 000 map).

#### **4.3 Assumptions and limitations**

It is possible that this Phase I HIA study may have missed heritage resources in the Project Area as heritage sites may occur in tall grass or in Blue Gum lots while others may lie below the surface of the earth and may only be exposed once development commences.

If any heritage resources of significance is exposed during the construction, operation or closure of the mining project the South African Heritage Resources Authority (SAHRA) should be notified immediately, all development activities must be stopped and an archaeologist accredited with the Association for Southern African Professional

Archaeologist (ASAPA) should be notified in order to determine appropriate mitigation measures for the discovered finds. This may include obtaining the necessary authorisation (permits) from SAHRA to conduct the mitigation measures.

#### **4.4 Some remarks on terminology**

Terms that may be used in this report are briefly outlined below:

- **Conservation:** The act of maintaining all or part of a resource (whether renewable or non-renewable) in its present condition in order to provide for its continued or future use. Conservation includes sustainable use, protection, maintenance, rehabilitation, restoration and enhancement of the natural and cultural environment.
- **Conservation (*in-situ*):** The conservation and maintenance of ecosystems, natural habitats and cultural resources in their natural and original surroundings.
- **Cultural (heritage) resources:** A broad, generic term covering any physical, natural and spiritual properties and features adapted, used and created by humans in the past and present. Cultural resources are the result of continuing human cultural activity and embody a range of community values and meanings. These resources are non-renewable and finite. Cultural resources include traditional systems of cultural practice, belief or social interaction. They can be, but are not necessarily identified with defined locations.
- **Cultural (heritage) resource management:** A process that consists of a range of interventions and provides a framework for informed and value-based decision-making. It integrates professional, technical and administrative functions and interventions that impact on cultural resources. Activities include planning, policy development, monitoring and assessment, auditing, implementation, maintenance, communication, and many others. All these activities are (or will be) based on sound research.
- **Heritage resources:** The various natural and cultural assets that collectively form the heritage. These assets are also known as cultural and natural resources. Heritage (cultural) resources include all human-made phenomena and intangible products that are the result of the human mind. Natural, technological

or industrial features may also be part of heritage resources, as places that have made an outstanding contribution to the cultures, traditions and lifestyles of the people or groups of people of South Africa.

- Stone Age: Refers to the prehistoric past, although Late Stone Age peoples lived in South Africa well into the Historical Period. The Stone Age is divided into an Earlier Stone Age (3 million years to 150 000 thousand years ago) the Middle Stone Age (150 000 years to 40 000 years ago) and the Late Stone Age (40 000 years to 300 years ago).
- Iron Age: Refers to the last two millennia and 'Early Iron Age' to the first thousand years AD. 'Late Iron Age' refers to the period between the 16<sup>th</sup> century and the 19<sup>th</sup> century and can therefore include the Historical Period.
- Historical period: Refers to the first appearance or use of 'modern' Western writing in a particular area or region of the world.
- Pre-historical: Refers to the time before any historical documents were written or any written language developed in a particular area or region of the world.
- Recent past: Refers to the 20<sup>th</sup> century. Remains from this period are not necessarily older than sixty years and therefore may not qualify as archaeological or historical remains. Some of these remains, however, may be close to sixty years of age and may, in the near future, qualify as heritage resources.
- Maintenance: Keeping something in good health or repair.
- Preservation: Conservation activities that consolidate and maintain the existing form, material and integrity of a cultural resource.
- Protected area: A geographically defined area designated and managed to achieve specific conservation objectives. Protected areas are dedicated primarily to the protection and enjoyment of natural or cultural heritage, to the maintenance of biodiversity, and to the maintenance of life-support systems.
- Reconstruction: Re-erecting a structure on its original site using original components.
- Replication: The act or process of reproducing by new construction the exact form and detail of a vanished building, structure, object, or a part thereof, as it appeared at a specific period.
- Restoration: Returning the existing fabric of a place to a known earlier state by removing additions or by reassembling existing components.

- Sustainability: The ability of an activity to continue indefinitely, at current and projected levels, without depleting social, financial, physical and other resources required to produce the expected benefits.
- Translocation: Dismantling a structure and re-erecting it on a new site using original components.
- Project Area: refers to the area (footprint) where the developer wants to focus its development activities (refer to plan).
- Phase I studies refer to surveys using various sources of data in order to establish the presence of all possible types and ranges of heritage resources in any given Project Area.
- Phase II studies include in-depth cultural heritage studies such as archaeological mapping, excavating and sometimes laboratory work. Phase II work may include the documenting of rock art, engraving or historical sites and dwellings; the sampling of archaeological sites or shipwrecks; extended excavations of archaeological sites; the exhumation of human remains and the relocation of graveyards, etc. Phase II work involve permitting processes, require the input of different specialists and the co-operation and approval of SAHRA.

## **5 CONTEXTUALISING THE PROJECT AREA**

The following brief overview of pre-historical, historical, cultural and economic evidence will help to contextualise the Project Area.

Heritage resources which are quite common in the larger Project Area include:



- Historical remains associated with farmstead complexes consisting of houses, associated outbuildings, cattle enclosures and graveyards.
- Abandoned graveyards left by farm workers who moved from farms to urban areas.

The following overview of pre-historical, historical and cultural evidence indicates the wide range of heritage resources which do occur across the larger Project Area and the Mpumalanga Province.

## **5.1 Stone Age and rock art sites**

Stone Age sites are marked by stone artefacts that are found scattered on the surface of the earth or as parts of deposits in caves and rock shelters. The Stone Age is divided into the Early Stone Age (ESA) (covers the period from 2.5 million years ago to 250 000 years ago), the Middle Stone Age (MSA) (refers to the period from 250 000 years ago to 22 000 years ago) and the Late Stone Age (LSA) (the period from 22 000 years ago to 200 years ago).

Dongas and eroded areas at Maleoskop near Groblersdal is one of only a few places in Mpumalanga where ESA Olduwan and Acheulian artefacts have been recorded. Evidence for the MSA has been excavated at the Bushman Rock Shelter near Ohrigstad. This cave was repeatedly visited over a prolonged period. The oldest layers date back to 40 000 years BP and the youngest to 27 000BP (Esterhuysen & Smith 2007).

LSA occupation of the Mpumalanga Province also has been researched at Bushman Rock Shelter where it dates back 12 000BP to 9 000BP and at Höningnestkrans near Badfontein where a LSA site dates back to 4 870BP to 200BP (Esterhuysen & Smith 2007).

The LSA is also associated with rock paintings and engravings which were done by San hunter-gatherers, Khoi Khoi herders and EIA farmers (Maggs 1983, 2008).

Approximately 400 rock art sites are distributed throughout Mpumalanga, notably in the northern and eastern regions at places such as Emalahleni (Witbank) (4), Lydenburg (2), White River and the southern Kruger National Park (76), Nelspruit and the Nsikazi District (250). The Ermelo area holds eight rock paintings (Smith & Zubieta 2007).

The rock art of the Mpumalanga Province can be divided into San rock art which is the most wide spread, herder or Khoe Khoe paintings (thin scattering from the Limpopo Valley) through the Lydenburg district into the Nelspruit area) and localised late white farmer paintings. Farmer paintings can be divided into Sotho-Tswana finger paintings and Nguni engravings (Only 20 engravings occur at Boomplaats, north-west of Lydenburg). Farmer paintings are more localised than San or herder paintings and were mainly used by the painters for instructional purposes (Smith & Zubieta 2007).

During the LSA and Historical Period, San people called the Batwa lived in sandstones caves and rock shelters near Lake Chrissie in the Ermelo area. The Batwa are descendants of the San, the majority of which intermarried with Bantu-Negroid people such as the Nhlapo from Swazi-descend and Sotho-Tswana clans such as the Pai and Pulana. Significant intermarriages and cultural exchanges occurred between these groups. The Batwa were hunter-gatherers who lived from food which they collected from the veldt as well as from the pans and swamps in the area. During times of unrest, such as the *difaqane* in the early nineteenth century, the San would converge on Lake Chrissie for food and sanctuary. The caves, lakes, water pans and swamps provided relatively security and camouflage. Here, some of the San lived on the surfaces of the water bodies by establishing platforms with reeds. With the arrival of the first colonists in the nineteenth century many of the local Batwa family groups were employed as farm labourers. Descendants of the Batwa people still live in the larger Project Area (Schapera 1927, Potgieter 1955, Schoonraad & Schoonraad 1975).

## **5.2 Iron Age remains**

The Iron Age is associated with the first agro-pastoralists or farming communities who lived in semi-permanent villages and who practised metal working during the last two millennia. The Iron Age is usually divided into the Early Iron Age (EIA) (covers the 1<sup>st</sup>

millennium AD) and the Later Iron Age (LIA) (covers the first 880 years of the 2<sup>nd</sup> millennium AD).

Evidence for the first farming communities in the Mpumalanga Province is derived from a few EIA potsherds which occur in association with the LSA occupation of the Höningnest Shelter near Badfontein. The co-existence of EIA potsherds and LSA stone tools suggest some form of 'symbiotic relationship' between the Stone Age hunter-gatherers who lived in the cave and EIA farmers in the area (also note Batwa and Swazi/Sotho Tswana relationship) (Esterhuysen & Smith 2007).

The Welgelegen Shelter on the banks of the Vaal River near Ermelo also reflects some relationship between EIA farmers who lived in this shelter and hunter-gatherers who manufactured stone tools and who occupied a less favourable overhang nearby during AD1200 (Schoonraad & Beaumont 1971).

EIA sites were also investigated at Sterkspruit near Lydenburg (AD720) and in Nelspruit where the provincial governmental offices were constructed. The most infamous EIA site in South Africa is the Lydenburg head site which provided two occupation dates, namely during AD600 and from AD900 to AD1100. At this site the Lydenburg terracotta heads were brought to light. Doornkop, located south of Lydenburg, dates from AD740 and AD810 (Evers 1981, Whitelaw 1996).

The Late Iron Age is well represented in Mpumalanga and stretches from AD1500 well into the nineteenth century and the Historical Period. Several spheres of influence, mostly associated with stone walled sites, can be distinguished in the region. Some of the historically well-known spheres of influence include the following:

- Early arrivals in the Mpumalanga Province such as Bakone clans who lived between Lydenburg, Badfontein and Machadodorp and Eastern Sotho clans such as the Pai, Pulana and Kutswe who established themselves in the eastern parts of the province (Collett 1979, 1983; Delius 2007; Makhura 2007; Delius & Schoeman, 2008).
- Swazi expansion into the Highveld and Lowveld of the Mpumalanga Province occurred during the reign of Sobhuza (AD1815 to 1836/39) and Mswati

(AD1845 to 1868) while Shangaan clans entered the province across the Lembombo Mountains in the east during the second half of the nineteenth century (Delius 2007, Makhura 2007.).

- The Bakgatla (Pedi) chiefdom in the Steelpoort Valley rose to prominence under Thulare during the early 1800's and was later ruled by Sekwati and Sekhukune from the village of Tsjate in the Leolo Mountains. The Pedi maintained an extended sphere of influence across the Limpopo and Mpumalanga Provinces during the nineteenth century (Mönnig 1978, Delius 1984).
- The Ndzundza-Ndebele established settlements at the foot of the Bothasberge (Kwa Maza and Esikhunjini) in the 1700's and lived at Erholweni from AD1839 to AD1883 where the Ndzundza-Ndebele's sphere of influence known as KoNomthjarhelo stretched across the Steenkampsberge.
- The Bakopa lived at Maleoskop (1840 to 1864) where they were massacred by the Swazi while the Bantwane live in the greater Groblersdal and Marble Hall areas.
- Corbelled stone huts which are associated with ancestors of the Sotho on Tafelkop near Davel which date from the AD1700's into the nineteenth century (Hoernle 1930).
- Stone walled settlements spread out along the eastern edge of the Groot Dwarsriver Valley served as the early abode for smaller clans such as the Choma and Phetla communities which date from the nineteenth century.

### **5.3 The Historical Period**

Historical towns closest to the Project Area include Piet Retief and Ermelo.

Long before Ermelo came into being the area was frequented by travellers moving between Lydenburg and Natal. The area was well watered and dotted with lakelets and attracted settlers from Lydenburg and elsewhere. The reverend Lion Cachet of Utrecht began to hold regular services on several of the new farms.

In AD1880 a village was proclaimed on the farm Nooitgedacht. The town was named for Ermelo in Gelderland, Holland and was managed by the Dutch Reformed Church until 1895 when the Transvaal government took over. In 1901, during the Anglo-Boer War, the town was completely destroyed by the British. The town was rebuilt from scratch after 1903. Today Ermelo is the educational, communications, industrial and commercial centre for an intensely farmed district. Coal is mined by several large mines and Ermelo lies on the railway line between the Highveldt coal fields and the bulk export harbour of Richards Bay on Kwa Zulu-Natal's north coast.

Heritage sites in Ermelo include: a memorial near the Dutch Reformed Church in honour of the men from the town and district who fought and died in the Anglo Boer War; rock paintings in caves and rock shelters and the Paul Kruger Bridge across the Vaal River which was built in 1897 by the celebrated architect, Sytze Wierda.

#### **5.4 A coal mining heritage**

Coal mining on the Eastern Highveld is now older than one century and has become the most important coal mining region in South Africa. Whilst millions of tons of high-grade coal are annually exported overseas more than 80% of the country's electricity is generated on low-grade coal in Eskom's power stations such as Duvha, Matla and Arnot situated near coalmines on the Eastern Highveld.

The earliest use of coal (charcoal) in South Africa was during the Iron Age (300-1880AD) when metal workers used charcoal, iron and copper ores and fluxes (quartzite stone and bone) to smelt iron and copper in clay furnaces.

Colonists are said to have discovered coal in the French Hoek Valley near Stellenbosch in the Cape Province in 1699. The first reported discovery of coal in the interior of South Africa was in the mid-1830 when coal was mined in Kwa Zulu/Natal.

The first exploitation for coal was probably in Kwa Zulu/Natal as documentary evidence refers to a wagon load of coal brought to Pietermaritzburg to be sold in 1842. In 1860 the coal trade started in Dundee when a certain Pieter Smith charged ten



shillings for a load of coal dug by the buyer from a coal outcrop in a stream. In 1864 a coal mine was opened in Molteno. The explorer, Thomas Baines mentioned that farmers worked coal deposits in the neighbourhood of Bethal (Transvaal) in 1868. Until the discovery of diamonds in 1867 and gold on the Witwatersrand in 1886, coal mining only satisfied a very small domestic demand.

With the discovery of gold in the Southern Transvaal and the development of the gold mining industry around Johannesburg came the exploitation of the Boksburg-Spring coal fields, which is now largely worked out. By 1899, at least four collieries were operating in the Middelburg-Witbank district, also supplying the gold mining industry. At this time coal mining also has started in Vereeniging. The Natal Collieries importance was boosted by the need to find an alternative for imported Welsh anthracite used by the Natal Government Railways.

By 1920 the output of all operating colliers in South Africa attained an annual figure of 9,5million tonnes. Total in-situ reserves were estimated to be 23 billion tonnes in Witbank-Springs, Natal and Vereeniging. The total in situ reserves today are calculated to be 121 billion tonnes. The largest consumers of coal are Sasol, Iscor and Eskom.

## **5.5 A vernacular stone architectural heritage**

A unique stone architectural heritage was established in the Eastern Highveld from the second half of the 19<sup>th</sup> century well into the early 20<sup>th</sup> century. During this time period stone was used to build farmsteads and dwellings, both in urban and in rural areas. Although a contemporary stone architecture also existed in the Karoo and in the Eastern Free State Province of South Africa a wider variety of stone types were used in the Eastern Highveld. These included sandstone, ferricrete ('oukclip'), dolerite ('bloukclip'), granite, shale and slate.

The origins of a vernacular stone architecture in the Eastern Highveld may be ascribed to various reasons of which the ecological characteristics of the region may be the most important. Whilst this region is generally devoid of any natural trees which could be used as timber in the construction of farmsteads, outbuildings, cattle enclosures and other structures, the scarcity of fire wood also prevented the manufacture of baked clay bricks.

Consequently stone served as the most important building material in the Eastern Highveld (Naude 1993, 2000). One of these historical structures were excavated and described after a heritage mitigation project was conducted for a coal mine (Pistorius 2005).

LIA Sotho, Pedi, Ndebele and Swazi communities contributed to the Eastern Highveld's stone walled architecture. The tradition set by these groups influenced settlers from Natal and the Cape Colony to utilize the same resources to construct dwellings and shelters. Farmers from Scottish, Irish, Dutch, German and Scandinavian descend settled and farmed in the Eastern Highveld. They brought the knowledge of stone masonry from Europe. This compensated for the lack of fire wood on the eastern Highveld which was necessary to bake clay bricks.

## **6 THE PHASE I HERITAGE IMPACT ASSESSMENT**

### **6.1 Types and ranges of heritage resources**

The Phase I HIA for the proposed Project Area revealed the following types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act (No 25 of 1999), namely:

- Remains from the historical period in and near the Project Area.
- Informal graveyards and graves in and near the Project Area.

No pre-historical remains were recorded. This study also did not provide for a paleontological study.

The graveyards and historical remains were geo-referenced and mapped (Figures 8, 9 & 20).

The significance of these heritage resources is indicated as well as mitigation measures should any of these heritage resources be affected by the proposed Kangra Project (Tables 3-5).

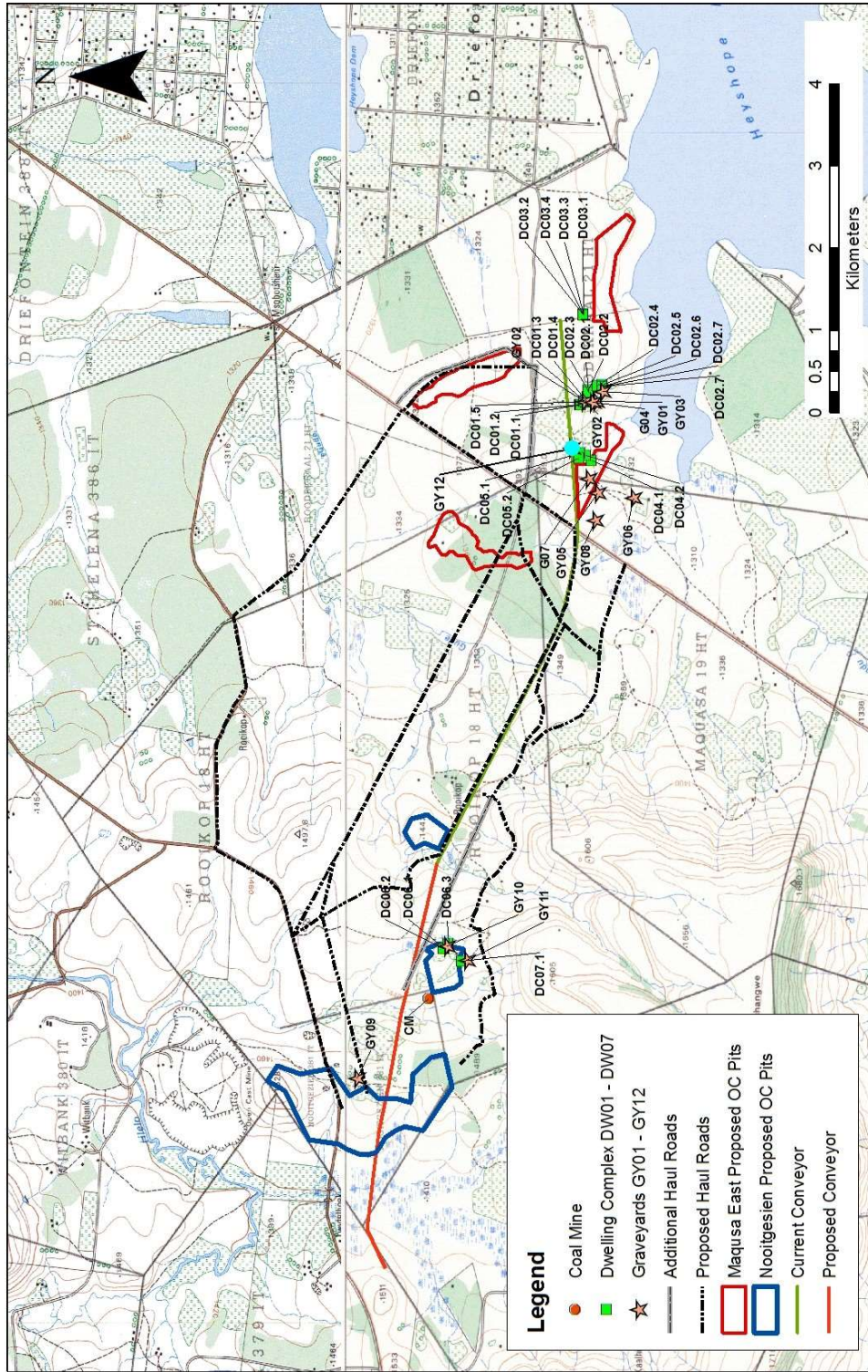


Figure 8 - Kangra Coal's Project Area between Ermelo and Piet Retief near the Heyshope Dam in the Mpumalanga Province.

Note the presence of heritage resources such as graveyards, graves and historical remains in and near the Project Area (above).

## **6.2 Historical remains**

Historical remains consisting of small villages occur in and near the Project Area. These villages comprise of remains consisting of dwellings and enclosures for stock such as cattle kraals and enclosures for smaller stock (sheep and/or goat).

These dwellings and enclosures were constructed with dolerite stone which was collected from dolerite dykes as well as from outcrops of ferricrete. These dwelling complexes cover small surface areas and in most instances are associated with one or more informal graveyard.

It seems as if these villages were occupied by one or more extended families, probably during the latter part of the nineteenth century well into the twentieth century.

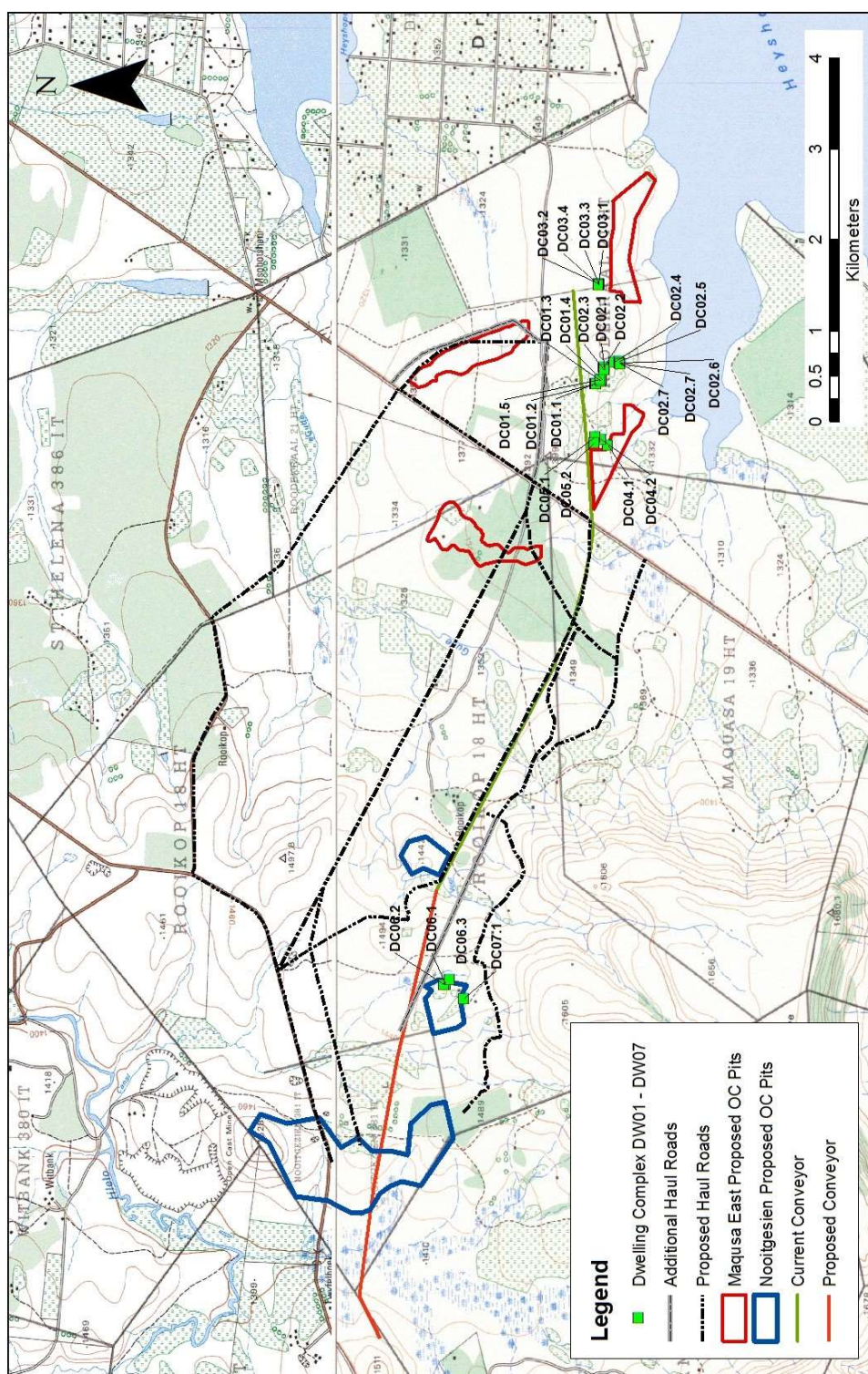
The following historical remains were recorded, namely ) (Figure 9):

### **6.2.1 Dwelling Complex 01**

This complex of structures include the following remains, namely:

- A foundation consisting of dolerite and ferricrete stone with an elongated ground plan which measures 5x2m (DC01.1).
- A rectangular foundation measuring 9mx9m which was constructed with a double row of dolerite stone with rubble as infill material between these walls (DC01.2). A monolith was erected inside one of the walls of this structure.
- A large cattle enclosure which was constructed with dolerite stone and with a diameter of 40m (DC01.3).
- A circular house foundation which was constructed with a double row of sandstone and with rubble as infill material between these walls. The diameter of the dwelling is 6m (DC01.4).
- A second circular foundation which was constructed with upright stones of which one half of the foundation was robbed. The diameter of this dwelling is approximately 6m (DC01.5).







**Figures 10 & 11– An elongated foundation for a possible dwelling which was constructed with dolerite and ferricrete (above). A large circular stone-built enclosure in which cattle was penned (below).**





### 6.2.2 Dwelling Complex 02

This complex of structures include the following remains, namely:

- One half of the remains of an enclosure which was constructed with dolerite stone. The diameter of the enclosure is 35m (DC02.1).



**Figure 12 & 13- Circular enclosure constructed with dolerite stone of which one half is missing (above).**

- Stones which are randomly scattered and which possibly represents the disturbed remains of a dwelling's foundation (DC02.2).
- One half of the remains of an enclosure which was constructed with dolerite stone. The enclosure was constructed with a double row of dolerite stones and was filled in with rubble. The enclosure's diameter is 30m (DC02.3).
- Randomly scattered stones which probably represents the disturbed remains of a dwelling's foundation (DC02.4).
- Part of a cattle enclosure which was constructed with dolerite stone (DC02.5).
- Circular hut foundation constructed with upright ferricrete stones and with a diameter of 4.5m (DC02.6).



**Figure 14- Circular foundations for dwellings such as huts which were constructed with ferricrete stone (above).**

- Circular hut foundation constructed with upright ferricrete stones and with a diameter of 4,5m (DC02.7).

### **6.2.3 Dwelling Complex 03**

This dwelling complex consists of structures which were constructed with small stones. The structures are not well preserved and in several instances not interpretable. The following structures were distinguished, namely:

- Possible cattle enclosure with a diameter of 20m (DC03.1).
- Piles of stones (DC03.2).
- Pile of stones (DC03.3).
- Pile of stones (DC03.4).



**Figure 15- Piles of stone which were part of a dwelling which occurred in a dwelling complex (above).**

#### **6.2.4 Dwelling Complex 04**

Structures in this dwelling complex was constructed with small stones. The structures are not well preserved and in most instances not interpretable, namely:

- Dilapidated small enclosure with a diameter of 1,5m (DC04.1).
- Small enclosure with a diameter of 0,5m (DC04.2).

#### **6.2.5 Dwelling Complex 05**

Structures in this dwelling complex was constructed with small stones and the structures are not well preserved, namely:

- Pile of stones (DC05.1)
- Small dolerite enclosure with a diameter of 5,0m (DC05.2).



### 6.2.6 Dwelling Complex 06

This dwelling complex is associated with GY10 and the following structures, namely:

- A large cattle enclosure which was constructed with dolerite stone and which was partly sunk into the earth. The diameter of this enclosure is approximately 40m (DC06.1)
- A smaller enclosure which is also partly sunk into the surface. The diameter of this enclosure is 6,0m (DC06.1).
- A circular foundation for a dwelling consisting of a double row of stones. The double wall was filled in with rubble. The diameter of this structure is 3,0m (DC06.3).



**Figure 16- A large enclosure which was constructed with dolerite stone. Its double wall was filled-in with rubble. This structure is partly sunk into the surface of the land (above).**

### **6.2.7 Dwelling Complex 07**

The remains of this dwelling complex is limited to GY11 and a dolerite enclosure (DC07.1). The enclosure's diameter is approximately 40m.

### **6.2.8 Possible historical coal mine**

The remains of what seems to be a possible coal mine (CM) was recorded against a steep slope in the Project Area. Several shallow excavations next to a sandstone bank suggest that coal may have been mined here at an early period, perhaps during the early 20th century and possibly earlier as well. At least two lower grinding stones occur near one of these excavations.



**Figure 17- Two shallow excavations where coal was mined against a sandstone embankment in the Project Area (above).**

It is not clear when these mining activities occurred. However, the presence of lower grinding stones emphasises the possibility that these activities occurred a long time ago and that the mining activities most likely have historical significance.



**Figure 18- Lower grinding stones which occur next to the shallow excavations where coal was mined against a steep slope in the Project Area (above).**

#### 6.2.9 Table

Table outlining the coordinates and significance rating for historical remains.

Historical remains	Coordinates	Significance
<u>Dwelling Complex 01</u>		
(DC01.1) Elongated ferricrete foundation	27° 01.549' 30° 24.373'	<b>Low</b>
(DC01.2) Dolerite foundation for a possible dwelling	27° 01.555' 30° 24.377'	
(DC01.3) Cattle enclosure	27° 01.586' 30° 24.391'	
(DC01.4) Circular house foundation	27° 01.590' 30° 24.402'	
(DC01.5) Upright stones on half circle circumference (dwelling foundation?)	27° 01.579' 30° 24.398'	
<u>Dwelling Complex 02</u>		
(DC02.1) Half circular structure such as a possible house foundation?	27° 01.603' 30° 24.459'	<b>Low</b>
(DC02.2) Few scattered dolerite stones	27° 01.602' 30° 24.475'	

(DC02.3) Cattle enclosure (part of wall robbed)	27° 01.118' 30° 24.489'	
(DC02.4) Scattered stones	27° 01.663' 30° 24.503'	
(DC02.5) Cattle enclosure (parts of wall robbed)	27° 01.696' 30° 24.506'	
(DC02.6) Circular ferricrete hut foundation	27° 01.695' 30° 24.498'	
(DC02.7) Circular ferricrete hut foundation	27° 01.697' 30° 24.495'	
<u>Dwelling Complex 03</u>		<b>Low</b>
(DC03.1) Possible cattle enclosure or circular dwellings foundation	27° 01.571' 30° 23.975'	
(DC03.2) Pile of small stones	27° 01.574' 30° 24.966'	
(DC03.3) Pile of small stones	27° 01.572' 30° 24.968'	
(DC03.4) Pile of small stones	27° 01.571' 30° 24.964'	
<u>Dwelling Complex 04</u>		<b>Low</b>
(DC04.1) Dilapidated small enclosure	27° 01.625' 30° 24.012'	
(DC04.2) Small dolerite enclosure (associated with random occurring small piles of stone)	27° 01.587' 30° 24.044'	
<u>Dwelling Complex 05</u>		<b>Low</b>
(DC05.1) Pile of stones	27° 01.550' 30° 24.057'	
(DC05.2) Small dolerite enclosure	27° 01.546' 30° 24.025'	
<u>Dwelling Complex 06</u>		<b>Low</b>
(DC06.1) Large enclosure sunk into ground	27° 00.661' 30° 20.806'	
(DC06.2) Small enclosure sunk into ground	27° 00.654' 30° 20.806'	
(DC06.3) Circular dwelling foundation	27° 00.686' 30° 20.838'	
<u>Dwelling Complex 07</u>		<b>Low</b>
(DC07.1) Large dolerite enclosure	27° 00.773' 30° 20.724'	
<u>Coal Mine</u>		<b>Low</b>
(CM)	27° 00.557' 30° 20.476'	



**Table 1- Coordinates for historical farmstead complexes in and near the Project Area (above).**

### **6.3 Graveyards**

At least twelve graveyards were recorded in and near the Project Area (Figure 20).

It seems as if all or most of the graveyards hold graves older than sixty years.

#### **6.3.1 Graveyard 01**

This graveyard (GY01) is associated with historical remains comprising the foundations of structures such as dwellings. GY01 holds approximately fifteen graves which are all covered with piles of dolerite stone. One grave is edged with cement strips and is fitted with a cement slab with the following inscription:

- 'Nthobane Lienn Mabnang Wazaalwa 1914 Washona 02-12-1993'



**Figure 19- GY01 holds fifteen graves which are covered with piles of dolerite stone (above).**



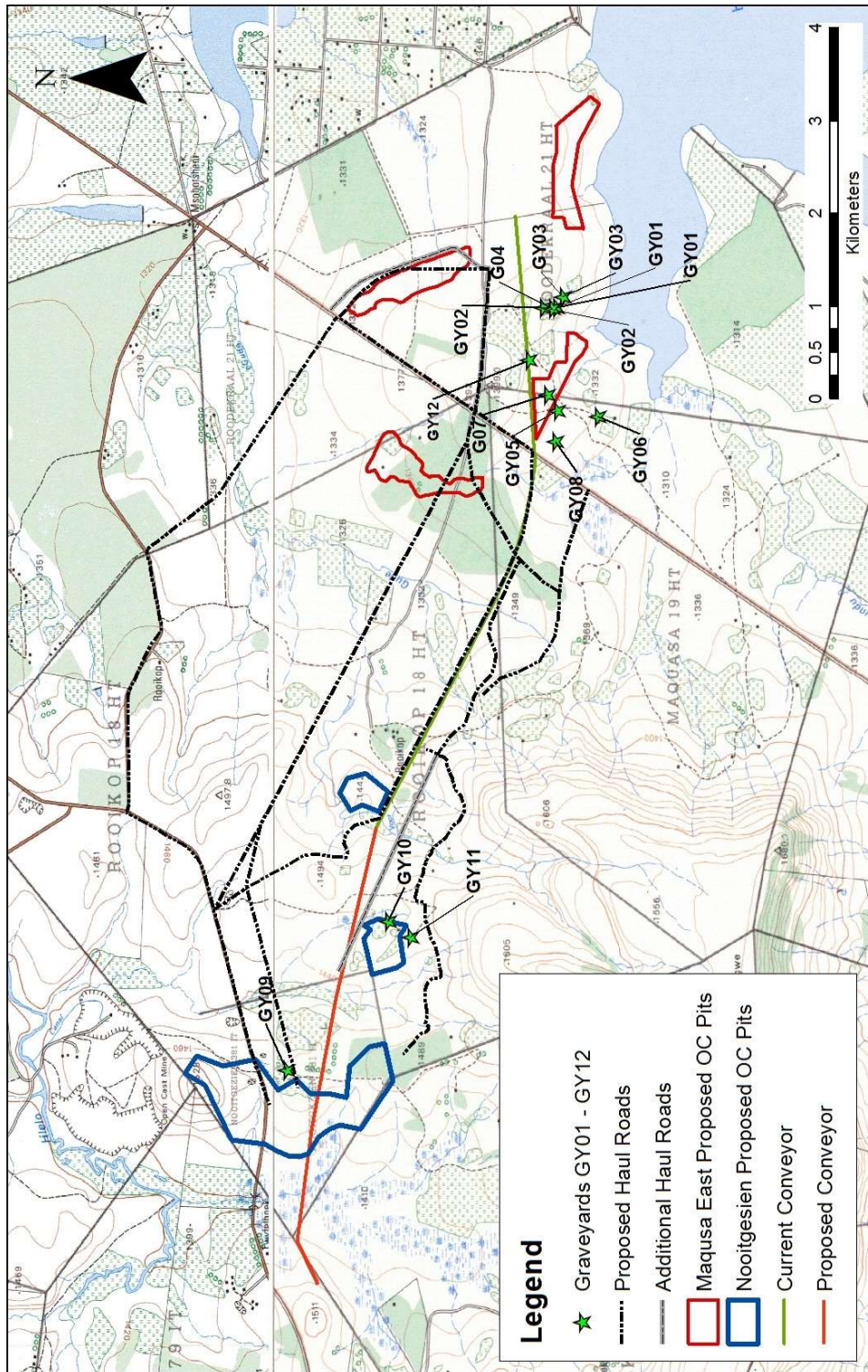


Figure 20 - Kangra Coal's Project Area between Ermelo and Piet Retief near the Heyshope Dam in the Mpumalanga Province.

Note the presence of heritage resources such as historical remains and graveyards and graves recorded in the Project Area (above).

### **6.3.2 Graveyard 02**

This graveyard (GY02) holds approximately eleven graves which are all covered with piles of stone.



**Figure 21- GY02 holds eleven graves which are covered with piles of dolerite stone (above).**

### **6.3.3 Graveyard 03**

GY03 comprises five graves which are covered with piles of ferricrete stone.

### **6.3.4 Grave 04**

This single grave (G04) is probably part of the complex of historical remains and graveyards which occur in an area up the higher banks of the Heyshope dam.

### 6.3.5 Graveyard 05

This isolated graveyard (GY05) holds six graves of which one is fitted with a granite headstone. This grave was relocated some time in the past by Kangra Coal.

The inscription on the headstone reads as follow:

- ‘ In loving memory of Kanyesile Madonsela R.I.P Relocated by Kangra Coal’



**Figure 22- GY05 holds eleven graves which are covered with piles of dolerite stone (above).**

### 6.3.6 Graveyard 06

This isolated graveyard (GY06) holds twenty seven graves of which four are fitted with granite headstones. These graves were all relocated by Kangra Coal sometime in the past. The inscription on one of the headstone reads as follow:

- ‘ In loving memory of grandfather Yende RIP Relocated by Kangra Coal’



### 6.3.7 Grave 07

This single grave (G07) comprises an elongated pile of dolerite stones.

### 6.3.8 Graveyard 08

GY08 is demarcated with a heavy dolerite stone wall. It holds approximately sixteen graves of which only one grave is fitted with a cement head stone.



**Figure 23- GY08 holds approximately sixteen graves which are covered with piles of dolerite stone. This graveyard is demarcated with a heavy dolerite stone wall (above).**

### 6.3.9 Graveyard 09

This graveyard (GY08) is demarcated with a heavy dolerite stone wall. It holds six graves of which four are fitted with granite head stones.

The inscription on one of these head stones read as follows:

- ‘ Isikhunbozo Sila Goso Ugotshwayo Phakathi Washona 1954 Lala ngoxolo’



**Figures 24 & 25- GY09 holds six graves of which four are fitted with granite headstones and trimmings (above). GY10 holds four graves which are all covered with piles of stone (below).**





#### **6.3.10 Graveyard 10**

This graveyard (GY10) is associated with historical remains such as a large and smaller enclosure which both are buried beneath the surface.

GY10 holds four graves which are all covered with piles of stone.

#### **6.3.11 Graveyard 11**

This graveyard (GY11) is associated with an informal dwelling that is currently being occupied as well as with historical remains such as a large enclosure.

GY11 comprises of at least fifteen graves which are all covered with piles of stone.



**Figure 26- GY11 is located near a hamlet. It comprises of at least fifteen graves which are covered with piles of stone (above).**

### 6.3.12 Graveyard 12

GY12 is located directly adjacent (south) of the conveyer which runs between the Maquasa East Mining Area and the Maquasa West Mining Area.

This graveyard holds eight graves which are all covered with piles of stone.

### 6.3.13 Tables

Table outlining the coordinates and significance rating for graveyards.

Graveyards	Coordinates	Significance
GY01. Approximately 15 graves covered with dolerite stones	27° 01.655' 30° 24.397'	HIGH
GY02. Approximately 11 graves covered with dolerite stones	27° 01.579' 30° 24.398'	HIGH
GY03. Approximately 5 graves covered with ferricrete stones	27° 01.696' 30° 24.462'	HIGH
G04. Single grave edged with large upright dolerite stones	27° 01.633' 30° 24.392'	HIGH
GY05. Isolated graveyard with 6 graves. Holds one relocated grave with granite headstone	27° 01.662' 30° 23.795'	HIGH
GY06. Isolated graveyard with 27 graves. Holds four relocated graves with granite headstones	27° 01.899' 30° 23.764'	HIGH
G07. Single grave covered with elongated pile of dolerite stones	27° 01.605' 30° 23.891'	HIGH
GY08. Holds approximately 16 graves which are demarcated with stone wall	27° 01.650' 30° 23.617'	
GY09. Holds 6 graves of which 4 are fitted with granite headstones. Demarcated with dolerite stone wall	27° 00.087' 30° 19.956'	HIGH

GY10. Holds 4 graves covered with dolerite stones	27° 00.676' 30° 20.825'	<b>HIGH</b>
GY11. Holds approximately 15 graves which are covered with dolerite stones	27° 00.810' 30° 20.731'	<b>HIGH</b>
GY12. Next to conveyer. Holds 8 graves covered with dolerite stone	27° 01.512' 30° 24.108'	<b>HIGH</b>

**Table 2- Coordinates for graveyards in the Project Area (above).**

## **7 THE SIGNIFICANCE, POSSIBLE IMPACT ON AND THE MITIGATION OF THE HERITAGE RESOURCES**

### **7.1 The significance of the heritage resources**

The historical remains and graveyards will be negatively affected when the proposed Kangra Project is implemented during the construction phase.

The significance of the heritage resources therefore has to be indicated as well as mitigation measures for those heritage resources which will be affected by the proposed Kangra Project.

The significance of the impacts on the heritage resources was determined using a ranking scale, based on the following:

- Occurrence
  - Probability of occurrence (how likely is it that the impact may/will occur?), and
  - Duration of occurrence (how long may/will it last?)
- Severity
  - Magnitude (severity) of impact (will the impact be of high, moderate or low severity?), and
  - Scale/extent of impact (will the impact affect the national, regional or local environment, or only that of the site?).

Each of these factors has been assessed for each potential impact using the following ranking scales:

Probability: 5 – Definite/don't know 4 – Highly probable 3 – Medium probability 2 – Low probability	Duration: 5 – Permanent 4 - Long-term (ceases with the operational life) 3 - Medium-term (5-15 years)
---	--

1 – Improbable 0 – None	2 - Short-term (0-5 years) 1 – Immediate
Scale: 5 – International 4 – National 3 – Regional 2 – Local 1 – Site only 0 – None	Magnitude: 10 - Very high/don't know 8 – High 6 – Moderate 4 – Low 2 – Minor

The environmental significance of each potential impact was assessed using the following formula:

$$\text{Significance Points (SP)} = (\text{Magnitude} + \text{Duration} + \text{Scale}) \times \text{Probability}$$

The maximum value is 100 Significance Points (SP). Potential environmental impacts are rated as very high, high, moderate, low or very low significance on the following basis:

- More than 80 significance points indicates VERY HIGH environmental significance.
- Between 60 and 80 significance points indicates HIGH environmental significance.
- Between 40 and 60 significance points indicates MODERATE environmental significance.
- Between 20 and 40 significance points indicates LOW environmental significance.
- Less than 20 significance points indicates VERY LOW environmental significance.

#### **7.1.1 The historical remains**

All buildings and features older than sixty years are considered to be of historical significance and are protected by Section 34 and Section 38 of the National Heritage



Resources Act (No 25 of 1999). The historical remains can be considered to be of low significance when considering criteria such as the following (Table 1):

- These remains are common across the Eastern Highveld (although being threatened on an increasing scale due to general development).
- These remains do not have any educational, research, aesthetical or any other significance which warrants their continued existence, conservation or even future use (e.g. as a historical site [open air museum]).
- The remains have been adequately documented for future reference during the Phase I HIA study.

<b>Significance rating</b>	<b>Criteria for significance rating</b>	<b>Mitigation/Management Measures</b>
<b>High (3)</b>	National/provincial value Educational, research, aesthetical conservation value Future use	Conserve unaffected for posterity (preferably) <i>in situ</i>
<b>Medium (2)</b>	Provincial value Medium educational, research, aesthetical conservation value No future use	Phase II investigation before demolishing. Permitting required
<b>Low (1)</b>	Local and site specific value Low educational, research, aesthetical conservation value No future use	Document during Phase I HIA Demolish during construction. No permitting required

**Table 3- Significance rating for historical remains in the Project Area (above).**

### **7.1.2 The graveyards**

All graveyards and graves can be considered to be of high significance and are protected by various laws (Table 2). Legislation with regard to graves includes Section 36 of the

National Heritage Resources Act (No 25 of 1999) whenever graves are older than sixty years. The act also distinguishes various categories of graves and burial grounds. Other legislation with regard to graves includes those which apply when graves are exhumed and relocated, namely the Ordinance on Exhumations (No 12 of 1980) and the Human Tissues Act (No 65 of 1983 as amended).

## 7.2 Possible impact on the heritage resources

It is highly likely that historical remains DC03 to DC07 and graveyards GY05, GY07, GY09, GY0110 and GY11 will be directly affected (destroyed) by the Kangra Project whilst the historical remains DC01, DC02 and DC03 and graveyards GY01, GY02, GY03, G04, GY06 and GY08 may only be impacted indirectly by the Kangra Project.

The impact on the heritage resources will occur during the construction phase as the removing of top soil to commence with mining occur at the onset of the Kangra Project.

The significance of the impact on the heritage resources therefore have to be indicated.

### 7.2.1 The historical remains

The significance of the impact on the historical remains is outlined in Tables 4(a) and 4(b).

Historical Remains	Probability of project impacting on site(s)	Magnitude if project impacts on site(s)	Duration if project impacts on site(s)	Scale if project impacts on site(s)	Significance points	Significance rating
<b>DC03 to DC07 and CM</b>	<b>5</b>	<b>10</b>	<b>5</b>	<b>1</b>	<b>90</b>	<b>VERY HIGH</b>

**Table 4(a)- The significance of the impact on historical remains that will be directly affected (destroyed) by the Kangra Project.**

Historical Remains	Probability of project impacting on site(s)	Magnitude if project impacts on site(s)	Duration if project impacts on site(s)	Scale if project impacts on site(s)	Significance points	Significance rating
<b>DC01-DC02</b>	<b>5</b>	<b>8</b>	<b>5</b>	<b>1</b>	<b>70</b>	<b>HIGH</b>

**Table 4(b)- The significance of the impact on historical remains that will be indirectly affected by the Kangra Project.**

### **7.2.2 The graveyards**

The significance of the impacts on the graveyards and graves is outlined in Tables 5(a) and 5(b).

Graveyards and graves	Probability of project impacting on this site	Magnitude if project impacts on this site	Duration if project impacts on this site	Scale if project impacts on this site	Significance points	Significance rating
GY05, GY07 GY09 GY10, GY11	<b>5</b>	<b>10</b>	<b>5</b>	<b>1</b>	<b>90</b>	<b>VERY HIGH</b>

**Table 5(a)- The significance of the impact on graveyards that will be directly affected (destroyed) by the Kangra Project.**

Graveyards and graves	Probability of project impacting on this site	Magnitude if project impacts on this site	Duration if project impacts on this site	Scale if project impacts on this site	Significance points	Significance rating
GY01, GY02 GY03, G04 GY06	<b>5</b>	<b>8</b>	<b>5</b>	<b>1</b>	<b>70</b>	<b>HIGH</b>

**Table 5(b)- The significance of the impact on graveyards and graves that will be indirectly affected by the Kangra Project.**

### **7.3 Mitigating the heritage resources**

The following mitigation measures have to be applied to the historical remains and graveyards and graves which will be affected directly or indirectly during the construction phase for the proposed Kangra Project, namely:

#### **7.3.1 The historical remains**

These remains have low significance and have been described; geo-referenced; tabulated; mapped on a 1:50 000 topographical map and have been photographed, the evidence of which is provided in this report. These remains therefore have been adequately documented for future reference by any researcher or interested person seeking knowledge about the early occupation, life-ways, settlement patterns and traditions on the Eastern Highveld during the early twentieth century.

As these remains have been documented in this Phase I HIA study Kangra needs not to apply for a demolishing permit from SAHRA for these remains that will be directly (destroyed) or indirectly affected in order to make way for the proposed Kangra Project.

#### **7.3.2 The graveyards**

It seems as if some or all of the graveyards and graves may hold graves which are older than sixty years. The graveyards and graves can be mitigated in two ways depending on whether they may be affected, directly or indirectly, namely:

- By means of exhumation and relocation when graveyards are affected directly (GY05, GY07, GY09, GY10 and GY11). The exhumation of human remains and the relocation of graveyards are regulated by various laws, regulations and administrative procedures. This task is undertaken by forensic archaeologists or by reputed undertakers who are acquainted with all the administrative procedures and relevant legislation that have to be adhered to whenever human remains are exhumed and relocated. This process also includes social consultation with a 60 days statutory notice period for graves older than sixty years. Permission for the exhumation and relocation of human remains have to

be obtained from the descendants of the deceased (if known), the National Department of Health, the Provincial Department of Health, the Premier of the Province and the local police.

- Graveyards can be demarcated with brick walls or with fences when they are affected indirectly and not in any physical way (GY01, GY02, GY03, G04, GY06, GY08). Conserving graveyards *in situ* in mining areas create the risk and responsibility that they may be damaged, accidentally, that the mine remains responsible for the graveyards' future unaffected existence, maintenance and that controlled access must exist for any relatives or friends who wish to visit the deceased. Safe corridors not less than 15m wide therefore must be maintained between graveyards and mining related activities and the graveyards and graves must be fenced-off. A Conservation Management Plan for the ongoing protection of these graveyards and graves must be included in the Environmental Management Plan for the mine.



## **8 CONCLUSION AND RECOMMENDATIONS**

The Phase I HIA for the proposed Project Area revealed the following types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act (No 25 of 1999), namely:

- Remains from the historical period in and near the Project Area.
- Informal graveyards and graves in and near the Project Area.

No pre-historical remains were recorded. This study also did not provide for a paleontological study.

The graveyards and historical remains were geo-referenced and mapped (Figures 8, 9 & 20).

### **The significance of the heritage resources**

The historical remains and graveyards will be negatively affected when the proposed Kangra Project is implemented during the construction phase.

The significance of the heritage resources therefore has to be indicated as well as mitigation measures for those heritage resources which will be affected by the proposed Kangra Project.

The significance of the impacts on the heritage resources was determined using a ranking scale.

### **The historical remains**

All buildings and features older than sixty years are considered to be of historical significance and are protected by Section 34 and Section 38 of the National Heritage Resources Act (No 25 of 1999). The historical remains can be considered to be of low significance when considering criteria such as the following (Table 1):

- These remains are common across the Eastern Highveld (although being threatened on an increasing scale due to general development).

- These remains do not have any educational, research, aesthetical or any other significance which warrants their continued existence, conservation or even future use (e.g. as a historical site [open air museum]).
- The remains have been adequately documented for future reference during the Phase I HIA study.

### **The graveyards**

All graveyards and graves can be considered to be of high significance and are protected by various laws (Table 2). Legislation with regard to graves includes Section 36 of the National Heritage Resources Act (No 25 of 1999) whenever graves are older than sixty years. The act also distinguishes various categories of graves and burial grounds. Other legislation with regard to graves includes those which apply when graves are exhumed and relocated, namely the Ordinance on Exhumations (No 12 of 1980) and the Human Tissues Act (No 65 of 1983 as amended).

### **Possible impact on the heritage resources**

It is highly likely that historical remains DC03 to DC07 and graveyards GY05, GY07, GY09, GY0110 and GY11 will be directly affected (destroyed) by the Kangra Project whilst the historical remains DC01, DC02 and DC03 and graveyards GY01, GY02, GY03, G04, GY06 and GY08 may only be impacted indirectly by the Kangra Project.

The impact on the heritage resources will occur during the construction phase as the removing of top soil to commence with mining occur at the onset of the Kangra Project.

The significance of the impact on the heritage resources therefore has to be indicated.

### **The historical remains**

The significance of the impact on the historical remains is outlined in Tables 4(a) and 4(b).

### **The graveyards**

The significance of the impacts on the graveyards and graves is outlined in Tables 5(a) and 5(b).

### **Mitigating the heritage resources**

The following mitigation measures have to be applied to the historical remains and graveyards and graves which will be affected directly or indirectly during the construction phase for the proposed Kangra Project, namely:

#### **The historical remains**

These remains have low significance and have been described; geo-referenced; tabulated; mapped on a 1:50 000 topographical map and have been photographed, the evidence of which is provided in this report. These remains therefore have been adequately documented for future reference by any researcher or interested person seeking knowledge about the early occupation, life-ways, settlement patterns and traditions on the Eastern Highveld during the early twentieth century.

As these remains have been documented in this Phase I HIA study Kangra Coal needs not to apply for a demolishing permit from SAHRA for these remains that will be directly (destroyed) or indirectly affected in order to make way for the proposed Kangra Project.

#### **The graveyards**

It seems as if some or all of the graveyards and graves may hold graves which are older than sixty years. The graveyards and graves can be mitigated in two ways depending on whether they may be affected, directly or indirectly, namely:

- By means of exhumation and relocation when graveyards are affected directly (GY05, GY07, GY09, GY10 and GY11). The exhumation of human remains and the relocation of graveyards are regulated by various laws, regulations and administrative procedures. This task is undertaken by forensic archaeologists or by reputed undertakers who are acquainted with all the administrative procedures and relevant legislation that have to be adhered to whenever human remains are exhumed and relocated. This process also includes social consultation with a 60 days statutory notice period for graves older than sixty years. Permission for the exhumation and relocation of human remains have to be obtained from the descendants of the deceased (if known), the National Department of Health, the Provincial Department of Health, the Premier of the Province and the local police.

- Graveyards can be demarcated with brick walls or with fences when they are affected indirectly and not in any physical way (GY01, GY02, GY03, G04, GY06, GY08). Conserving graveyards *in situ* in mining areas create the risk and responsibility that they may be damaged, accidentally, that the mine remains responsible for the graveyards' future unaffected existence, maintenance and that controlled access must exist for any relatives or friends who wish to visit the deceased. Safe corridors not less than 15m wide therefore must be maintained between graveyards and mining related activities and the graveyards and graves must be fenced-off. A Conservation Management Plan for the ongoing protection of these graveyards and graves must be included in the Environmental Management Plan for the mine.

## 9 SELECT BIBLIOGRAPHY

Bergh, J.S. (red.) 1998. *Geskiedenisatlas van Suid Afrika. Die vier noordelike provinsies*. J.L. van Schaik: Pretoria.

Delius, P. 1984. *The land belongs to us*. Raven Press: Johannesburg.

Delius, P. 2007. *Mpumalanga. History and Heritage*. CTP Book Printers: Cape Town.

Delius, P. & Hay, M. 2009. *Mpumalanga: an illustrated history*. Johannesburg: The Highveld Press.

Delius, P & Schoeman, A. Revisiting Bokoni: Populating the stone ruins of the Mpumalanga Escarpment. In Swanepoel, N., Esterhuisen, A. & Bonner, P. (eds.) *Five hundred years rediscovered. South African precedents and prospects*, 135-167.

Erasmus, B.P.J. 1995. *Oppad in Suid Afrika. 'n Gids tot Suid Afrika, Streek vir Streek*. Jonathan Ball Uitgewers Bpk.

Esterhuizen A. & Smith J. 2007. Stories in Stone. In Delius, P (ed). *Mpumalanga History and Heritage*. 41-64. Pietermaritzburg Kwa Zulu/Natal University Press.

Evers, T.M. 1981. The Iron Age in the Eastern Transvaal, South Africa. In Voight, E.A. (ed). *Guide to archaeological sites in Northern and Eastern Transvaal*. Pretoria: South African Association of Archaeologists, 64-109.

Grové, G. 1999. *Mapochseland en sy mense*. Published by Grietjie Grove: Roosenekal.

Hoernle, R.F. 1930. The stone hut settlements on Tafelkop near Bethal. *Bantu Studies*. 4, pp217-233.

Maggs, T.M. 2008. The Mpumalanga Escarpment settlements. In (Swanepoel, N., Esterhuisen, A. & Bonner, P. eds.) *Five hundred years rediscovered. South African precedents and prospects*. 169-182.



Makhura, T. 2007. Early inhabitants. In Delius, P. (ed). Mpumalanga. History and Heritage. University of Kwa Zulu Natal Press: Scottsville.

Makura, T. 2007. The pre-colonial histories of Mpumalanga communities. In Delius, P (ed). *Mpumalanga History and Heritage*. 91-136. Pietermaritzburg Kwa Zulu/Natal University Press.

Mason, R.J. 1968. Transvaal and Natal Iron Age settlement revealed by aerial photography and excavation. *African Studies*. 27:167-180.

Naude, M. 1993. The use of stone on farmsteads on the eastern Transvaal. *Africana Society of Pretoria* (11): 49-55.

Naude, M. 2000. Vernacular stone buildings and structures on farmsteads in the southern districts of the Mpumalanga Province. *South African Journal of Cultural History*. 14(2): 31-64.

Pistorius, J.C.C. 2008. A Phase I Heritage Impact Assessment (HIA) study for the proposed new Maquasa West open cast mine between Ermelo and Piet Retief in the Mpumalanga Province of South Africa. *Unpublished report prepared for Kangra Coal (Pty) Ltd*.

Pistorius, J.C.C. 2011. Kusipongo Expansion Project: A heritage base line study for proposed adit positions in a project area near the Heyshope Dam to the west of Piet Retief in the Mpumalanga Province of South Africa. *Unpublished report prepared for Kangra Coal (Pty) Ltd*.

Pistorius, J.C.C. 2012. A Phase I Heritage Impact Assessment (HIA) study for Kangra Coal's (Pty) Ltd (Kangra Coal Coal) proposed new Mining Areas for the Maquasa East and the Maquasa West Open Cast Minin operations near the Heyshope Dam between Ermelo and Piet Retief in the Mpumalanga Province of South Africa. *Unpublished report prepared for Ground Water Consulting Services*.

Potgieter, E.F. 1955. *The disappearing Bushmen of Lake Chrissie: A preliminary survey*. J. L. Van Schaik: Pretoria.

Prins, F.E. 2001. Rock art and motivation: the evidence from Magageng. *Pictogram*. 12: 14-18.

Pretorius, Fransjohan. 1999. *Life on commando during the Anglo Boer War 1899-1902*. Human & Rousseau: Cape Town.

Schoeman, M.H. 1997. *The Ndzundza archaeology of the Steelpoort river valley*. Unpublished MA dissertation. University of the Witwatersrand: Johannesburg.

Smith, B.W. & Zubieta, L. 2007. The power of ancient art. In Delius, P. (ed.) *Mpumalanga. History and Heritage*. University of Kwa Zulu Natal Press: Scottsville.

Schoonraad, M. & Beaumont, P. 1971. The Welgelegen Shelter, Eastern Transvaal. In Schoonraad M. (ed.). *Rock paintings of Southern Africa (Supplement to the South African Journal of Science*. Special Publication No. 2).

Schoonraad, M. & Schoonraad, E. 1975. Rotsskilderinge in die Oos Transvaalse Laeveld. In Barnard, C. (ed.) *Die Transvaalse Laeveld*. Cape Town: Tafelberg.

*The Ndzundza-Ndebele and the Mapoch caves*. Report issued by the KwaNdebele Monuments Commission (KMC), 1983. Cyro Print: Pretoria.

Van Jaarsveld, F.A. 1985. *Die Ndzundza-Ndebele en die Blankes in Transvaal 1845-1883*. Ongepubliseerde M.A. verhandeling. Rhodes Universiteit: Grahamstad.

Van Vuuren, C.J. 1983. *Die vestigingspatroon van die Suid-Ndebele*. Ongepubliseerde M.A. verhandeling. Universiteit van Pretoria: Pretoria.

Van Vuuren, C.J. 1992. *Die aard en betekenis van 'n eie etnisiteit onder die Suid-Ndebele*. Ongepubliseerde D.Phil proefskrif. Universiteit van Pretoria: Pretoria.

Whitelaw, G. 1996. Lydenburg revisited. Another look at the Mpumalanga Early Iron Age sequence. *South African Archaeological Bulletin*. 51.

Schapera, I. 1927. The Tribal Divisions of the Bushmen. *Man*. Published by the Royal Anthropological Institute of Great Britain and Ireland. 27, 68-73.

Van Hoepen, E.C.N. 19 1939. A pre-European Bantu culture in the Lydenburg district. *Argeologiese navorsing van die Nasionale Museum, Bloemfontein* 11(5):47-74.

## **APPENDIX A: DETAILS OF THE SPECIALIST**

**Profession:** Archaeologist, Museologist (Museum Scientists), Lecturer, Heritage Guide Trainer and Heritage Consultant

**Qualifications:**

BA (Archaeology, Anthropology and Psychology) (UP, 1976)

BA (Hons) Archaeology (distinction) (UP, 1979)

MA Archaeology (distinction) (UP, 1985)

D Phil Archaeology (UP, 1989)

Post Graduate Diploma in Museology (Museum Sciences) (UP, 1981)

**Work experience:**

Museum curator and archaeologist for the Rustenburg and Phalaborwa Town Councils (1980-1984)

Head of the Department of Archaeology, National Cultural History Museum in Pretoria (1988-1989)

Lecturer and Senior lecturer Department of Anthropology and Archaeology, University of Pretoria (1990-2003)

Independent Archaeologist and Heritage Consultant (2003-)

**Accreditation:** Member of the Association for Southern African Professional Archaeologists. (ASAPA)

**Summary:** Julius Pistorius is a qualified archaeologist and heritage specialist with extensive experience as a university lecturer, museum scientist, researcher and heritage consultant. His research focussed on the Late Iron Age Tswana and Lowveld-Sotho (particularly the Bamalatji of Phalaborwa). He has published a book on early Tswana settlement in the North-West Province and has completed an unpublished manuscript on the rise of Bamalatji metal workings spheres in Phalaborwa during the last 1 200 years. He has written a guide for Eskom's field personnel on heritage management. He has published twenty scientific papers in academic journals and several popular articles on archaeology and heritage matters. He collaborated with environmental companies in compiling State of the Environmental Reports for Ekurhuleni, Hartbeespoort and heritage management plans for the Magaliesberg and Waterberg. Since acting as an independent consultant he has done approximately 800 large to small heritage impact assessment reports. He has a longstanding working relationship with Eskom, Rio Tinto (PMC), Rio Tinto (EXP), Impala Platinum, Angloplats (Rustenburg), Lonmin, Sasol, PMC, Foskor, Kudu and Kelgran Granite, Bafokeng Royal Resources etc. as well as with several environmental companies.

## **APPENDIX E-7: WASTE CLASSIFICATION**



# Waste Classification Assessment Proposed Co-Disposal Facility at Kangra Maquasa East Operations

## Report

Version - Final 1  
17 November 2022

Kangra Coal

GCS Project Number: 22-0161\_waste

Client Reference: 111862



## Waste Classification Assessment Proposed Co-Disposal Facility at Kangra Maquasa East Operations

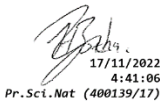

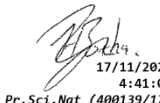
Report  
Version - Final 1



17 November 2022

Kangra Coal  
22-0161\_waste

### DOCUMENT ISSUE STATUS

Report Issue	Final 1		
GCS Reference Number	GCS Ref - 22-0161_waste		
Client Reference	111862		
Title	Waste Classification Assessment Proposed Co-Disposal Facility at Kangra Maquasa East Operations		
	Name	Signature	Date
Author	Hendrik Botha (MSc, PriSciNat)	 17/11/2022 4:41:06 Pr.Sci.Nat (400139/17)	17 November 2022
Proof-reader	Lisa Botha (BSc. Hons)		17 November 2022
Director	Hendrik Botha (MSc, PriSciNat)	 17/11/2022 4:41:06 Pr.Sci.Nat (400139/17)	17 November 2022

### LEGAL NOTICE

This report or any proportion thereof and any associated documentation remain the property of GCS until the mandator effects payment of all fees and disbursements due to GCS in terms of the GCS Conditions of Contract and Project Acceptance Form. Notwithstanding the aforesaid, any reproduction, duplication, copying, adaptation, editing, change, disclosure, publication, distribution, incorporation, modification, lending, transfer, sending, delivering, serving or broadcasting must be authorised in writing by GCS.

**DECLARATION OF INDEPENDENCE**

GCS (Pty) Ltd was appointed to conduct this waste assessment study and to act as the independent specialist. GCS objectively performed the work, even if this results in views and findings that are not favourable. GCS has the expertise in conducting the specialist investigation and does not have a conflict of interest in the undertaking of this study. This report presents the findings of the investigations which include the activities set out in the scope of work.

## EXECUTIVE SUMMARY

GCS Water and Environment (Pty) Ltd (GCS) was appointed by Kangra Coal (Pty) Ltd to undertake a waste classification assessment for the coal discard and coal slurry material that will be deposited at the proposed co-disposal facility at Maquasa East, near Driefontein, Mpumalanga Province. The project falls in quaternary catchment W51B of the Pongola to Mtamvuna Water Management Area (WMA) (DWS, 2016).

In summary, the waste streams could be typified as follows (GNR 635, 2013):

- ‘Kdiscard1’ (coal discard material)- Type 3 (Low Risk); and
- ‘kSlurry1’ (coal tailings/coal slurry material)- Type 3 (Low Risk).

Hydrocarbon assessment was excluded from the current investigation at the request of the client (not expected to occur in the samples).

None of the waste streams was flammable. Volatile particle sizes were very low.

Acute toxicity hazard classification, Category 5 was assigned to both streams investigated. Si and Al were also considered for both the oral and inhalation routes due to known toxicity effects.

Acute toxicity risk/hazard category results (please refer to Annexure B) based on the DEEEP protocols, were recorded as follows (Persoone, G, et. al., 2003):

- ‘KDiscard1’ - Class I (No lethal/sub-lethal hazard) (Wt % 0)
- ‘KSlurry1’ - Class II (Slight lethal/sub-lethal hazard) (Wt % 33).

It should be noted that it is not expected that the ingredients as recorded in the XRF test will leach in the same form or at the same concentrations. For a summary of SANS 10234 classification findings, please refer to Section 4.

The proposed co-disposal facility will be lined with a Class C Barrier, hence environmental risk will be zero if the barrier is installed correctly.

## CONTENTS PAGE

DECLARATION of Independence .....	3
Executive Summary.....	4
CONTENTS PAGE.....	v
List of Figures.....	v
List of Tables.....	vi
List of Appendices .....	vi
<b>1 Introduction .....</b>	<b>1</b>
1.1 Project background .....	1
1.1.1 Water Treatment Plant:.....	1
1.1.2 Co-Disposal Facility .....	2
1.2 Objectives .....	3
1.3 Scope of Work .....	3
1.4 Limitations of this classification .....	4
<b>2 Waste classification .....</b>	<b>6</b>
2.1 Definitions.....	6
2.2 Waste assessment screening criteria .....	8
2.2.1 Determining Waste Types.....	9
2.3 Waste assessment laboratory results .....	10
2.4 Geochemical assessment results .....	13
2.4.1 XRF Results.....	13
2.4.2 Waste assessment .....	14
2.5 Waste type determination (GNR 635, 2013).....	14
2.6 Pollution Barrier Requirements (GNR 636, 2013) .....	15
<b>3 SANS 10234 (2008) Classification - GHS .....</b>	<b>16</b>
3.1 Physical Hazards.....	16
3.2 Health Hazards .....	17
3.2.1 Toxicity Categories & Exposure Routes.....	17
3.2.2 A – Acute Toxicity.....	18
3.3 Background Information .....	20
3.3.1 A: Silica (Si).....	20
3.3.2 A: Aluminium (Al).....	21
3.3.3 B – Skin Corrosion & Skin Irritation .....	21
3.3.4 C – Eye Irritation and Damage to Eyes.....	22
3.3.5 D – Skin and/or Respiratory Sensitisation .....	22
3.3.6 E – Mutagenicity.....	23
3.3.7 F – Carcinogenicity.....	23
3.3.8 G – Reproductive Toxicity .....	24
3.3.9 H – Target Organ Systemic Toxicity – Single Exposure (SE) .....	25
3.3.10 I – Target Organ Systemic Toxicity – Repeated Exposure (RE).....	25
3.3.11 J - Hazardous to the Aquatic Environment.....	26
3.3.12 J (a) - Acute Aquatic Toxicity.....	27
3.3.13 J (b) - Chronic Aquatic Toxicity.....	27
<b>4 Conclusions .....</b>	<b>28</b>
<b>5 Bibliography .....</b>	<b>33</b>

## LIST OF FIGURES

Figure 1-1: Proposed WTP and possible brine evaporation pond.....	2
---	---



Figure 1-2: Proposed Co-Disposal Facility (Phase 1 already approved, Phase 2 & 3 will be co-disposal)	3
Figure 1-3: Site locality and drainage .....	5
Figure 2-1: Waste classification based on GN R. 634 of 2013 Waste Standards .....	10
Figure 2-2: Class C Barrier .....	16

## LIST OF TABLES

Table 2-1: TCT & LCT (TLCP Leach), 'KSlurry1', October 2022 .....	11
Table 2-2: TCT & LCT (TLCP Leach), 'KDiscard1', October 2022 .....	12
Table 2-3: XRF results for the representative samples collected in October 2022 .....	13
Table 2-4: Waste stream Compositions (XRF) .....	13
Table 2-5: Waste Types for Landfill Disposal .....	14
Table 2-6: Pollution barrier requirements as per GNR 636 (2013) .....	15
Table 3-1: Classification for 1.00% cut-off value where stipulated effects may arise ....	20
Table 3-2: Classification for 0.1% cut-off value where stipulated effects may arise .....	20
Table 3-3: Acute toxicity hazard categories - Aquatic Environment .....	27
Table 4-1: GHS classification summary, 'KDiscard1' stream, October 2022 .....	30
Table 4-2: GHS classification summary, 'KSlurry1' stream, October 2022 .....	31

## LIST OF APPENDICES

Appendix A: Laboratory Reports .....	35
Appendix B: Safety Data Sheets .....	61

## 1 INTRODUCTION

GCS Water and Environment (Pty) Ltd (GCS) was appointed by Kangra Coal (Pty) Ltd to undertake a waste classification assessment for the coal discard and coal slurry material that will be deposited at the proposed co-disposal facility at Maquasa East, near Driefontein, Mpumalanga Province (refer to Figure 1-3). The project falls in quaternary catchment W51B of the Pongola to Mtamvuna Water Management Area (WMA) (DWS, 2016).

### 1.1 Project background

Kangra Coal is an existing coal mine located in Driefontein, near Piet Retief, in the Mkhondo Local Municipality within the Gert Sibande District Municipality. The Maquasa East (MQE) operations include the historical opencast and underground operations. Kangra is proposing to construct a water treatment plant as well as a co-disposal facility at their Maquasa East operations. The treatment plant will be used to treat water from the existing decant point as well as any surplus water within the mining operations.

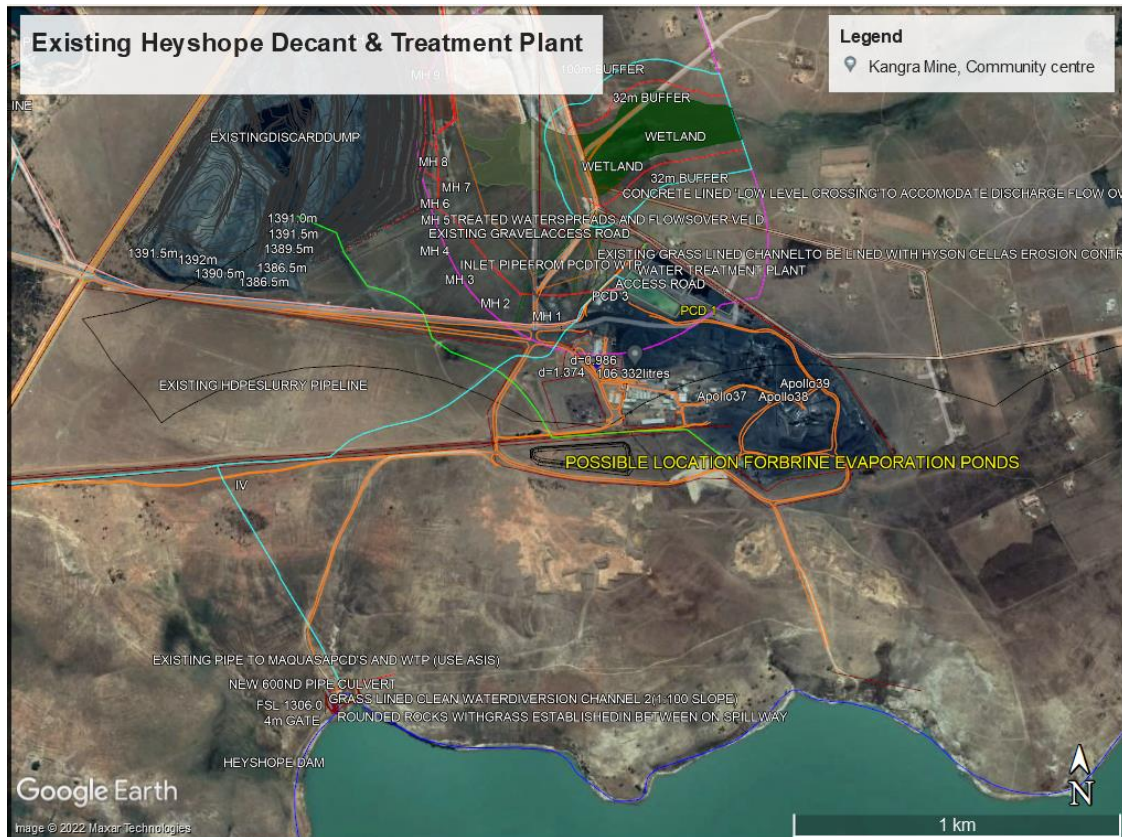
#### 1.1.1 Water Treatment Plant:

Decant is currently observed in the form of clear groundwater discharge emanating from the old underground workings at MQE close to the Heyshope Dam. This decant is observed at an elevation range of approx. 1303 to 1306 mamsl and is contained in an unlined contamination dam. This excess decant is currently pumped from the unlined dam back to the MQE PCDs. Based on available data from previous studies undertaken at the mine decant observed emanating from the old workings occurs at a rate ranging from 1 220 to 2 700 m<sup>3</sup>/d (average 1 800 m<sup>3</sup>/d), depending on the rainfall season.

Kangra intends to upgrade the current contamination dam with a correctly lined dam as approved by the Department of Water and Sanitation to prevent any seepages onto the Heyshope Dam. The decant will be pumped into the proposed wastewater treatment plant that will be situated close to the Maquasa East PCDs. Construction and operation of the discussed infrastructure will trigger listed activities that will require authorisation.

The master layout plan associated with the proposed water treatment plant and brine storage facilities proposed (and existing PCDs) is shown in Figure 1-1.

It should also be noted that Kangra is investigating the possibility of storing brine on the discard dump/co-disposal that will come from the water treatment plant. This is one of the two options, with the other being dedicated brine evaporation ponds. GCS has not yet received confirmation as to which option Kangra are opting for, thus impacts relating to both are considered in this assessment.



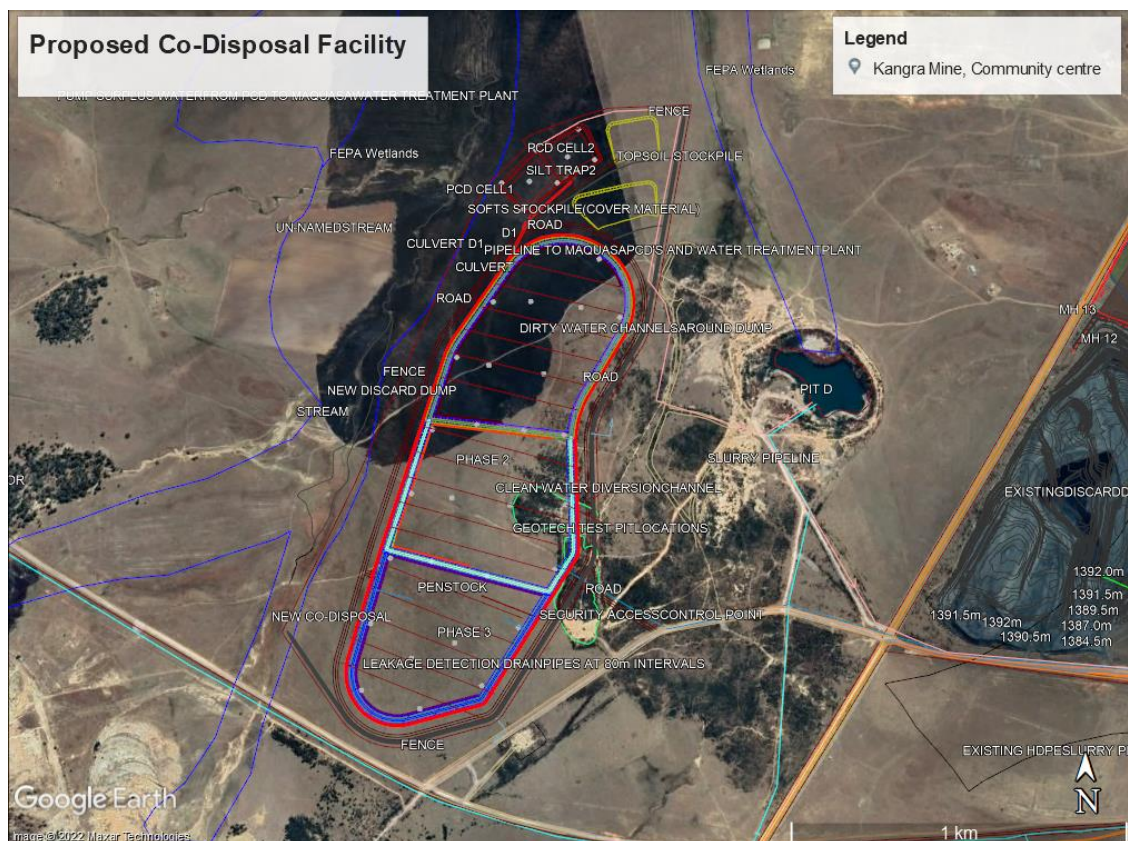
**Figure 1-1: Proposed WTP and possible brine evaporation pond**

### 1.1.2 Co-Disposal Facility

The discard dump at MQE has an approved environmental authorisation and a water use license. As a result of changing operational requirements, there is now a need for a co-disposal facility at MQE, this co-disposal facility is not authorised.

- The co-disposal facility will be located within the MQE operation on the remaining (RE) portion of the farm Rooikop 18 HT. The co-disposal facility will accommodate discarded produced from the beneficiation plant located at Maquasa East, which currently washes and processes coal from the surrounding Kangra Coal operations and will receive coal from future expansion areas.
- This discard dump was originally designed as a three-compartment side hill-type dump with a footprint of approximately 65ha. The three-compartment layout allows for a modular implementation approach with the benefit of delaying capital expenditure. The implementation of this project will be done in two phases:
  - Phase 1 will entail the use of the approved discard dump, and
  - Phases 2 and 3 will entail the use of a co-disposal facility that requires authorisations.

In the phases, the plan is to build the full waste dump over 20 years. Phase 1 (7 years capacity), Phase 2 (7 years capacity), and Phase 3 (6 years capacity). GFK are undertaking detailed designs of the dump, as well as stormwater sizing. The facility will be lined with an impermeable barrier. The layout plan for the co-disposal facility is shown in Figure 1-2.



**Figure 1-2: Proposed Co-Disposal Facility (Phase 1 already approved, Phase 2 & 3 will be co-disposal)**

## 1.2 Objectives

The objective of this report is to provide the classification data for coal discard and coal slurry waste streams designated for co-disposal. The reason for this classification is for compliance to regulatory stipulations & standards, whereby it will be assessed and determined if the waste stream contains hazardous components of concern and whether there would be an associated risk to the surrounding environment (physical, health and/or environmental) according to the classification standards, SANS 10234 (2008).

## 1.3 Scope of Work

The classification was conducted per the following regulatory stipulations:

- National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008), 1 July 2009.
- National Environmental Management: Waste Amendment Act, 2014 (Act No. 26 of 2014). GG37714, 2 June 2014.
- National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008). Waste Classification and Management Regulations, GG36784, GNR 634, 23 August 2013.

- National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008). National Norms and Standards for the Assessment of Waste for Landfill Disposal, GG36784, GNR 635, 23 August 2013.
- National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008). National Norms and Standards for Disposal of Waste to Landfill, GG36784, GNR 636, 23 August 2013.
- GGN39020 GNR 632 of July 2015: NEMWA Regulations regarding the planning and management of residue stockpiles and residue deposits from a prospecting mining, exploration or production operation
- South African National Standard. SABS Standards Division. Globally Harmonized System of Classification and labelling of chemicals (GHS). SANS 10234 (2008). Edition 1.1.

Assessment analyses were performed in alignment with the stipulations found in the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008), GG. 36784, GNR 635 National Norms & Standards for Assessment of Waste for Disposal to Landfill (2013) (Australian Standard Leaching Procedures (AS 4439.1 - 3, 1997 - 1999).

Leachable variable concentrations will be determined from a distilled water leach (ratio 1:20) as per regulatory stipulations (GNR 635, 2013), to fit a mono-disposal scenario, as well as a TCLP leach (1:20), together with total concentrations (TC) as specified in these regulations.

#### **1.4 Limitations of this classification**

No organic (hydrocarbon) components were tested for in the current investigation, as waste streams were sampled directly from the plants. Hence, no hydrocarbon contamination is anticipated.

Although Aquatico is an accredited facility it is not accredited for the waste analyses method. Certain components of the analysis package have been outsourced to laboratories with experience in executing the specified procedures according to legislative requirements (as far as possible) until a laboratory is established which is accredited for the waste analyses method (stipulated in the Australian Standard Leaching Procedure) (AS 4439.1 - AS 4439.3).

It should be noted that all findings and inferences made in this report are solely based on the limited data available from this investigation and thus it should be consolidated with other specialist investigations on the area (e.g., geohydrology reports, etc.) where applicable, to take a holistic approach with regards to predictions based on the proposed scenario.

In doing so adequate management and/or mitigative measures and procedures can be established and considered for implementation. Disposal requirements will be discussed in light of the GNR 636 (2013).



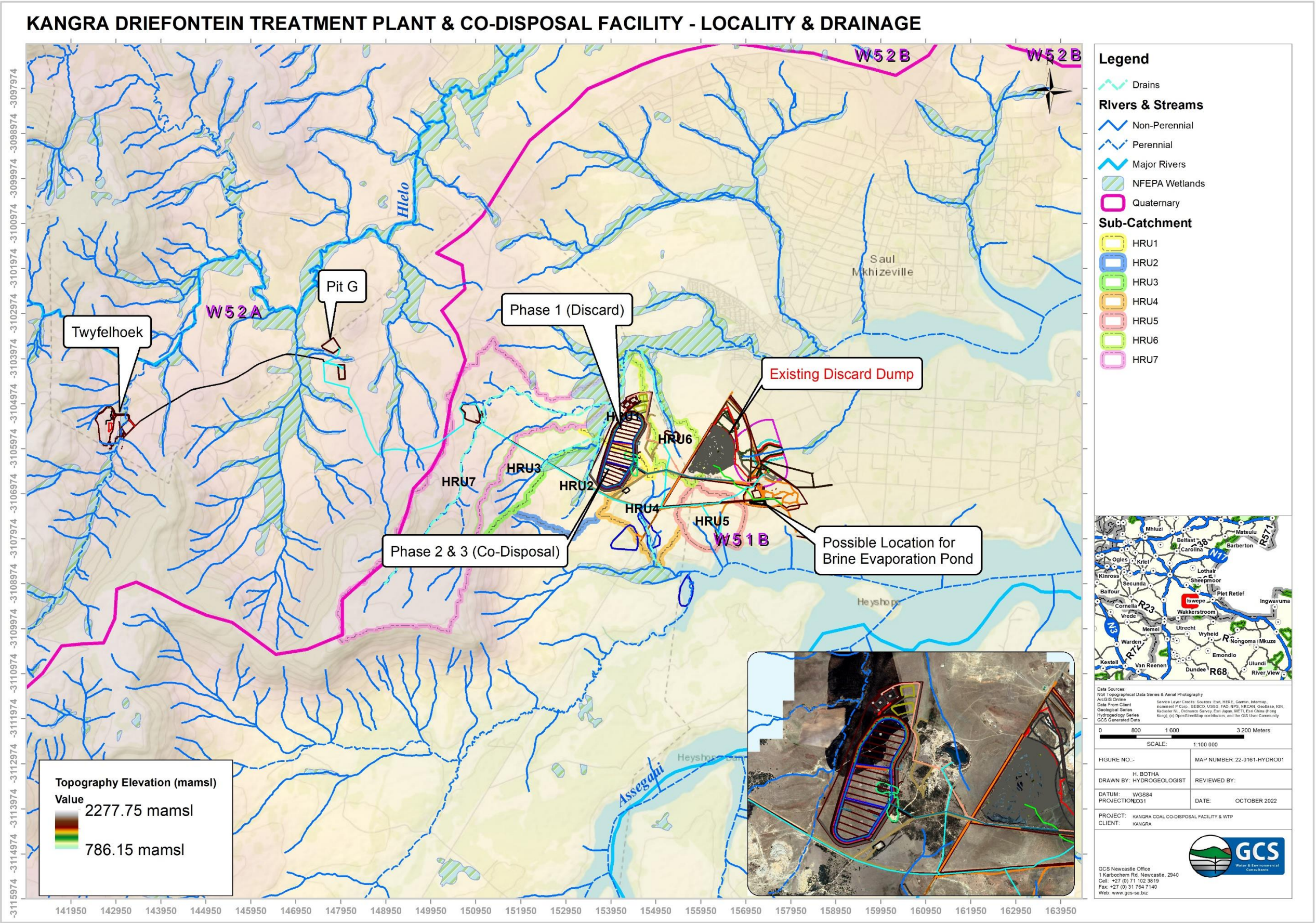


Figure 1-3: Site locality and drainage



## 2 WASTE CLASSIFICATION

Two (2) samples were collected from Kangra Driefontien/Maquasa Operations, namely a coal slurry sample "Kslurry1" and a coal discard sample "Kdiscard1". The samples will be co-disposed at the proposed co-disposal facility. The samples were submitted to Aquatico Laboratories (SANAS Testing Laboratory T0685) for material analyses and SDS generation.

### 2.1 Definitions

Definitions were derived from the above-mentioned regulatory documents (see Section 1 of this report), as well as those illustrated in the references. Some are quoted from the SANS 10234 (2008) standards. If any further references are not given here, please refer to the standard.

#### Residue Stockpiles & Residue Deposits

According to (2)(b) of Annexure 1 (NEM: WAA, 2014) the definition of a "residue stockpile" is as follows: any debris, discard, tailings, slimes, screening, slurry, waste rock, foundry sand, mineral processing plant waste, ash or any other product derived from or incidental to a mining operation and which is stockpiled, stored or accumulated within the mining area for potential re-use, or which is disposed of, by the holder of a mining right, mining permit or, production right or an old order right, including historic mines and dumps created before the implementation of this Act [and]:

Residue Deposits: any residue stockpile remaining at the termination, cancellation or expiry of a prospecting right, mining right, mining permit, exploration right or production right.

Residue deposits and residue stockpiles include:

1. Wastes resulting from exploration, mining, quarrying, and physical and chemical treatment of minerals:
  - a. Wastes from mineral excavation
  - b. Wastes from physical and chemical processing of metalliferous minerals
  - c. Wastes from physical and chemical processing of non-metalliferous minerals
  - d. Wastes from drilling muds and other drilling operations [wastes]

Total Concentrations (TC): "...the Total Concentration of a particular element or chemical substance in a waste, expressed as mg/Kg."

Leachable Concentrations (LC): "...the Leachable Concentration of a particular element or chemical substance in a waste, expressed as mg/l."

Based on the above-mentioned definitions, the Total Concentrations (TC) are indicative of the total amount of any element or chemical substance (as listed in the regulations and/or tested for) that is present in the waste stream, whereas the Leachable Concentrations (LC) are indicative of the amount (in mg/l) of those particular elements/chemical substances, identified in the TC, that tends to leach from the solid under the conditions created during the test and the ratio of leaching fluid to solid

**Waste Classification: means establishing -**

- 1) Whether a waste is hazardous based on the nature of its physical, health and environmental hazardous properties (hazard classes); and
- 2) The degree or severity of hazard posed (hazard categories);
  - AMD (Acid Mine Drainage) - Occurs when sulphur-containing minerals (e.g. pyrite or iron-sulphide) in geological strata are exposed to oxygen and water to form acidic (pH<5) leaches laden with metals and sulphates.
  - Acute Toxicity - "Adverse effects occurring after oral or dermal administration of a single dose of a substance, or multiple doses are given within 24h or an inhalation exposure of 4h."
  - AP (Acid Potential) - The potential of a rock/soil sample to generate acid when leaching.
  - Carcinogen - "Chemical substance or a mixture of chemical substances which induce cancer or increase its incidence when inhaled, ingested or absorbed through the skin."
  - Chronic aquatic toxicity - "Potential or actual properties of a substance to cause adverse effects to aquatic organisms during exposures that are determined about the life-cycle of the organism. "
  - Class II Slight Acute/Chronic Environmental Toxicity Hazard - When the percentage effect observed in at least one toxicity test is markedly higher than in the control, but the effect levels are below 50% (TU is <1).
  - EC50 - "Concentration of a substance, in milligrams per litre of water, that causes the maximum response to 50% of a population of Daphnia (water flea) and crustacea."
  - Hazard Category - "Division of criteria within each hazard class, for example, oral acute toxicity includes five hazard categories and flammable liquids include four hazard categories. These categories compare hazard severity within a hazard class and should not be taken as a comparison of hazard categories more generally."
  - Hazard class - "Nature of the physical, health or environmental hazard, for example, flammability, carcinogenicity or acute toxicity."

- Hazard statement - “statement assigned to a hazard class and category that describes the nature of the hazards of a hazardous product, including, where appropriate, the degree of hazard.”
- LC50 - “Concentration of a substance in the air or in water which causes the death of 50% of a group of test organisms.”
- LD50 - “Concentration of a substance, expressed in milligrams per kilogram of body mass, which causes the death of 50% of a group of test animals when ingested, or exposed to the bare skin, all at once.”
- NP (Neutralisation Potential) - Describes the ability of rock (based on the amount of alkaline material) to neutralise acid leaches.
- NNP (Nett Neutralisation Potential) - is the difference between the NP and the AP.
- NPR (Neutralising Potential Ratio) - reflects the ratio of AP to NP.
- Precautionary statement - “Phrase or pictogram (or both) that describes recommended measures that should be taken into account to minimise or prevent adverse effects resulting from exposure to a hazardous product, or improper storage or handling of a hazardous product.”
- XRF (X-Ray Fluorescence) - Analytical technique used to determine the chemical composition of a sample by measuring the fluorescent x-ray emitted from a sample after being subjected to an x-ray source.

## 2.2 Waste assessment screening criteria

General Notices (GNR) 634, 635 & 636 were released in the Government Gazette (2013) and describe a classification system for waste. These guidelines stipulate the use of the Australian Standard Leaching Procedure (ASLP), to determine Total Concentrations (TC) and Leachable Concentrations (LC) for specified variables, both inorganic and organic, ultimately establishing suitability for landfill disposal in alignment with the objectives stated above. Test work was carried out by Aquatico Laboratories (Pty) Ltd.

The leaches were performed at a 1:20 liquid/solid ratio as prescribed in the method referred to in the regulations, however, it should be noted that this ratio would not normally be expected to occur naturally in the environment and represents an absolute worst-case scenario, wherein leaching is attempted induced, to determine what concentration of any particular element, has potential for leaching/risk.

It is important to note that the leaching of any element from the solid phase can be influenced by various factors, such as, among others, particle size, surface area, redox potential, pH, biological influences, etc. These conditions are not always relevant in the natural environment and those that do occur in the natural environment from where a sample was collected are not all replicable in situ.

In GNR 635, three categories are specified for leaching, dependent on the aims of disposal. According to Section (5)(2)(a), (b) & (c) these are:

- a) Waste to be disposed of with, or waste that contains, putrescible wastes: Use 0.1M acetic acid solution with altered pH 5.0 or pH 2.9 determined as per section 7.5(a-e) of AS 4439.3;
- b) Waste to be disposed of with non-putrescible waste: Use a basic 0.1M sodium tetraborate decahydrate solution of pH  $9.2 \pm 0.1$ , as well as an acetic acid solution (with pH 5.0 or pH 2.9) determined as per section 7.5(a-e) of AS 4439.3; or
- c) Non-putrescible waste to be disposed of without any other wastes: Use reagent water.

In the current scenario, the objective involves either mono-disposal (into a discard dump) or co-disposal (e.g., backfilling into an opencast pit) and therefore distilled water (reagent water) - and TCLP leaches were selected.

Total Concentrations (TC) were determined by the use of microwave-assisted digestion where a dilution ratio of 100:1 is commonly used.

### **2.2.1 Determining Waste Types**

GNR 635, Section 7(2) stipulates (refer to Figure 2-1).

- a) Wastes with any element or chemical substance concentration above the LCT3 or TCT2 limits ( $LC > LCT3$  or  $TC > TCT2$ ) are Type 0 wastes;
- b) Wastes with any element or chemical substance concentration above the LCT2 but below or equal to the LCT3 limits, or above the TCT1 but below or equal to the TCT2 limits ( $LCT2 < LC \leq LCT3$  or  $TCT1 < TC \leq TCT2$ ), are Type 1 Wastes;
- c) Wastes with any element or chemical substance concentration above the LCT1 but below or equal to the LCT2 limits and all concentrations below or equal to the TCT1 limits ( $LCT1 < LC \leq LCT2$  and  $TC \leq TCT1$ ) are Type 2 Wastes;
- d) Wastes with any element or chemical substance concentration above the LCT0 but below or equal to the LCT1 limits and all TC concentrations below or equal to the TCT1 limits ( $LCT0 < LC \leq LCT1$  and  $TC \leq TCT1$ ) are Type 3 Wastes; or



- e) Wastes with all element and chemical substance concentration levels for metal ions and inorganic anions below or equal to the LCT0 and TCT0 limits ( $LC \leq LCT0$  and  $TC \leq TCT0$ ), and with all chemical substance concentration levels also below the following total concentration limits for organics and pesticides, are Type 4 Wastes.

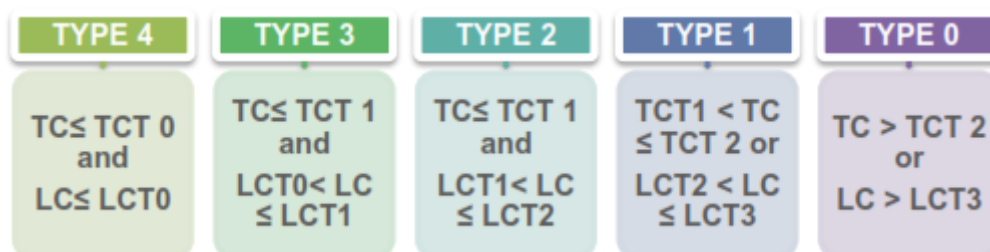


Figure 2-1: Waste classification based on GN R. 634 of 2013 Waste Standards

### 2.3 Waste assessment laboratory results

The paste pH levels detected in the waste streams were:

- KSlurry1 - Paste pH 7.94 (neutral range pH 6.0 - 8.5); and
- KDiscard1 - Paste pH 7.34 (neutral range pH 6.0 - 8.5).

It is assumed for this report that the paste pH levels recorded would remain stable, with no significant fluctuations.

Results for the TCT, LCT and LCT test for both samples are summarised in Table 2-1 to Table 2-2. Hydrocarbons are not expected to be present in any one of the two waste streams, based on previous assessment results and were therefore excluded.

Laboratory certificates are available in **Appendix A**.

Table 2-1: TCT &amp; LCT (TLCP Leach), 'KSlurry1', October 2022

WASTE ASSESSMENT - DATA TABLE					
PROJECT NAME		GCS - Waste			Guideline for Compliance - GNR 635 (2013) - National Norms & Standards for the Assessment of Waste for Landfill Disposal
Total Concentration-Sample Dry Mass (g)	1	DATE COMPILED	14 November 2022		
Total Concentration-Sample Volume (ml)	50	DATE SAMPLED	10 October 2022		
Leachable Concentrations - Sample Dry Mass (g)	20	COMPILED BY	Theodore Meyer		
Leachable Concentrations - Sample Volume (ml)	400	LOCALITY NAME	KSlurry1		
Total Concentration Solids					
VARIABLE	Guideline Limits (mg/kg)			Variable Concentration (mg/l)	Variable Concentration (mg/kg)
	TCT0	TCT1	TCT2		
Paste pH (1:2)	-	-	-	-	7.94
Iron as Fe	-	-	-	662	33100
Total Cyanide as CN	14	10500	42000	<0.100	<5.00
Redox	-	-	-	-	135
Arsenic as As	5.8	500	2000	0.076	3.8
Boron as B	150	15000	60000	<1.50	<75.0
Barium as Ba	62.5	6250	25000	5.66	283
Cadmium as Cd	7.5	260	1040	<0.075	<3.75
Cobalt as Co	50	5000	20000	<0.500	<25.0
Chromium as Cr	46000	800000	-	6	300
Copper as Cu	16	19500	78000	0.454	22.7
Mercury as Hg	0.93	160	640	<0.009	<0.450
Manganese as Mn	1000	25000	100000	6.19	310
Molybdenum as Mo	40	1000	4000	0.646	32.3
Nickel as Ni	91	10600	42400	0.588	29.4
Lead as Pb	20	1900	7600	0.634	31.7
Antimony as Sb	10	75	300	<0.100	<5.00
Selenium as Se	10	50	200	<0.100	<5.00
Vanadium as V	150	2680	10720	<1.00	<50.0
Zinc as Zn	240	160000	640000	<1.00	<50.0
Aluminium (Al)	-	-	-	202	10100
Total Fluoride (F)	100	10000	40000	-	192
Hexavalent chromium (Cr <sup>6+</sup> )	6.5	500	2000	-	<5
Moisture %	-	-	-	-	8.39
Leachable Concentrations - TCLP					
VARIABLE	Guideline Limits (mg/l)				Variable Concentration (mg/l)
	LCT0	LCT1	LCT2	LCT3	
Aluminium as Al	-	-	-	-	<2.00
Iron as Fe	-	-	-	-	<2.00
Total Cyanide as CN	0.07	3.5	7	28	<0.01
Total oxidised nitrogen as N	-	-	-	-	<10.0
Arsenic as As	0.01	0.5	1	4	<0.010
Boron as B	0.5	25	50	200	<0.500
Barium as Ba	0.7	35	70	280	<0.700
Cadmium as Cd	0.003	0.15	0.3	1.2	<0.003
Cobalt as Co	0.5	25	50	200	<0.400
Chromium as Cr	0.1	5	10	40	<0.100
Hexavalent chromium (Cr <sup>6+</sup> )	0.05	2.5	5	20	<0.020
Copper as Cu	2	100	200	800	<1.00
Mercury as Hg	0.006	0.3	0.6	2.4	<0.006
Manganese as Mn	0.5	25	50	200	4.68
Molybdenum as Mo	0.07	3.5	7	28	0.098
Nickel as Ni	0.07	3.5	7	28	<0.070
Lead as Pb	0.01	0.5	1	4	<0.010
Antimony as Sb	0.02	1	2	8	<0.020
Selenium as Se	0.01	0.5	1	4	<0.010
Vanadium as V	0.2	10	20	80	<0.200
Zinc as Zn	5	250	500	2000	<2.00
Total Dissolved solids @ 180°C	1000	12500	25000	100000	6612
Chloride as Cl	300	15000	30000	120000	<50.0
Sulphate (SO <sub>4</sub> )	250	12500	25000	100000	484
Nitrate (NO <sub>3</sub> ) as N	11	550	1100	4400	<10.0
Fluoride as F	1.5	75	150	600	<1.00

Table 2-2: TCT &amp; LCT (TLCP Leach), 'KDiscard1', October 2022

WASTE ASSESSMENT - DATA TABLE					
PROJECT NAME		GCS - Waste			Guideline for Compliance - GNR 635 (2013) - National Norms & Standards for the Assessment of Waste for Landfill Disposal
Total Concentration-Sample Dry Mass (g)	1	DATE COMPILED	14 November 2022		
Total Concentration-Sample Volume (ml)	50	DATE SAMPLED	10 October 2022		
Leachable Concentrations - Sample Dry Mass (g)	20.2	COMPILED BY	Theodore Meyer		
Leachable Concentrations - Sample Volume (ml)	400	LOCALITY NAME	KDiscard1		
Total Concentration Solids					
VARIABLE	Guideline Limits (mg/kg)			Variable Concentration (mg/l)	Variable Concentration (mg/kg)
	TCT0	TCT1	TCT2		
Paste pH (1:2)	-	-	-	-	7.34
Iron as Fe	-	-	-	726	36300
Total Cyanide as CN	14	10500	42000	<0.100	<5.00
Redox	-	-	-	-	85
Arsenic as As	5.8	500	2000	0.232	11.6
Boron as B	150	15000	60000	<1.50	<75.0
Barium as Ba	62.5	6250	25000	7.92	396
Cadmium as Cd	7.5	260	1040	<0.075	<3.75
Cobalt as Co	50	5000	20000	<0.500	<25.0
Chromium as Cr	46000	800000	-	1.5	75
Copper as Cu	16	19500	78000	0.316	15.8
Mercury as Hg	0.93	160	640	<0.009	<0.450
Manganese as Mn	1000	25000	100000	3.19	160
Molybdenum as Mo	40	1000	4000	0.673	33.7
Nickel as Ni	91	10600	42400	0.621	31.1
Lead as Pb	20	1900	7600	0.471	23.6
Antimony as Sb	10	75	300	<0.100	<5.00
Selenium as Se	10	50	200	<0.100	<5.00
Vanadium as V	150	2680	10720	<1.00	<50.0
Zinc as Zn	240	160000	640000	1.6	80
Aluminium (Al)	-	-	-	350	17500
Total Fluoride (F)	100	10000	40000	-	308
Hexavalent chromium (Cr <sup>6+</sup> )	6.5	500	2000	-	<5
Moisture %	-	-	-	-	4.27
Leachable Concentrations - TCLP					
VARIABLE	Guideline Limits (mg/l)				Variable Concentration (mg/l)
	LCT0	LCT1	LCT2	LCT3	
Aluminium as Al	-	-	-	-	<2.00
Iron as Fe	-	-	-	-	<2.00
Total Cyanide as CN	0.07	3.5	7	28	<0.01
Total oxidised nitrogen as N	-	-	-	-	<10.0
Arsenic as As	0.01	0.5	1	4	<0.010
Boron as B	0.5	25	50	200	<0.500
Barium as Ba	0.7	35	70	280	<0.700
Cadmium as Cd	0.003	0.15	0.3	1.2	<0.003
Cobalt as Co	0.5	25	50	200	<0.400
Chromium as Cr	0.1	5	10	40	<0.100
Hexavalent chromium (Cr <sup>6+</sup> )	0.05	2.5	5	20	<0.020
Copper as Cu	2	100	200	800	<1.00
Mercury as Hg	0.006	0.3	0.6	2.4	<0.006
Manganese as Mn	0.5	25	50	200	2.33
Molybdenum as Mo	0.07	3.5	7	28	0.08
Nickel as Ni	0.07	3.5	7	28	<0.070
Lead as Pb	0.01	0.5	1	4	<0.010
Antimony as Sb	0.02	1	2	8	<0.020
Selenium as Se	0.01	0.5	1	4	<0.010
Vanadium as V	0.2	10	20	80	<0.200
Zinc as Zn	5	250	500	2000	<2.00
Total Dissolved solids @ 180°C	1000	12500	25000	100000	5636
Chloride as Cl	300	15000	30000	120000	<50.0
Sulphate (SO <sub>4</sub> )	250	12500	25000	100000	113
Nitrate (NO <sub>3</sub> ) as N	11	550	1100	4400	<10.0
Fluoride as F	1.5	75	150	600	<1.00

## 2.4 Geochemical assessment results

### 2.4.1 XRF Results

XRF results for the waste streams are summarized in Table 2-3 and waste stream composition based on XRF is presented in Table 2-4.

**Table 2-3: XRF results for the representative samples collected in October 2022**

VARIABLE	UNITS	MONITORING LOCALITIES	
		KDiscard1	KSlurry1
Fe <sub>2</sub> O <sub>3</sub>	%	4.68	5.56
SiO <sub>2</sub>	%	34.41	54.07
Al <sub>2</sub> O <sub>3</sub>	%	9.53	7.78
K <sub>2</sub> O	%	1.42	2.11
P <sub>2</sub> O <sub>5</sub>	%	0.06	0.04
Mn <sub>2</sub> O <sub>4</sub>	%	0.03	0.04
CaO	%	3.39	3.23
MgO	%	0.45	0.35
TiO <sub>2</sub>	%	0.51	0.44
Na <sub>2</sub> O	%	0.37	0.44
V <sub>2</sub> O <sub>5</sub>	%	0.01	0.01
BaO	%	0.09	0.09
Cr <sub>2</sub> O <sub>3</sub>	%	0.04	0.09
SrO	%	0.06	0.05
ZrO <sub>2</sub>	%	0.04	0.05
MnO	%	0.03	0.04
LOI	%	44.35	22.90
Total XRF (oxides)	%	99.44	97.26

**Table 2-4: Waste stream Compositions (XRF)**

VARIABLE	UNITS	MONITORING LOCALITIES	
		KDiscard1	KSlurry1
Fe	%	3.270	3.892
Si	%	16.085	25.275
Al	%	5.043	4.117
K	%	1.178	1.755
P	%	0.027	0.018
Mn	%	0.021	0.029
Ca	%	2.425	2.308
Mg	%	0.272	0.212
Ti	%	0.303	0.263
Na	%	0.275	0.326
V	%	0.006	0.006
Ba	%	0.083	0.079
Cr	%	0.027	0.063
Sr	%	0.053	0.041
Zr	%	0.030	0.037
Mn	%	0.021	0.029
LOI	%	44.350	22.897
Total XRF (oxides)	%	99.440	97.257

### 2.4.2 Waste assessment

From the results obtained in the waste streams tested, the following summary of exceedances was identified:

- In the 'KSlurry1' sample, the Ba, Cu, Pb and total F concentrations exceeded the TCT0 limits and were all recorded below the TCT1 limits. None of these variables exceeded the TCLP leach; however, the Mn, Mo, TDS and SO<sub>4</sub> variables exceeded the LCT0 limit (all of these variables were recorded below the LCT1 limits).
- In the 'KDiscard1' sample, the As, Ba, Pb and total F concentrations exceeded the TCT0 limits and were all recorded below the TCT1 limits. None of these variables exceeded the TCLP leach; however, the Mn, Mo and TDS variables exceeded the LCT0 limit (all of these variables were recorded below the LCT1 limits).

## 2.5 Waste type determination (GNR 635, 2013)

Section 7 of the GNR 635 (2013) stipulates waste type determination (refer to section 8.2 of this report). A summary of the different categories is illustrated in Table 2-5, below.

Table 2-5: Waste Types for Landfill Disposal	
LC > LCT3; TC > TCT2	Type 0
LCT2 < LC ≤ LCT3; TCT1 < TC ≤ TCT2	Type 1
LCT1 < LC ≤ LCT2; TC ≤ TCT1	Type 2
LCT0 < LC ≤ LCT1; TC ≤ TCT1	Type 3
LC ≤ LCT0; TC ≤ TCT0	Type 4

The regulation (GNR 635, 2013) also makes additional comments to classification criteria, such as:

- If a particular substance in a waste stream is not listed with LCT and TCT threshold values and the stream has been classified as hazardous (SANS 10234 health and/or environmental conditions), the waste is considered to be a type 1 waste.
- If the TC for a particular element/substance exceeds the TCT2 limit and its concentration cannot be reduced to below this limit, but the LC is below the LCT3 limit, it is considered a type 1 waste.
- Pre-listed wastes (Annexure 1 f GNR 636, 2013) are considered Type 1 wastes (unless assessed and determined otherwise).
- Waste streams with all element/chemical metal ions and inorganic anion concentrations below or equal to the LCT0 limits are considered Type 3 wastes, irrespective of their total concentrations (if compliant with the listed criteria).



## 2.6 Pollution Barrier Requirements (GNR 636, 2013)

Pollution barriers required for the waste type identified are listed in Table 2-6.

**Table 2-6: Pollution barrier requirements as per GNR 636 (2013)**

Waste Type	Landfill Disposal Requirements
Type 0 Waste	The disposal of Type 0 waste in landfills is not allowed. The waste must be treated and re-assessed in terms of the Norms & Standards for the Assessment of Waste for Landfill Disposal
Type 1 Waste	Type 1 waste may only be disposed of at a Class A landfill designed per Section 3(1) and (2) of these Norms and Standards, or, subject to Section 3(4) of these Norms & Standards, may be disposed of at a landfill site designed per the requirements for a Hh/HH landfill as specified in the Minimum Requirements for Waste Disposal by Landfill (2nd Ed., DWAF, 1998).
Type 2 Waste	Type 2 waste may only be disposed of at a Class B landfill designed per Section 3(1) and (2) of these Norms & Standards, or, subject to section 3(4) of these Norms & Standards, may be disposed of at a landfill site designed per the requirements for a GLB+ landfill as specified in the Minimum Requirements for Waste Disposal by Landfill (2nd Ed., DWAF, 1998).
Type 3 Waste	Type 3 waste may only be disposed of at a Class C landfill designed per sections 3(1) and (2) of these Norms & Standards, or, subject to section 3(4) of these Norms & Standards, may be disposed of at a landfill site designed per the requirements for a GLB+ landfill as specified in the Minimum Requirements for Waste Disposal by Landfill (2nd Ed., DWAF, 1998).
Type 4 Waste	Type 4 waste may only be disposed of at a Class D landfill designed per sections 3(1) and (2) of these Norms & Standards, or, subject to section 3(4) of these Norms & Standards, may be disposed of at a landfill site designed per the requirements for a GLB- landfill as specified in the Minimum Requirements for Waste Disposal by Landfill (2nd Ed., DWAF, 1998).

Both waste streams in the current investigation could be classified as **Type 3 wastes**, posing low risk to the receiving environment. The waste requires a Class C barrier or equivalent for long-term disposal and temporary storage (refer to Figure 2-2).

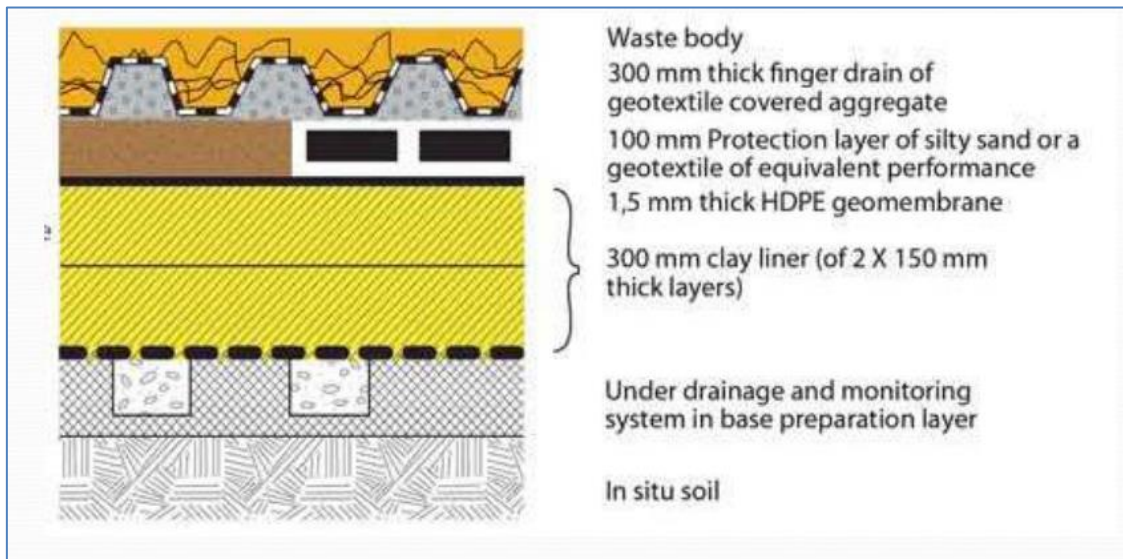


Figure 2-2: Class C Barrier

### 3 SANS 10234 (2008) CLASSIFICATION - GHS

The SANS 10234 (2008) standard contains the harmonised criteria for the classification of hazardous substances and mixtures (including waste), to ensure safe transport and use concerning potential physical health and environmental hazards. It provides valuable information and contains the harmonised elements of labelling and safety data sheets. Criteria and minimum requirements for the latter are also included. All definitions and abbreviations as per SANS 10234: 2008 apply.

The two waste streams in question in this investigation were classified according to the hazardous characteristics and categories, as well as the severity of those hazardous components where/if relevant. Physical hazards were assessed as far as possible and available data will be presented in section 10.5.1 below, however, classification will be based mainly on chemical characteristics potentially leading to health and environmental risk.

#### 3.1 Physical Hazards

The majority of physical analyses were not tested for or not applicable (N/A). Physical hazards include:

Physical hazards include:

1. Explosives (N/A)
2. Flammable Gasses (N/A)
3. Flammable Aerosols (N/A)

- 
4. Oxidizing Gasses (N/A)
  5. Gasses under pressure (N/A)
  6. Flammable Liquids (N/A)
  7. Flammable Solids
    - a. 'KDiscard1' - Negative at 30, 60 and 90 degrees Celsius - sample has no flammability).
    - b. 'KSlurry1' - Negative at 30, 60 and 90 degrees Celsius - sample has no flammability).
  8. Self-reactive Substances & Mixtures (N/A)
  9. Pyrophoric Substances (N/A)
  10. Self-heating Substances & Mixtures (N/A)
  11. Substances & Mixtures that, on contact with water, emit flammable gasses (N/A)
  12. Oxidising Substances & Mixtures (N/A)
  13. Organic Peroxides (N/A)
  14. Corrosive to Metals (N/A) Density:
    - a. 'KDiscard1' SG = 2.087 g/cm<sup>3</sup>
    - b. 'KSlurry1' SG = 2.335 g/cm<sup>3</sup>

### 3.2 Health Hazards

For classification, the XRF analysis was conducted, to determine sample composition and will be used for Acute Toxicity Estimate (ATE) calculations on the inorganic sample fraction (refer to online references RTECS & ECHA CLP) where applicable. XRF is usually sufficient for mine mineral waste samples.

#### 3.2.1 Toxicity Categories & Exposure Routes

There are five acute toxicity categories into which chemical substances can be allocated based on different exposure routes. The selected route of exposure for these waste streams is the oral route, although inhalation could potentially also be a route of concern. Acute toxicity via oral, dermal or inhalation routes, per the cut-off values provided in the SANS 10234 Standard, was investigated and included where sufficient data was obtained. Gases and vapours were not deemed applicable in this study and toxicological information is also very limited. Known LC50 values for inhalation routes were even more limited. As insufficient pharmacodynamic and pharmacokinetic data were readily available, provisions for 10.1.2.4.2.4 (SANS 10234) were implemented where necessary for unknown ingredients, based on wt%.

According to 10.1.2.4.1.1 (SANS 10234), ingredients falling into any of the GHS categories should be included, however, ingredients can be ignored if the oral test limit does not show acute toxicity at 2000 mg/Kg body weight (BW). The standard indicates that the classification of mixtures for acute toxicity is only needed for a single route of exposure, provided that the same route of exposure is followed for all the ingredients. The rat is the accepted test species for oral and inhalation routes.

A conservative approach was implemented wherein the lowest ATE value for an element (i.e., ensuring the highest toxicity potential) was used, where database information contained more than one value for the same exposure route.

Cut-off values/concentration limits for hazard classes according to the SANS 10234 (for inclusion in SDS - refer to **Appendix B**):

- Elemental composition of  $\geq 1.0\%$  that contributes to acute toxicity, skin corrosion, skin irritation, serious damage to eyes, eye irritation, respiratory sensitisation, skin sensitisation, mutagenicity (Category 2), target organ systemic toxicity (with single or repeated exposure), or if it is hazardous to the aquatic environment.
- Elemental composition of  $\geq 0.1\%$  that contributes to mutagenicity (Category 1), carcinogenicity or reproductive toxicity.

### 3.2.2 A - Acute Toxicity

According to the results, Fe, Si, Al, K, Ca and S (“ingredients”) recorded above the 1% cut-off value. These “ingredients” are not included as high-risk species in the waste assessment criteria (GNR 635, 2013), however, some toxicity data, albeit limited, are available for these elements. Furthermore, Fe, Si, Al, K, Ca, Mg, Ti, Na, Ba and S concentrations all exceeded the cut-off value of 0.1%.

LOI refers to the fraction of components that escaped (i.e., volatile components) from the mixture when heated to a certain temperature and these are not taken into consideration. The additivity formula (see below) was applied (see SANS 10.1.2.4.1.2) to determine Acute Toxicity Estimates (ATEs) for the mixture, based on concentrations of the relevant ingredients, as well as unknown fractions (dilution effects):

$$\frac{100}{ATE_{mix}} = \sum_{i=1}^{\infty} \left( \frac{C_i}{ATE_i} \right)$$

<i>ATE</i>	=	Acute Toxicity Estimate (e.g. LD50 / LC50)
<i>C<sub>i</sub></i>	=	Concentration of ingredient <i>i</i>
<i>I</i>	=	Individual Relevant ingredient from 1 to <i>n</i>
<i>N</i>	=	Number of ingredients

It should be noted that ATEs for individual elements could exert different effects when in molecular forms, however for this investigation it is expected that when leaching occurs, the elemental form will be of consequence.

The calculated ATE values for the 'Kdiscard1', as well as the 'Kslurry1' streams, lead to classification as Category 5 waste, based on the oral exposure route. Dermal and inhalation routes were also considered (refer to Table 3-1 and Table 3-2).



**Table 3-1: Classification for 1.00% cut-off value where stipulated effects may arise**

Ingredients equal to or exceeding the 1.00% Cut-off Value		
Oral Toxicity	KSlurry1	KDiscard1
Calculated ATE	>5000 mg/Kg	>5000 mg/Kg
Acute Toxicity Category	Category 5	Category 5
Symbol	No Symbol	No Symbol
Signal Word	Warning	Warning
Hazard Statement	May be Harmful if Swallowed	May be Harmful if Swallowed
Additional Statements	4.06% of the mixture consists of ingredients of unknown toxicity.	3.6% of the mixture consists of ingredients of unknown toxicity.

**Table 3-2: Classification for 0.1% cut-off value where stipulated effects may arise**

Ingredients equal to or exceeding the 0.1% Cut-off Value		
Oral Toxicity	KSlurry1	KDiscard1
Calculated LD50 or LC50	>5000 mg/Kg	>5000 mg/Kg
Acute Toxicity Category	Category 5	Category 5
Symbol	No Symbol	No Symbol
Signal Word	Warning	Warning
Hazard Statement	May be Harmful if Swallowed	May be Harmful if Swallowed
Additional Statements	4.65% of the mixture consists of ingredients of unknown toxicity.	4.18% of the mixture consists of ingredients of unknown toxicity.

Of the above-mentioned elements and available information, only Iron (Fe) contained an LD50 concentration below 2000 mg/Kg for the oral exposure route. The remaining ingredients either exceeded this limit or no data/insufficient data, was available on the RTECS and alternative databases. Other main ingredients of concern (i.e., with known acute toxicity) concerning other exposure routes, were Silica (Si) and Aluminium (Al). Other ingredients deemed relevant to the classification, were also considered. Data was not extrapolated between different test animals or exposure routes.

### 3.3 Background Information

#### 3.3.1 A: Silica (Si)

Like many other elements, Silica occurs in several minerals that are found naturally in the earth's crust and trace amounts of silica are generally present in all soils. Si is present in various minerals, sedimentary, igneous and metamorphic rocks (e.g., Quartz, Biotite, Vermiculite Hornblende, Anorthoclase, etc.). Si is considered to be chemically unreactive and poorly water-soluble in the environment (EPA, 1991 & IARC, 1997).

Free Silica ( $\text{SiO}_2$ ) is generally found in two forms: crystalline and amorphous (the former presents a more serious health risk than its amorphous form). Under certain circumstances, the surface chemistry of Si may vary and amorphous Si may, for instance, contain crystalline Si (Williams, et. al., 2019). Understanding the type of silica that is present is imperative to understanding the associated health concerns. Crystalline Silica that is inhaled, could cause adverse health effects (e.g., Silicosis) with chronic repetitive exposure if these particles are of respirable size ( $<10\text{ }\mu\text{m}$ ) and at high concentrations (i.e., exceeding those found naturally in the environment). Silicosis affects lung function and increases susceptibility to secondary infections such as tuberculosis.

### 3.3.2 A: Aluminium (Al)

Similarly, aluminium dust has been known to cause effects in the lungs when inhaled, such as granuloma, proteinosis of alveoli, pneumonia, etc. (CCOHS). It should be noted that according to the REACH dossiers and CLP notifications, some notifiers have indicated that impurities or additives present in a substance impacts the notified classification.

### 3.3.3 B - Skin Corrosion & Skin Irritation

The potential for skin corrosion and/or skin irritation is dependent on several factors even before testing is performed, such as substances that may become corrosive or irritant when coming into contact with water (e.g., when moistened by mucous membranes, etc.).

According to the information database, all ingredients investigated during this study that exceed the 0.1% cut-off value have the potential to cause skin irritation (based on available information), although many of them are unlikely to cause such symptoms. In many instances' irritation is caused by mechanical or frictional action due to particle size. It is furthermore important to note that such health effects are based on pure elemental ATE concentrations, however, they do not occur naturally in the soil in this form and although health effects are important to consider, they are considered relative.

Information on potassium, sodium and calcium, in powder form, indicate the potential to be corrosive and cause burns, inflammation, blistering and damage to skin and eyes (harmonized classification and labelling - CLP00). Several of these elements (e.g., Mg, Na, Ca, etc.) possess physical properties, like spontaneous ignition when in contact with water or air, although as mentioned above, these properties are not expected in molecular form in the natural soil. Literature also stipulates that pH levels of an ingredient below 2 or above 11.5 indicate skin or eye corrosiveness unless proven otherwise by credible data.

Paste pH levels on the solid samples and liquid phase also indicated neutral pH levels and therefore skin or eye irritation, other than that caused by particle size (through mechanical action) is not expected to occur with exposure to this material. Distilled water leach analysis also indicated neutral pH levels in leaches.

None of the waste streams tested was classified as irritative or corrosive to the skin, based on the assumption that pH levels will remain unchanged over time and that these streams will not be mixed with other waste streams, which could cause pH levels to change.

#### **3.3.4 C - Eye Irritation and Damage to Eyes**

As mentioned above, certain ingredients are known to potentially be eye irritants (especially at low-level dust with repeated exposure) in their granular form through mechanical action (e.g., Fe, S, etc.). This can especially be problematic when strong gusts of wind are common in the area.

Each irritant or corrosive component is considered to contribute to the overall properties of the mixture in proportion to its potency and concentration, however, the exact form and concentration that the ingredient will be transferred in are unknown, making accurate classification difficult. Ca, K and Na, are known to have the potential for causing serious damage to the eyes (it is assumed that these effects could be irreversible). These elements are not expected in their pure elemental forms and they will not be classified as hazardous to the eyes.

#### **3.3.5 D - Skin and/or Respiratory Sensitisation**

A respiratory sensitizer is a substance that, when inhaled, causes hypersensitivity of the airways. Respiratory hypersensitivity is considered as alveolitis, asthma and rhinitis. A skin sensitizer is a substance that, when coming into contact with the skin, will cause an allergic response (SANS 10234).

A substance shall respectively be considered a respiratory sensitizer or skin sensitizer (classified into Category 1) when there is human evidence or positive results from animal studies to confirm sensitivity (SANS 10234). Of the ingredients exceeding the 0.1% threshold in both waste stream mixtures, there is evidence of respiratory sensitisation with Si (respiratory irritation and stimulation) exposure.

This is however dependent on particle size. The exposure risk of a particular mineral waste stream should also be compared to the content of the natural environment where the waste stream is found. The elements, Ca, Mg and Mn have also been known to cause respiratory irritation, whereas Na in the elemental form at high concentrations could destroy mucous membrane tissues in the upper respiratory tract. Neither of the waste streams tested is classified as skin or respiratory sensitizer.

None of the waste streams tested is classified as skin or respiratory sensitizers.

### 3.3.6 E - Mutagenicity

Mutagenicity refers to "...chemicals that cause mutations in the germ cells of humans and that can be transmitted to the progeny (SANS 10234)." These encompass heritable genetic alterations expressed at phenotypic levels and DNA modifications when known, for example, certain base pair changes and chromosomal translocations. Mutagens increase the incidence of mutations in populations of cells and/or organisms.

Genotoxic agents are those substances that alter genetic material or segregate damages or interfere with DNA expression and replication and usually serve as indicators for mutagenicity.


Of the ingredients (XRF test) exceeding the 0.1% threshold in either of the waste stream mixtures, there is no evidence of mutagenicity/genotoxicity.

### 3.3.7 F - Carcinogenicity

A carcinogen is a substance that induces cancer or increases the risk of contracting cancer through inhalation, skin absorption or ingestion. This classification is based on the inherent characteristics of substances and not on the level of risk that the use of the substance may present. Due to the presence of Si in the tested waste stream, it will be mentioned here (please also refer to Section 10.4.2.A.1 above). Crystalline silica has been classified as a human lung carcinogen. The waste streams currently under investigation contain natural, geological material with fine particles that could potentially be inhaled if airborne.

Crystalline Silica that is inhaled, could cause adverse health effects (e.g., Silicosis) with chronic repetitive exposure if these particles are of respirable size ( $<10\ \mu\text{m}$ ) and at high concentrations (i.e., exceeding those found naturally in the environment). Silicosis affects lung function and increases susceptibility to secondary infections such as tuberculosis. Particle size distribution analyses in the current investigation indicated that 4.39 % ('SOM Discard') and 33.5 % ('SOM Slurry') of the particles in each sample were below  $10\ \mu\text{m}$ . It should furthermore be noted that the microscopic particle form/structure is not considered during such a test and therefore we must assume conservatively that all particles are homogeneously round and possess an aerodynamic diameter. In addition, XRF results obtained for Si are a reflection of total Si (a combination of crystalline and amorphous) and Si present in the sample is likely naturally occurring, further reducing the associated risk with inhalation.

Dust containing Si, such as quartz dust has been classified as a Category 1A human carcinogen (Si content) by the International Agency for Research on Cancer (IARC).

Category:	Category 1A
Symbol:	
Signal Word:	Danger
Hazard Statement:	H350: May cause cancer due to inhalation

Evidence also exists for Fe as an equivocal tumorigenic agent (RTECS), as well as for Mn, however, there is no confirmation on the latter (IARC, NTP or OSHA).

### 3.3.8 G - Reproductive Toxicity

Effects of reproductive toxicity include impairment of sexual function and fertility or developmental toxicity. “Adverse effects on sexual function and fertility include, but are not limited to, alterations to the female and male reproductive system, adverse effects on the onset of puberty, gamete production and transport, reproductive cycle normality, sexual behaviour, fertility, ability to give birth, pregnancy outcomes, premature ageing, or modifications in other functions that are dependent on the integrity of the reproductive systems. Adverse effects on, or via, lactation, are also included in reproductive toxicity (SANS 10234).” “Developmental toxicity includes any effect which interferes with normal development of the offspring, either before or after birth and that results from exposure of either parent before conception, or exposure of the developing offspring during prenatal development, or postnatally, to the time of sexual maturation (SANS 10234).” It also refers to adverse effects induced during pregnancy, or as a result of exposure by the parents. Such effects can be shown during any season of the lifespan. Major effects include the death of the developing organism, altered growth and structural abnormalities and functional deficiency.

Human evidence (ECHA) in a single study showed mental retardation in an infant due to exposure to high Al concentrations through the mother during pregnancy, however, results were inconclusive as no direct correlation between the Al and recorded condition was established. The two waste streams in question do not need to be classified in terms of reproductive toxicity.



### **3.3.9 H - Target Organ Systemic Toxicity - Single Exposure (SE)**


Three factors (based on reliable evidence) are important for classification into this category, based on a single exposure:

- Consistent and identifiable toxic effects (in humans and animals);
- Toxicologically significant changes that have affected the function or morphology of tissue or an organ (or both), or
- Serious changes to the biochemistry or haematology of the organism that are relevant for human health.

The primary source of evidence should be based on human data and should include significant changes in single organs or biological systems, as well as those changes involving several organs. Exposure to high elemental Fe, Ca and Mn concentrations has shown to be toxic only with prolonged exposure. Reliability and information based on human trials are uncertain. A human study in RTECS on elemental Fe exposure indicates an LD50 of 200 mg/Kg with toxic effects including hepatitis (hepatocellular necrosis). No Target Organ Systemic Toxicity is expected with a single exposure in either of the two waste streams in question.

### **3.3.10 I - Target Organ Systemic Toxicity - Repeated Exposure (RE)**

The criteria for repeated exposure remain the same as for single exposure, except for effects noticed with repeated exposure and not only with a single exposure. Si and Al were both detected and are often present in the dust (e.g., quartz or AlO dust). Quartz dust is known to cause specific target organ toxicity with repeated exposure (specifically in the lungs), due to high Al and Si levels and therefore samples are conservatively classified into Category 1. Potential dust originating from these waste streams could have been altered in terms of natural characteristics during process activities and therefore a conservative approach should endure ensuring appropriate mitigative/management actions are taken to minimise risk with exposure. In-field stream characteristics could decrease this risk and this inference is based on a worst-case scenario. It should however be noted that the respective LD50 values for both variables exceed 2000 mg/Kg (oral exposure).

Category:	Category 1
Symbol:	
Signal Word:	Danger
Hazard Statement:	H372: Causes damage to lungs through prolonged or repeated exposure via inhalation

### 3.3.11 J - Hazardous to the Aquatic Environment

that a highly toxic ingredient is present at less than 1%, where such an ingredient will be taken into consideration. Normally, the available XRF data will be used to determine potential acute toxicity based on the ingredients of the sample.

Four basic elements to determine whether a substance or mixture is toxic to the aquatic environment (i.e., ecosystem; ranging from soil microflora to primates) are stipulated in the SANS 10234:

- Acute aquatic toxicity
- Bioaccumulation
- Degradation (abiotic or biotic) for organic chemicals
- Chronic aquatic toxicity

Three trophic levels (indicator species) are identified in the standard for this determination, namely:

- Fish - 96h (LC50)
- Crustacea (e.g., Daphnia Magna) - 48h (EC50)
- Algae - 72h or 96h (ErC50)

Classification of an ingredient in terms of acute toxicity data is based on acute toxicity data only, whereas classification in terms of chronic toxicity uses a combination of acute toxicity data and environmental fate data (e.g., degradability and bioaccumulation data). It should be noted that available data is limited.

### 3.3.12 J (a) - Acute Aquatic Toxicity

Toxicity values for each species are not available for each ingredient and therefore the highest toxicity (i.e., most sensitive species) where data was found, is normally implemented during classification as per stipulations in the standard.

**Table 3-3: Acute toxicity hazard categories - Aquatic Environment**

Hazard Category of Acute Toxicity	Classification Criteria	
1	96h LC <sub>50</sub> (for fish) 48h EC <sub>50</sub> (for crustacea) 72h or 96h ErC <sub>50</sub> (for algae or other aquatic plants)	≤1 mg/L ≤1 mg/L ≤1 mg/L
2	96h LC <sub>50</sub> (for fish) 48h EC <sub>50</sub> (for crustacea) 72h or 96h ErC <sub>50</sub> (for algae or other aquatic plants)	> 1 to ≤ 10 mg/L and/or > 1 to ≤ 10 mg/L and/or > 1 to ≤ 10 mg/L
3	96h LC <sub>50</sub> (for fish) 48h EC <sub>50</sub> (for crustacea) 72h or 96h ErC <sub>50</sub> (for algae or other aquatic plants)	> 10 to ≤ 100 mg/L and/or > 10 to ≤ 100 mg/L and/or > 10 to ≤ 100 mg/L

During the current investigation, the distilled water leach of each waste stream was submitted for definitive toxicity testing based on the three trophic levels specified in the standard (refer to Annexure A). Each risk category quantifies acute or chronic risk associated with each waste stream. Rankings (Classes I - V) are based on the highest toxicity unit (TU) found in the battery of tests. A weight % is also assigned to each stream. Higher values indicate a higher rate of toxicity within a specific class. Risk/hazard category results based on the DEEEP protocols, were recorded as follows (Persoone, G, et. al., 2003):

- 'KDiscard1' - Class I (No lethal/sub-lethal hazard) (Wt % 0)
- 'KSlurry1' - Class II (Slight lethal/sub-lethal hazard) (Wt % 33)

The slight lethal/sub-lethal effect recorded from the 'KSlurry1' sample was based on a 30% growth-inhibition effect (sub-lethal) observed on micro-algae (micro-algae are often used as an indicator of potential chronic toxicity), as well as a 16.67% mortality effect on the vertebrate trophic level (lethal) on the 10% dilution level. It should however be noted that no significant toxicity was observed in the 100% sample result.

The pH and dissolved oxygen levels in both tested waste streams were within acceptable ranges for aquatic organisms will survive (these factors can be excluded as potential driving factors for toxicity).

### 3.3.13 J (b) - Chronic Aquatic Toxicity


"Classification of mixtures as a whole is not possible for chronic categories since both toxicity data and environmental fate data are needed, and there are no degradability and bioaccumulation data available for mixtures as a whole (SANS 10234). Micro-algae are often used as an indicator of chronic toxicity and in the current investing

## 4 CONCLUSIONS


Neutral pH levels were recorded from both waste streams. In the current scenario, it was assumed that no major changes in pH levels would take place over time. Of the two waste streams tested, both were categorised into the Type 3 (low risk) category (GNR 635, 2013) requiring a Class C liner (pollution barrier).

None of the waste streams was flammable. Volatile particle sizes were very low, reducing potential inhalation risks. Calculated ATE values for both waste streams, lead to acute toxicity hazard classification as Category 5, based on oral exposure routes (based on available data), despite Si and Al concentrations detected in both samples. Si and Al were also considered for both the oral and inhalation routes due to known toxicity effects (see below).

Target Organ Systemic Toxicity - Repeated Exposure (RE):

Category:	Category 1
Symbol:	
Signal Word:	Danger
Hazard Statement:	H372: Causes damage to lungs through prolonged or repeated exposure via inhalation

Carcinogenicity:

Category:	Category 1A
Symbol:	
Signal Word:	Danger
Hazard Statement:	H350: May cause cancer due to inhalation

Acute toxicity risk/hazard category results (please refer to Annexure b) based on the DEEEP protocols, were recorded as follows (Persoone, G, et. al., 2003): - KDiscard1' - Class I (No lethal/sub-lethal hazard) (Wt % 0) - 'KSlurry1' - Class II (Slight lethal/sub-lethal hazard) (Wt % 33) It should be noted that it is not expected that the ingredients as recorded in the XRF test will leach in the same form or at the same concentrations. A summary of the classification for both waste streams is presented in Table 4-1 and Table 4-2, below.

All inferences made in the current investigation are based on the limited data available. Please refer to the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) regulations to ensure alignment with all of its requirements. It remains the client's responsibility to ensure implementation and compliance with any related/supplementary regulatory documents.



Table 4-1: GHS classification summary, 'KDiscard1' stream, October 2022

Sample ID	KDiscard1	
Hazard Class	Category	Statement
<b>1. Physical Hazards</b>		
Explosives	N/A	None
Flammable Gasses	N/A	None
Flammable Aerosols	N/A	None
Oxidising Gasses	N/A	None
Gasses under Pressure	N/A	None
Flammable Liquids	N/A	None
Flammable Solids	Not Flammable; Flash Point = Negative at 30, 60 and 90 degrees Celsius	None
Self-reacting Substances & Mixtures	N/A	None
Pyrophoric Substances	N/A	None
Self-heating Substances & Mixtures	N/A	None
Substances & Mixtures that, on contact with Water Emits Flammable Gasses	N/A	None
Oxidising Substances & Mixtures	N/A	None
Organic Peroxides	N/A	None
Corrosive to Metals	N/A	None
<b>2. Health Hazards</b>		
Acute Toxicity	Category 5	May be harmful if swallowed; 3.6% of the mixture consists of ingredients of unknown toxicity.
Skin Corrosion and Skin Irritation	Not Classified	None
Serious Eye Damage & Eye Irritation	Not Classified	None
Respiratory Sensitization and Skin Sensitization	Not Classified	None
Germ Cell Mutagenicity	Not Classified	None
Carcinogenicity	Category 1A	H350 - May cause cancer, due to inhalation
Reproductive Toxicity	Not Classified	None
Specific Target Organ Toxicity - Single Exposure	Not Classified	None
Specific Target Organ Toxicity - Repeated Exposure	Category 1	H372 - Causes damage to lungs through prolonged or repeated exposure via inhalation

<b>3. Hazards to the Aquatic Environment</b>		
Acute Toxicity	No SANS 10234 Category Assigned	Class I (Non-lethal/Sub-lethal Hazard) (Persoone, G, et. al., 2003)
Chronic Toxicity	N/A	None (limiting data)
*Please refer to ingredient information contained in text		

Table 4-2: GHS classification summary, 'KSlurry1' stream, October 2022

Sample ID	KSlurry1	
Hazard Class	Category	Statement
<b>1. Physical Hazards</b>		
Explosives	N/A	None
Flammable Gasses	N/A	None
Flammable Aerosols	N/A	None
Oxidising Gasses	N/A	None
Gasses under Pressure	N/A	None
Flammable Liquids	N/A	None
Flammable Solids	Not Flammable; Flash Point = Negative at 30, 60 and 90 degrees Celsius	None
Self-reacting Substances & Mixtures	N/A	None
Pyrophoric Substances	N/A	None
Self-heating Substances & Mixtures	N/A	None
Substances & Mixtures that, on contact with Water Emits Flammable Gasses	N/A	None
Oxidising Substances & Mixtures	N/A	None
Organic Peroxides	N/A	None
Corrosive to Metals	N/A	None
<b>2. Health Hazards</b>		
Acute Toxicity	Category 5	May be harmful if swallowed; 4.06% of the mixture consists of ingredients of unknown toxicity.
Skin Corrosion and Skin Irritation	Not Classified	None
Serious Eye Damage & Eye Irritation	Not Classified	None
Respiratory Sensitization and Skin Sensitization	Not Classified	None

Germ Cell Mutagenicity	Not Classified	None
Carcinogenicity	Category 1A	H350 - May cause cancer, due to inhalation
Reproductive Toxicity	Not Classified	None
Specific Target Organ Toxicity - Single Exposure	Not Classified	None
Specific Target Organ Toxicity - Repeated Exposure	Category 1	H372 - Causes damage to lungs through prolonged or repeated exposure via inhalation
<b>3. Hazards to the Aquatic Environment</b>		
Acute Toxicity	No SANS 10234 Category Assigned	Class II (Slight lethal/Sub-lethal Hazard) (Persoone, G, et. al., 2003)
Chronic Toxicity	N/A	Limiting data, although 'Slight lethal/Sub-lethal Hazard' classification is based on chronic effects species
*Please refer to ingredient information contained in text		

## 5 BIBLIOGRAPHY

- Adamson, P., 1981. *Southern African Storm Rainfall: Technical Report TR102*, Pretoria: Department of Environmental Affairs.
- Alexander, J., 2002. The Standard Design Flood. *South African Institution of Engineers*, pp. 26-30.
- Bailey, A. & Pitman, W., 2015. *Water Resources of South Africa 2012 Study (WR2012): Executive Summary Version 1*. WRC Report No. K5/2143/1, Gezina, South Africa: Water Research Commission Report.
- Batsumi Consulting Engineers , 2021. *Mokopelane Waste Water Treatment Works Report*. Civil Engineering Waste Water Treatment: Makopelane., s.l.: FETAKGOMO TUBATSE LOCAL MUNISIPALITY .
- Campbell, .. W. A. M. B., 1986. *Evaluation of flood estimation methods- Phase II: An evaluation of hydrological techniques for making flood estimations on small unguaged catchments*, Pretoria: Water Research Commission.
- CSIR, 2005. *GUIDELINES FOR HUMAN SETTLEMENT PLANNING AND DESIGN*. Ecologically sound urban development, s.l.: s.n.
- CSIR, 2005. *Guidelines for Human Settlement Planning and Design: Volume 2*, Pretoria: CSIR Building and Construction Technology, s.l.: s.n.
- DEA, 2008. *National Environmental Management: Waste Act (Act No.59 of 2008)*, s.l.: Government Gazette.
- DEA, 2013b. *The National Norms and Standards for Disposal of Waste to Landfill*, s.l.: Government Notice R636 in Government Gazette 36784 of 23 August 2013.
- DEA, 2019. *South African National Land-Cover (SANLC) 2018*, South Africa: DEA on 1st October 2019.
- DMEA, 1998g. *1:250 000 Geological Series - 2730 Vryheid*, s.l.: s.n.
- DWAF, 1996b. *Water Quality Guidelines - Volume 1: Domestic Use*, s.l.: s.n.
- DWAF, 1998. *Minimum Requirements for Waste Disposal By Landfill, 2nd Edition*, South Africa: Department of Waster Affairs and Forestry.
- DWAF, 2003. *1:500 000 Hydrogeological map series of the Republic of South Africa - 2722 Kimberly*, s.l.: s.n.
- DWAF, 2006. *Groundwater Resource Assessment II*, s.l.: s.n.
- DWAF, 2007. *Best Practice Guidelines - G3: Water Monitoring Systems*, s.l.: DWS.
- DWAF, 2008. *Best Practice Guidelines: Impact Prediction (G4)*, s.l.: DWS.
- DWS, 2011. *The Groundwater Dictionary - A Comprihensive Reference of Groundwater Related Terminology. 2nd Edition.*, s.l.: s.n.
- DWS, 2016. *New Water Management Areas*, South Africa: Government Gazette No. 40279.
- EPA, 1991.. *R.E.D. facts. Silicon dioxide and silica gel*. U.S. Environmental Protection Agency. 738F91107. [http://www.epa.gov/pesticides/chem\\_search/reg\\_actions/reregistration/fs\\_G-74\\_1-Sep-91.pdf](http://www.epa.gov/pesticides/chem_search/reg_actions/reregistration/fs_G-74_1-Sep-91.pdf). October 6, 2015., s.l.: s.n.
- ESRI, 2018. *ArcView10.5*, s.l.: Environmental Systems Research Institute, California.
- Eyring, V. B. S. M. G. A. S. C. A. S. B. S. R. J. a. T. K. E., 2016. *Overview of the Coupled Model Intercomparison Project Phase 6 (CMIP6) experimental design and organization*, *Geosci. Model Dev.*, 9, 1937-1958, doi:10.5194/gmd-9-1937-2016. s.l.:s.n.
- GCS, August 2022. *Water Quality Monitoring Report for the Maquasa East, Maquasa West & Nooitgesien Operations: Second Quarter, 2022 Monitoring Period*, s.l.: s.n.
- GFK, 2022. *Engineering Designs and Master Layout Plan for Kangra Coal WTP & Co-Disposal Facility*, s.l.: GFK.
- GG41920, GNR 990, 21 September 2018., 2018. *National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008). Amendments to the Regulations regarding the planning and management of residue stockpiles and residue deposits 2015*, s.l.: s.n.
- IARC., 1997 . *Silica. IARC Monographs on the evaluation of carcinogenic risks to humans. Volume 68. Silica, some silicates, coal dust and para-aramid fibrils*. Lyon, France: International Agency for Research on Cancer. <https://monographs.iarc.fr/wpcontent/uploads/2018/0/>, s.l.: s.n.
- JAXA, 2022. *Advanced Land Observation Satellite (ALOS) Global Digital Surface Model (DSM)*, Tokyo: Earth Observation Research Center (EORC), Japan Aerospace Exploration Agency (JAXA).
- Kindersley, 2012. *New Neighbourhood Design and Development Standards Manual. Section 6 Storm Water Drainage System*, s.l.: s.n.

- King, G., Maritz, E. & Jonck, F., 1998. *2726 Kroonstad - 1:500 000 Hydrological Map Series of the Republic of South Africa*, s.l.: s.n.
- Kottek, M. et al., 2006. *World Map of the Köppen-Geiger climate classification updated*. *Meteorol. Z.* 15, 259-263. doi:10.1127/0941-2948/2006/0130. s.l.:s.n.
- Lynch, S., 2004. *Development of a Raster Database of Annual, Monthly and Daily Rainfall for Southern Africa*, WRC Report No. 1156/1/04, Pretoria: Water Research Commission.
- Meteoblue, 2022. *Climate Data*. s.l.:<https://www.meteoblue.com>.
- Meteoblue, 2022. *Climate Data*. s.l.:<https://www.meteoblue.com>.
- NEMWA, 2013. *National Norms and Standards for the Remediation of Contaminated Land and Soil Quality in the Republic of South Africa*. *National Environmental Management: Waste Act*, 2008. No. 36447., s.l.: Government Gazette, 10 May 2013.
- NWA, 1998. *The South African National Water Act*, s.l.: South Africa.
- SABS: SANS 10234, 2008. *Globally Harmonized System of Classification and Labelling of Chemicals (GHS)*. Edition 1.1., s.l.: s.n.
- SANRAL, 2013. *South African Drainage Manual*. Pretoria: South African National Road Agency.
- SANRAL, 2013. *South African Drainage Manual*, Pretoria: SANRAL.
- SANS, 2008. *South African National Standard 10234:2008 - Globally Harmonized System of Classification and Labelling of Chemicals (GHS)*, s.l.: ISBN 978-0-626-22221-5.
- SANS, 2015. *South African National Standard 241-1:2015 - Drinking water - Part 1: Microbiological, physical, aesthetic and chemical determinants*, s.l.: 978-0-626-.
- Schulze, R., 1997. *South African Atlas of Agrohydrology and Climatology*. WRC Report No. TT85/96, Pretoria: Water Research Commission.
- Smithers, J. & Schulze, R., 2002. *Design Rainfall and Flood Estimation*, WRC Report No. K5/1060, Pretoria: Water Research Commission.
- Soregaroli, B.A. & Lawrence, R.W., 1998. *Update on Waste Characterisation Studies Proc. Mine Design, Operations & Closure Conference*. Polson, Montana., s.l.: s.n.
- US Army Corps of Engineers, 2016. *HEC RAS Hydraulic Modelling Software*. Version 5.0. California: s.n.
- Van Deventer, H. S.-A. L. M. N. P. C. S. A. C. N. G. M. J. N. L. M. O. D. S. P. S. E. & S. K., 2018. *NBA2018 National Wetland Map 5*. s.l.:s.n.
- Vegter, J., 1995. *An explanation of a set of National Groundwater Maps*. *Water Research Commission*. Report No TT 74/95.. s.l.:s.n.
- WRC, 2015. <http://www.waterresourceswr2012.co.za/resource-centre/>. [Online].



## APPENDIX A: LABORATORY REPORTS



## Test Report

**Client:** Groundwater Consulting Services (GCS)  
**Address:** 63 Wessel Road, Woodmead, 2191  
**Report no:** 137249  
**Project:** GCS - Waste

**Date of certificate:** 14 November 2022  
**Date accepted:** 11 October 2022  
**Date completed:** 24 October 2022  
**Revision:** 0

<b>Locality name:</b>		KSlurry1			
<b>Date sampled:</b>		10 October 2022			
<b>Sample dry Mass(g):</b>		1.00			
<b>Sample Volume (mL):</b>		50.0			
<b>Guideline Limits:</b>					
<b>Units:</b>					
		Total Concentrations			
		TCT 0	TCT 1	TCT 2	
		mg/Kg	mg/Kg	mg/Kg	mg/L mg/Kg
Metal Ions					
Arsenic as As	5.80	500	2000	0.076	3.80
Boron as B	150	15000	60000	<1.50	<75.0
Barium as Ba	62.5	6250	25000	5.66	283
Cadmium as Cd	7.50	260	1040	<0.075	<3.75
Cobalt as Co	50.0	5000	20000	<0.500	<25.0
Chromium as Cr	46000	800000	-	6.00	300
Hexavalent chromium (Cr6?)	7	500	2000	NR	NR
Copper as Cu	16.0	19500	78000	0.454	22.7
Mercury as Hg	0.930	160	640	<0.009	<0.450
Manganese as Mn	1000	25000	100000	6.19	310
Molybdenum as Mo	40.0	1000	4000	0.646	32.3
Nickel as Ni	91.0	10600	42400	0.588	29.4
Lead as Pb	20.0	1900	7600	0.634	31.7
Antimony as Sb	10.0	75.0	300	<0.100	<5.00
Selenium as Se	10.0	50.0	200	<0.100	<5.00
Vanadium as V	150	2680	10720	<1.00	<50.0
Zinc as Zn	240	160000	640000	<1.00	<50.0
Inorganic Anions					
Fluoride as F	100	10000	40000	NR	NR
Total Cyanide as CN	14.00	10500.00	42000.00	<0.100	<5.00
Percentage Solids					
Moisture %	-	-	-	8.39	
Solid %	-	-	-	NR	

O = Outsourced S = Sub-contracted NR = Not requested RTF = Results to follow NATD = Not able to determine ATR = Alternative test report  
 N/A = Not Applicable

www.aquatico.co.za

89 Regency Drive, R21 Corporate Park, Centurion, South Africa

Tel: +27 12 450 3800 Fax: +27 12 450 3851



### Test Report

**Client:** Groundwater Consulting Services (GCS) **Date of certificate:** 14 November 2022  
**Address:** 63 Wessel Road, Woodmead, 2191 **Date accepted:** 11 October 2022  
**Report no:** 137249 **Date completed:** 24 October 2022  
**Project:** GCS - Waste **Revision:** 0

Locality name:	KSlurry1				
Date sampled:	10 October 2022				
Sample dry Mass(g):					1.00
Sample Volume (mL):	Total Concentrations				50.0
Guideline Limits:	TCT 0	TCT 1	TCT 2		
Units:	mg/Kg	mg/Kg	mg/Kg	mg/L	mg/Kg
Variables					
Aluminium (Al)	-	-	-	202	10100
Iron as Fe	-	-	-	662	33100

O = Outsourced S = Sub-contracted NR = Not requested RTF = Results to follow NATD = Not able to determine ATR = Alternative test report  
 N/A = Not Applicable



## Test Report

**Client:** Groundwater Consulting Services (GCS)  
**Address:** 63 Wessel Road, Woodmead, 2191  
**Report no:** 137249  
**Project:** GCS - Waste

**Date of certificate:** 14 November 2022  
**Date accepted:** 11 October 2022  
**Date completed:** 24 October 2022  
**Revision:** 0

<b>Locality name:</b>					KSlurry1		
<b>Date sampled:</b>					10 October 2022		
<b>Sample dry Mass(g):</b>	<b>Leachable Concentrations</b>				<b>Distilled Water</b>	<b>Borax</b>	<b>TCLP</b>
<b>Sample Volume (mL):</b>	LCT 0	LCT 1	LCT 2	LCT 3	20.0	NR	20.0
<b>Units</b>	mg/L	mg/L	mg/L	mg/L	400	NR	400
<b>Metal Ions</b>							
Arsenic as As	0.010	0.500	1.00	4.00	NR	NR	<0.010
Boron as B	0.500	25.0	50.0	200	NR	NR	<0.500
Barium as Ba	0.700	35.0	70.0	280	NR	NR	<0.700
Cadmium as Cd	0.003	0.150	0.300	1.20	NR	NR	<0.003
Cobalt as Co	0.500	25.0	50.0	200	NR	NR	<0.400
Chromium as Cr	0.100	5.00	10.0	40.0	NR	NR	<0.100
Hexavalent chromium (Cr6+ )	0.050	2.50	5.00	20.0	NR	NR	<0.020
Copper as Cu	2.00	100	200	800	NR	NR	<1.00
Mercury as Hg	0.006	0.300	0.600	2.40	NR	NR	<0.006
Manganese as Mn	0.500	25.0	50.0	200	NR	NR	4.68
Molybdenum as Mo	0.070	3.50	7.00	28.0	NR	NR	0.098
Nickel as Ni	0.070	3.50	7.00	28.0	NR	NR	<0.070
Lead as Pb	0.010	0.500	1.00	4.00	NR	NR	<0.010
Antimony as Sb	0.020	1.00	2.00	8.00	NR	NR	<0.020
Selenium as Se	0.010	0.500	1.00	4.00	NR	NR	<0.010
Vanadium as V	0.200	10.0	20.0	80.0	NR	NR	<0.200
Zinc as Zn	5.00	250	500	2000	NR	NR	<2.00
<b>Inorganic Anions</b>							
Total Dissolved solids @ 180°C	1000	12500	25000	100000	NR	NR	6612
Chloride as Cl	300	15000	30000	120000	NR	NR	<50.0
Sulphate (SO <sub>4</sub> )	250	12500	25000	100000	NR	NR	484
Nitrate (NO <sub>3</sub> ) as N	11.0	550	1100	4400	NR	NR	<10.0
Fluoride as F	1.50	75.0	150	600	NR	NR	<1.00
Total Cyanide as CN	0.070	3.50	7.00	28.0	NR	NR	<0.01
<b>Physical characteristics</b>							
Paste pH (1:2)	-	-	-	-	7.94		
Redox	-	-	-	-	135		

O = Outsourced S = Sub-contracted NR = Not requested RTF = Results to follow NATD = Not able to determine ATR = Alternative test report  
 N/A = Not Applicable



## Test Report

**Client:** Groundwater Consulting Services (GCS)  
**Address:** 63 Wessel Road, Woodmead, 2191  
**Report no:** 137249  
**Project:** GCS - Waste

**Date of certificate:** 14 November 2022  
**Date accepted:** 11 October 2022  
**Date completed:** 24 October 2022  
**Revision:** 0

<b>Locality name:</b>					KSlurry1		
<b>Date sampled:</b>					10 October 2022		
					Distilled Water	Borax	TCLP
<b>Sample dry Mass(g):</b>	Leachable Concentrations				20.0	NR	20.0
<b>Sample Volume (mL):</b>	LCT 0	LCT 1	LCT 2	LCT 3	400	NR	400
<b>Units</b>	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Variables							
Aluminium (Al)	-	-	-	-	NR	NR	<2.00
Iron (Fe)	-	-	-	-	NR	NR	<2.00
Total oxidised nitrogen as N	-	-	-	-	NR	NR	<10.0

O = Outsourced S = Sub-contracted NR = Not requested RTF = Results to follow NATD = Not able to determine ATR = Alternative test report  
 N/A = Not Applicable



## Test Report

**Client:** Groundwater Consulting Services (GCS)  
**Address:** 63 Wessel Road, Woodmead, 2191  
**Report no:** 137249  
**Project:** GCS - Waste

**Date of certificate:** 14 November 2022  
**Date accepted:** 11 October 2022  
**Date completed:** 24 October 2022  
**Revision:** 0

<b>Locality name:</b>		KDiscard1			
<b>Date sampled:</b>		10 October 2022			
<b>Sample dry Mass(g):</b>		1.00			
<b>Sample Volume (mL):</b>		50.0			
<b>Guideline Limits:</b>					
<b>Units:</b>				mg/L	mg/Kg
		TCT 0	TCT 1	TCT 2	
		mg/Kg	mg/Kg	mg/Kg	
<b>Metal Ions</b>					
Arsenic as As	5.80	500	2000	0.232	11.6
Boron as B	150	15000	60000	<1.50	<75.0
Barium as Ba	62.5	6250	25000	7.92	396
Cadmium as Cd	7.50	260	1040	<0.075	<3.75
Cobalt as Co	50.0	5000	20000	<0.500	<25.0
Chromium as Cr	46000	800000	-	1.50	75.0
Hexavalent chromium (Cr6? )	7	500	2000	NR	NR
Copper as Cu	16.0	19500	78000	0.316	15.8
Mercury as Hg	0.930	160	640	<0.009	<0.450
Manganese as Mn	1000	25000	100000	3.19	160
Molybdenum as Mo	40.0	1000	4000	0.673	33.7
Nickel as Ni	91.0	10600	42400	0.621	31.1
Lead as Pb	20.0	1900	7600	0.471	23.6
Antimony as Sb	10.0	75.0	300	<0.100	<5.00
Selenium as Se	10.0	50.0	200	<0.100	<5.00
Vanadium as V	150	2680	10720	<1.00	<50.0
Zinc as Zn	240	160000	640000	1.60	80.0
<b>Inorganic Anions</b>					
Fluoride as F	100	10000	40000	NR	NR
Total Cyanide as CN	14.00	10500.00	42000.00	<0.100	<5.00
<b>Percentage Solids</b>					
Moisture %	-	-	-	4.27	
Solid %	-	-	-	NR	

O = Outsourced S = Sub-contracted NR = Not requested RTF = Results to follow NATD = Not able to determine ATR = Alternative test report  
 N/A = Not Applicable





### Test Report

**Client:** Groundwater Consulting Services (GCS)  
**Address:** 63 Wessel Road, Woodmead, 2191  
**Report no:** 137249  
**Project:** GCS - Waste

**Date of certificate:** 14 November 2022  
**Date accepted:** 11 October 2022  
**Date completed:** 24 October 2022  
**Revision:** 0

Locality name:	KDiscard1				
Date sampled:	10 October 2022				
Sample dry Mass(g):					1.00
Sample Volume (mL):	Total Concentrations				50.0
Guideline Limits:	TCT 0	TCT 1	TCT 2		
Units:	mg/Kg	mg/Kg	mg/Kg	mg/L	mg/Kg
Variables					
Aluminium (Al)	-	-	-	350	17500
Iron as Fe	-	-	-	726	36300

O = Outsourced S = Sub-contracted NR = Not requested RTF = Results to follow NATD = Not able to determine ATR = Alternative test report  
 N/A = Not Applicable



## Test Report

**Client:** Groundwater Consulting Services (GCS)  
**Address:** 63 Wessel Road, Woodmead, 2191  
**Report no:** 137249  
**Project:** GCS - Waste

**Date of certificate:** 14 November 2022  
**Date accepted:** 11 October 2022  
**Date completed:** 24 October 2022  
**Revision:** 0

<b>Locality name:</b>					<b>KDiscard1</b>		
<b>Date sampled:</b>					<b>10 October 2022</b>		
<b>Sample dry Mass(g):</b>	<b>Leachable Concentrations</b>				<b>Distilled Water</b>	<b>Borax</b>	<b>TCLP</b>
<b>Sample Volume (mL):</b>	<b>LCT 0</b>	<b>LCT 1</b>	<b>LCT 2</b>	<b>LCT 3</b>	<b>20.0</b>	<b>NR</b>	<b>20.2</b>
<b>Units</b>	<b>mg/L</b>	<b>mg/L</b>	<b>mg/L</b>	<b>mg/L</b>	<b>mg/L</b>	<b>mg/L</b>	<b>mg/L</b>
<b>Metal Ions</b>							
Arsenic as As	0.010	0.500	1.00	4.00	NR	NR	<0.010
Boron as B	0.500	25.0	50.0	200	NR	NR	<0.500
Barium as Ba	0.700	35.0	70.0	280	NR	NR	<0.700
Cadmium as Cd	0.003	0.150	0.300	1.20	NR	NR	<0.003
Cobalt as Co	0.500	25.0	50.0	200	NR	NR	<0.400
Chromium as Cr	0.100	5.00	10.0	40.0	NR	NR	<0.100
Hexavalent chromium (Cr6+ )	0.050	2.50	5.00	20.0	NR	NR	<0.020
Copper as Cu	2.00	100	200	800	NR	NR	<1.00
Mercury as Hg	0.006	0.300	0.600	2.40	NR	NR	<0.006
Manganese as Mn	0.500	25.0	50.0	200	NR	NR	2.33
Molybdenum as Mo	0.070	3.50	7.00	28.0	NR	NR	0.080
Nickel as Ni	0.070	3.50	7.00	28.0	NR	NR	<0.070
Lead as Pb	0.010	0.500	1.00	4.00	NR	NR	<0.010
Antimony as Sb	0.020	1.00	2.00	8.00	NR	NR	<0.020
Selenium as Se	0.010	0.500	1.00	4.00	NR	NR	<0.010
Vanadium as V	0.200	10.0	20.0	80.0	NR	NR	<0.200
Zinc as Zn	5.00	250	500	2000	NR	NR	<2.00
<b>Inorganic Anions</b>							
Total Dissolved solids @ 180°C	1000	12500	25000	100000	NR	NR	5636
Chloride as Cl	300	15000	30000	120000	NR	NR	<50.0
Sulphate (SO <sub>4</sub> )	250	12500	25000	100000	NR	NR	113
Nitrate (NO <sub>3</sub> ) as N	11.0	550	1100	4400	NR	NR	<10.0
Fluoride as F	1.50	75.0	150	600	NR	NR	<1.00
Total Cyanide as CN	0.070	3.50	7.00	28.0	NR	NR	<0.01
<b>Physical characteristics</b>							
Paste pH (1:2)	-	-	-	-	7.34		
Redox	-	-	-	-	85.0		

O = Outsourced S = Sub-contracted NR = Not requested RTF = Results to follow NATD = Not able to determine ATR = Alternative test report  
 N/A = Not Applicable



## Test Report

**Client:** Groundwater Consulting Services (GCS)  
**Address:** 63 Wessel Road, Woodmead, 2191  
**Report no:** 137249  
**Project:** GCS - Waste

**Date of certificate:** 14 November 2022  
**Date accepted:** 11 October 2022  
**Date completed:** 24 October 2022  
**Revision:** 0

<b>Locality name:</b>					KDiscard1		
<b>Date sampled:</b>					10 October 2022		
					Distilled Water	Borax	TCLP
<b>Sample dry Mass(g):</b>	Leachable Concentrations				20.0	NR	20.2
<b>Sample Volume (mL):</b>	LCT 0	LCT 1	LCT 2	LCT 3	400	NR	400
<b>Units</b>	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
Variables							
Aluminium (Al)	-	-	-	-	NR	NR	<2.00
Iron (Fe)	-	-	-	-	NR	NR	<2.00
Total oxidised nitrogen as N	-	-	-	-	NR	NR	<10.0

O = Outsourced S = Sub-contracted NR = Not requested RTF = Results to follow NATD = Not able to determine ATR = Alternative test report  
 N/A = Not Applicable

**Report**  
**FINAL CERTIFICATE OF ANALYSIS**  
**REVISION: 0**

<b>TO:</b> <b>CLIENT NAME:</b> <b>CLIENT ADDRESS:</b>  <b>TEL:</b> <b>MOBILE:</b> <b>EMAIL:</b>	<b>Thco Meyer</b> <b>Aquaflow Laboratories (Pty) Ltd</b> <b>89 Regency Drive, R21 Corporate Park</b> <b>Centurion</b>  <b>+27 12 450 3800</b> <a href="mailto:info@mecon@aquaflow.co.za">info@mecon@aquaflow.co.za</a>	<b>FROM:</b>  <b>ADDRESS:</b>    <b>TEL:</b> <b>FAX:</b> <b>REQUEST DATE:</b>	<b>US Analytical Services</b> <b>XRF Laboratory</b> <b>13 Edding Nook, Highveld Technopark, Centurion</b>  <b>+27 12 865 4291</b> <b>+27 12 865 4294</b> <b>13-Oct-2022</b>
---	--	---	---


		ANALYSED GRADE PERCENTAGES																					
		Fe <sub>2</sub> O <sub>3</sub>	SiO <sub>2</sub>	Al <sub>2</sub> O <sub>3</sub>	K <sub>2</sub> O	P <sub>2</sub> O <sub>5</sub>	Mn <sub>2</sub> O <sub>3</sub>	%	CaO	MgO	TiO <sub>2</sub>	%	V <sub>2</sub> O <sub>5</sub>	BaO	Cr <sub>2</sub> O <sub>3</sub>	SeO	ZnO	MoO	%	LOI	Total (KBr)	Density g/cm <sup>3</sup>	
CLIENT SAMPLE ID	US SAMPLE ID																						
1586347426.usa1/Batch/1372561.usa/m/158634	HS766	9.505	54.072	7.779	2.114	0.041	0.041	3.229	0.351	0.439	0.440	0.011	0.008	0.003	0.048	0.050	0.038	22.987	97.257	2.335			
1586347426.usa1/Batch/1372561.usa/m/158632	HS767	4.875	34.411	9.528	1.419	0.052	0.026	3.383	0.451	0.506	0.371	0.010	0.002	0.009	0.063	0.041	0.027	44.353	99.440	2.087			

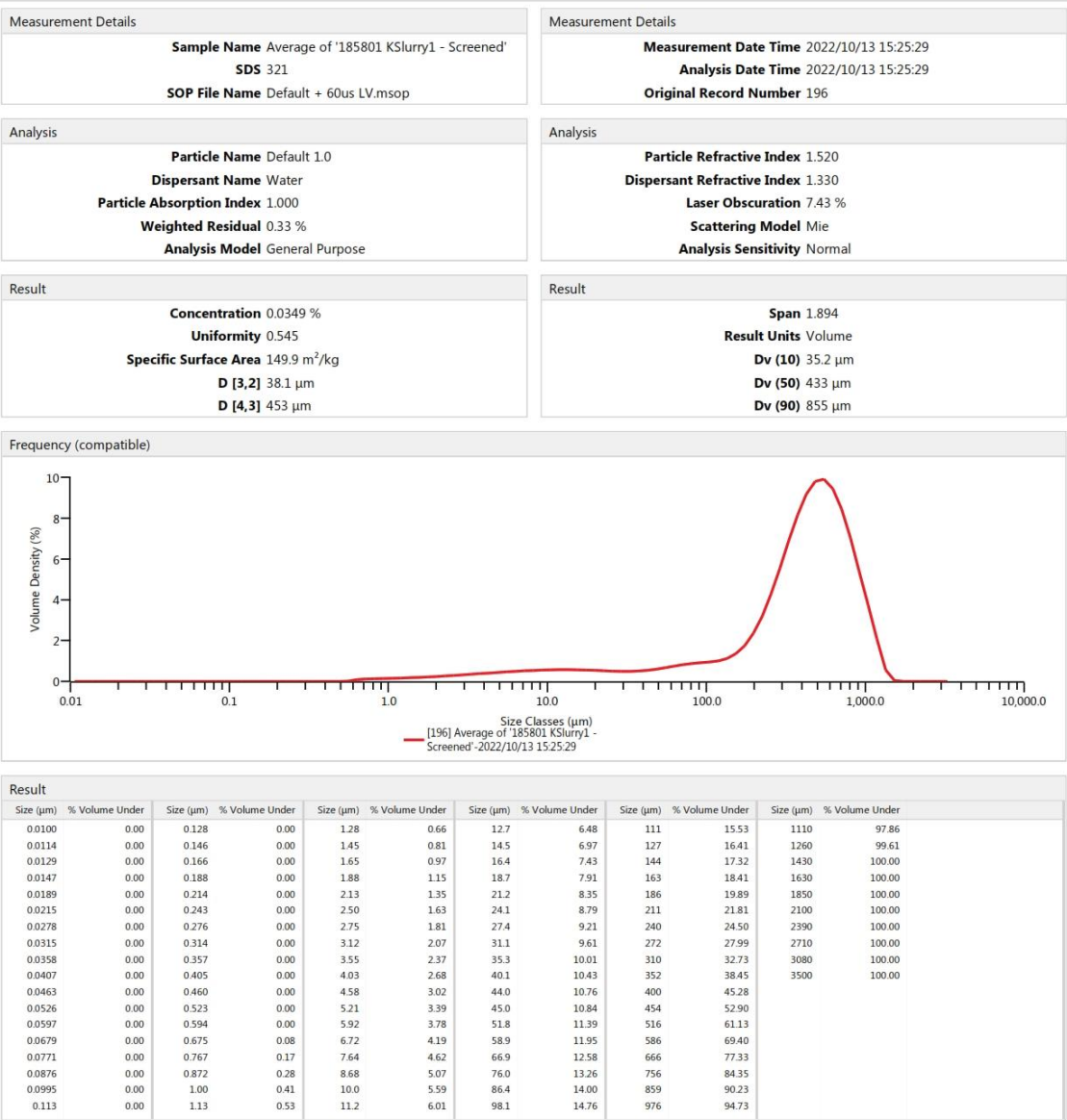
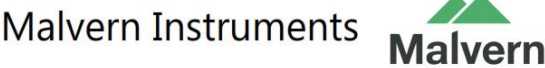
**NOTES:**  

- \*The results relate specifically to the items as labeled
- \*The report shall not be reproduced except in full, without the written approval of the laboratory

Identification of test method: USI method identifier: Instrument model: Asset number:	Major and Minor Elements by XRF USI-AP-1001 ARL ADVANTX <sup>®</sup> SERIES US-AS 0205
Identification file: Automation code: Authorized by:	USI 47697_Report 24-Oct-2022 NAME: E Mapela DESIGNATION: Technician

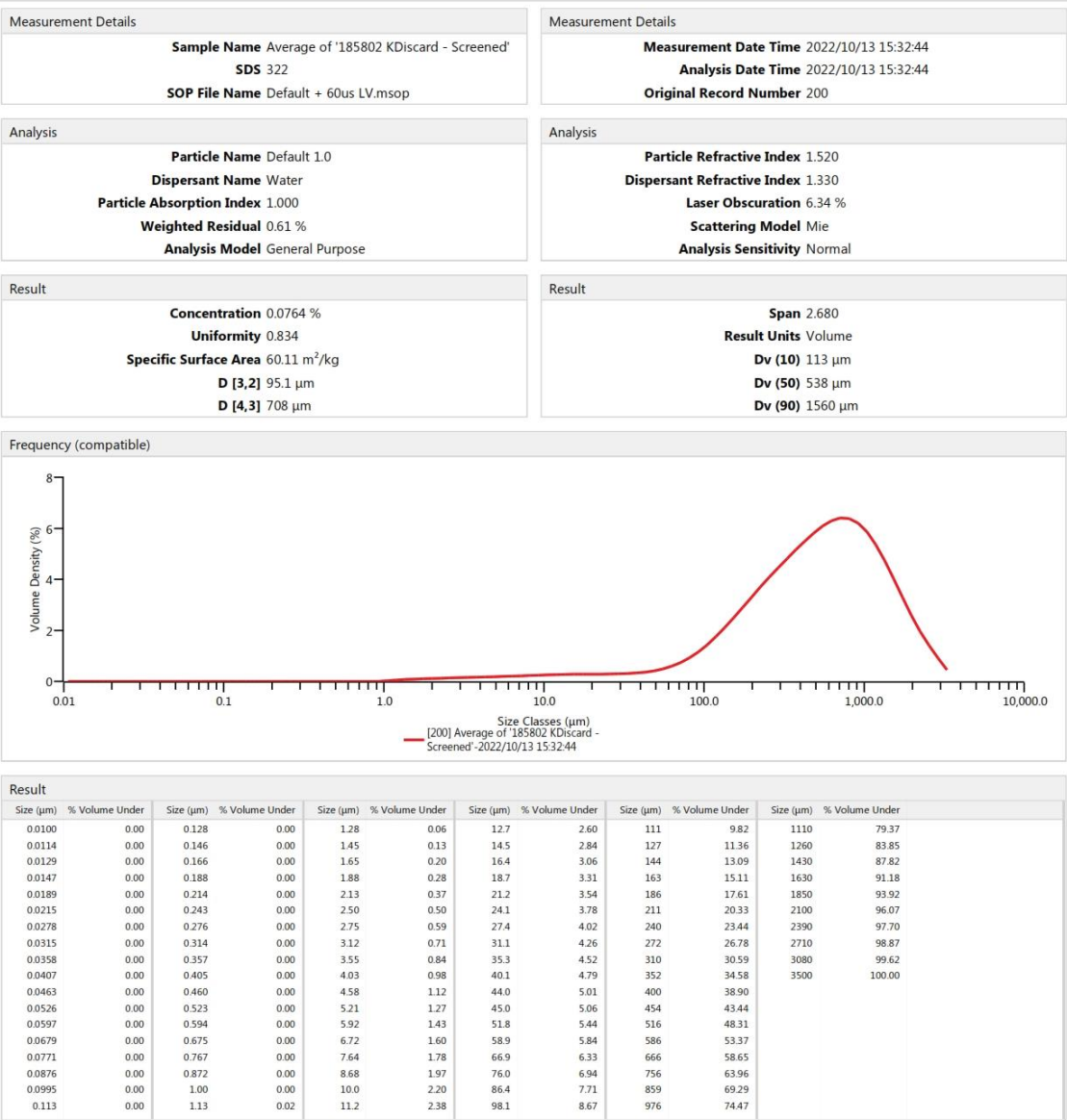
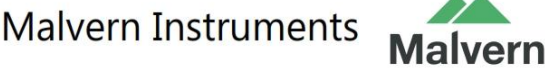
<p align="center"><b>CERTIFICATE OF ANALYSIS</b></p> <p align="center">No unauthorised copies may be made of this report.</p>							
<b>To:</b> Aquatic Laboratories (Pty) Ltd <b>Attention:</b> Theo Meyer <b>Project ID:</b> BATCH 137250 (POAQL 2022 408)		<b>Date of Request:</b> 13-10-2022		<b>UIS Analytical Services</b> Analytical Chemistry Laboratories 2, 4			
<b>Tel:</b> <b>Fax:</b>				<b>Tel:</b> (012) 665 4294			
<p align="center"><b>Certificate of analysis: 47957</b></p>							
Lims ID	Sample ID	F mg/kg	C <sup>+</sup> mg/kg				
857566	1568347/KSlurry1/Batch/no'137250/Lab/no'185801	192	<5				
857566 QC	Duplicate	187	<5				
857567	1568347/KDiscard1/Batch/no'137250/Lab/no'185802	308	<5				
		Chemical elements: Instrument: Method	CrI+ F Fluoride Ion Selective Electrode, Spectrophotometer Hexavalent Chromium in Soil/Ore by alkaline digestion & Spectrophotometry, Total Fluorine in solution by alkaline fusion & ion selective electrode				
Date:	26-10-2022	Date:	26-10-2022				
Analysed by:	R Kayser RGM Rakome' V Mammubu	Authorised :	SD Maembe				
			Page 1 of 1				

Particle size distribution





Particle size distribution





2 Brammer St, Industries East  
Germiston South  
Republic of South Africa  
Telephone: +27 11 323 7300  
Fax: +27 86 576 8152  
Email: sales@interwaste.co.za  
www.interwaste.co.za

Sample Identification Number: IW2022-0955

Laboratory Analysis Report for Landfill Assessment			
<b>Requested By:</b>	Cheila Canario	<b>Waste Name:</b>	Sample 185801 (KSlurry1)
<b>Generator:</b>	Aquatico	<b>Received Date:</b>	17/10/2022
<b>Lab Reference:</b>	IW2022-0955	<b>Analysis Date:</b>	18/10/2022
<b>No. of Samples:</b>	1	<b>Report Date:</b>	20/10/2022
<b>Sample Description:</b>	Black Powder		

Table 1: Miscellaneous tests for sample: IW2022-0955

Parameter Tested	Unit	IW2022-0955
Sample Moisture Content*	% (w/w)	NT
Conductivity	uS/cm	NT
Initial Sample pH	pH Units	NT
Sample pH after HCl Addition	pH Units	NT
Leach Solution Applied	Solution Type	NT
Final Leach Solution pH	pH Units	NT
Physical State	N/A	Solid
Water Miscibility	N/A	Immiscible
Calorific Value*	MJ/kg	NT
Additional Information	N/A	Low Odour, Not Flammable, Flashpoint:-ve@30,60 & 90°C

UTD = Unable to determine; NT = Not tested; \* = Not a SANAS accredited method; Conductivity and pH measured by electronic conductivity and pH meter at ~22°C (10% H<sub>2</sub>O extracts of solids). Moisture by mass loss on heating at ~103°C for 30 mins.

**Determining the landfill site class for disposal:**

The assigned waste type determines the class of landfill site where a particular waste stream may be disposed. A waste type of one (Type 1) is assigned to waste that presents the most risk to the environment when disposed of at a landfill site and therefore requires disposal at a site with stringent engineering controls corresponding to a so called "Class A" site. Type four (Type 4) waste presents a low risk to the environment when disposed of to a landfill site and therefore may be disposed of at a less stringently engineered, "Class D" site. Type zero waste (Type 0) may not be disposed of to any landfill site in South Africa without prior treatment. The *National Waste Classification and Management Regulations* detail specific requirements surrounding the classification and assessment of waste for disposal to landfill (See references). Note that a GHS (SANS10234) compliant classification and safety data sheet is required before a final waste management decision should be taken and should be read in conjunction with this assessment.

**Standard Operational Procedure:**

Identification of analysis methods:

IW-S-1: Determination of Metals in Liquids and solids using ICP-OES Optima 8300; IW-S-2: Determination of the VOC content of liquid and solids using GC6850, MS5976C; IW-S-3: pH Measurement; IW-S-4: EC Measurement; IW-S-5: Calibration and measurement of samples using Supercal Modular calorimeter; IW-S-6: Toxicity characteristic leaching procedure – TCLP; IW-S-7: Field Portable X-ray Fluorescence FTXRF; AS 4439.1-1999: Wastes, sediments and contaminated soils - Preparation of leachates - Preliminary assessment; AS 4439.3-1997: Wastes, sediments and contaminated soils - Preparation of leachates - Bottle leaching procedures.

**Scope of Accreditation:**

Materials/Products Tested	Types of Tests	Standard Specifications, Equipment/Techniques Used
1- Waste (Solid, sludge and liquid)	Quantification of metals by ICP-OES following ASLP, reagent water (Ag, Al, As, B, Ba, Be, Bi, Cd, Co, Cr, Cu, Fe, Hg, Mn, Mo, Ni, Rb, P, Pb, Sb, Se, Sn, Sr, Ti, Tl, U, V, Zn)	IW-M-01 - Based on method 6010C
2- Solids & Liquids	Determination of VOC; BTEX by GC/MS Headspace	IW-M-02 - Based on method EPA 8260B; EPA 5030B(Liquid) and EPA 5035 (solid)
3- Potable water & leachates	pH at 25 °C	IW-M-03
4- Potable water & leachates	Electrical Conductivity at 25°C	IW-M-04

**Disclaimer:**

Analysis results relate only to the samples submitted. The laboratory has no control over the sampling protocol, the representivity of the samples and the manner in which the samples were collected, transported, stored, preserved or otherwise handled outside of the laboratory facility and therefore takes no responsibility whatsoever for these activities. Third parties using INTERWASTE results can verify the results by contacting the laboratory. INTERWASTE are not liable or responsible for the customer use and/or interpretation of test results. This certificate cannot be reproduced without the written consent of INTERWASTE laboratory.

**Confidentiality Disclaimer:**

All test results are confidential and are issued on a clear and accurate report of Analysis. Reports are submitted for exclusive use by our clients and/or our sales consultants. No reference to the work, the results, or to INTERWASTE HUB LAB may be made in any form of advertising, news release or other public announcement without written authorization.

**References**

- 1.) Government Notice R.365, National Environmental Management: Waste Act (59/2008): National norms and standards for the assessment of waste for landfill disposal, Gazette No. 36

Signed by: Dr. Chella Canario  
Signed at: 2022-10-20 14:06:02 +02:00  
Reason: Chief Chemist





2 Brammer St, Industries East  
Germiston South  
Republic of South Africa  
Telephone: +27 11 323 7300  
Fax: +27 86 576 8152  
Email: sales@interwaste.co.za  
www.interwaste.co.za

Sample Identification Number: **IW2022-0956**

Laboratory Analysis Report for Landfill Assessment			
<b>Requested By:</b>	Cheila Canario	<b>Waste Name:</b>	Sample 185802 (KDiscard1)
<b>Generator:</b>	Aquatico	<b>Received Date:</b>	17/10/2022
<b>Lab Reference:</b>	IW2022-0956	<b>Analysis Date:</b>	18/10/2022
<b>No. of Samples:</b>	1	<b>Report Date:</b>	20/10/2022
<b>Sample Description:</b>	Black Powder		

Table 1: Miscellaneous tests for sample: IW2022-0956

Parameter Tested	Unit	IW2022-0956
Sample Moisture Content*	% (w/w)	NT
Conductivity	uS/cm	NT
Initial Sample pH	pH Units	NT
Sample pH after HCl Addition	pH Units	NT
Leach Solution Applied	Solution Type	NT
Final Leach Solution pH	pH Units	NT
Physical State	N/A	Solid
Water Miscibility	N/A	Immiscible
Calorific Value*	MJ/kg	NT
Additional Information	N/A	Low Odour, Not Flammable, Flashpoint: -ve@30,60 & 90°C

UTD = Unable to determine; NT = Not tested; \* = Not a SANAS accredited method; Conductivity and pH measured by electronic conductivity and pH meter at ~22°C (10% H<sub>2</sub>O extracts of solids). Moisture by mass loss on heating at ~103°C for 30 mins.



**Determining the landfill site class for disposal:**

The assigned waste type determines the class of landfill site where a particular waste stream may be disposed. A waste type of one (Type 1) is assigned to waste that presents the most risk to the environment when disposed of at a landfill site and therefore requires disposal at a site with stringent engineering controls corresponding to a so called "Class A" site. Type four (Type 4) waste presents a low risk to the environment when disposed of to a landfill site and therefore may be disposed of at a less stringently engineered, "Class D" site. Type zero waste (Type 0) may not be disposed of to any landfill site in South Africa without prior treatment. The *National Waste Classification and Management Regulations* detail specific requirements surrounding the classification and assessment of waste for disposal to landfill (See references). Note that a GHS (SANS10234) compliant classification and safety data sheet is required before a final waste management decision should be taken and should be read in conjunction with this assessment.

**Standard Operational Procedure:**

Identification of analysis methods:

IW-S-1: Determination of Metals in Liquids and solids using ICP-OES Optima 8300; IW-S-2: Determination of the VOC content of liquid and solids using GC6850, MS5976C; IW-S-3: pH Measurement; IW-S-4: EC Measurement; IW-S-5: Calibration and measurement of samples using Supercal Modular calorimeter; IW-S-6: Toxicity characteristic leaching procedure – TCLP; IW-S-7: Field Portable X-ray Fluorescence FTXRF; AS 4439.1-1999: Wastes, sediments and contaminated soils - Preparation of leachates - Preliminary assessment; AS 4439.3-1997: Wastes, sediments and contaminated soils - Preparation of leachates - Bottle leaching procedures.

**Scope of Accreditation:**

Materials/Products Tested	Types of Tests	Standard Specifications, Equipment/Techniques Used
1- Waste (Solid, sludge and liquid)	Quantification of metals by ICP-OES following ASLP, reagent water (Ag, Al, As, B, Ba, Be, Bi, Cd, Co, Cr, Cu, Fe, Hg, Mn, Mo, Ni, Rb, P, Pb, Sb, Se, Sn, Sr, Ti, Tl, U, V, Zn)	IW-M-01 - Based on method 6010C
2- Solids & Liquids	Determination of VOC; BTEX by GC/MS Headspace	IW-M-02 - Based on method EPA 8260B; EPA 5030B(Liquid) and EPA 5035 (solid)
3- Potable water & leachates	pH at 25 °C	IW-M-03
4- Potable water & leachates	Electrical Conductivity at 25°C	IW-M-04

**Disclaimer:**

Analysis results relate only to the samples submitted. The laboratory has no control over the sampling protocol, the representivity of the samples and the manner in which the samples were collected, transported, stored, preserved or otherwise handled outside of the laboratory facility and therefore takes no responsibility whatsoever for these activities. Third parties using INTERWASTE results can verify the results by contacting the laboratory. INTERWASTE are not liable or responsible for the customer use and/or interpretation of test results. This certificate cannot be reproduced without the written consent of INTERWASTE laboratory.

**Confidentiality Disclaimer:**

All test results are confidential and are issued on a clear and accurate report of Analysis. Reports are submitted for exclusive use by our clients and/or our sales consultants. No reference to the work, the results, or to INTERWASTE HUB LAB may be made in any form of advertising, news release or other public announcement without written authorization.

**References**

- 1.) Government Notice R.365, National Environmental Management: Waste Act (59/2008): National norms and standards for the assessment of waste for landfill disposal, Gazette No. 36

Signed by: Dr. Cheila Canario  
Signed at: 2022-10-20 14:06:33 +02:00  
Reason: Chief Chemist





Company registration number: 2012/106020/07  
VAT number: 4740264959

Tests performed at: GAUTENG OFFICE:  
P.O. Box 11216, Silver Lakes, Pretoria, 0054  
78 Pony Street, Tijgervallei Office Park, Block 5, Unit 2, Silver Lakes  
Fax: 086 535 7368  
Tel: 012 753 2192  
Email: [lizet@biotoxsa.co.za](mailto:lizet@biotoxsa.co.za) or [marliseb@biotoxsa.co.za](mailto:marliseb@biotoxsa.co.za)



Toxicity Specialists

## TOXICITY TEST REPORT

**For:**  
Aquatico Laboratories

89 Regency Drive, Route 21 Corporate Park, Irene  
PO Box 905008, Garsfontein, 0042  
[theo@aquatico.co.za](mailto:theo@aquatico.co.za)/[outsourcing@aquatico.co.za](mailto:outsourcing@aquatico.co.za)

**Survey:**  
2022-10

**Report reference:**  
AQL-WST-A-22\_TOX(sup)

**Revision:**  
0

**Project:**  
GCS-Waste

**Samples:**  
KDiscard1, KSlurry1

Tests performed by: Praise Manyenga (Senior Analyst); Lethabo Mothupi (Junior Analyst)  
Inputs and results verified by: Praise Manyenga (Laboratory Manager)  
Classification (DEEP) performed by: Marliese Brown (Quality Assurance Manager)

Report approved by:

Lizet Swart  
Quality Manager

Results approved by:

Praise Manyenga  
Technical Signatory

Report issue date  
16 November 2022

A= Accredited NA =Not accredited O=Outsourced S=Sub-contracted NR=Not requested RTF=Results to follow  
The results relate only to the test item(s) tested and for samples as sampled and received from the Client  
Results marked "Not SANAS Accredited" in this report are not included in the SANAS Schedule of Accreditation for this laboratory



Supplement to toxicity testing report number AQL-WST-A-22\_TOX

## Table of contents

1. ANALYSES REQUESTED AND SAMPLE INFORMATION .....	3
2. METHODOLOGY .....	3
Sampling and sample handling .....	3
Test Conditions .....	3
Quality Assurance .....	3
Assessments .....	3
3. HAZARD CLASSIFICATION METHODOLOGY .....	6
4. RESULTS AND HAZARD CLASSIFICATION DATA .....	7
5. COMMENTS .....	8
6. REFERENCES .....	9
END OF REPORT .....	9

## List of Tables

<b>Table 1:</b> Analyses requested and description for the different samples, including sampling and delivery dates. ....	3
<b>Table 2:</b> Toxicity Units (Tonkes and Baltus, 1997) .....	6
<b>Table 3:</b> Hazard classification system for natural water <u>samples</u> (Persoone <i>et al.</i> (2003)) .....	6
<b>Table 4:</b> Weight score allocation for each test type (Persoone <i>et al.</i> (2003)) .....	6
<b>Table 5:</b> Hazard class per dilution level scale .....	7
<b>Table 6:</b> Hazard classification of water <u>samples</u> .....	7
<b>Table 7:</b> Hazard classification of water <u>sample dilutions</u> (as per Table 6 methodology) .....	7
<b>Table 8:</b> Site hazard classification of water <u>samples</u> .....	8

A= Accredited NA =Not accredited OS=Outsourced SC=Sub-contracted NR=Not requested RTF=Results to follow.  
 Results marked "NA" and "OS" and "SC" in this report are not included in the SANAS Schedule of Accreditation for this laboratory. The results relate only to the test item(s) tested and for samples as sampled and received by/from the Client.  
 Any opinions/interpretations noted in this report are not included in the scope of accreditation. Any part of this report shall not be reproduced, except in full, without the written approval of BioToxLab

Page 2 of 9





Supplement to toxicity testing report number AQL-WST-A-22\_TOX

## 1. ANALYSES REQUESTED AND SAMPLE INFORMATION

Enclosed please find Test Certificate of analysis number AQL-WST-A-22\_TOX(sup). The results relate only to the sample(s) tested. BioToxLab does not accept responsibility for any matters arising from the further use of the results. Tests marked "Not SANAS accredited" (NA or OS) in this Certificate of Analyses are not included in the SANAS Schedule of Accreditation for this Laboratory.

No part of this Certificate of Analyses may be quoted in isolation of the rest of the text without the written permission of BioToxLab. Opinions and Interpretations expressed herein are outside the scope of SANAS accreditation.

Please contact the Laboratory if further information is required.

**Table 1:** Analyses requested and description for the different samples, including sampling and delivery dates.

Sample name	Sampling date	Sample type (water, sediment, product etc)	Sampled by	Delivery date	Delivered by	Additional comments (sample description or deviations)	Tests requested - Marked with X									
							Screening	Definitive	Water						Sediment	
									<i>Daphnia magna</i>	<i>Poecilia reticulata</i>	<i>Allulobus fischeri</i>	<i>Selenastrum capricornutum</i>	<i>Spartina polytriza</i>	Phyto seeds	Ostracod	
KDiscard1	2022.10.10	DI leachate from a coal slurry and coal discard	Aquatico	2022.10.14	Aquatico	Delivered >3 days after sampling		X	X	X		X				
KSlurry1	2022.10.10	DI leachate from a coal slurry and coal discard	Aquatico	2022.10.14	Aquatico	Delivered >3 days after sampling		X	X	X		X				

Key:

Screening = 100% (undiluted) sample tested only

Definitive = Series of sample dilutions tested to enhance classification accuracy and to determine safe dilution

## 2. METHODOLOGY

### Sampling and sample handling

Samples were analysed as received from the Client. The samples received from Aquatico Laboratories were exposed as definitives on 3 trophic levels (*Selenastrum capricornutum*, *Daphnia magna* and *Poecilia reticulata*).

### Test Conditions

All toxicity tests were conducted in environmentally controlled rooms using standard techniques.

### Quality Assurance

The BioToxLab Aquatic Toxicology Laboratory's Policy and Quality Manual, intended to support and maintain all aspects of the Quality System, is based on the application of ISO/IEC 17025. The following Quality Assurance information can be made available on request (1) inhouse reference toxicant test data and control charts (2) Proficiency Testing Scheme (PTS) test data (3) lot and batch numbers (4) raw toxicity test data.

### Assessments

Given the limitations of substance-specific assessments, and the risk of allowing ecological toxicity hazards to go unchecked/undetected, water resource managers and scientists have for some time called for methodologies that will allow more complete assessment s of ecological toxicity hazards to be used in addition to the substance-specific approach. The National Water Act (Act no. 36 of 1998), providing for water in sufficient quantity and in sufficient quality for basic human needs and for maintenance of aquatic ecosystem function, implemented an approach known as the

A= Accredited NA =Not accredited OS=Outsourced SC=Sub-contracted NR=Not requested RTF=Results to follow. Results marked "NA" and "OS" and "SC" in this report are not included in the SANAS Schedule of Accreditation for this laboratory. The results relate only to the test item(s) tested and for samples as sampled and received by/from the Client. Any opinions/interpretations noted in this report are not included in the scope of accreditation. Any part of this report shall not be reproduced, except in full, without the written approval of BioToxLab





Supplement to toxicity testing report number AQL-WST-A-22\_TOX

Direct Estimation of Ecological Effect Potential (DEEEP) protocol as a means of circumventing the shortcomings of direct toxicant monitoring. This protocol consists of a battery of tests to directly assess lethal (acute) and sub-lethal (chronic) toxicity, using test organisms from a range of trophic levels. These toxicity tests can demonstrate whether contaminants are bioavailable, it can evaluate the aggregate toxic effects of all contaminants in the medium and it can evaluate the toxicity of substances whose biological effects may not have been well characterized.

Lethal or sub-lethal toxicity testing (as applied for this assessment) is applied by exposing biota to water sources in order to determine the potential risk of such waters to the biota/biological integrity of the receiving water bodies and the environment. A risk category is determined based on the percentage of mortalities (lethal) or inhibition (sub-lethal) of the exposed biota. It is important to note that the hazard classification is based on the standardised battery of selected test biota and therefore represents the risk/hazard towards similar biota in the receiving aquatic environment. The toxicity hazard is therefore in terms of the aquatic biotic integrity and does in no way represent toxicology towards humans or other mammals.

Physical and chemical properties as required to be performed by the standard toxicity methods are also presented in this report as supplementary data to the toxicity testing data.

Standard, internationally accepted methods and materials were applied in order to conduct lethal and sub-lethal toxicity testing.

#### ***Selenastrum capricornutum* sub-lethal growth inhibition test (A)**

Synonym:	<i>Raphidocelis subcapitata</i> ; <i>Pseudokirchneriella subcapitata</i>			
BioToxLab method number:	QM7.2/TMH-02			
Standard method:	SANS 8692:2015			
Deviation from the method:	None			
Test endpoint:	EC <sub>20</sub> /EC <sub>50</sub>			
Exposure period:	72-hours			
Test chamber type:	10cm path length long cells			
Test sample volume:	25 mL			
Number of replicates per sample:	3			
Test temperature (21-25°C):	22.7°C – 23.7°C			
Test organism species name and source:	<i>Selenastrum capricornutum</i> , Printz algae beads (CCAP 278/4 Cambridge, UK)			
Optical density measurement:	Jenway 6300 Spectrophotometer			
Algal beads batch number(s):	SC 260422			
Matrix dissolving batch number(s):	MD 200722			
Nutrient batch number(s):	A: SC030522	B: SC030522	C: SC030522	D: SC030522
Statistical methods used:	Microsoft Excel® spreadsheet formulated by supplier (MicroBioTests Inc., Belgium) – RegTox and Regression analysis			
Date(s) of performance of the test(s):	2022.10.18			
Uncertainty of measurement:	Available on request			
Validity (from Regtox sheet: cell density factor ≥67):	Yes			

A= Accredited NA =Not accredited OS=Outsourced SC=Sub-contracted NR=Not requested RTF=Results to follow. Results marked "NA" and "OS" and "SC" in this report are not included in the SANAS Schedule of Accreditation for this laboratory. The results relate only to the test item(s) tested and for samples as sampled and received by/from the Client. Any opinions/interpretations noted in this report are not included in the scope of accreditation. Any part of this report shall not be reproduced, except in full, without the written approval of BioToxLab

Page 4 of 9



Supplement to toxicity testing report number AQL-WST-A-22\_TOX

**Daphnia magna lethality toxicity test (A)**

BioToxLab method number:	QM7.2/TMH-03
Standard method:	SANS 6341: 2015
Deviation from the method:	None
Test endpoint:	LC <sub>10</sub> /LC <sub>50</sub>
Exposure period:	24- and 48-hours
Test chamber type:	Polycarbonate test plates (6 rinsing wells and 24 testing wells)
Test sample volume:	25 mL
Number of replicates per sample:	4
Number of test organisms per chamber:	5
Test temperature (20-22°C):	21.0°C
Test organism species name, age & source:	<i>Daphnia magna</i> – ephippia obtained from MicroBiotests, <24h old
Feeding frequency during testing:	None
Ephippia batch number(s):	DM240322
ISO media batch number(s):	ISO070622
Statistical methods used:	Microsoft Excel®
Date(s) of performance of the test(s):	2022.10.24
Uncertainty of measurement:	Available on request
Validity criteria (control mortality≤10%):	0%

**Poecilia reticulata lethality toxicity test (A)**

BioToxLab method number:	QM7.2/TMH-04
Standard method:	SANS 7346-1: 2013
Deviation from the method:	None
Test endpoint:	LC <sub>10</sub> /LC <sub>50</sub>
Exposure period:	96-hours
Test chamber type:	250 mL disposable polystyrene cups
Test sample volume:	200 mL
Number of replicates per sample:	2
Number of test organisms per chamber:	6
Test temperature (22-24°C):	23.0°C – 23.8°C
Test organism species name, age & source:	<i>Poecilia reticulata</i> – 7-21 days old. Obtained from external stock
Feeding frequency during testing:	None
ISO media batch number(s):	ISO070622
Statistical methods used:	Microsoft Excel®
Date(s) of performance of the test(s):	2022.10.24
Uncertainty of measurement:	Available on request
Validity criteria (control mortality≤10%):	8.33%

**Physical and chemical properties**

Parameter	BioToxLab Method number	Test temperature (25°C±3°C)	Instrument	Batch number(s)	Date(s) of test(s)
pH (A)	QM7.2/TMC-05	26.0°C	HQ440d	pH1.67: N/A pH4: A1354 pH7: A2122A pH10: A1334	2022.10.18
EC (A)	QM7.2/TMC-06	26.0°C	HQ440d	1413µS/m: A1306	2022.10.18
Dissolved oxygen (NA)	QM7.2/TMC-07	26.0°C	HQ440d	N/A	2022.10.18

Uncertainty of measurement for accredited (A) methods available on request

A= Accredited NA =Not accredited OS=Outsourced SC=Sub-contracted NR=Not requested RTF=Results to follow. Results marked "NA" and "OS" and "SC" in this report are not included in the SANAS Schedule of Accreditation for this laboratory. The results relate only to the test item(s) tested and for samples as sampled and received by/from the Client. Any opinions/interpretations noted in this report are not included in the scope of accreditation. Any part of this report shall not be reproduced, except in full, without the written approval of BioToxLab



Supplement to toxicity testing report number AQL-WST-A-22\_TOX

### 3. HAZARD CLASSIFICATION METHODOLOGY

The toxicity unit (TU) for each test performed is calculated as 100% (full strength effluent expressed as percentage) divided by the effective concentration or LC<sub>50</sub> expressed as percentage sample dilution (e.g. *Daphnia magna* and *Poecilia reticulata* lethal toxicity tests) and EC<sub>50</sub> (e.g. *Aliivibrio fischeri* bioluminescent test and *Selenastrum capricornutum* growth inhibition tests) (Tonkes & Baltus, 1997) (Table 2). If there is insufficient toxicity in a sample to allow for the determination of an EC<sub>50</sub>/LC<sub>50</sub> value, then a toxicity unit of <1 will be assigned to the sample.

**Table 2:** Toxicity Units (Tonkes and Baltus, 1997)

Toxicity Unit	Conclusion/Description
<1	Limited to no toxicity
1 – 2	Negligibly toxic
2 – 10	Mildly toxic
10 – 100	Acutely toxic
> 100	Highly toxic

A risk/hazard category is determined by using a hazard classification system developed by Persoone *et al.* (2003) whereby one can classify sites using the toxicity data of the non-diluted samples. The percentage effect (PE) of toxicity (mortalities, growth inhibition, luminescence inhibition) is used to rank the sample into one of five classes (Table 3 – effluent/waste samples) based on the highest toxic response obtained in at least one of the tests applied.

**Table 3:** Hazard classification system for effluent/waste samples

Class	Symbol	Hazard rating	PE	Percentage effect
I	☺	No lethal/sub-lethal hazard	≤10/20%	None of the tests show a toxic effect (i.e. an effect value that is significantly higher than that noted in the controls)
II	☹	Slight lethal/sub-lethal hazard	10/20% ≤ PE < 50%	A statistically significant (P<0.05) PE is reached in at least one test, but the effect level is below 50% (TU<1)
III	☠	Lethal/sub-lethal hazard	50% ≤ PE < 100%	The 50% effect level is reached or exceeded in at least one test but the effect level is below 100% (1 ≤ TU < 10)
IV	☠☠	High lethal/sub-lethal hazard	PE 100% in at least one test	The 100% effect is reached or exceeded in at least one test (10 ≤ TU < 100)
V	☠☠☠	Very high lethal/sub-lethal hazard	PE 100% in all tests	The 100% effect is reached or exceeded in all the tests applied (TU ≥ 100)

Each sample is furthermore weighted (Table 4) according to its relative toxicity level (out of 100%). Higher values indicate that more of the individual tests indicated toxicity within a specific class.

**Table 4:** Weight score allocation for each test type (Persoone *et al.* (2003))

Score	Category
0	No significant toxicity effect
1	Significant toxicity effect < PE50
2	Toxicity effect > PE50 but < PE100
3	The PE100 is reached

Class weight score calculated as follows:  
 Class weight score = (Σ all test scores)/n where n is the number of tests performed  
 Class weight score % = (class score) / (maximum class weight score) x 100

EP (Percentage effect) = an effect measured either as mortality or inhibition (depending on the type of test). A >10% effect is regarded as slight lethal toxicity for *Daphnia* and *Poecilia* while a >20% effect is regarded as slight sub-lethal toxicity for *Selenastrum*. A 50% effect is regarded as a lethal/sub-lethal toxicity for all the tests (*Daphnia*, *Poecilia* and *Selenastrum*)

A= Accredited NA =Not accredited OS=Outsourced SC=Sub-contracted NR=Not requested RTF=Results to follow.  
 Results marked "NA" and "OS" and "SC" in this report are not included in the SANAS Schedule of Accreditation for this laboratory. The results relate only to the test item(s) tested and for samples as sampled and received by/from the Client. Any opinions/interpretations noted in this report are not included in the scope of accreditation. Any part of this report shall not be reproduced, except in full, without the written approval of BioToxLab





Supplement to toxicity testing report number AQL-WST-A-22\_TOX

The toxicity hazard for each dilution level used to assess the hazard and perform calculations and classifications are presented in Table 5 in order to assess/review data trends and are done according to the following scale:

**Table 5:** Hazard class per dilution level scale

Scale	Description
0-≤10% ( <i>Daphnia</i> , <i>Poecilia</i> ) 0-≤20% ( <i>Selenastrum</i> )	Not toxic
10-≤50 ( <i>Daphnia</i> , <i>Poecilia</i> ) 20-≤50 ( <i>Selenastrum</i> )	Slightly toxic
50-≤100 ( <i>Daphnia</i> , <i>Poecilia</i> , <i>Selenastrum</i> )	Toxic
≥100 ( <i>Daphnia</i> , <i>Poecilia</i> , <i>Selenastrum</i> )	Highly toxic

**4. RESULTS AND HAZARD CLASSIFICATION DATA****Table 6:** Hazard classification of water samples

Site/ sample	Microalgae (A) <i>Selenastrum capricornutum</i>			Crustacea (A) <i>Daphnia magna</i>			Vertebrates (A) <i>Poecilia reticulata</i>			Weight %
	% effect	TU	Test score	% effect	TU	Test score	% effect	TU	Test score	
KDiscard1	-8.80	<1	0	0	<1	0	0	<1	0	0
KSlurry1	-30.05	<1	1	0	<1	0	0	<1	0	33

TUs not applicable to screening testing (N/A)

**Table 7:** Hazard classification of water sample dilutions (as per Table 5 methodology)

Sample name	Dilution level	Toxicity hazard	Sample name	Toxicity hazard	Sample name	Toxicity hazard
<i>S. capricornutum</i> KDiscard1	100%	Not toxic	<i>D. magna</i> KDiscard1	Not toxic	<i>P. reticulata</i> KDiscard1	Not toxic
	50%	Not toxic		Not toxic		Not toxic
	25%	Not toxic		Not toxic		Not toxic
	10%	Not toxic		Not toxic		Not toxic
	1%	Not toxic		Not toxic		Not toxic
<i>S. capricornutum</i> KSlurry1	100%	Slightly toxic	<i>D. magna</i> KSlurry1	Not toxic	<i>P. reticulata</i> KSlurry1	Not toxic
	50%	Slightly toxic		Not toxic		Not toxic
	25%	Slightly toxic		Not toxic		Not toxic
	10%	Not toxic		Not toxic		Slightly toxic
	1%	Slightly toxic		Not toxic		Not toxic

A= Accredited NA =Not accredited OS=Outsourced SC=Sub-contracted NR=Not requested RTF=Results to follow.  
Results marked "NA" and "OS" and "SC" in this report are not included in the SANAS Schedule of Accreditation for this laboratory. The results relate only to the test item(s) tested and for samples as sampled and received by/from the Client. Any opinions/interpretations noted in this report are not included in the scope of accreditation. Any part of this report shall not be reproduced, except in full, without the written approval of BioToxLab



Supplement to toxicity testing report number AQL-WST-A-22\_TOX

Table 8: Site hazard classification of water samples

	Results	KDiscard1	KSlurry1
Water quality	Test date yymmdd	2022.10.18	2022.10.18
	pH @ 25°C (A)	8.1	8.4
	EC (Electrical conductivity) (mS/m) @ 25°C (A)	29.3	55.6
	Dissolved oxygen (mg/l) (NA)	6.9	7.8
S. capricornutum (micro-algae) (A)	Test started on yymmdd	2022.10.18	2022.10.18
	72hour inhibition (-) / stimulation (+) (%)	-9(F)	-30(F)
	EC/LC20 (72hours)	n.r.	n.r.
	EC/LC50 (72hours)	n.r.	n.r.
	Toxicity unit (TU) / Description	<1	<1
D. magna (waterflea) (A)	Test started on yymmdd	2022.10.24	2022.10.24
	48hour mortality rate (-) (%)	0	0
	EC/LC10 (48hours)	n.r.	n.r.
	EC/LC50 (48hours)	n.r.	n.r.
	Toxicity unit (TU) / Description	<1	<1
P. reticulata (suppy) (A)	Test started on yymmdd	2022.10.24	2022.10.24
	96hour mortality rate (-) (%)	0	6
	EC/LC10 (96hours)	n.r.	n.r.
	EC/LC50 (96hours)	n.r.	n.r.
	Toxicity unit (TU) / Description	<1	<1
Estimated safe dilution factor (%) [for definitive testing only]		None required	<1
Overall classification - Hazard class**		Class I - No lethal/sub-lethal hazard	Class II - Slight lethal/sub-lethal hazard
Weight (%)		0	33

**Key:**  
 % = for definitive testing, only the 100% concentration (undiluted) sample mortality/inhibition/stimulation is reflected by this summary table. The dilution series results are considered for EC/LC values and Toxicity unit determinations  
 n.r. = not relevant, i.e. the 100% concentration caused less than 10/20/50% (effective concentration) mortalities or inhibition  
 n.c. = not calculable, although the 100% concentration led to more than 20% inhibition, the 20% inhibition rate was exceeded throughout the test  
 (F) = Inhibition/Mortality rate with "F" indicates that the sample was filtered, this is often essential with turbid or coloured samples to perform the *Selenastrum* test. Filtration could potentially lower the toxicity for the specific test, but *Daphnia* and *Poecilia* test samples are never filtered and hence toxicity will still be detected if affected by filtration  
 \*\*\* = The overall hazard classification takes into account the full battery of tests and is not based on a single test result. Note that the overall hazard classification is expressed as both lethal (*Daphnia* & *Poecilia*) and sub-lethal (*Selenastrum*) levels of toxicity  
 Weight (%) = relative toxicity levels (out of 100%), higher values indicate that more of the individual tests indicated toxicity within a specific class  
 color/sample name shaded in orange = definitive test

Site	Hazard classification		Percentage Effect
KDiscard1	I	☺	No lethal/sub-lethal hazard None of the tests show a toxic effect (i.e. an effect value that is significantly higher than that noted in the controls)
KSlurry1	II	☹	Slight lethal/sub-lethal hazard A statistically significant (P<0.05) PE is reached in at least one test, but the effect level is below 50% (TU<1)

Sample KDiscard1 showed no lethal or sub-lethal environmental toxicity hazard (Class I). Sample KSlurry1 was classified as having a slight lethal and sub-lethal environmental toxicity hazard (Class II) based on the 30% micro-algae (*S. capricornutum*) growth inhibition effect (sub-lethal) together with the 16.67% vertebrate (*P. reticulata*) mortality effect (lethal) noted on the 10% dilution level (although no significant toxicity was noted on the 100% sample result) (refer to Table 7).

## 5. COMMENTS

Two liquid samples (DI leachates) were delivered to the BioToxLab office on 2022.10.14. The pH levels of the samples were 8.06 (KDiscard1) and 8.40 (KSlurry1) which are within the acceptable range (pH 6-9) in which pH can be excluded as a driving factor for toxicity (USEPA, 1996). The conductivities (ECs) of the samples were 29.3 mS/m (KDiscard1) and 55.6 mS/m (KSlurry1). A dissolved oxygen (DO) concentration above 4 mg/L is required for aquatic organisms (USEPA, 1996) to survive. The DO levels for the 2 samples were 6.94 mg/L (KDiscard1) and 7.75 mg/L (KSlurry1).

This report (AQL-WST-A-22\_TOX(sup)) now supersedes the previous report (AQL-WST-A-22\_TOX) sent as a typing error picked up was corrected.

A= Accredited NA =Not accredited OS=Outsourced SC=Sub-contracted NR=Not requested RTF=Results to follow.  
 Results marked "NA" and "OS" in this report are not included in the SANAS Schedule of Accreditation for this laboratory. The results relate only to the test item(s) tested and for samples as sampled and received by/from the Client. Any opinions/interpretations noted in this report are not included in the scope of accreditation. Any part of this report shall not be reproduced, except in full, without the written approval of BioToxLab





Supplement to toxicity testing report number AQL-WST-A-22\_TOX

Any queries regarding the results can be lodged with Lizet Swart within 14 days from the date of receiving this report after which the samples will be discarded. It is not advised to use these samples for any retesting other than range confirmation of chemical parameters – re-sampling must be done in the case of any queries relating to the results associated with the samples.

## 6. REFERENCES

- DEPARTMENT OF WATER AFFAIRS AND FORESTRY, 2003. The Management of Complex Industrial Waste Water Discharges. Introducing the Direct Estimation of Ecological Effect Potential (DEEEP) approach, a discussion document. Institute of Water Quality Studies, Pretoria.
- PERSOONE G, MARSALEK B, BLINOVA I, TÖRÖKNE A, ZARINA T, MANUSADZIANAS L, NALECZ-JAWECKI G, TOFAN L, STEPANOVA L, TOTHOVA L, KOLAR B (2003). A practical and user-friendly toxicity classification system with Microbiotests for natural waters and wastewaters (personal communication).
- SOUTH AFRICAN NATIONAL STANDARD, (SANS), ISO/IEC 17025:2017. General requirements for the competence of testing and calibration laboratories. 3<sup>rd</sup> Edition. South African Bureau of Standards, Pretoria.
- SOUTH AFRICAN NATIONAL STANDARD, SANS 6341:2015. "Water quality – Determination of the inhibition of the mobility of *Daphnia magna* Straus (*Cladocera*, *Crustacea*) – Acute toxicity test.
- SOUTH AFRICAN NATIONAL STANDARD, SANS 8692: 2015. "Water quality – Fresh water algal growth inhibition test with unicellular green algae
- SOUTH AFRICAN NATIONAL STANDARD, SANS 7346-1:2013. "Water quality – Determination of the acute lethal toxicity of substances to a freshwater fish [*Brachydanio rerio* Hamilton-Buchanan (Teleostei, Cyprinidae) Part 1: Static method – also applicable to *Poecilia reticulata* (Teleostei, Poeciliidae)
- TONKES M. and BALTUS C.A.M. 1997. Praktijkonderzoek aan complexe effluënten met de Totaal Effluent Milieubezwaarlijkheid (TEM) – metodiek. RIZA – rapportnummer 97.033. RIZA, Lelystad, The Netherlands.
- UNITED STATES ENVIRONMENTAL PROTECTION AGENCY (USEPA), 1996. Ecological effects test guidelines. Fish acute toxicity test, Freshwater and marine. OPPTS 850.1075.

## END OF REPORT


A= Accredited NA =Not accredited OS=Outsourced SC=Sub-contracted NR=Not requested RTF=Results to follow. Results marked "NA" and "OS" and "SC" in this report are not included in the SANAS Schedule of Accreditation for this laboratory. The results relate only to the test item(s) tested and for samples as sampled and received by/from the Client. Any opinions/interpretations noted in this report are not included in the scope of accreditation. Any part of this report shall not be reproduced, except in full, without the written approval of BioToxLab

Page 9 of 9

## APPENDIX B: SAFETY DATA SHEETS

**SAFETY DATA SHEET (SDS)****Sample ID: 'KDiscard1'**

Section 1: Identification	
Product or Sample Name:	KDiscard1
Chemical Name:	Mixture
Chemical Formula:	Not Applicable
Sample Type:	Coal Discard
CAS Number:	Not Applicable
EC Number:	Not Applicable
Identified Uses:	Not Applicable
Company (Generator) Name:	Kangra Coal (Pty) Ltd Werk
Emergency Telephone Number:	Not Available

Section 2: Hazards Identification	
Classification According to Regulation (EC) No. 1272/2008	
Description:	Black Powder; immiscible; low odour
Physical:	None
Flammability:	Negative; Flash Point = Negative at 30, 60 and 90 degrees Celsius - sample has no flammability
Health:	Acute Toxicity: Category 5 Carcinogen - Category 1A Specific Target Organ Toxicity - Repeated Exposure - Category 1
Aquatic Toxicity Hazard:	Not Classified; Class I (Non-lethal/Sub-lethal Hazard) (Persoone, G, et. al., 2003)
Pictogram(s):	
Signal Word(s):	Danger Warning

<b>Hazard Statement(s):</b>	<p>May be Harmful if Swallowed (H303)  May be Harmful if Inhaled (H333)  Causes eye irritation (H320)  May cause cancer due to inhalation (H350)  Causes damage to lungs through prolonged or repeated exposure via inhalation (H372)  Harmful to Aquatic Life (H402)</p>
<b>Precautionary Statement(s):</b>	<p>IF INHALED: (P304) + Call a POISON CENTRE or Doctor/Physician if you feel unwell (P312)  Obtain special instructions before use (P201)  Do Not Handel until all Safety Precautions have been Read &amp; Understood (P202)  Use Personal Protective Equipment as Required (P281)  IF EXPOSED OR CONCERNED: Get medical advise/attention (P308 + P313)  Store locked up (P405)  Collect spillage (P391)  Do not breathe dust/fume/gas/mist/vapours/spray (manufacturer/supplier or the competent authority to specify applicable conditions (P260)  Wash ...thoroughly after handling (manufacturer/supplier or the competent authority to specify parts of the body to be washed after handling (P264)  Do not eat, drink or smoke when using this product (P270)  Get medical advise/attention if you feel unwell (P314)  Dispose of contents/container to ... (P501) - Class C liner (Type 3)  Avoid Release to the Environment - <i>if this is not the intended use</i> (P273)  If in Eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present, and easy to do. Continue rinsing (P305+P351+P338)  If Eye Irritation Persists: (P337) + Get Medical Advice/Attention (P313)</p>

### Section 3: Composition/Information on Ingredients

**Table 2: XRF results, elemental composition.**

VARIABLE	UNITS	MONITORING LOCALITIES	CAS Number
		KDiscard1	
Fe	%	3.270	7439-89-6
Si	%	16.085	7440-21-3
Al	%	5.043	7429-90-5
K	%	1.178	7440-09-7
P	%	0.027	7723-14-0
Mn	%	0.021	7440-66-6
Ca	%	2.425	7440-70-2
Mg	%	0.272	7439-95-4
Ti	%	0.303	7440-32-6
Na	%	0.275	7440-23-5
V	%	0.006	7440-62-2
Ba	%	0.083	7440-39-3
Cr	%	0.027	7440-47-3
Sr	%	0.053	7440-24-6
Zr	%	0.030	7440-67-7
Mn	%	0.021	7439-96-5
LOI	%	44.350	-
Total XRF (oxides)	%	99.440	-

### Section 4: First-Aid Measures

**Possible Routes of Exposure:** Oral & inhalation.

**Main route(s) selected:** Oral

**Ingestion:** Rinse mouth thoroughly with plenty of water. Drink plenty of water. Do not induce vomiting. Consult a doctor/physician if patient feels unwell.

**Inhalation:** If breathing difficulty is observed administer oxygen (qualified person) and if breathing has ceased administer artificial respiration. Call a poison centre or consult a doctor/physician if patient feels unwell.

**Eye Contact:** Thoroughly rinse opened eyes with water for several minutes. Do not rub eyes. Remove any contact lenses if possible and continue rinsing. Consult a doctor/physician if necessary or if irritation persists.

**Skin Contact:** Wash the area of contact thoroughly with soap and water. Consult a doctor/physician if patient feels unwell.

**Immediate Medical Attention Required:** Unknown.

**Possible Symptoms and/or Effects:** Unknown.

**Possible Delayed Effects:**

- May potentially cause cancer.
- Can cause damage to lungs through inhalation with prolonged or repeated exposure.

### Section 5: Fire-Fighting Measures

**Suitable Extinguishing Media:**

Not Flammable.

**Inappropriate Extinguishers:**

None Identified.

**Specific Hazards Arising from the Mixture:**

None Identified.

**Special Protective Equipment and Precautions for Fire Fighters:**

No specific precautions identified based on nature of waste stream.

Appropriate protective equipment should be used, e.g., overall, boots, gloves and eye and face protection together with a breathing apparatus.

### Section 6: Accidental Release Measures

**Personal Precautions:** Use appropriate PPE. Wash hands and clothing after handling. Remove and wash clothing after handling.

**Environmental Precaution:** Prevent entry of spilled product into waterbodies, waterways or confined areas.

**Methods for Containment & Clean-up:** SHEQ Department procedures for contamination containment and remediation (also refer to Section 13).

Remaining accidental release measures are not applicable.

### Section 7: Handling and Storage

**Precautions for Safe Handling and Storage:**

Make use of appropriate PPE (respiratory masks with appropriate filters, overalls, safety glasses, gloves).



For safe storage refer to waste type determination.  
Ensure no unauthorised entry to the storage site. Ensure proper ventilation.

## Section 8: Exposure Controls/Personal Protection

### Occupational Exposure Limits:

Particulates not otherwise regulated – Total Dust:

**OSHA PEL:** TWA 10 mg/m<sup>3</sup> (total) TWA 5 mg/m<sup>3</sup> (respirable)

**General Industry** – TWA 15mg/m<sup>3</sup>

**Construction** – TWA 15mg/m<sup>3</sup>

**NIOSH REL:** TWA 10mg/m<sup>3</sup> (total) TWA 5 mg/m<sup>3</sup> (respirable)

**ACGIH:** TWA 10 mg/m<sup>3</sup> (inhalation of particles)

### ECHA – Information on Chemicals (REACH Dossiers):

The derived no-or minimum effect level (DN(M)EL) – depicts the exposure level(s) above which humans should not be exposed to a substance.

Two main potentially hazardous constituents: Si & Al (see available data below).

#### 1. ) Crystalline Silica:

OSHA PEL: 0.05 mg/m<sup>3</sup> (8 hrs)

NIOSH REL: 0.05 mg/m<sup>3</sup> (quartz dust)

#### 2. ) Aluminium

**Oral Exposure (general population):** Long term systemic effect with repeated exposure – DNEL 3.95mg/Kg/bw/day.

Acute systemic effects – Not Applicable.

Local Effects: No Data Available.

Data on Workers: No Data Available.

**Inhalation Exposure (workers):** Long term systemic effect with repeated exposure – DNEL 3.72mg/m<sup>3</sup>.

Long-term local effects – the same as systemic effects. No acute hazard identified.

**General Population:** No hazards identified (systemic nor local).

**Dermal Exposure:** No acute or long-term hazard identified in terms of systemic or local effects in the general population or for workers.

### Appropriate Engineering Controls:

Refer to Section 7 of this SDS – no additional specific engineering controls identified.

**Individual Protection Measures:**

Avoid inhaling dust and contact with eyes. Make use of appropriate PPE (respiratory masks with appropriate filters, overalls, safety glasses, gloves), all compliant with relevant standards (e.g., NOISH, and or European Standards or equivalent (EU or OSHA). All PPE must be certified and approved.

Section 9: Physical & Chemical Properties	
a.) Appearance	Rough, black granular texture; immiscible
b.) Odour	Low Odour
c.) Odour Threshold	Not Determined
d.) pH	Paste pH 7.34
e.) Melting Point/Freezing Point	Not Determined
f.) Initial Boiling Point and Boiling Range	Not Determined
g.) Flash Point	Negative at 30°C, 60°C & 90°C
h.) Evaporation Rate	Not Determined
i.) Flammability (solid or gas)	Not Flammable
j.) Upper/Lower Flammability or Explosive Limits	Not Determined
k.) Vapour Pressure	Not Determined
l.) Vapour Density	Not Determined
m.) Relative Density	2.087 g/cm <sup>3</sup>
n.) Solubility	Not Determined
o.) Partition Coefficient: n-octanol/water	Not Determined
p.) Auto-ignition Temperature	Not Determined
q.) Decomposition Temperature	Not Determined
r.) Viscosity	Not Determined

Section 10: Stability & Reactivity	
a.) Reactivity	Redox Potential (85)
b.) Chemical Stability	Substance appears stable under normal ambient conditions; unauthorised entry not permitted
c.) Possibility of Hazardous Reactions	None Known
d.) Conditions to Avoid	None Known
e.) Incompatible Materials	None Known
f.) Hazardous Decomposition Products	None Known

Section 11: Toxicological Information	
Potential Exposure Routes Investigated:	Main route: Oral (inhalation also considered for certain high risk elements)
Likely Exposure Route:	Oral or Inhalation (fine dust)
a.) Acute Toxicity	Category 5
b.) Skin Corrosion/Irritation	Not Classified
c.) Serious Eye Damage & Eye Irritation	Not Classified
d.) Respiratory Sensitization and Skin Sensitization	Not Classified
e.) Germ Cell Mutagenicity	Not Classified
f.) Carcinogenicity	Category 1A
g.) Reproductive Toxicity	Not Classified
h.) Specific Target Organ Toxicity - Single Exposure	Not Classified
i.) Specific Target Organ Toxicity - Repeated Exposure	Category 1
j.) Aspiration Hazards	Not Classified

#### Supplementary Information:

Crystalline Silica dust (identified as a human carcinogen) if inhaled, could cause adverse health effects (e.g., Silicosis) with chronic repetitive exposure if these particles are of respirable size (<10 µm) and at high concentrations (i.e., exceeding those found naturally in the environment). Silicosis affects lung function and increases susceptibility to secondary infections such as tuberculosis (CCOHS & IARC).

Similarly, aluminium dust has been known to cause effects in the lungs when inhaled, such as granuloma, proteinosis of alveoli, pneumonia, etc. (CCOHS).

Section 12: Ecological Information	
<b>1.) Toxicity</b>	
<b>Acute Aquatic Toxicity</b>	Not Classified; Class I (Non-lethal/Sub-lethal Hazard) (Persoone, G, et. al., 2003)
<b>Chronic Aquatic Toxicity</b>	Not Applicable unless analysed as a whole - Mixture (Environmental Fate Data Required)
<b>2.) Persistence &amp; Degradability</b>	No analysed
<b>3.) Bioaccumulative Potential</b>	No analysed
<b>4.) Mobility in Soil</b>	No analysed
<b>5.) Other Adverse Effects</b>	None Known

Section 13: Disposal Considerations
Based on the assessment a waste Type 3 was identified. The GNR 636 (2013) stipulates a Class C liner requirement for Type 3 waste streams.

Section 14: Transport Information	
UN Number	None (Waste Mixture)
UN Proper Shipping Name	None (Waste Mixture)
Transport Hazard Class(es)	None (Waste Mixture)
Packing Group	Not Applicable
Environmental Hazards	Unknown. Limited information as to individual ingredients. Keep away from water sources.
Specific Precautions	Appropriate PPE should be worn

Section 15: Regulatory Information	
Ingredients of the 'KDiscard1' mixture were evaluated in accordance with the SANS 10234 (2008) standard to assess any potential hazard.	
<b>Additional:</b> Legal Framework applicable to integrated waste management in South Africa and potentially applicable to the waste stream under investigation: The Stockholm Convention on Persistent Organic Pollutants (POP's), to which SA became a signatory in 2001 and ratified in 2002 (requires that member countries phase out POP's and prevent their import and export).	

Section 16: Other Information	
Compilation Date & Date of Issue:	16-Nov-22
SDS Supplier:	Aquatico Scientific (Pty) Ltd

A composite sample of the waste stream was received by Aquatico and accepted based on the conjecture that it is representative of the waste stream.

All data obtained from the sampled waste stream is considered to be accurate and reflective of quality during the time of sampling. No kinetic type analyses were conducted to measure changes over time and it was assumed that no significant changes would occur. Aquatico takes no responsibility for reliability/accuracy/suitability of information based on analyses performed, legislative compliance (e.g., repealed or amended legislation) or intended use (including consequences thereof) for the waste streams tested and shall not be held liable. Classification was performed based on available data.

**Abbreviations / Acronyms:**

<b>Abbreviations / Acronyms:</b>	<b>ACGIH</b> - American Conference of Governmental Industrial Hygienists
	<b>CAS</b> - Chemical Abstracts Service
	<b>CCOHS</b> - Canadian Centre for Occupational Health and Safety
	<b>DNEL</b> - Derived No Effect Level
	<b>DN (M) EL</b> - derived no-or minimum effect level
	<b>ECHA</b> - European Chemicals agency
	<b>EU</b> - European Union
	<b>NIOSH</b> - National Institute for Occupational Safety and Health
	<b>NIOSH REL</b> - NIOSH Recommended Exposure Limit
	<b>OSHA</b> - Occupational Safety and Health Administration
	<b>OSHA PEL</b> - OSHA Permissible Exposure Limit
	<b>POP</b> - Persistent Organic Pollutants
	<b>PPE</b> - Personal Protective Equipment
	<b>REACH</b> - Registration, Evaluation, Authorisation and Restriction of Chemicals
	<b>SDS</b> - Safety Data Sheet
	<b>TWA</b> - Time-Weighted Average
<b>XRF</b> - X-ray Fluorescence	
<b>XRD</b> - X-ray Diffraction	

**Literature References:**

- EPA. 1991. R.E.D. facts. Silicon dioxide and silica gel. U.S. Environmental Protection Agency. 738F91107. [http://www.epa.gov/pesticides/chem\\_search/reg\\_actions/reregistration/fs\\_G-74\\_1-Sep-91.pdf](http://www.epa.gov/pesticides/chem_search/reg_actions/reregistration/fs_G-74_1-Sep-91.pdf). October 6, 2015.
- IARC. 1997. Silica. IARC Monographs on the evaluation of carcinogenic risks to humans. Volume 68. Silica, some silicates, coal dust and para-aramid fibrils. Lyon, France: International Agency for Research on Cancer. <https://monographs.iarc.fr/wp-content/uploads/2018/06/mono68-6.pdf>. December 12, 2018.
- National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008), 1 July 2009.
- National Environmental Management: Waste Amendment Act, 2014 (Act No. 26 of 2014). GG37714, 2 June 2014.
- National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008). Waste Classification and Management Regulations, GG36784, GNR 634, 23 August 2013.
- National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008). National Norms and Standards for the Assessment of Waste for Landfill Disposal, GG36784, GNR 635, 23 August 2013.
- National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008). National Norms and Standards for Disposal of Waste to Landfill, GG36784, GNR 636, 23 August 2013.



- PERSOONE G, BLAHOSLAV M, BLINOVA I, TÖRÖKNE A, ZARINA T, MANUSADZIANAS L, NALECZ-JAWECKI G, TOFAN L, STEPANOVA L, TOTHOVA L, KOLAR B (2003). A practical and user-friendly toxicity classification system with Microbiotests for natural waters and wastewaters.
- SABS: SANS 10234 (2008). Globally Harmonized System of Classification and Labelling of Chemicals (GHS). Edition 1.1.
- Soregaroli, B.A. & Lawrence, R.W. (1998). Update on Waste Characterisation Studies. Proc. Mine Design, Operations & Closure Conference. Polson, Montana.

**SAFETY DATA SHEET (SDS)****Sample ID: 'KSlurry1'**

Section 1: Identification	
Product or Sample Name:	KSlurry1
Chemical Name:	Mixture
Chemical Formula:	Not Applicable
Sample Type:	Coal Slurry
CAS Number:	Not Applicable
EC Number:	Not Applicable
Identified Uses:	Not Applicable
Company (Generator) Name:	Kangra Coal (Pty) Ltd Werk
Emergency Telephone Number:	Not Available

Section 2: Hazards Identification	
Classification According to Regulation (EC) No. 1272/2008	
Description:	Black Powder; immiscible; low odour
Physical:	None
Flammability:	Negative; Flash Point = Negative at 30, 60 and 90 degrees Celsius - sample has no flammability
Health:	Acute Toxicity: Category 5 Carcinogen - Category 1A Specific Target Organ Toxicity - Repeated Exposure - Category 1
Aquatic Toxicity Hazard:	Not Classified; Class II (Slight lethal/Sub-lethal Hazard) (Persoone, G, et. al., 2003)
Pictogram(s):	
Signal Word(s):	Danger Warning

<b>Hazard Statement(s):</b>	<p>May be Harmful if Swallowed (H303)  May be Harmful if Inhaled (H333)  Causes eye irritation (H320)  May cause cancer due to inhalation (H350)  Causes damage to lungs through prolonged or repeated exposure via inhalation (H372)  Harmful to Aquatic Life (H402); May cause long lasting harmful effects to aquatic life (H413)</p>
<b>Precautionary Statement(s):</b>	<p>IF INHALED: (P304) + Call a POISON CENTRE or Doctor/Physician if you feel unwell (P312)  Obtain special instructions before use (P201)  Do Not Handel until all Safety Precautions have been Read &amp; Understood (P202)  Use Personal Protective Equipment as Required (P281)  IF EXPOSED OR CONCERNED: Get medical advise/attention (P308 + P313)  Store locked up (P405)  Collect spillage (P391)  Do not breathe dust/fume/gas/mist/vapours/spray (manufacturer/supplier or the competent authority to specify applicable conditions (P260)  Wash ...thoroughly after handling (manufacturer/supplier or the competent authority to specify parts of the body to be washed after handling (P264)  Do not eat, drink or smoke when using this product (P270)  Get medical advise/attention if you feel unwell (P314)  Dispose of contents/container to ... (P501) - Class C liner (Type 3)  Avoid Release to the Environment - <i>if this is not the intended use</i> (P273)  If in Eyes: Rinse cautiously with water for several minutes. Remove contact lenses if present, and easy to do. Continue rinsing (P305+P351+P338)  If Eye Irritation Persists: (P337) + Get Medical Advice/Attention (P313)</p>

## Section 3: Composition/Information on Ingredients

Table 2: XRF results, elemental composition.

VARIABLE	UNITS		CAS Number
		KSlurry1	
Fe	%	3.892	7439-89-6
Si	%	25.275	7440-21-3
Al	%	4.117	7429-90-5
K	%	1.755	7440-09-7
P	%	0.018	7723-14-0
Mn	%	0.029	7440-66-6
Ca	%	2.308	7440-70-2
Mg	%	0.212	7439-95-4
Ti	%	0.263	7440-32-6
Na	%	0.326	7440-23-5
V	%	0.006	7440-62-2
Ba	%	0.079	7440-39-3
Cr	%	0.063	7440-47-3
Sr	%	0.041	7440-24-6
Zr	%	0.037	7440-67-7
Mn	%	0.029	7439-96-5
LOI	%	22.897	-
Total XRF (oxides)	%	97.257	-

## Section 4: First-Aid Measures

**Possible Routes of Exposure:** Oral & inhalation.

**Main route(s) selected:** Oral

**Ingestion:** Rinse mouth thoroughly with plenty of water. Drink plenty of water. Do not induce vomiting. Consult a doctor/physician if patient feels unwell.

**Inhalation:** If breathing difficulty is observed administer oxygen (qualified person) and if breathing has ceased administer artificial respiration. Call a poison centre or consult a doctor/physician if patient feels unwell.

**Eye Contact:** Thoroughly rinse opened eyes with water for several minutes. Do not rub eyes. Remove any contact lenses if possible and continue rinsing. Consult a doctor/physician if necessary or if irritation persists.

**Skin Contact:** Wash the area of contact thoroughly with soap and water. Consult a doctor/physician if patient feels unwell.

**Immediate Medical Attention Required:** Unknown.

**Possible Symptoms and/or Effects:** Unknown.

**Possible Delayed Effects:**

- May potentially cause cancer.
- Can cause damage to lungs through inhalation with prolonged or repeated exposure.

### Section 5: Fire-Fighting Measures

**Suitable Extinguishing Media:**

Not Flammable.

**Inappropriate Extinguishers:**

None Identified.

**Specific Hazards Arising from the Mixture:**

None Identified.

**Special Protective Equipment and Precautions for Fire Fighters:**

No specific precautions identified based on nature of waste stream.

Appropriate protective equipment should be used, e.g., overall, boots, gloves and eye and face protection together with a breathing apparatus.

### Section 6: Accidental Release Measures

**Personal Precautions:** Use appropriate PPE. Wash hands and clothing after handling. Remove and wash clothing after handling.

**Environmental Precaution:** Prevent entry of spilled product into waterbodies, waterways or confined areas.

**Methods for Containment & Clean-up:** SHEQ Department procedures for contamination containment and remediation (also refer to Section 13).

Remaining accidental release measures are not applicable.

### Section 7: Handling and Storage

**Precautions for Safe Handling and Storage:**

Make use of appropriate PPE (respiratory masks with appropriate filters, overalls, safety glasses, gloves).



For safe storage refer to waste type determination.  
Ensure no unauthorised entry to the storage site. Ensure proper ventilation.

## Section 8: Exposure Controls/Personal Protection

### Occupational Exposure Limits:

Particulates not otherwise regulated – Total Dust:

**OSHA PEL:** TWA 10 mg/m<sup>3</sup> (total) TWA 5 mg/m<sup>3</sup> (respirable)

**General Industry** – TWA 15mg/m<sup>3</sup>

**Construction** – TWA 15mg/m<sup>3</sup>

**NIOSH REL:** TWA 10mg/m<sup>3</sup> (total) TWA 5 mg/m<sup>3</sup> (respirable)

**ACGIH:** TWA 10 mg/m<sup>3</sup> (inhalation of particles)

### ECHA – Information on Chemicals (REACH Dossiers):

The derived no-or minimum effect level (DN(M)EL) – depicts the exposure level(s) above which humans should not be exposed to a substance.

Two main potentially hazardous constituents: Si & Al (see available data below).

#### 1. ) Crystalline Silica:

OSHA PEL: 0.05 mg/m<sup>3</sup> (8 hrs)

NIOSH REL: 0.05 mg/m<sup>3</sup> (quartz dust)

#### 2. ) Aluminium

**Oral Exposure (general population):** Long term systemic effect with repeated exposure – DNEL 3.95mg/Kg/bw/day.

Acute systemic effects – Not Applicable.

Local Effects: No Data Available.

Data on Workers: No Data Available.

**Inhalation Exposure (workers):** Long term systemic effect with repeated exposure – DNEL 3.72mg/m<sup>3</sup>.

Long-term local effects – the same as systemic effects. No acute hazard identified.

**General Population:** No hazards identified (systemic nor local).

**Dermal Exposure:** No acute or long-term hazard identified in terms of systemic or local effects in the general population or for workers.

### Appropriate Engineering Controls:

Refer to Section 7 of this SDS – no additional specific engineering controls identified.

**Individual Protection Measures:**

Avoid inhaling dust and contact with eyes. Make use of appropriate PPE (respiratory masks with appropriate filters, overalls, safety glasses, gloves), all compliant with relevant standards (e.g., NOISH, and or European Standards or equivalent (EU or OSHA). All PPE must be certified and approved.

Section 9: Physical & Chemical Properties	
a.) Appearance	Black granular texture; immiscible
b.) Odour	Low Odour
c.) Odour Threshold	Not Determined
d.) pH	Paste pH 7.94
e.) Melting Point/Freezing Point	Not Determined
f.) Initial Boiling Point and Boiling Range	Not Determined
g.) Flash Point	Negative at 30°C, 60°C & 90°C
h.) Evaporation Rate	Not Determined
i.) Flammability (solid or gas)	Not Flammable
j.) Upper/Lower Flammability or Explosive Limits	Not Determined
k.) Vapour Pressure	Not Determined
l.) Vapour Density	Not Determined
m.) Relative Density	2.335 g/cm <sup>3</sup>
n.) Solubility	Not Determined
o.) Partition Coefficient: n-octanol/water	Not Determined
p.) Auto-ignition Temperature	Not Determined
q.) Decomposition Temperature	Not Determined
r.) Viscosity	Not Determined

Section 10: Stability & Reactivity	
a.) Reactivity	Redox Potential (135)
b.) Chemical Stability	Substance appears stable under normal ambient conditions; unauthorised entry not permitted
c.) Possibility of Hazardous Reactions	None Known
d.) Conditions to Avoid	None Known
e.) Incompatible Materials	None Known
f.) Hazardous Decomposition Products	None Known

Section 11: Toxicological Information	
Potential Exposure Routes Investigated:	Main route: Oral (inhalation also considered for certain high risk elements)
Likely Exposure Route:	Oral or Inhalation (fine dust)
a.) Acute Toxicity	Category 5
b.) Skin Corrosion/Irritation	Not Classified
c.) Serious Eye Damage & Eye Irritation	Not Classified
d.) Respiratory Sensitization and Skin Sensitization	Not Classified
e.) Germ Cell Mutagenicity	Not Classified
f.) Carcinogenicity	Category 1A
g.) Reproductive Toxicity	Not Classified
h.) Specific Target Organ Toxicity - Single Exposure	Not Classified
i.) Specific Target Organ Toxicity - Repeated Exposure	Category 1
j.) Aspiration Hazards	Not Classified

#### Supplementary Information:

Crystalline Silica dust (identified as a human carcinogen) if inhaled, could cause adverse health effects (e.g., Silicosis) with chronic repetitive exposure if these particles are of respirable size (<10 µm) and at high concentrations (i.e., exceeding those found naturally in the environment). Silicosis affects lung function and increases susceptibility to secondary infections such as tuberculosis (CCOHS & IARC).

Similarly, aluminium dust has been known to cause effects in the lungs when inhaled, such as granuloma, proteinosis of alveoli, pneumonia, etc. (CCOHS).

Section 12: Ecological Information	
<b>1.) Toxicity</b>	
<b>Acute Aquatic Toxicity</b>	Not Classified; Class II (Slight lethal/Sub-lethal Hazard) (Persoone, G, et. al., 2003)
<b>Chronic Aquatic Toxicity</b>	Not Applicable unless analysed as a whole - Mixture (Environmental Fate Data Required); above-mentioned toxicity also based on chronic species
<b>2.) Persistence &amp; Degradability</b>	No analysed
<b>3.) Bioaccumulative Potential</b>	No analysed
<b>4.) Mobility in Soil</b>	No analysed
<b>5.) Other Adverse Effects</b>	None Known

Section 13: Disposal Considerations
Based on the assessment a waste Type 3 was identified. The GNR 636 (2013) stipulates a Class C liner requirement for Type 3 waste streams.

Section 14: Transport Information	
UN Number	None (Waste Mixture)
UN Proper Shipping Name	None (Waste Mixture)
Transport Hazard Class(es)	None (Waste Mixture)
Packing Group	Not Applicable
Environmental Hazards	Unknown. Limited information as to individual ingredients. Keep away from water sources.
Specific Precautions	Appropriate PPE should be worn

Section 15: Regulatory Information
Ingredients of the 'KSlurry1' mixture were evaluated in accordance with the SANS 10234 (2008) standard to assess any potential hazard.
<b>Additional:</b> Legal Framework applicable to integrated waste management in South Africa and potentially applicable to the waste stream under investigation: The Stockholm Convention on Persistent Organic Pollutants (POP's), to which SA became a signatory in 2001 and ratified in 2002 (requires that member countries phase out POP's and prevent their import and export).

Section 16: Other Information	
Compilation Date & Date of Issue:	16-Nov-22
SDS Supplier:	Aquatico Scientific (Pty) Ltd

A composite sample of the waste stream was received by Aquatico and accepted based on the conjecture that it is representative of the waste stream.

All data obtained from the sampled waste stream is considered to be accurate and reflective of quality during the time of sampling. No kinetic type analyses were conducted to measure changes over time and it was assumed that no significant changes would occur. Aquatico takes no responsibility for reliability/accuracy/suitability of information based on analyses performed, legislative compliance (e.g., repealed or amended legislation) or intended use (including consequences thereof) for the waste streams tested and shall not be held liable. Classification was performed based on available data.

**Abbreviations / Acronyms:**

<b>Abbreviations / Acronyms:</b>	<b>ACGIH</b> - American Conference of Governmental Industrial Hygienists
	<b>CAS</b> - Chemical Abstracts Service
	<b>CCOHS</b> - Canadian Centre for Occupational Health and Safety
	<b>DNEL</b> - Derived No Effect Level
	<b>DN (M) EL</b> - derived no-or minimum effect level
	<b>ECHA</b> - European Chemicals agency
	<b>EU</b> - European Union
	<b>NIOSH</b> - National Institute for Occupational Safety and Health
	<b>NIOSH REL</b> - NIOSH Recommended Exposure Limit
	<b>OSHA</b> - Occupational Safety and Health Administration
	<b>OSHA PEL</b> - OSHA Permissible Exposure Limit
	<b>POP</b> - Persistent Organic Pollutants
	<b>PPE</b> - Personal Protective Equipment
	<b>REACH</b> - Registration, Evaluation, Authorisation and Restriction of Chemicals
	<b>SDS</b> - Safety Data Sheet
	<b>TWA</b> - Time-Weighted Average
<b>XRF</b> - X-ray Fluorescence	
<b>XRD</b> - X-ray Diffraction	

**Literature References:**

- EPA. 1991. R.E.D. facts. Silicon dioxide and silica gel. U.S. Environmental Protection Agency. 738F91107. [http://www.epa.gov/pesticides/chem\\_search/reg\\_actions/reregistration/fs\\_G-74\\_1-Sep-91.pdf](http://www.epa.gov/pesticides/chem_search/reg_actions/reregistration/fs_G-74_1-Sep-91.pdf). October 6, 2015.
- IARC. 1997. Silica. IARC Monographs on the evaluation of carcinogenic risks to humans. Volume 68. Silica, some silicates, coal dust and para-aramid fibrils. Lyon, France: International Agency for Research on Cancer. <https://monographs.iarc.fr/wp-content/uploads/2018/06/mono68-6.pdf>. December 12, 2018.
- National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008), 1 July 2009.
- National Environmental Management: Waste Amendment Act, 2014 (Act No. 26 of 2014). GG37714, 2 June 2014.
- National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008). Waste Classification and Management Regulations, GG36784, GNR 634, 23 August 2013.
- National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008). National Norms and Standards for the Assessment of Waste for Landfill Disposal, GG36784, GNR 635, 23 August 2013.
- National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008). National Norms and Standards for Disposal of Waste to Landfill, GG36784, GNR 636, 23 August 2013.



- PERSOONE G, BLAHOSLAV M, BLINOVA I, TÖRÖKNE A, ZARINA T, MANUSADZIANAS L, NALECZ-JAWECKI G, TOFAN L, STEPANOVA L, TOTHOVA L, KOLAR B (2003). A practical and user-friendly toxicity classification system with Microbiotests for natural waters and wastewaters.
- SABS: SANS 10234 (2008). Globally Harmonized System of Classification and Labelling of Chemicals (GHS). Edition 1.1.
- Soregaroli, B.A. & Lawrence, R.W. (1998). Update on Waste Characterisation Studies. Proc. Mine Design, Operations & Closure Conference. Polson, Montana.

## **APPENDIX F: DRAFT EMPR**

# **Draft Environmental Management Programme Report (EMPr) for the Wastewater Treatment Plant and Co-Disposal Facility for Maquasa East Operations**

Draft for Public Participation

September 2024

Kangra Coal (Pty) Ltd

GCS Project Number: 22-0161

Client Reference: KC/003/22

DMR Reference: MP 30/5/1/23/2/1/133 EM




# Draft Environmental Management Programme Report (EMPr) the Wastewater Treatment Plant and Co-Disposal Facility for Maquasa East Operations

Draft for Public Participation



September 2024

## DOCUMENT ISSUE STATUS

Report Issue	Draft for Public Participation		
GCS Reference Number	21-0161		
Client Reference	KC/003/22		
DMR Reference	MP 30/5/1/23/2/1/133 EM		
Title	Draft Environmental Management Programme Report (EMPr) for the Wastewater Treatment Plant and Co-Disposal Facility for Maquasa East Operations		
	Name	Signature	Date
Author	Reneé Steele		September 2024
Document Reviewer	Gerda Bothma		September 2024

## LEGAL NOTICE

This report or any proportion thereof and any associated documentation remain the property of GCS until the mandator effects payment of all fees and disbursements due to GCS in terms of the GCS Conditions of Contract and Project Acceptance Form. Notwithstanding the aforesaid, any reproduction, duplication, copying, adaptation, editing, change, disclosure, publication, distribution, incorporation, modification, lending, transfer, sending, delivering, serving, or broadcasting must be authorised in writing by GCS.

## ACRONYMS AND ABBREVIATIONS

CA	Competent Authority
CARA	Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983)
CBA	Critical Biodiversity Area
cEO	contractor's Environmental Officer
CLO	Community Liaison Officer
DAFF	Department of Agriculture, Forestry and Fisheries
DFFE	Department of Environment, Forestry and Fisheries
DOT	Department of Transport
DSS	Developer Site Supervisor
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
EAPASA	Environmental Assessment Practitioners of South Africa
EAR	Environmental Audit Report
ECA	Environmental Conservation Act, 1989 (Act No. 73 of 1989)
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EMF	Environmental Management Framework
EMPr	Environmental Management Programme
EPC	Engineering, Procurement and Construction
ERAP	Emergency Response Action Plan
ESA	Ecological Support Area
FPA	Fire Protection Agency
FPO	Fire Protection Officer
FSR	Final Scoping Report
GCS	GCS Water and Environmental Consultants (Pty) Ltd
GIS	Geographic Information System
GN	Government Notice
GNR	Government Notice Regulation
ha	hectare
HCS	Hazardous Chemical Substance
HGM	Hydrogeomorphic
HIA	Heritage Impact Assessment
IEA	Integrated Environmental Authorisation
I&AP	Interested and Affected Party
km	kilometre



---

L	litres
m	metres
m <sup>2</sup>	square metres
m <sup>3</sup>	cubic metres
mamsl	metres above mean sea level
mm	millimetres
ML	megalitres
MW	megawatts
NCR	Noise Control Regulations
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NEM: AQA	National Environmental Management: Air Quality Act, 2004 (Act No. 39 of 2004)
NEM: BA	National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)
NEM: WA	National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)
NFA	National Forestry Act, 1998 (Act No. 4 of 1998)
NHRA	National Heritage Resources Agency
NFEPA	National Freshwater Ecosystems Priority Area
NPAES	National Protected Areas Expansion Strategy
NRTA	National Road Traffic Act, 1996 (Act No. 93 of 1996)
NWA	National Water Act, 1998 (Act No. 36 of 1998)
OHSA	Occupational Health and Safety Act, 1993 (Act No. 85 of 1993)
PM	Project Manager
PPE	Personal Protective Equipment
PPP	Public Participation Process
SABS	South African Bureau of Standards
SACNASP	South African Council for Natural Scientific Professionals
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System
SALA	Subdivision of Agricultural Land Act, 1970 (Act No. 70 of 1970)
SANBI	South African National Biodiversity Institute
SANS	South African National Standards
SAPS	South African Police Services
SARTSM	South African Road Traffic Signs Manual
SCC	Species of Conservation Concern
SDF	Spatial Development Framework
SDS	Safety Data Sheets
S&EIA	Scoping and Environmental Impact Assessment

SPLUMA	Spatial Planning and Land Use Management Act, 2013 (Act No. 16 of 2013)
SWMP	Stormwater management plan
WWTP	Wastewater Treatment Plant
WUL	Water Use License
WULA	Water Use License Application

## TABLE OF CONTENTS

<b>ACRONYMS AND ABBREVIATIONS .....</b>	<b>III</b>
<b>TABLE OF CONTENTS.....</b>	<b>VI</b>
<b>LIST OF FIGURES.....</b>	<b>VI</b>
<b>LIST OF TABLES.....</b>	<b>VII</b>
<b>LIST OF APPENDICES .....</b>	<b>VII</b>
<b>1 INTRODUCTION .....</b>	<b>1</b>
1.1 PURPOSE OF THE EMPr.....	5
1.2 CONTENT OF THE EMPr .....	6
1.3 DETAILS OF THE EAP .....	7
1.4 DETAILS OF THE APPLICANT .....	7
1.5 ASSUMPTIONS AND LIMITATIONS.....	7
1.6 APPLICABLE LEGISLATION, POLICY AND BEST PRACTICE GUIDELINES.....	8
1.7 ASPECTS OF THE ACTIVITY THAT ARE COVERED BY THE EMPr.....	23
1.7.1 Wastewater Treatment Plant .....	23
1.7.2 Brine Treatment Plant.....	23
1.7.3 Co-disposal Facility .....	24
1.8 PROJECT PHASES AND ACTIVITIES.....	24
1.9 COMPOSITE ENVIRONMENTAL SENSITIVITY MAP .....	26
<b>2 ENVIRONMENTAL IMPACT STATEMENT .....</b>	<b>28</b>
<b>3 ROLES AND RESPONSIBILITIES .....</b>	<b>32</b>
<b>4 ENVIRONMENTAL DOCUMENTATION REPORTING AND COMPLIANCE .....</b>	<b>38</b>
4.1 DOCUMENT CONTROL/FILING SYSTEM .....	38
4.2 DOCUMENTATION TO BE AVAILABLE .....	38
4.3 WEEKLY ENVIRONMENTAL CHECKLIST.....	38
4.4 ENVIRONMENTAL SITE MEETINGS .....	39
4.5 REQUIRED METHOD STATEMENTS.....	39
4.6 ENVIRONMENTAL INCIDENT LOG (DIARY) .....	40
4.7 NON-COMPLIANCE.....	41
4.8 CORRECTIVE ACTION RECORDS .....	41
4.9 PHOTOGRAPHIC RECORD.....	42
4.10 COMPLAINTS REGISTER.....	42
4.11 CLAIMS FOR DAMAGES .....	43
4.12 INTERACTIONS WITH I&APs.....	43
4.13 ENVIRONMENTAL AUDITS.....	43
4.14 FINAL ENVIRONMENTAL AUDITS .....	44
4.15 ENVIRONMENTAL AWARENESS PLAN .....	44
<b>5 PROPOSED IMPACT MANAGEMENT ACTIONS .....</b>	<b>46</b>
<b>6 PROPOSED ENVIRONMENTAL MONITORING PROGRAMME .....</b>	<b>87</b>
6.1 SURFACE WATER MONITORING.....	87
6.2 GROUNDWATER MONITORING .....	87
6.3 DUST FALLOUT MONITORING .....	89
6.4 AQUATIC BIOMONITORING .....	89

## LIST OF FIGURES

Figure 1: Regional Locality Map.....	3
Figure 2: Site layout and affected properties.....	4
Figure 3: Composite Environmental Sensitivity Map .....	27

Figure 4: Proposed Surface Water Monitoring Points .....	88
Figure 5: Current MQE Aquatic Biomonitoring Points .....	90

## LIST OF TABLES

Table 1: Project Infrastructures and Property Description .....	1
Table 2: Contents of this Environmental Management Programme (EMPr) .....	6
Table 3: Details of the EAP .....	7
Table 4: Details of the Applicant .....	7
Table 5: Applicable legislation, policy and best practice guidelines .....	10
Table 6: Key impacts during the Construction Phase .....	28
Table 7: Key impacts during the Operational Phase .....	29
Table 8: Key impacts during the Decommissioning Phase.....	31
Table 9: Roles and Responsibilities for Implementation of the EMPr.....	33
Table 10: Proposed additional surface water monitoring points.....	87

## LIST OF APPENDICES

**APPENDIX A: CURRICULUM VITAE OF EAP**

**APPENDIX B: GENERIC METHOD STATEMENT**

## 1 INTRODUCTION

GCS Water and Environmental Consultants (Pty) Ltd (GCS) has been appointed by Kangra Coal (Pty) Ltd (the applicant/"Kangra") as the Environmental Assessment Practitioner (EAP) to undertake the Application for an Integrated Environmental Authorisation (IEA) for the construction of a wastewater treatment plant (WWTP) for the treatment of effluent, and a new co-disposal facility (CDF), including supporting and associated infrastructure, at their Maquasa East (MQE) Operations (refer to Figure 1 and Figure 2).

An IEA and Waste Management License (WML) is required in terms of the National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA), National Environmental Management: Waste Act, 2008 (Act 59 of 2008) (NEMWA). This application is undertaken in terms of the 2014 NEMA Environmental Impact Assessment (EIA) Regulations, Government Notice 982 of 4 December 2014 (Government Gazette No. 38282), as amended.

Kangra's Maquasa mining operation is located near Piet Retief within the Mpumalanga Province. The mining area is situated approximately 45km west of Piet Retief and just off the N12 national road on a secondary road leading to the Heyshope Dam.

All mining and project related infrastructure is located at Maquasa East (MQE) and includes a coal washing plant and associated infrastructure. This plant is used for the processing of all coal mined from Maquasa West and the Nooitgesien opencast mining area. No mining is taking place at Maquasa East as all of the coal reserves have already been mined.

The project will entail the development of the infrastructure listed in Table 1. The table also includes the property details over which the development is proposed.

**Table 1: Project Infrastructures and Property Description**

Project	Property	SG Code	Local Municipality
Wastewater Treatment Plant (WWTP), Brine Treatment Plant, Brine PCD & pipeline	Remaining Extent (RE) of the farm Roodekraal 21HT	TOHT00000000002100000	Mkhondo LM
WWTP discharge pipeline	Farm Roodekraal 21 HT	TOHT00000000002100000	Mkhondo LM
	RE of the farm Roodekraal 21HT	TOHT00000000002100000	
Co-Disposal Facility (CDF)	RE of the farm Rooikop 18HT	TOHT00000000001800000	Pixley Ka Seme LM
	RE of the farm Maquasa 19HT	TOHT00000000001900000	
CDF pipelines & external haul roads	RE of the farm Rooikop 18HT	TOHT00000000001800000	Pixley Ka Seme LM
	RE of the farm Roodekraal 21HT	TOHT00000000002100000	Mkhondo LM



The proposed developments are located within an area where anthropogenic impacts such as alien vegetation encroachment, gravel roads, natural vegetation removal, hardening of surfaces to establish the mining infrastructure, fencing, grazing of animals and disturbances to the wetland systems around the site have been identified. The Terrestrial Critical Biodiversity Area (CBA) of the site is mixed between transformed areas and ecological support areas (ESA).

The proposed projects are crucial for the continued operation of the Maquasa Operations. The implementation of the proposed structures will allow for the improvement of MQE's contaminated water management practices, and the additional disposal capacity allow for the full Life of Mine (LoM) of Kangra's mining operations near Piet Retief to be achieved.

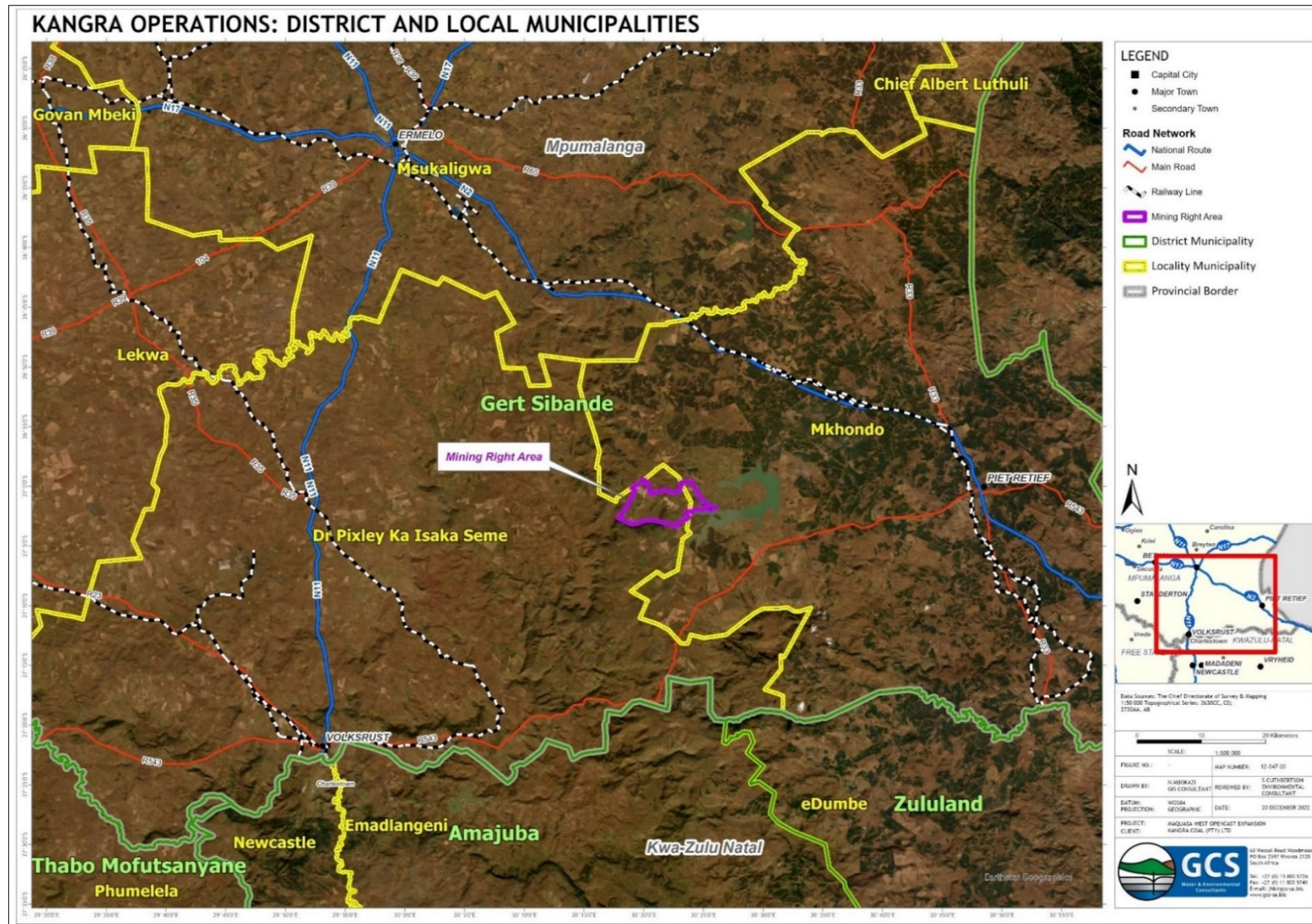


Figure 1: Regional Locality Map



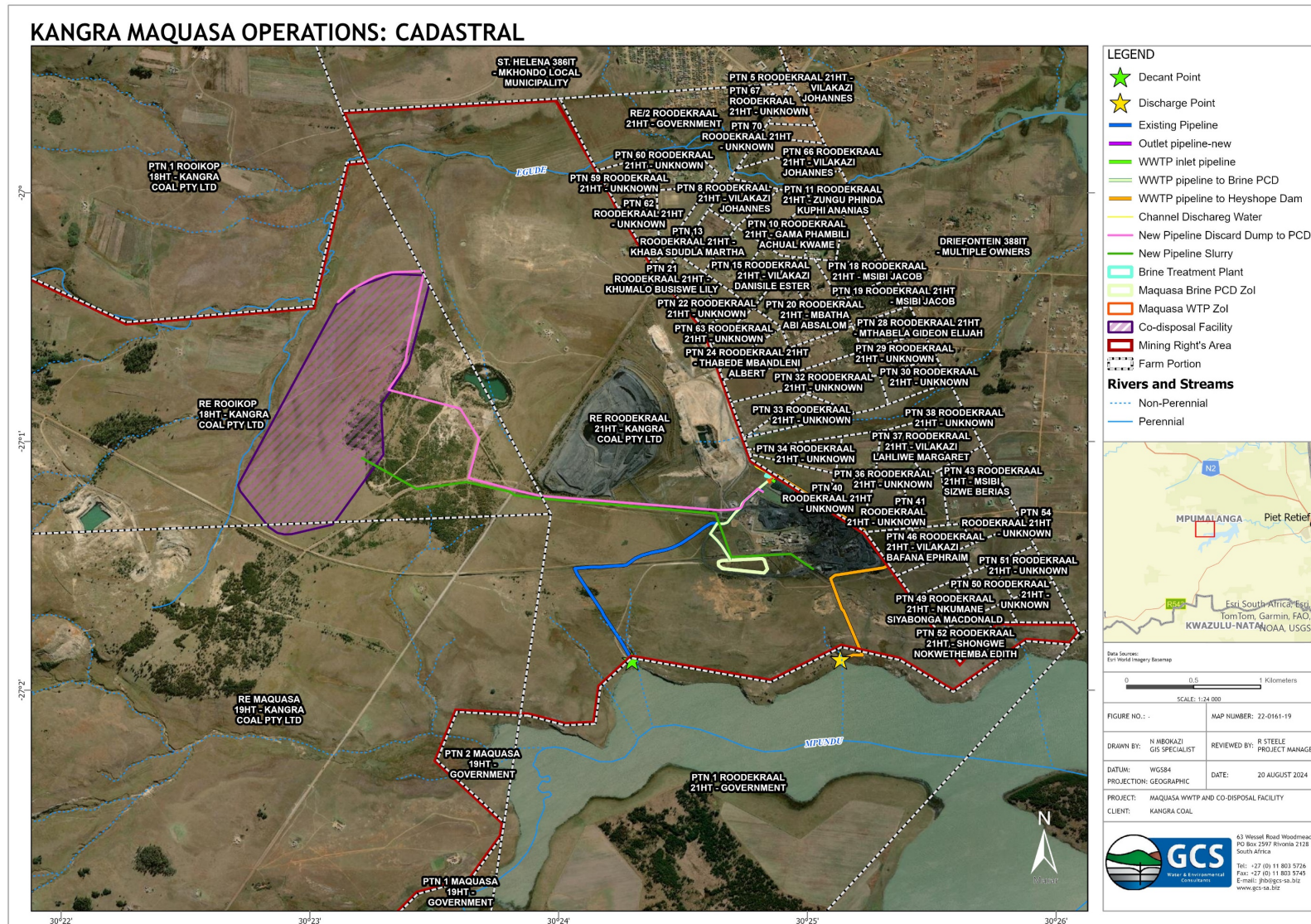


Figure 2: Site layout and affected properties

### 1.1 Purpose of the EMPr

Section 19 of the NEMA EIA Regulations (as amended), requires that the Applicant submit an EMPr to the Competent Authority (CA). This EMPr will form part of the EA for the proposed Project, once approved.

The EMPr is an important environmental management tool, developed in line with best practices under NEMA and other environmental legislation, and informed by the EAP's professional experience as well as any relevant specialist information. The EMPr provides management guidance for activities undertaken at the development site. If correctly followed, the EMPr ensures that any adverse environmental impacts which could result from the development are adequately managed and mitigated.

The EMPr outlines all environmental management and monitoring actions required throughout the project lifecycle. The EMPr is legally binding and any person who contravenes the provisions herein is liable for imprisonment or a fine. This document should be viewed as "live" and thus, should be updated as and when necessary. The purpose of this document is therefore to guide environmental management throughout the various lifecycle phases of the proposed development.

The objectives of the EMPr are as follows:

- Ensure compliance with the relevant environmental legislation and conditions of the EA;
- Ensure that development activities are appropriately managed;
- Verify environmental performance through information on impacts as they occur;
- Respond to changes or unforeseen events; and
- Provide feedback on the continual improvement in environmental performance.

It is understood that all contract documentation related to the construction, operation and decommissioning (if required) of the proposed development will include the conditions of the EA and provisions of the EMPr. ***It is important to note that the contractual obligations must include the recording of any complaints on the project in the environmental register. Further, it is incumbent on the ECO to keep an accurate audit trail showing compliance with the EMPr during the construction phase.***

This EMPr will remain a dynamic document throughout the life of the project. Following the issuance of an EA, the EMPr must be updated to include the specific conditions in the EA, as well as any required monitoring or reporting requirements of the Competent Authority.

## 1.2 Content of the EMPr

According to Appendix 4 of the NEMA EIA Regulations (as amended), the EMPr for a project must include certain information. Table 2 describes how this report meets those requirements.

**Table 2: Contents of this Environmental Management Programme (EMPr)**

REQUIREMENT	SECTION IN THIS REPORT
Details of– i. the EAP who prepared the EMPr; and ii. the expertise of that EAP to prepare an EMPr, including a curriculum vitae;	Section 1.3 and Appendix A
A detailed description of the aspects of the activity that are covered by the EMPr as identified by the project description;	Section 1.7
A map at an appropriate scale which superimposes the proposed activity, its associated structures, and infrastructure on the environmental sensitivities of the preferred site, indicating any areas that should be avoided, including buffers;	Figure 3
A description of the impact management outcomes, including management statements, identifying the impacts and risks that need to be avoided, managed and mitigated as identified through the environmental impact assessment process for all phases of the development including– i. Planning and design; ii. Pre-construction activities; iii. Construction activities; iv. Rehabilitation of the environment after construction and where applicable post-closure; and v. Where relevant, operation activities;	Section 5
A description of proposed impact management actions, identifying the manner in which the impact management outcomes contemplated above will be achieved, and must, where applicable, include actions to– i. Avoid, modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation; ii. Comply with any prescribed environmental management standards or practices; iii. Comply with any applicable provisions of the Act regarding the closure, where applicable;	Section 5
The method of monitoring the implementation of the impact management actions;	Section 5
The frequency of monitoring the implementation of the impact management actions;	Section 5
An indication of the persons who will be responsible for the implementation of the impact management actions;	Section 5
The time periods within which the impact management actions must be implemented;	Section 5
The mechanism for monitoring compliance with the impact management actions;	Section 5
A program for reporting on compliance, taking into account the requirements as prescribed by the Regulations;	Section 5
An environmental awareness plan describing the manner in which– i. The applicant intends to inform his or her employees of any environmental risk which may result from their work; and ii. Risks must be dealt with in order to avoid pollution or the degradation of the environment; and	Section 4.15 Section 5
Any specific information that may be required by the competent authority.	N/A



### 1.3 Details of the EAP

The details of the EAP who prepared this report can be found in Table 2. The EAP CV and registrations are attached as **Appendix A**.

**Table 3: Details of the EAP**

ITEM	DETAILS
Company Name	GCS Water and Environmental (Pty) Ltd
Company Representative	Gerda Bothma
EAP	Reneé Steele
EAP Professional Registrations	<ul style="list-style-type: none"> <li>Registered Environmental Assessment Practitioner (EAP) with the Environmental Assessment Practitioners Association of South Africa (Reference: 2022/4847).</li> <li>Professional Natural Scientist with the South African Council for Natural and Scientific Professionals (SACNASP) (Reference: 008920).</li> </ul>
EAP Qualifications	<ul style="list-style-type: none"> <li>BSc Honours Environmental Monitoring and Modelling, UNISA</li> <li>BSc Zoology, University of KwaZulu-Natal</li> </ul>
Telephone No.	+27 (0)11 803 5726
Facsimile No.	+27 (0)11 803 5745
E-mail Address	<a href="mailto:gerdab@gcs-sa.biz">gerdab@gcs-sa.biz</a>
Postal Address	P.O. Box 2597, Rivonia, 2128

### 1.4 Details of the Applicant

The applicant is Kangra Coal (Pty) Ltd. The relevant contact details for the applicant are provided in Table 3.

**Table 4: Details of the Applicant**

ITEM	DETAILS
Company Name	Kangra Coal (Pty) Ltd
Company Representative	Paul Redelinghuys
Contact Person	Mahlatse Monareng
Telephone No.	+27 (13) 110 6309
E-mail Address	<a href="mailto:mahlatse.monareng@kangracol.co.za">mahlatse.monareng@kangracol.co.za</a>
Postal Address	Kangra Group (Pty) Ltd, P.O. Box 745, Piet Retief

### 1.5 Assumptions and Limitations

This EMPr has been drafted with the acknowledgement of the following assumptions and limitations:

- Information used to guide the development of this EMPr was gained through the national web-based screening tool, through specialist input and using the EAP's experience in such developments;

- It is assumed that all information received from the proponent is correct, with nothing withheld; and
- It is assumed that the proponent will be developing the proposed projects as described within this report and that no deviation will be required.

### **1.6 Applicable legislation, policy and best practice guidelines**

The EMPr has been developed using knowledge of relevant national, provincial and local legislation and policy as well as best practice guidelines. The Applicant is bound to comply with the legislation and policy provisions throughout the life cycle of the project.

Table 5 lists the relevant legislation and guidelines applicable to the development.

The environment is composed of biophysical, ecological, economic and social components. Construction is a disruptive activity, and all due consideration must be given to the environment, including the social environment during the execution of the project to minimise negative impacts on affected parties. Minimisation of areas disturbed by construction activities (i.e. the footprint of the development area) should reduce many of the construction-related environmental impacts of the project and reduce rehabilitation requirements and costs. All relevant standards relating to international, national, provincial and local legislation, as applicable, should be adhered to. This includes requirements relating to waste generation and emissions, waste disposal practices, noise regulations, road traffic ordinances, etc. Every effort should be made to minimise, reclaim, and/or recycle waste materials.

Table 5: Applicable legislation, policy and best practice guidelines

LEGISLATION/GUIDELINE	OBJECTIVE & RELEVANCE
LEGISLATION	
Constitution of the Republic of South Africa (Act 108 of 1996)	<p>The Constitution is the supreme law governing all other legislation. Environmental legislation is shaped by the Bill of Rights set out in the Constitution. It sets out the rights of every citizen of South Africa and aims to address past social injustices. With respect to the environment, section 24 of the Constitution states that:</p> <p><i>“Everyone has the right:</i></p> <ol style="list-style-type: none"> <li><i>To an environment that is not harmful to their health or well-being.</i></li> <li><i>To have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that:</i> <ol style="list-style-type: none"> <li><i>Prevent pollution and ecological degradation;</i></li> <li><i>Promote conservation; and</i></li> <li><i>Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development”.</i></li> </ol> </li> </ol> <p>In fulfilment of its constitutional mandate to take reasonable legislative measures that give effect to Section 24, the government has promulgated several environmental laws. These laws provide a legal framework that embodies internationally recognised legal principles. The principal act governing activities that affect the environment is NEMA.</p> <p>The Constitution itself has no permitting requirements. However, the way the environmental right is applied implies that environmental impacts associated with developments should be considered separately and cumulatively. Furthermore, Section 24 includes the notion that justifiable economic and social development should be promoted, through using natural resources and ecologically sustainable development.</p> <p><b><i>MQE must ensure that significant environmental impacts are avoided; and where impacts cannot altogether avoided, they must be minimised and mitigated throughout the lifecycle of the proposed projects.</i></b></p>
Promotion of Access to Information Act, 2000 (Act No. 2 of 2000)	<ul style="list-style-type: none"> <li>Access to information is a right, not a privilege.</li> <li>S 32 of the Constitution protects the right to access to information, and applies vertically, in that it imposes a duty on the state to provide access to information to someone requesting the information, and horizontally, in that it imposes a duty on natural and juristic persons to provide access to information.</li> <li>In the case of natural and juristic persons, the information must be required by the requester for the protection of the right, but this restriction does not apply where information is requested from the state.</li> <li>The Promotion of Access to Information Act, 2000 (Act 2 of 2000) (PAIA) was enacted to give effect to the right, in pursuit of a culture of openness, transparency and justification in South Africa, shifting away from a culture of secrecy and authoritarianism.</li> </ul> <p><b><i>The act assists the public in requesting information, and all have the right to access information.</i></b></p>
Environmental Conservation Act, 1989 (73 of 1989) (ECA), as amended	<p>The ECA has now largely been replaced by the NEMA but certain provisions remain in force.</p> <p>The National Noise Control Regulations<sup>1</sup> (NCR) were promulgated in terms of Section 25 of the ECA, relating to noise, vibration and shock. The NCRs were revised<sup>2</sup> to make it obligatory for all authorities to apply the regulations. Under the ECA, the following SANS for assessing and controlling noise include:</p>

<sup>1</sup> GNR 154 in Government Gazette No. 13717 dated 10 January 1992

<sup>2</sup> Under GN155 of 10 January 1992

LEGISLATION/GUIDELINE	OBJECTIVE & RELEVANCE
	<ul style="list-style-type: none"> <li>• 10328:2008 “Methods for environmental noise impact assessments”; and</li> <li>• 10103:2004 “The measurement and rating of environmental noise with respect to annoyance and speech communication”.</li> </ul> <p><b><i>The proposed projects are likely to increase ambient noise levels during the construction (temporary) and operational phases. Noise impacts are closely related to construction activities and heavy traffic volumes. The SANS published under ECA will be considered for the purposes of the noise impact assessment in the EIA and the EMPr will include mitigation measures relating to the mitigation of noise impacts.</i></b></p>
National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA), as amended.	<p>NEMA is the framework law giving effect to the constitutional environmental right and for regulatory tools with respect to environmental impacts. Section 28(1) includes a statutory duty of care, providing that “Every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment”.</p> <p>In terms of sections 24(2) and 24D of NEMA, the then Minister of Environmental Affairs promulgated certain listed activities that may not commence without an EA. Activities promulgated in terms of GN983 and GN9835 require a basic assessment process, while activities promulgated in terms of GN984 require that a full scoping and EIA process be conducted.<sup>3</sup></p> <p>Section 24C(2A) of NEMA indicates that “where listed activities are directly related to the extraction and primary processing of a mineral resource” the Minister of Mineral Resources and Energy is the CA or official/s at the DMRE and which power he has delegated to the relevant Regional Managers (RMs).</p> <p>The National Environmental Laws Amendment Act, 2022 (Act 2 of 2022) (NEMA Amendment Act) was promulgated on 24 June 2022. It will introduce a major shift in South Africa’s environmental legislation on a date to be fixed and proclaimed by the President (which has yet to occur). This includes:</p> <ul style="list-style-type: none"> <li>• Residue stockpiles and residue deposits (RS) will be excluded from NEMWA and will therefore no longer be regarded as waste for which a WML is required. Instead, RS and deposits will be regulated under NEMA.</li> <li>• The RMs will be the CA “where the listed or specified activity is a mining activity”.</li> </ul> <p><b><i>Note that, should the NEMA Amendment Act commence prior to construction, Kangra would no longer require a WML for the CDF and it would be governed under NEMA.</i></b></p>
NEMA EIA Regulations, 2014 (GNR 326, as amended)	<p>Chapter 6 of the 2014 EIA Regulations provides for the requirements for public participation, which must be carried out as part of the EA and WML application process. In terms of Regulations 21 and 23, the outcome of the PPP must be reported in the FSR and EIR submitted to the CA. The PPP, “must give all potential or registered parties (I&amp;APs), including the CA, a period of at least 30 days to submit comments on each of the EMPr, S&amp;EIRs, and where applicable the closure plan, as well as the report contemplated in regulation 32, if such reports or plans are submitted at different times” (Regulation 40 (1)).</p> <p>PPP will be undertaken in accordance with Chapter 6 of the EIA Regulations, 2014. It must:</p> <ul style="list-style-type: none"> <li>• provide access to all information that reasonably has or may have the potential to influence any decision regarding an application;</li> <li>• involve consultation with the CA, every state department that administers a law relating to the environment relevant to the application, all relevant organs of state, and all I&amp;APs; and</li> <li>• provide opportunity for I&amp;APs to comment on reports and plans prior to submission of an application and once an application has been submitted to the CA.</li> </ul> <p>The process must include:</p>

<sup>3</sup> GNs 983, 984 and 985 are promulgated under NEMA in GG 38282 of 4 December 2014 (as amended).



LEGISLATION/GUIDELINE	OBJECTIVE & RELEVANCE
	<ul style="list-style-type: none"> <li>notification of the application to all I&amp;APs, as stipulated in Regulation 41;</li> <li>registration of all I&amp;APs, as required in Regulations 42 and 43; and</li> <li>a CRR and records of meetings of and with I&amp;APs, as outlined in Regulation 44.</li> </ul> <p>Regulation 39 of the EIA Regulations, 2014 requires that:</p> <p><i>"(1) If the proponent is not the owner or person in control of the land on which the activity is to be undertaken, the proponent must, before applying for an environmental authorisation in respect of such activity, obtain the written consent of the landowner or person in control of the land to undertake such activity on that land.</i></p> <p><i>(2) Sub regulation (1) does not apply in respect of–</i></p> <p><i>(b) activities constituting, or activities directly related to prospecting ... of a mineral ...resource or extraction and primary processing of a mineral...resource."</i></p>
NEMA and MPRDA: Financial Provision (FP)	<p>NEMA requires <i>inter alia</i> mining right holders to hold in place FP for the rehabilitation, closure and ongoing post-decommissioning management of negative environmental impacts.</p> <p>FP assessments were previously governed by the MPRDA and the quantum calculated according to the DMRE published rates.</p> <p>On 20 November 2015, the NEMA Financial Provisioning Regulations, 2015<sup>4</sup> (2015 FP Regulations) were promulgated, resulting in significant changes from the MPRDA's requirements. Five (5) further draft updated iterations of the 2015 NEMA FP Regulations were published by the DFEE, with the last iteration published in 2022. The 2015 FP Regulations were immediately applicable to applicants for a new mineral right but not to mineral rights holders where the right was granted before the commencement of the 2016 FP Regulations. Under the 2015 FP Regulations' transitional provisions, holders of a mineral right granted prior to the commencement of the 2015 NEMA FP Regulations (Existing Holders) were able to elect to comply either within three (3) months of their financial year-end or 15 months from the promulgation of the 2015 FP Regulations. Various extensions of this transitional period have subsequently been published, with the latest extension date being 19 September 2023.</p> <p><b><i>Kangra will comply with the relevant FP Regulations when required to do so.</i></b></p> <p><b><i>The DMRE will require that FP be provided by Kangra before issuing it with an EA / WML.</i></b></p>
DFEE Web-Based Screening Tool	<p>In terms of Regulation 16(1)(b)(v), read with Regulation 21 of the 2014 EIA Regulations, it is compulsory for an EIA application to include a sensitivity report generated by the national web-based environmental screening tool.<sup>5</sup> (DFEE Screening Tool).</p> <p>The content of specialist reports for certain of the themes is prescribed in the Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes.<sup>6</sup> (Assessment Protocols); and Appendix 4 of the EIA Regulations will not apply to such themes. Two Assessment Protocols have been gazetted, in March and October 2020.</p> <p><b><i>Specialist studies have been undertaken to verify the sensitivity themes as identified in the DFEE Screening Tool. Specific requirements for the content of the EIA specialist reports are included in the Assessment Protocols and these specialist reports will comply with the aforesaid for purposes of the EIA.</i></b></p>

<sup>4</sup> GN 1147 of 20 November 2015: Regulations pertaining to the Financial Provision for Prospecting, Exploration, Mining or Production Operations (GG 39425)

<sup>5</sup> GN R960 of GG 42561, dated 5 July 2019

<sup>6</sup> In terms of in terms of sections 24(5)(a) and (h) and 44 of NEMA and GN R320 of GG 43110 on 20 March 2020 and GN R1150 of GG 43855 on 30 October 2020

LEGISLATION/GUIDELINE	OBJECTIVE & RELEVANCE
National Environmental Management: Waste Act (Act 59 of 2008) (NEMWA), as amended	<p>The NEMWA's purpose is to: assist in regulating waste management; ensure the protection of human health; and prevent pollution and environmental degradation through sound waste management principles and guidelines. The NEMWA defines waste broadly.<sup>7</sup></p> <p>It furthermore provides for:</p> <ul style="list-style-type: none"> <li>• national norms and standards for regulating waste management by all spheres of government;</li> <li>• licensing and control of waste management activities;</li> <li>• remediation of contaminated land;</li> <li>• a national waste information system; and</li> <li>• provision for compliance and enforcement.</li> </ul> <p>The NEMWA imposes a general duty upon waste holders to take reasonable measures to avoid waste generation and, where this is impossible, to: minimise the toxicity and quantities of waste generated; reuse, reduce, recycle and recover waste; and ensure that it is treated and disposed of in an environmentally sound way. Failure to do so is a criminal offence, with a maximum fine of R10 million or imprisonment of up to 10 years, or both.</p>
Regulations published under NEMWA in GN 921 of Government Gazette 37083 on 29 November 2013 (2013 WML Regulations)	<p>It is necessary to hold a WML for defined waste management activities. The 2013 WML Regulations, provide that a WML is required for undertaking certain waste management activities ("Waste Listed Activities"). The Waste Listed Activities are separated into three (3) categories, namely Category A, B and C. Category A and B Waste Listed Activities require a WML, for which either a basic assessment or an EIA process needs to be undertaken that complies with the 2014 EIA Regulations. Category C activities do not require a WML but must comply with <i>inter alia</i> the Norms and Standards for Storage of Waste, 2013.<sup>8</sup></p> <p><b><i>On commencement of the NEMA Amendment Act, RS will be excluded from NEMWA and will therefore no longer be regarded as waste for which a WML is required. Instead, RS will be under NEMA.</i></b></p> <p><b><i>As the NEMA Amendment Act has still not commenced, Kangra has submitted an application for a WML for the proposed RS (i.e., the CDF), which is a Category B Waste Listed Activities in the 2013 WML Regulations, which is part of the S&amp;EIR process.</i></b></p>
NEMWA Regulations regarding the Planning and Management of Residue Stockpiles and Residue Deposits, published in GN 632 of GG 39020 on 24 July 2015 (Residue Regulations)	<p>The Residue Regulations provide the tools for and correspond to the statutory provision relating to managing RS in the manner prescribed in section 43A of the NEMWA.</p> <p>They regulate the planning, management and reporting of RS, including:</p> <ul style="list-style-type: none"> <li>• The assessment of impacts and analyses of risks relating to the management of RS;</li> <li>• Characterisation and classification of RS;</li> <li>• Conducting feasibility studies for the investigation and the selection of site for RS, including geotechnical and hydrological investigations, by competent persons and a registered professional civil / mining engineer;</li> </ul>

<sup>7</sup> (a) any substance, material or object, that is unwanted, rejected, abandoned, discarded or disposed of, or that is intended or required to be discarded or disposed of, by the holder of that substance, material or object, whether or not such substance, material or object can be re-used, recycled or recovered and includes all wastes as defined in Schedule 3 to this Act; or  
(b) any other substance, material or object that is not included in Schedule 3 that may be defined as a waste by the Minister by notice in the Gazette but any waste or portion of waste, referred to in paragraphs (a) and (b), ceases to be a waste—  
(i) once an application for its re-use, recycling or recovery has been approved or, after such approval, once it is, or has been re-used, recycled or recovered;  
(ii) where approval is not required, once a waste is, or has been re-used, recycled or recovered;  
(iii) where the Minister has, in terms of section 74, exempted any waste or a portion of waste generated by a particular process from the definition of waste; or  
(iv) where the Minister has, in the prescribed manner, excluded any waste stream or a portion of a waste stream from the definition of waste.

<sup>8</sup> Published in GN 926 of GG 37088 on 29 November 2013

LEGISLATION/GUIDELINE	OBJECTIVE & RELEVANCE
	<ul style="list-style-type: none"> <li>• Design of the RS;<sup>9</sup></li> <li>• Impact management;</li> <li>• Duties of the holder of the right or permit;</li> <li>• Monitoring and reporting systems;</li> <li>• Dust management and control; and</li> <li>• Decommissioning, closure and post-closure management requirements.</li> </ul> <p>When the NEMA Amendment Act commences, the Residue Regulations <sup>10</sup> will remain operational and shall be deemed to have been made under NEMA. <sup>11</sup></p>
NEMWA Waste Classification and Management Regulations (Waste Classification Regulations) and other Regulations.	<p>Classification of certain waste streams is required in terms of the Waste Classification and Management Regulations, <sup>12</sup> to ensure that the correct waste management standards and disposal methods are implemented.</p> <p>The National Norms and Standards for the Assessment of Waste for Landfill Disposal and the National Norms and Standards for the Disposal of Waste to Landfill<sup>13</sup> provide the norms and standards for disposal of waste to landfill.</p> <p><b><i>A Waste Classification was undertaken, based on the current prescribed criteria. It was concluded that the waste streams classify as a Type 3 (low risk) waste, which requires a Class C liner (pollution barrier).</i></b></p> <p><b><i>When the NEMA Amendment Act commences none of these Regulations will be applicable to RS.</i></b></p>
National Waste Information Regulations <sup>14</sup>	<p>These Regulations regulate the collection of data and information to fulfil the objectives of the national waste information system, as set out in section 61 of the NEMWA, and include reporting obligations. A registered person must keep a record of the information submitted to the SAWIS or the DFFE.</p> <p><b><i>Kangra will comply with these regulations.</i></b></p>
National Environmental Management: Air Quality Act, 2004 (Act 39 of 2004) (NEM: AQA)	<p>NEMAQA was promulgated to ensure the protection and regulation of air quality and provide measures that will prevent pollution and sustainability. Under NEMAQA, the Minister of Environmental Affairs, Forestry and Fisheries must identify substances in ambient air which present a threat to health, well-being or the environment and establish national standards for ambient air quality, including the permissible quantity or concentration of each substance in ambient air.</p> <p>The “Listed Activities and Associated Minimum Emission Standards”<sup>15</sup>, list activities that could result in atmospheric emissions requiring an atmospheric emissions licence (AEL) before being undertaken.</p> <p>The “National Dust Control Regulations”<sup>16</sup>, provide that an acceptable dust fallout rate for a non-residential area is considered more than 600mg/m<sup>2</sup>/day but less than 1200mg/m<sup>2</sup>/day (30-day average), with maximum allowable two exceedances per year, provided these exceedances do not take place in consecutive months. Where the dust fallout rate is exceeded, a prescribed dust fallout monitoring programme must be developed and include:</p>

<sup>9</sup> Including the general layout; type of deposition method used; rate of rise; design of the pollution control barrier system; stormwater control; freeboard; pooling; required factor of safety; control of decanting of excess water; retention of polluted water; design of the penstock; outfall pipe, under-drainage system and return water dams; height of the phreatic surface; slope angles and method of construction of the outer walls and their effects on shear stability; slope erosion by wind and water, and its control by vegetation, berms or catchment paddocks; and the potential for pollution.

<sup>10</sup> Published in Government Notice R632 in Government Gazette 39020 on 24 July 2015.

<sup>11</sup> Proposed by section 86 of the NEMLA IV Bill.

<sup>12</sup> Published in GN634 of GG 36784 on 23 August 2013

<sup>13</sup> Published under GN R635 and GN R636 respectively in GG 36784 of 23 August 2013

<sup>14</sup> Published in GN 625 of GG 35583 on 13 August 2012

<sup>15</sup> Published in GN 893 of GG 37054 on 22 November 2013

<sup>16</sup> Published in GN 827 of GG 36974 on 1 November 2013

LEGISLATION/GUIDELINE	OBJECTIVE & RELEVANCE
	<ul style="list-style-type: none"> <li>the establishment of a network of dust monitoring points, using method ASTM D1739:1970 (or an equivalent standard), sufficient in number to: establish the contribution to dust fallout in residential and non-residential areas near the premises; monitor identified or likely sensitive receptor locations; and establish the baseline dust fall for the district; and</li> <li>a schedule for submitting to the air quality officer dust fallout monitoring reports annually or at more frequent intervals, if requested by the air quality officer.</li> </ul> <p>Greenhouse gases have been declared priority pollutants under the “Declaration of Greenhouse Gases as Priority Air Pollutants”<sup>17</sup>.</p> <p><b><i>An AEL will not be required for the proposed projects; however, a duty of care should be employed during construction and operation to minimise air pollution as far as possible. MQE must take all reasonable measures to minimise the generation of dust and ensure compliance with the Dust Control Regulations.</i></b></p>
National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004) (NEM: BA)	<p>In line with the Convention on Biological Diversity, NEMBA aims to legally provide for biodiversity conservation, sustainable use and equitable access and benefit sharing. NEMBA creates a basic legal framework for the formation of a national biodiversity strategy and action plan and identification of biodiversity hotspots and bioregions, which may then be given legal recognition. It imposes obligations on landowners (state or private) regarding alien invasive species (AIS). NEMBA requires that provision be made by a site developer to remove any aliens which have been introduced to the site or are present on the site.</p> <p>The NEMBA also provides for listing of threatened or protected ecosystems in one of four (4) categories: critically endangered, endangered, vulnerable or protected. Threatened ecosystems are listed to reduce the rate of ecosystem and species extinction, by preventing further degradation and loss of structure, function and composition of threatened ecosystems. The purpose of listing protected ecosystems is primarily to conserve sites of exceptionally high conservation value.</p> <p>Section 53 of NEM: BA provides that:</p> <p><i>“(1) The Minister may, by notice in the Gazette, identify any process or activity in a listed ecosystem as a threatening process.</i></p> <p><i>(2) A threatening process identified in terms of subsection (1) must be regarded as a specified activity contemplated in section 24(2)(b) of the NEMA and a listed ecosystem must be regarded as an area identified for the purpose of that section.”</i></p> <p>No notices have been published yet under this section.</p> <p>Picking parts of, or cutting, chopping off, uprooting, damaging or destroying, any specimen of a listed threatened or protected species is a restricted activity under NEMBA. A permit is required for a restricted activity involving a listed threatened or protected (TOPS) species without a permit. Chapter 7 of the NEMBA regulates the process for the application of a permit under NEMBA.</p> <p>The following notices have been published in terms of section 56(1) of NEMBA:</p> <ul style="list-style-type: none"> <li>National List of Ecosystems that are Threatened and in need of protection (TOPS List),<sup>18</sup> which contains the National List of Ecosystems that are threatened and in need of protection. This includes preventing further degradation and loss of structure, function and composition of threatened ecosystems and preserving witness sites of exceptionally high conservation value. The purpose of listing threatened ecosystems is primarily to reduce the rate of ecosystem and species extinction.</li> <li>Lists of Critically Endangered, Endangered, Vulnerable and Protected Species;<sup>19</sup> and</li> <li>Threatened and Protected Species Regulations.<sup>20</sup></li> </ul>

<sup>17</sup> Published in GN 710 of GG 40996 on 21 July 2017

<sup>18</sup> Published under GN1002 in GG34809 of 9 December 2012

<sup>19</sup> Published under GNR151 in GG 29567 of 23 February 2007

<sup>20</sup> Published under GNR152 in GG 29657 of 23 February 2007

LEGISLATION/GUIDELINE	OBJECTIVE & RELEVANCE
	<p>Chapter 5 of NEMBA pertains to AIS and provides that a person may not carry out a restricted activity involving a specimen of an AIS without a permit issued in terms of Chapter 7 of NEMBA. Such permit can only be issued after a prescribed assessment of risks and potential impacts on biodiversity is carried out. Applicable, and exempted AIS are contained within the Alien and Invasive Species List 2020.<sup>21</sup> The NEMBA Alien and Invasive Species Regulations<sup>22</sup> categorises the different types of alien and invasive plant and animal species and how they should be managed. The Revised National Biodiversity Framework 2019 - 2024 was recently published.<sup>23</sup></p> <p><b><i>It is not anticipated that the proposed projects will disturb more than 10ha of indigenous vegetation, with the Project Area mainly being in already disturbed areas or low biodiversity sensitive areas, within the MQE MR surface infrastructure area.</i></b></p> <p><b><i>MQE must control and eradicate AIS in line with the NEMBA Alien and Invasive Species Regulations.</i></b></p>
Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983) (CARA)	<p>In terms of CARA, landowners are legally responsible for the control of weeds and alien vegetation. CARA makes provision for three (3) categories of AIP:</p> <ul style="list-style-type: none"> <li>• Category 1a: must immediately be removed and destroyed;</li> <li>• Category 1b: need to be immediately removed and contained;</li> <li>• Category 2: requires a permit to retain the species on site and it must be ensured that they do not spread. All category 2 plants in riparian zones need to be removed; and</li> <li>• Category 3: require a permit to retain these species. All category 3 plants in the riparian zone need to be removed.</li> </ul> <p>CARA also regulates the conservation of soil and states that degradation of the agricultural potential is illegal. It furthermore requires the protection of land against soil erosion and the prevention of water logging and associated salinization.</p> <p>Permissions / permits are required under CARA for the 'cultivation' of 'virgin soil'; cultivation and/or draining vlei(s), marshes or water sponges; and cultivation of an area within a watercourse's flood area.</p> <p><b><i>MQE will comply with CARA in relation to AIP control and soil conservation.</i></b></p> <p><b><i>No permits under CARA are envisaged to be required for the proposed projects.</i></b></p>
National Veld and Forest Fire Act, 1998 (Act 101 of 1998) (NVFFA)	<p>The NVFA's purpose is to prevent and combat veld, forest and mountain fires throughout South Africa. It applies to the open countryside beyond the urban limit and puts in place a range of requirements. The NVFA sets out the responsibilities of landowners or persons in control of the land which includes:</p> <ul style="list-style-type: none"> <li>• Prepare and maintain firebreaks on their side of the boundary if there is a reasonable risk of veld fire. The NVFA sets out the procedure in this regard and the role of neighbouring landowners and the fire protection association;</li> <li>• Have such equipment, protective clothing and trained personnel for extinguishing fires as are prescribed (in the regulations);</li> <li>• If there are no regulations, reasonably required in the circumstances, take all reasonable steps to notify the FPO of the local FPA (if there is one) when a fire breaks out; and</li> <li>• Do everything in their power to stop the spread of the fire.</li> </ul> <p>Landowners must ensure that: (i) firebreaks are wide and long enough to have a reasonable chance of preventing a veldfire from spreading to or from neighbouring property, (ii) that it does not cause soil erosion; and (iii) it is reasonably free of inflammable material capable of carrying a veldfire across it.</p>

<sup>21</sup> Published under GNR 1003 in GG 43726 of 18 September 2020

<sup>22</sup> Published under GNR1020 dated 25 September 2020

<sup>23</sup> In terms of GN 2423 of 26 August 2022,



LEGISLATION/GUIDELINE	OBJECTIVE & RELEVANCE
	<i>The projects are in the countryside beyond the urban limit, and thus the provisions of the Act are applicable. Measures to mitigate the risk of veld fires will be included in the EMPr.</i>
National Forests Act, 1998 (Act 84 of 1998) (NFA)	<p>In terms of section 15(3) of the NFA, the Minister published a list of protected tree species.<sup>24</sup> The effect thereof is that no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree or any product derived from a protected tree, except under a licence or exemption granted by the Minister to an applicant and subject to such period and conditions as may be stipulated.</p> <p><b><i>Should MQE required any licence to disturb a protected tree, it will be duly applied for.</i></b></p>
National Heritage Resources Act, 1999 (Act 25 of 1999) (NHRA)	<p>The protection and management of South Africa's heritage resources are controlled by the NHRA. The national enforcing authority for the NHRA is the South African Heritage Resources Agency (SAHRA). In terms of the NHRA, historically important features, such as graves, archaeology and fossil beds, are protected. Similarly, culturally significant symbols, spaces and landscapes are also afforded protection. In terms of section 38 of the NHRA, a permit is required for certain categories of development as follows:</p> <p><i>"(1) (a): The construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;</i>  <i>(c): Any development or other activity which will change the character of a site -</i>  <i>i. exceeding 5 000 m<sup>2</sup> in extent;</i>  <i>ii. involving three or more existing erven or subdivisions thereof;</i>  <i>iii. involving three or more erven or divisions thereof which have been consolidated within the past 5 years; or</i>  <i>iv. the costs of which will exceed a sum in terms of regulations by SAHRA or a provincial heritage resource authority."</i></p> <p>In terms of Section 38(8) of the NHRA, section 38(1) approval from SAHRA is not required where an environmental impact assessment is undertaken under NEMA, including a HIA, and SAHRA's requirements are considered by the CA when granting the EA.</p> <p>Section 38(8) of the NHRA provides that:</p> <p><i>"The provisions of this section do not apply to a development as described in subsection (1) if an evaluation of the impact of such development on heritage resources is required in terms of the ECA, or the integrated environmental management guidelines issued by the Department of Environment Affairs and Tourism, or the Minerals Act, 1991 (Act No. 50 of 1991), or any other legislation: Provided that the consenting authority must ensure that the evaluation fulfils the requirements of the relevant heritage resources authority in terms of subsection (3), and any comments and recommendations of the relevant heritage resources authority with regard to such development have been taken into account prior to the granting of the consent."</i></p> <p>Accordingly, provision is made for the assessment of heritage impacts as part of an environmental assessment process and, if such an assessment complies with the NHRA and SAHRA's requirements and the CA considers heritage impacts when granting the EA, a separate application for consent under the NHRA is not required.</p> <p><b><i>MQE should if any heritage finds or artefacts be discovered inform the South African Police or the Heritage Authority, as per the approved EMP for the proposed project.</i></b></p>
Hazardous Substance Act, 1973 (Act No. 15 of 1973) (HSA)	<p>The HSA aims to control the production, import, use, handling and disposal of hazardous substances. Under the HSA, hazardous substances are defined as substances that are toxic, corrosive, irritant, strongly sensitising, flammable and pressure generating under certain circumstances and may injure, cause ill-health or even death in humans. Where hazardous substances from any of the 4 groups below are to be used, (see below) care must be taken that they are sourced, transported, handled and disposed of in compliance with HSA.</p> <ul style="list-style-type: none"> <li>• Group I: industrial chemicals (IA) and pesticides (IB);</li> </ul>

<sup>24</sup> GN 536 of GG 41887 on of 7 September 2018

LEGISLATION/GUIDELINE	OBJECTIVE & RELEVANCE
	<ul style="list-style-type: none"> <li>• Group II: 9 classes of wastes excluding Class 1: explosives and class 7: radioactive substances;</li> <li>• Group III: electronic products and group; and</li> <li>• Group IV: radioactive substances.</li> </ul> <p>The HSA provides for the:</p> <ul style="list-style-type: none"> <li>• Control of certain electronic products;</li> <li>• Division of such substances or products into the groups above in relation to the degree of danger, with licensing requirements for certain activities undertaken in respect of Groups I and III;</li> <li>• Prohibition and control of the importation, manufacture, sale, use, operation, application, modification, disposal or dumping of such substances and products; and</li> <li>• Matters connected therewith.</li> </ul> <p><b><i>Hazardous substances may be stored, handled or transported as part of the proposed projects and include diesel and other liquid fuel, oil and hydraulic fluid, cement, etc. MQE will comply with the HSA, as required.</i></b></p>
National Water Act, 1998 (Act 36 of 1998) (NWA)	<p>The NWA is the primary legislation controlling and managing the use of water resources and pollution thereof. It provides for fundamental reformation of legislation relating to water resource use. The NWA's preamble recognises that the ultimate aim of water resource management is to achieve sustainable use of water for the benefit of all users and that water resources quality protection is necessary to ensure sustainability of the nation's water resources in the interests of all water users. The NWA's purpose is stated in section 2 and enforced by the DWS.</p> <p>The NWA presents strategies to facilitate sound management of water resources; provides for the protection of water resources; and regulates use of water by means of Catchment Management Agencies (CMA), Water User Associations, Advisory Committees, and International Water Management. As the NWA is founded on the principle of trusteeship, the government has overall responsibility for and authority over water resource management, including the equitable allocation and beneficial use of water in the public interest. Industry (including mines) can therefore only be entitled to use water if the use is permissible under the NWA.</p> <p>Section 19 of the NWA provides for pollution prevention and requires that a person who owns, controls, occupies, or uses the land in question, is responsible for taking reasonable measures to prevent pollution of water resources. A CMA may take action to prevent or remedy the pollution and recover all reasonable costs from the responsible party.</p> <p>Under Section 21 of the NWA, certain consumptive and non-consumptive water uses are identified and can only commence once authorised. Water use is broadly defined in the NWA and includes taking and storing water; activities which reduce stream flow; waste discharges and disposals; controlled activities; altering a watercourse; removing water found underground for certain purposes; and recreation. Consumptive water uses include taking water from a water resource (section 21(a) of NWA) and storing water (section 21(b)). Non-consumptive water uses include impeding or diverting a watercourse's flow (section 21(c)); altering a watercourse's bed, banks, course or characteristic or impeding the flow of a watercourse (sections 21 (c) and (i)); and disposal of waste in a matter that may detrimentally impact on a watercourse (section 21(g)).</p> <p>Where a water use constitutes a Scheduled 1 Use (permissible use without an authorisation requirement); permissible water uses in terms of section 22 of the NWA; or is authorised in terms of a General Authorisation (GA), a WUL is not required.<sup>25</sup></p> <p><b><i>The proposed projects will include sections 21 (c), (i) and (g) water uses. A Water Use Licence Application (WULA) will be submitted to the DWS to authorises these water uses.</i></b></p>

<sup>25</sup> Various GAs have been published under the NWA, including for Sections 21(c),(i),(g), and (a) water uses. In respect of sections 21(c) and (i) water uses, activities can be conducted within 100m of a watercourse and 500m of a wetland without a WUL if the impacts to the watercourse / wetland are low. Water uses that will be conducted under a GA need to be registered with the DWS.

LEGISLATION/GUIDELINE	OBJECTIVE & RELEVANCE
Government Notice 704 (GN 704), published in Government Gazette 20119, dated 4 June 1999.	<p>GN 704, promulgated under section 26(1) of the NWA is specifically aimed at the protection of water resources associated with mining related activities. It provides minimum requirements which need to be adhered to for water resource protection on a mine. GN 704 regulates the use of water; management of dirty and clean water infrastructure; and related activities at mines. This includes minimum requirements for infrastructure that hold dirty water. A mine can apply for exemptions from these requirements and could be granted approval, should sufficient management measures be put in place to ensure environmental protection. Regulation 4 of GN 704 places some restrictions in terms of the locality of certain infrastructure which could have an impact on water resources.</p> <p><b><i>MQE will comply with GN 704. Certain exemptions from GN 704 may however be necessary, including for construction of certain infrastructure in proximity to watercourses. This will be included in the WULA process.</i></b></p>
Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002) (MPRDA), as amended	<p>The MPRDA governs mineral resources in South Africa, regulates mining and mining authorisations and has as one of its principal objectives the equitable access and the sustainable development of the South Africa's mineral resources.</p> <p>Section 5A of the MPRDA indicates that: "No person may prospect for or remove, mine, conduct technical co-operation operations, reconnaissance operations, explore for and produce any mineral or petroleum or commence with any work incidental thereto on any area without - (a) an environmental authorisation (EA)".</p> <p>Section 37 of the MPRDA requires all mining and prospecting operations and related activities to be carried out in terms of the environmental management principles set out in Section 2 of NEMA.</p> <p>Social and environmental sustainability is enhanced through the requirement to submit a Social and Labour Plan (SLP), which records a mining company's obligations to improve social development. This includes a commitment to training and social investment, with the goal of transferring skills that can be used after mine closure.</p> <p><b><i>Kangra holds the MQE MR over the Project Area.</i></b></p> <p><b><i>It complies with the MPRDA and will continue to do so in respect of the proposed projects. A current Social Labour Plan (SLP) has been approved by the DMRE for MQE. There will be no increases in production or extensions to the MQE MR area and Kangra would therefore not be required to update the SLP for purposes of the proposed projects.</i></b></p>
Mine Health and Safety Act, 1996 (Act 29 of 1996) (MHSA)	<p>The MHSA aims to provide for protection of the health and safety (HS) of all employees and other personnel at RSA mines. Its main objectives are:</p> <ul style="list-style-type: none"> <li>• Protection of the HS of all persons at mines;</li> <li>• Requiring employers and employees to identify hazards and eliminate, control and minimise the risks relating to health and safety at mines;</li> <li>• Giving effect to the public international law obligations of South Africa that concern HS at all mines.</li> <li>• To promote: <ul style="list-style-type: none"> <li>○ a culture of HS in the mining industry;</li> <li>○ training in HS in the mining industry; and</li> <li>○ cooperation and consultation on HS between the State, employers, employees and their representatives.</li> </ul> </li> <li>• Providing for: <ul style="list-style-type: none"> <li>○ employee participation in matters of HS through HS representatives and the HS committees at mines;</li> <li>○ effective monitoring of HS conditions at mines;</li> <li>○ enforcement of HS measures at mines; and</li> <li>○ investigations and inquiries to improve HS at mines.</li> </ul> </li> </ul> <p><b><i>MQE already complies with the MHSA and will continue to do so in respect of the proposed projects.</i></b></p>

LEGISLATION/GUIDELINE	OBJECTIVE & RELEVANCE
	<i>It will conduct the required hazard assessment under the MHSA regarding potential HS impacts prior to commencing with construction of the proposed projects.</i>
MHSA: DMRE's Guideline for the Compilation of Mandatory Code of Practice ("COP") on Mine Residue Deposits, published in accordance with the MHSA ("RS COP Guideline")	<p>The RS COP Guideline is published pursuant to the MHSA and contains requirements as to what a mine needs to include in its COP for RS. This includes that an employer must identify hazards; assess the HS risks to which employees, and as far as reasonably practicable to persons who are not employees, may be exposed while they are at work; and record the significant hazards identified and risks assessed ("Risk Assessment"), prior to commencing operations. The Risk Assessment must: be based on a site selection process (including input from I&amp;APs); and a site-specific investigation (including that the site is geologically and geomorphologically stable); detail pre-existing natural contaminant levels and incremental levels arising from the RS; consider all MRDs on a site in an integrated system; consider the lifestyles /living conditions of persons potentially affected; and assess future events which can give rise to increased risks.</p> <p>The RS COP Guideline set outs the technical information required during the site investigation process and various technical reports that must be compiled as a basis the RS design, which mirror the RS Regulations in various respects. This includes a detailed investigation by a competent person of the RS's characteristics that may directly or indirectly affect the HS of mining and non-mining personnel in the vicinity of the site, and design requirements.</p> <p>It also requires a safety classification of the RS in accordance South African National Standards (SANS): Code of Practice, Mine Residue, SABS 10286: 1998 ("SABS 10286"), being the principal management guidance document for RS. SANS 10286 contains fundamental objectives, the principles, and minimum requirements for best practice, all aimed at ensuring that no unavoidable risks, problems and/or legacies are left to future generations. It does not, however, address the Safety, Health and Environmental (SHE) concerns of tailings storage, but places more focus on the need for management throughout the project's lifecycle. SANS 10286 also requires RS to be classified as either High, Medium or Low Hazard based on generic "catch-all" guidelines for determining a Zone of Influence, which is used.</p> <p><b><i>Kangra will compile a Risk Assessment on HS risks prior to commencing with operation of the proposed projects, for submission to the DMRE Mine Health Inspectorate.</i></b></p> <p><b><i>The risks, potential impacts and mitigation measures regarding HS that are identified in the detailed design and EIA will be included in the baseline process for the Risk Assessment.</i></b></p>
Occupational Health and Safety Act, 1993 (Act No. 85 of 1993) (OHSA)	The MHSA provides that OHSA is not applicable to any matter in respect of which any provision of the MHSA is applicable.
Compensation for Occupational Injuries and Diseases Act, 1993 (Act No. 130 of 1993) (COIDA)	<p>Under COIDA, employers are not held liable for compensation for injuries sustained by employees or compensation to dependants due to the death of an employee which occurred during the course and scope of their employment. Compensation is paid out of a statutory fund, administered by the Compensation Commissioner ("CC") (appointed under COIDA), which is set in accordance with a tariff prescribed in COIDA. The fund is a trust fund that is controlled by the CC, which the employer contributes to. The CC is appointed to administer the fund and approve claims lodged by employees or their dependants. The CC compensates the employee or their dependants directly.</p> <p><b><i>MQE will take cognisance of the requirements of the COIDA as part of daily operations should incidents occur.</i></b></p>
Restitution of Land Rights Act, 1994 (Act 22 of 1994) (RLRA)	The RLRA governs land restoration claims. Initially, the RLRA only allowed land claims to be lodged until December 1998 (Initial Period). This Initial Period was amended with the promulgation of the Restitution of Land Rights Amendment Act of 2014 and the process for the lodgement of claims was extended to 2019. However, a few months thereafter, the Constitutional Court delivered a judgment, <i>Land Access Movement of South Africa and Others v Chairperson of the National Council of Provinces and Others</i> 2016 (5) SA 635 (CC) (LAMOSA). <sup>26</sup> In terms of the LAMOSA judgments, the Department of

<sup>26</sup> which was followed by *Speaker of the National Assembly and Another v Land Access Movement of South Africa and Others* (2019) ZACC 10.

LEGISLATION/GUIDELINE	OBJECTIVE & RELEVANCE
	<p>Rural Development and Land Reform (DRDLR) is interdicted from processing those claims lodged after December 1998 until those lodged prior to December 1998 have been finalised.</p> <p>Under section 11(7), no person may sell, exchange, donate, lease, subdivide, rezone, or develop land in respect of which a land claim has been published in a government gazette without giving the Regional Land Claims Commissioner (LCC) one month's written notice of the intention to do so.</p> <p><b><i>MQE shall duly notify the LCC prior to developing the Project Area.</i></b></p>
Other National Legislation and Policy	<p>Other policies, legislation and associated regulations (where applicable) considered as part of the application process include:</p> <ul style="list-style-type: none"> <li>• Disaster Management Act, 2002 (Act No. 57 of 2002).</li> <li>• Integrated Resource Plan 2019.</li> <li>• Local Government: Municipal Systems Act, 2000 (Act 32 of 2000).</li> <li>• National Development Plan 2030.</li> <li>• Protection of Personal Information Act, 2013 (Act 4 of 2013).</li> <li>• Regulations of Gatherings Act, No. 205 of 1993</li> <li>• Traditional and Khoi-San Leadership Act, 2019 (Act 3 of 2019).</li> <li>• Water Services Act, 1997 (Act 108 of 1997).</li> <li>• Promotion of Access to Information Act, 2000 (Act 2 of 2000)</li> <li>• Promotion of Access to Justice Act, 2000 (Act 3 of 2000).</li> <li>• Basic Conditions of Employment Act, 1997 (Act 75 of 1997)</li> <li>• Labour Relations Act, 1995 (Act 66 of 1995).</li> </ul>
Provincial / Municipal Legislation and Policy	<p>Provincial / Municipal policies, legislation, and associated regulations (where applicable) considered as part of the application process include:</p> <ul style="list-style-type: none"> <li>• Mpumalanga Nature Conservation Act, 1998 (Act 10 of 1998).</li> <li>• Spatial Development Framework (SDF) 2019: Mpumalanga Province, as amended.</li> <li>• Gert Sibande District Municipality (GSDM) Spatial Development Framework 2009.</li> <li>• GSDM Noise Control By-Law, 2014.</li> <li>• GSDM Waste By-Laws, 2017.</li> <li>• Mkhondo Spatial Planning &amp; Land Use Management By-Law, 2016.</li> </ul>
Municipal Development Planning	<p>The following municipal development planning documentation is relevant to the application process:</p> <ul style="list-style-type: none"> <li>• Gert Sibande District Municipality Integrated Development Plan (IDP) 2022/27 and supporting documents.</li> <li>• Mkhondo IDP 2022/2027.</li> </ul>
OTHER STANDARDS AND GUIDELINES	
Standards and Guidelines	<p>In addition to the abovementioned Acts and their associated Regulations, the following guidelines and reports have been taken cognisance of during the application process:</p> <ul style="list-style-type: none"> <li>• Guidelines for consultation with communities and interested and affected parties issued by the DMRE.</li> </ul>



LEGISLATION/GUIDELINE	OBJECTIVE & RELEVANCE
	<ul style="list-style-type: none"> <li>• NEMA Implementation Guidelines: Sector Guidelines for EIA Regulation<sup>27</sup></li> <li>• Department of Environmental Affairs (DEA) (2011): A user-friendly guide to the National Environmental Management: Waste Act, 2008. South Africa, Pretoria.</li> <li>• Department of Environmental Affairs and Tourism (2004): Criteria for determining Alternatives in EIA, Integrated Environmental Management, Information Series 11.</li> <li>• DFFE Integrated Environmental Management Guideline on Need and Desirability, 2017.</li> <li>• Guideline for Implementation: Public Participation in the EIA Process.<sup>28</sup></li> <li>• Publication of Public Participation Guideline (GN 807 of 10 October 2012 GG No. 35769).</li> <li>• Mining and Biodiversity Guideline: mainstreaming biodiversity into the mining sector.</li> <li>• Department of Water and Forestry ("DWAF"), 2006. Groundwater Assessment II.</li> <li>• DWS, 2011 The Groundwater Dictionary - A comprehensive reference of groundwater related terminology, 2nd ed.</li> <li>• DWS, 2016 New Water Management Areas, South Africa: Government Gazette No 40279.</li> <li>• South African Water Quality Guidelines (DWAF): <ul style="list-style-type: none"> <li>○ South African Water Quality Guidelines (2nd Edition). Volume 4: Agricultural Use: Irrigation (1996a);</li> <li>○ Water Quality Guidelines - Volume 1: Domestic Use (1996b);</li> <li>○ South African Water Quality Guidelines (2nd Edition). Volume 5: Livestock Watering (1996c);</li> <li>○ Water Quality Guidelines Volume 7: Aquatic Ecosystems (1996d);</li> <li>○ Water Quality Guidelines Volume 2: Recreational Use (1996e); and</li> <li>○ Water Quality Guidelines Volume 3: Industrial Use (1996f).</li> </ul> </li> <li>• Best Practice Guidelines (DWAF): <ul style="list-style-type: none"> <li>○ G3: Water Monitoring Systems (2007);</li> <li>○ A5: Water Management for Surface Mines (2008b); and</li> <li>○ G4: Impact Prediction (2008)</li> </ul> </li> <li>• SANS 10103 of 2008: The measurement and rating of environmental noise with respect to annoyance and speech communication<sup>29</sup></li> <li>• SANS 10210 of 2004: Calculating and predicting road traffic noise.</li> <li>• SANS 10357: 2004: The calculation of sound propagation by the Concave method.</li> </ul>

<sup>27</sup> Published under GN 654 in GG 3333 of 29 June 2010

<sup>28</sup> Published in under GN 807 in GG 35769 of 10 October 2012

<sup>29</sup> Published under GN 718 in Government Gazette No. 18022

## 1.7 Aspects of the activity that are covered by the EMPr

The proposed development will comprise two main elements, namely the WWTP and related structures for the management of decant; and CDF and the related structures for the disposal of discard, filter and cake/or brine. These facilities are discussed below.

### 1.7.1 Wastewater Treatment Plant

The purpose of the proposed wastewater treatment plant (WWTP) is to treat decant water as well as surplus contaminated water within the mining operations. MQE is currently decanting clear groundwater from old underground workings at an average rate of 1 800m<sup>3</sup>/d. The WWTP will employ active treatment of the wastewater as it was found that passive treatment is not feasible nor possible due to the decant point's location, the high flow rates and the discharge quality required.

The implementation of the proposed active treatment of decant will entail:

- Upgrade of the decant/contamination dam: Formalising the dam wall to increase the storage capacity and lining the dam to prevent seepage;
- Upgrade of the decant point by drilling a row of eight (8) boreholes into the new dam wall at the decant dam in order to borehole well curtain (cut off) to cut off ground seepage water potentially entering the Heyshope Dam;
- Constructing a WWTP to treat decant and other mine contaminated water; and
- Constructing a Brine Pollution Control Dam (Brine PCD) and a Brine Treatment Plant.

Treated effluent from the WWTP will be discharged to the Heyshope Dam via an underground pipeline from the WWTP. Access to the WWTP and associated pipelines will be through existing roads.

Brine produced at the WWTP will initially be pumped to the proposed new Brine PCD. The Brine PCD was initially proposed for the evaporation of brine from the WWTP. However, during the detailed design process currently being undertaken, it became evident that naturally evaporating brine at the site would not be efficient due to the projected inflow rate of brine to the proposed PCD/evaporation dam. It is therefore necessary to construct a Brine Treatment Plant to remove water from the brine, thereby converting it to a dry filter cake that can be disposed of on the proposed CDF.

### 1.7.2 Brine Treatment Plant

A Brine Treatment Plant, with an anticipated throughput of 15m<sup>3</sup>/hr, or 285m<sup>3</sup>/day if pumping 19 hrs/day, will be constructed. The modular plant will cover an area of less than 0.06ha and will be skid mounted or containerized. The modular system allows for simpler expansion or alterations in the future should it be required.

The addition of the proposed Brine Treatment Plant to the development will reduce the risk of insufficient storage space for brine, reduce the risk of overflows from the Brine PCD and

allows for sludge/filter cake quantities to be disposed of to be accurately quantified each month.

The proposed technology is a system that comprises a combined evaporator and crystallizer in a single step. Brine which is pumped into the Brine Treatment Plant will first pass through a pre-heating stage to raise the temperature before entering the brine recirculation system. The process removes water from the brine through the creation of water vapour, which exits at the top. Brine is continuously recirculated in the system causing the concentration of the recirculated brine to gradually rise until it crystallizes and forms solids. It is anticipated that the clean water produced will comply with the SANS 241 potable water limits before being discharged. The remaining salts/filter cake will be directly transported to the CDF for disposal.

### **1.7.3 Co-disposal Facility**

The proposed co-disposal facility (CDF) falls within the exact footprint of the previously authorized (MDARDLEA Ref: 17/2/3/GS-240) MQE Discard Dump (DD).

As a result of changing operational requirements, and the lapsing of the previous authorisation, there is now a need to obtain a WML in terms of the NEMWA for the proposed CDF at MQE.

The CDF will accommodate discard produce from the beneficiation plant, slurry/filter cake and potentially brine from the WWTP.

The CDF's design will be similar to the authorized discard dump: a three-compartment side hill-type facility with a footprint of approximately 65ha. A phased development approach, over a period of 20 years, is envisaged: Phase 1 - 7 years; Phase 2 - 7 years and Phase 3 - 6 years capacity.

## **1.8 Project Phases and Activities**

The life cycle of the proposed activities can be divided into the Construction, Operational and Decommissioning Phases. The anticipated activities for each phase, for which mitigation and management measures are proposed, are listed below.

The Construction Phase activities will include:

- Clearing of vegetation.
- Stripping, handling and stockpiling of topsoil.
- Excavation of material/earthworks.
- Transportation of construction materials.
- Travel along unsurfaced roads.
- Construction of structures including development of berms and channels, pouring of concrete, installation of pipelines.
- Storage of construction materials and hydrocarbons
- Storage and handling of general, hazardous and construction waste.

The Operational Phase activities will include:

- Transportation of discard material and brine filter cake via truck using a haul road and the dumping onto the CDF using an access ramp;
- Compaction of waste material on the CDF with earth-moving equipment;
- Deposition of coal slurry. There is a possibility of the addition of brine to the discard dump.
- Handling and disposal of waste;
- Management of runoff and supernatant water.
- Maintenance of haul roads.
- Concurrent rehabilitation of lower CDF layers with fertile soil and vegetation.
- Pumping of contaminated water from the dam to WWTP.
- Pumping of brine from WWTP to brine evaporation dam.
- Dewatering of brine at the Brine Treatment Plant to produce filter cake.
- Discharging treated water from WWTP to Heyshope Dam.

The Decommissioning Phase activities will include:

- Termination of co-disposal activities. The capping and rehabilitation of the remainder of the CDF will be undertaken, as well as the rehabilitation of the haul roads and any disturbed areas around the CDF, which may not have been properly rehabilitated. This will involve the placement of topsoil and vegetation and the removal of alien invasive plants where necessary.
- Removal of the equipment such as pipelines, electrical and mechanical equipment (including the pump station); the de-silting of the PCD, removal of concrete foundations and removal of all rubble and waste.
- Installation of long-term stormwater systems or upgrades to the operational stormwater system.
- Termination of treatment activities and brine generation (only if no decant from the old MQE workings takes place) The Geohydrological Assessment (refer to Appendix E-4) indicates that the potential for decant during this phase. This will be confirmed through regular updates of the numerical groundwater model over the LoM.
- Ripping of compacted areas including haul roads
- Monitoring and maintenance: This will involve monitoring the environment, i.e. vegetation, surface water and groundwater monitoring to determine if the rehabilitation, as well as any management measures, have been effective. During this phase planning will be undertaken based on all the data collected during monitoring and detailed studies, to implement any additional measures required to apply for closure of the facility.

### 1.9 Composite Environmental Sensitivity Map

Based on the results of the desktop assessment and specialist studies, a composite environmental sensitivity map showing the proposed development is shown in Figure 3.

Key sensitive features identified within the proposed project footprint include the following:

- Non-perennial and perennial streams;
- Heyshope Dam
- Wetland areas; and
- Critical Biodiversity Area.



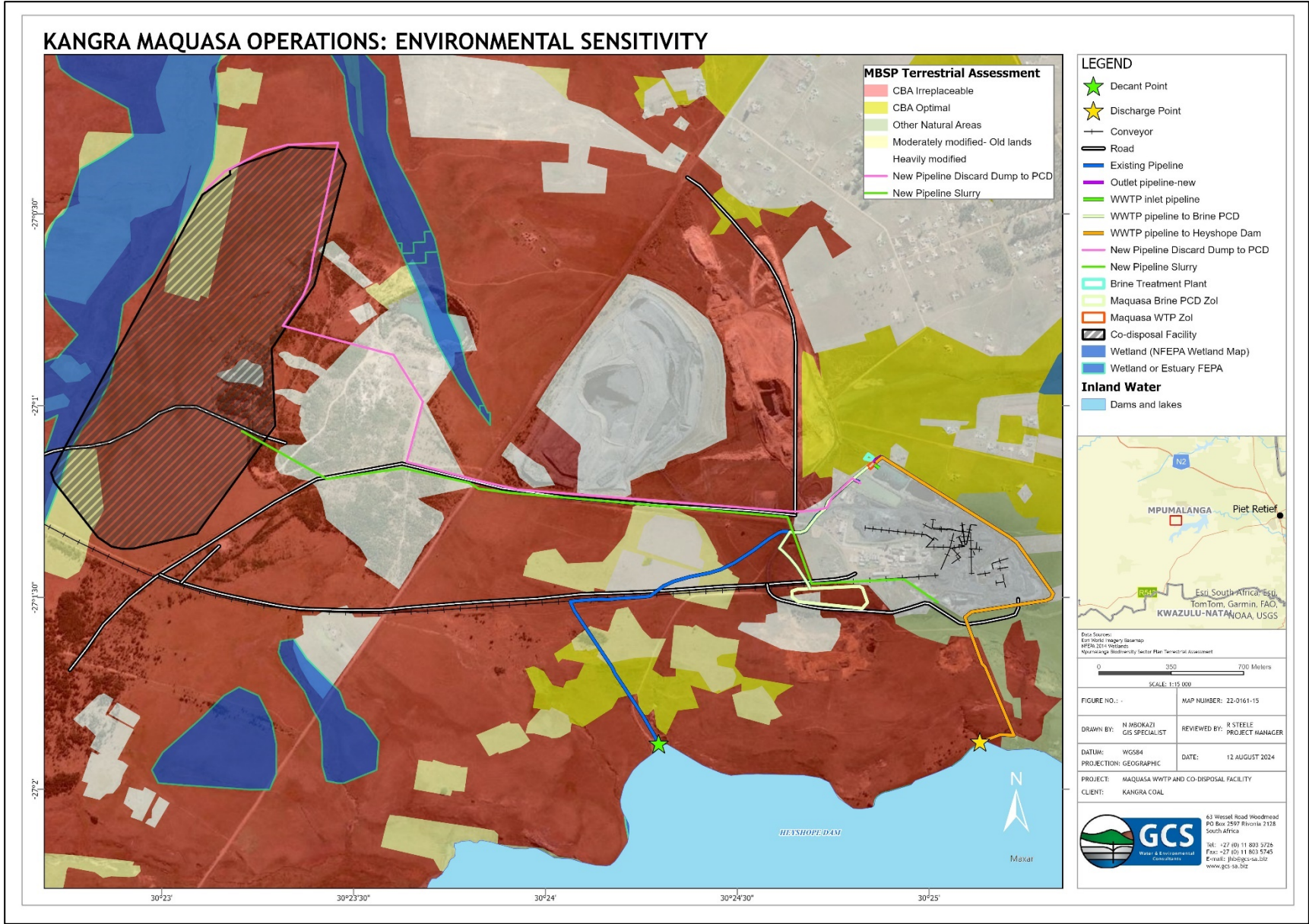


Figure 3: Composite Environmental Sensitivity Map

## 2 ENVIRONMENTAL IMPACT STATEMENT

Appendix 4 of the 2014 NEMA EIA Regulations, as amended, requires that the EMP include a description of the impact management outcomes, including management statements, identifying the impacts and risks that need to be avoided, managed and mitigated as identified through the environmental impact assessment process for all phases of the development.

The assessments undertaken during the environmental impact assessment process have not identified any fatal flaws which would preclude the authorisation of the proposed Project. The EAP is confident that all major negative impacts associated with the proposed development has been adequately described and can be mitigated to acceptable levels.

The goal of the proposed Project is to mitigate the negative impacts of decant on the environment and continue contributing to the local economy by allowing the full Life of Mine (LoM) to be realised.

It is the opinion of the EAP that there is no reason not to grant the requested environmental authorisation in respect of the proposed WWTP and CDF and related infrastructure.

The results of the impact assessment indicated that the most significant impacts on the receiving environment would be those listed below in Table 6, Table 7 and Table 8. The correct implementation of the mitigation measures outlined within this document will ensure that all impacts are managed, mitigated or avoided as far as practicably possible.

**Table 6: Key impacts during the Construction Phase**

ENVIRONMENTAL ASPECT	IMPACT
Air Quality	<ul style="list-style-type: none"> <li>• Generation of inhalable particle emissions and fugitive dust and dust fallout.</li> <li>• GHG emissions during the construction activities.</li> </ul>
Terrestrial Ecology	<ul style="list-style-type: none"> <li>• Loss of vegetation within the development footprint.</li> <li>• Degradation and loss of surrounding natural vegetation</li> <li>• Direct mortality of fauna due to earthworks, vehicle collisions, accidental hazardous chemical spills and persecution.</li> <li>• Disturbance due to dust and noise pollution and vibration may disrupt behaviour.</li> </ul>
Freshwater Ecology	<ul style="list-style-type: none"> <li>• Loss of riparian vegetation due to vegetation clearing and earthworks</li> <li>• Potential increase in sedimentation of the wetland features.</li> <li>• Contamination of the water in the wetlands petrochemical spillages</li> <li>• Contamination of the aquatic features due to spillages or leakages from on-site ablution facilities.</li> </ul>
Soils, Land Capability and Land Use	<ul style="list-style-type: none"> <li>• Loss of land capability due to construction of permanent infrastructure (CDF).</li> <li>• Soil interflow processes:               <ul style="list-style-type: none"> <li>○ Infilling of wetlands and watercourses inducing alternative flow paths (if infilling occurs).</li> <li>○ Alteration to natural hydrogeological flow paths.</li> <li>○ Impacts on the macro-soil structure.</li> </ul> </li> </ul>

ENVIRONMENTAL ASPECT	IMPACT
	<ul style="list-style-type: none"> <li>○ Impacts on the hydrogeological processes supporting the watercourses</li> <li>• Soil structure &amp; land capability: <ul style="list-style-type: none"> <li>○ Exposure of soils, leading to increased runoff from cleared areas and erosion of the watercourses, thus increasing the potential for sedimentation of the watercourses.</li> <li>○ Vegetation loss.</li> <li>○ Soil compaction and erosion</li> </ul> </li> <li>• Soil quality: <ul style="list-style-type: none"> <li>○ Natural nutrient content decreases due to soil exposure.</li> <li>○ Loss of natural bio-organisms essential to soil processes.</li> </ul> </li> <li>• Soil degradation. Compromised soil quality. Prolonged pollution may migrate to the nearby watercourse and/or percolate into the groundwater table.</li> <li>• Perched Water Table Dewatering.</li> </ul>
Geohydrological Aspects	<ul style="list-style-type: none"> <li>• Disturbing vadose zone during soil excavations/construction activities.</li> <li>• Poor quality seepage from machinery used to excavate soils. Oil, grease and fuel leaks could lead to hydrocarbon contamination of the vadose zone which could percolate into the shallow aquifer.</li> <li>• Groundwater recharge may increase in some areas and decrease in others.</li> <li>• Perched water table dewatering.</li> </ul>
Hydrological Aspects	<ul style="list-style-type: none"> <li>• Disturbing vadose zone during soil excavations/activities.</li> <li>• Surface water contamination and sedimentation from the following activities: <ul style="list-style-type: none"> <li>○ Washing of equipment and vehicles, unattended leaks and spills;</li> <li>○ Erosion and sedimentation of watercourses due to unforeseen circumstances (i.e. bad weather); and</li> </ul> </li> <li>• Alteration of natural drainage lines which may lead to ponding or increased runoff patterns (i.e. may cause stagnant water levels or increase erosion).</li> <li>• Perched water table dewatering</li> </ul>
Visual Impacts	<ul style="list-style-type: none"> <li>• Negative visual impact on aesthetics</li> <li>• Poor visibility due to dust creation</li> <li>• Visual intrusion due to glare, light trespass and skyglow</li> </ul>
Noise Impacts	Noise disturbance to sensitive receptors
Heritage & Paleontological Impacts	Loss of / damage to heritage/archaeological/palaeontological resources if unearthed during construction
Socio-Economic Impacts	<ul style="list-style-type: none"> <li>• Temporary job creation and skills development</li> <li>• Dust &amp; noise could increase as a result of an increase in traffic.</li> <li>• General construction activities resulting in an increase in fugitive dust emissions</li> </ul>

Table 7: Key impacts during the Operational Phase

ENVIRONMENTAL ASPECT	IMPACT
Air Quality	<ul style="list-style-type: none"> <li>• Generation of inhalable particle emissions and fugitive dust.</li> </ul>

ENVIRONMENTAL ASPECT	IMPACT
Terrestrial Ecology	<ul style="list-style-type: none"> <li>Disturbance created during the construction phase will leave the project area vulnerable to erosion and Invasive plant encroachment.</li> <li>This may lead to local disturbance of fauna and flora, through noise, light, trampling, etc. Fauna may move away from the site.</li> <li>Ongoing displacement and direct mortalities of faunal community due to disturbance.</li> </ul>
Freshwater Ecology	<ul style="list-style-type: none"> <li>Contamination of the water in the wetland features, which will impact on the PES of the features, due to leakage of untreated effluent from WWTW</li> <li>Contamination of the water in the wetland features, which will impact on the PES of the features, due to leakage of untreated effluent from pipelines</li> <li>Changes to the hydrological regime of the wetlands due to leakages from the treated discharge pipeline.</li> <li>Pollution of the Heyshope Dam due to treated effluent discharge limits not being met by the WWTW.</li> </ul>
Soils, Land Capability and Land Use	<ul style="list-style-type: none"> <li>Soil interflow processes: <ul style="list-style-type: none"> <li>Alteration to natural hydrogeological flow paths.</li> <li>Impacts on the macro-soil structure.</li> <li>Impacts on the hydrogeological processes supporting the watercourses.</li> </ul> </li> <li>Soil contamination</li> </ul>
Geohydrological Aspects	<ul style="list-style-type: none"> <li>Deterioration of groundwater quality due to seepage from PCDs.</li> <li>Deterioration of groundwater quality due to failure of liner or drainage system.</li> <li>Reduction to groundwater recharge over project area.</li> </ul>
Hydrological Aspects	<ul style="list-style-type: none"> <li>Contamination of vadose zone soils.</li> <li>Contamination of surface water due to contaminated runoff and sedimentation.</li> <li>Poor quality seepage into the subsoils from landfill may impact soil quality and eventually lead to poor quality seepage into the surroundings.</li> <li>Reduction of contamination of surface water resources.</li> </ul>
Visual Impacts	<ul style="list-style-type: none"> <li>Visual impact of the CDF due to increasing size of CDF over the life of the facility.</li> <li>Poor visibility conditions.</li> <li>Visual intrusion due to glare, light trespass and skyglow.</li> </ul>
Noise Impacts	<ul style="list-style-type: none"> <li>Noise disturbance to sensitive receptors</li> </ul>
Heritage & Paleontological Impacts	<ul style="list-style-type: none"> <li>None</li> </ul>
Socio-Economic Impacts	<ul style="list-style-type: none"> <li>Continued mining facilitated by the provision of a CDF for the disposal of mine wastes.</li> <li>Traffic volumes are anticipated to remain the same.</li> <li>Dust and noise as a result of general operational activities</li> </ul>

**Table 8: Key impacts during the Decommissioning Phase**

ENVIRONMENTAL ASPECT	IMPACT
Air Quality	<ul style="list-style-type: none"> <li>• Generation of inhalable particle emissions and fugitive dust and dust fallout.</li> <li>• GHG emissions during the construction activities.</li> </ul>
Terrestrial Ecology	<ul style="list-style-type: none"> <li>• Potential loss of indigenous vegetation units.</li> <li>• Potential increase in alien vegetation.</li> <li>• Contamination of the area by demolition and domestic waste.</li> <li>• Direct mortality of fauna Disturbance due to dust and noise pollution and vibration may disrupt behaviour.</li> </ul>
Freshwater Ecology	<ul style="list-style-type: none"> <li>• Positive effect on aquatic resources due to removal of surface infrastructure and rehabilitation of the area.</li> <li>• Soil degradation: Compromised soil quality. Prolonged pollution may migrate to the nearby watercourse and/or percolate into the groundwater table.</li> <li>• Negative effect on aquatic resources due to water quality deterioration as a result of erosion and sedimentation, inadequate stormwater management; and hydrocarbon/chemical spillages and/or dumping of material outside of designated areas.</li> </ul>
Soils, Land Capability and Land Use	<ul style="list-style-type: none"> <li>• Soil interflow processes: <ul style="list-style-type: none"> <li>◦ Infilling of wetlands and watercourses inducing alternative flow paths (if infilling occurs).</li> <li>◦ Alteration to natural hydropedological flow paths.</li> <li>◦ Impacts on the macro-soil structure.</li> <li>◦ Impacts on the hydropedological processes supporting the watercourses.</li> </ul> </li> <li>• Soil structure &amp; land capability: <ul style="list-style-type: none"> <li>◦ Exposure of soils, leading to increased runoff from cleared areas and erosion of the watercourses, thus increasing the potential for sedimentation of the watercourses.</li> <li>◦ Vegetation loss.</li> <li>◦ Soil compaction and erosion.</li> </ul> </li> <li>• Soil quality: <ul style="list-style-type: none"> <li>◦ Natural nutrient content decreases due to soil exposure.</li> <li>◦ Loss of natural bio-organisms essential to soil processes.</li> </ul> </li> <li>• Long-term implications due to presence of CDF Soil interflow processes: <ul style="list-style-type: none"> <li>◦ Infilling of wetlands and watercourses inducing alternative flow paths (if infilling occurs).</li> <li>◦ Alteration to natural hydropedological flow paths.</li> <li>◦ Impacts on the macro-soil structure.</li> </ul> </li> <li>• Impacts on the hydropedological processes supporting the watercourses.</li> <li>• Contamination of the area by petrochemical spillages.</li> <li>• Soil loss / Soil erosion</li> </ul>
Geohydrological Aspects	<ul style="list-style-type: none"> <li>• Poor quality seepage from machinery. Oil, grease and fuel leaks could lead to hydrocarbon contamination of the vadose zone which could percolate into the shallow aquifer.</li> <li>• Reduced volumes infiltrating the CDF reporting to PCD.</li> </ul>
Hydrological Aspects	<ul style="list-style-type: none"> <li>• The reshaping and rehabilitation of the co-disposal facility will be beneficial to the environment. Capping and reducing infiltration into the dump will help mitigate any poor-quality seepage.</li> </ul>



ENVIRONMENTAL ASPECT	IMPACT
	<ul style="list-style-type: none"> <li>Poor quality seepage into the subsoils from landfills may impact soil quality and eventually lead to poor quality seepage into the surroundings.</li> <li>Potential surface water contamination as a result of poor stormwater drainage on-site.\ Increased erosion due to vegetation loss.</li> <li>Contaminated runoff water into nearby streams from parked vehicles or unattended leaks or spills.</li> <li>Sedimentation of watercourses due to altered runoff patterns.</li> <li>Surface water contamination due to overflow from PCD and TSF during storm events</li> </ul>
Visual Impacts	<ul style="list-style-type: none"> <li>Positive visual impact on aesthetics</li> <li>Visual intrusion due to glare, light trespass and skyglow</li> </ul>
Noise Impacts	<ul style="list-style-type: none"> <li>Noise disturbance to sensitive receptors</li> </ul>
Heritage & Paleontological Impacts	<ul style="list-style-type: none"> <li>Loss of / damage to heritage/archaeological/palaeontological resources if unearthed during construction</li> </ul>
Socio-Economic Impacts	<ul style="list-style-type: none"> <li>Nuisance factors (dust, noise and traffic).</li> <li>Temporary job creation.</li> <li>Influx of workers post operations.</li> </ul>

### 3 ROLES AND RESPONSIBILITIES

The effective implementation of this EMPr is dependent on established and clear roles, responsibilities and reporting lines within an institutional framework. This section of the EMPr gives guidance to the various environmental roles and reporting lines, however, project-specific requirements will ultimately determine the need for the appointment of a specific person(s) to undertake specific roles and or responsibilities. As such, it must be noted that if no specific person, for example, an Environmental Control Officer (ECO) is appointed, the holder of the EA remains responsible for ensuring that the duties of the ECO indicated in this document are undertaken. Refer to Table 9.

Table 9: Roles and Responsibilities for Implementation of the EMPr

RESPONSIBLE PERSON	ROLES AND RESPONSIBILITIES
<b>Engineering, Procurement and Construction Manager (EPCM): Project Manager (PM)</b>	<p><u>Role</u></p> <p>The EPCM is accountable for ensuring compliance with the EMPr and any conditions of approval from the competent authority (CA). An Environmental Control Officer (ECO) will be contracted by the EPCM to objectively monitor the implementation of the EMPr according to relevant environmental legislation, and the conditions of the EA. The EPCM is further responsible for providing and giving the mandate to enable the ECO to perform responsibilities and must ensure that the ECO is integrated as part of the project team while remaining independent. The Project Manager (PM) appointed by the EPCM will be responsible for all activities undertaken at the construction site.</p> <p><u>Responsibilities</u></p> <ul style="list-style-type: none"> <li>• Be fully conversant with the conditions of the EA;</li> <li>• Ensure that all stipulations within the EMPr are communicated and adhered to by the Developer and its Contractor(s);</li> <li>• Issuing of site instructions to the Contractor for corrective actions required;</li> <li>• Monitor the implementation of the EMPr throughout the project through site inspections and meetings. Overall management of the project and EMPr implementation; and</li> <li>• Ensure that periodic environmental performance audits are undertaken on the project implementation.</li> </ul>
<b>Developer Site Supervisor (DSS)</b>	<p><u>Role</u></p> <p>The DSS reports directly to the PM, oversees site works, and liaises with the contractor(s) and the ECO. The DSS is responsible for the day-to-day implementation of the EMPr and for ensuring the compliance of all contractors with the conditions and requirements stipulated in the EMPr.</p> <p><u>Responsibilities</u></p> <ul style="list-style-type: none"> <li>• Ensure that all contractors identify a contractor's Environmental Officer (cEO);</li> <li>• Must be fully conversant with the conditions of the EA. Oversees site works, liaison with Contractor, DPM and ECO;</li> <li>• Must ensure that all landowners have the relevant contact details of the site staff, ECO and cEO;</li> <li>• Issuing of site instructions to the Contractor for corrective actions required;</li> <li>• Will issue all non-compliances to contractors; and</li> <li>• Ratify the Monthly Environmental Report.</li> </ul>

<b>Environmental Control Officer (ECO) (duties to be performed by the Mine's Environmental Officer)</b>	<p><u>Role</u></p> <p>The ECO should have appropriate training and experience in the implementation of environmental management specifications. The primary role of the ECO is to act as an independent quality controller and monitoring agent regarding all environmental concerns and associated environmental impacts. In this respect, the ECO is to conduct periodic site inspections, attend regular site meetings, pre-empt problems and suggest mitigation and be available to advise on incidental issues that arise. The ECO is also required to conduct compliance audits, verifying the monitoring reports submitted by the cEO. The ECO provides feedback to the DSS and DPM regarding all environmental matters. The Contractor and cEO are answerable to the ECO for non-compliance with the Performance Specifications as set out in the EA and EMPr.</p> <p>The ECO provides feedback to the DSS and DPM, who in turn report back to the Contractor and potential and Registered Interested and Affected Parties (I&amp;APs), as required. Issues of non-compliance raised by the ECO must be taken up by the Employer's Project Manager and resolved with the Contractor as per the conditions of their contract. Decisions regarding environmental procedures, specifications and requirements which have a cost implication (i.e. those that are deemed to be a variation, not allowed for in the Performance Specification) must be endorsed by the Employer's Project Manager. The ECO must also, as specified by the EA, report to the relevant CA as and when required.</p> <p><u>Responsibilities</u></p> <p>The responsibilities of the ECO will include the following:</p> <ul style="list-style-type: none"> <li>• Be aware of the findings and conclusions of all EA related to the development;</li> <li>• Be familiar with the recommendations and mitigation measures of the EMPr;</li> <li>• Be conversant with relevant environmental legislation, policies and procedures, and ensure compliance with them;</li> <li>• Undertake regular and comprehensive site inspections/audits of the construction site according to the generic EMPr and applicable licenses to monitor compliance as required;</li> <li>• Educate the construction team about the management measures contained in the EMPr and environmental licenses;</li> <li>• Compilation and administration of an environmental monitoring plan to ensure that the environmental management measures are implemented and are effective;</li> <li>• Monitoring the performance of the Contractors and ensuring compliance with the EMPr and associated Method Statements (to be compiled once detailed designs have been completed);</li> <li>• In consultation with the DSS order the removal of person(s) and/or equipment which are in contravention of the specifications of the EMPr and/or environmental licenses;</li> <li>• Liaison between the DPM, Contractors, authorities and other lead stakeholders on all environmental concerns;</li> </ul>
---	--

	<ul style="list-style-type: none"> <li>• Compile a regular Environmental Audit Report (EAR) highlighting any non-compliance issues as well as satisfactory or exceptional compliance with the EMPr;</li> <li>• Validating the regular site inspection reports, which are to be prepared by the cEO;</li> <li>• Checking the cEO's record of environmental incidents (spills, impacts, legal transgressions etc.) as well as corrective and preventive actions taken;</li> <li>• Checking the cEO's public complaints register in which all complaints are recorded, as well as action taken;</li> <li>• Assisting in the resolution of conflicts;</li> <li>• Facilitate training for all personnel on the site - this may range from carrying out the training to reviewing the training programmes of the Contractor;</li> <li>• In the case of non-compliances, the ECO must first communicate this to the Senior Site Supervisor, who has the power to ensure this matter is addressed. Should no action or insufficient action be taken, the ECO may report this matter to the authorities as non-compliance;</li> <li>• Maintenance, update and review of the EMPr;</li> <li>• Communication of all modifications to the EMPr to the relevant stakeholders.</li> </ul>
<b>Mine's Environmental Officer (EO)</b>	<p><u>Role</u></p> <p>The EO will report to mine management, liaise with the PM and is responsible for the implementation of the EMPr, environmental monitoring and reporting, providing environmental input to the PM and Contractor's Manager, liaising with Contractors and the landowners (where applicable) as well as a range of environmental coordination responsibilities.</p> <p><u>Responsibilities</u></p> <ul style="list-style-type: none"> <li>• Be fully conversant with the EMPr;</li> <li>• Be familiar with the recommendations and mitigation measures of this EMPr, and implement these measures;</li> <li>• Ensure that all stipulations within the EMPr are communicated and adhered to by the Employees and Contractor(s);</li> <li>• Confine the development site to the demarcated area;</li> <li>• Conduct environmental internal audits with regard to EMPr and authorisation compliance;</li> <li>• Assist the contractors in addressing environmental challenges on site;</li> <li>• Assist in incident management:</li> <li>• Reporting environmental incidents to the developer and ensuring that corrective action is taken, and lessons learnt shared;</li> <li>• Assist the contractor in investigating environmental incidents and compiling investigation reports;</li> </ul>

	<ul style="list-style-type: none"> <li>• Follow-up on pre-warnings, defects, non-conformance reports;</li> <li>• Measure and communicate environmental performance to the Contractor;</li> <li>• Conduct environmental awareness training on-site together with ECO and cEO;</li> <li>• Ensure that the necessary legal permits and/or licenses are in place and up to date;</li> <li>• Acting as mine's Environmental Representative on site and working together with the ECO and contractor.</li> </ul>
<b>Contractor</b>	<p><u>Role</u></p> <p>The Contractor appoints the cEO and has overall responsibility for ensuring that all work, activities, and actions linked to the delivery of the contract are in line with the EMPr and that Method Statements are implemented as described (to be compiled once detailed designs have been completed). External contractors must ensure compliance with this EMPr while performing the onsite activities as per their contract with the Project Developer. The contractors are required, where specified, to provide Method Statements setting out in detail how the impact management actions contained in the EMPr will be implemented (to be compiled once detailed designs have been completed).</p> <p><u>Responsibilities</u></p> <ul style="list-style-type: none"> <li>• Project delivery and quality control for the development services as per appointment;</li> <li>• Employ a suitably qualified person to monitor and report to the Project Developer's appointed person on the daily activities on-site during the construction period;</li> <li>• Ensure that safe, environmentally acceptable working methods and practices are implemented, and that equipment is properly operated and maintained, to facilitate proper access and enable any operation to be carried out safely;</li> <li>• Attend on-site meeting(s) prior to the commencement of activities to confirm the procedure and designated activity zones;</li> <li>• Ensure that Contractors' staff repair, at their own cost, any environmental damage as a result of a contravention of the specifications contained in EMPr, to the satisfaction of the ECO.</li> </ul>
<b>cEO</b>	<p><u>Role</u></p> <p>Each Contractor affected by the EMPr should appoint a cEO, who is responsible for the on-site implementation of the EMPr (or relevant sections of the EMPr). The Contractor's representative can be the site agent; site engineer; dedicated environmental officer; or an independent consultant. The Contractor must ensure that the Contractor's Representative is suitably qualified to perform the necessary tasks and is appointed at a level such that she/he can interact effectively with other site Contractors, labourers, the Environmental Control Officer and the public. As a minimum, the cEO shall meet the following criteria:</p>



	<p><u>Responsibilities</u></p> <ul style="list-style-type: none"><li>• Be on site throughout the project and be dedicated to the project;</li><li>• Ensure all their staff are aware of the environmental requirements, conditions and constraints with respect to all of their activities on site;</li><li>• Implementing the environmental conditions, guidelines and requirements as stipulated within the EA, EMPr and Method Statements (to be compiled once detailed designs have been completed);</li><li>• Attend the Environmental Site Meeting;</li><li>• Undertaking corrective actions where non-compliances are registered within the stipulated timeframes;</li><li>• Report back formally on the completion of corrective actions;</li><li>• Assist the ECO in maintaining all the site documentation;</li><li>• Prepare the site inspection reports and corrective action reports for submission to the ECO;</li><li>• Assist the ECO with preparing the monthly report; and</li><li>• Where more than one Contractor is undertaking work on site, each company appointed as a Contractor will appoint a cEO representing that company.</li></ul>
--	---

## **4 ENVIRONMENTAL DOCUMENTATION REPORTING AND COMPLIANCE**

To ensure accountable and demonstrated implementation of the EMPr, several reporting systems, documentation controls and compliance mechanisms must be in place as a minimum requirement.

### **4.1 Document Control/Filing System**

The holder of the EA is solely responsible for the upkeep and management of the EMPr file. This task will be assigned to the mine's EO. As a minimum, all documentation detailed below will be stored in the EMPr file. A hard copy of all documentation shall be filed, while an electronic copy may be kept where relevant. A duplicate file will be maintained in the office of the DSS (where applicable). This duplicate file must remain current and up-to-date. The filing system must be updated, and relevant documents added as required. The EMPr file must be made available at all times on request by the CA or other relevant authorities. The EMPr file will form part of any environmental audits undertaken as prescribed in the EIA Regulations.

### **4.2 Documentation to be available**

At the outset of the project, the following preliminary list of documents shall be placed in the filing system and be accessible at all times:

- A full copy of the signed EA from the CA in terms of NEMA;
- Any amendments to the EA;
- Copy of the generic and site-specific EMPr as well as any amendments thereof;
- Copy of declaration of implementing generic EMPr and subsequent approval of site-specific EMPr and amendments thereof;
- All method statements (to be compiled once detailed designs have been completed);
- Completed environmental checklists;
- Minutes and attendance register of environmental site meetings;
- An up-to-date environmental incident log;
- A copy of all instructions or directives issued;
- A copy of all corrective actions signed off. The corrective actions must be filed in such a way that a clear reference is made to the non-compliance record;
- Complaints register.

### **4.3 Weekly Environmental Checklist**

The mine's Environmental Officer (EO) is required to complete a Weekly Environmental Checklist, the format of which is to be agreed upon prior to commencement of the activity. The EO is required to sign and date the checklist, retain a copy in the EMPr file and submit a copy of the completed checklist to the DSS weekly. The checklists will form the basis for the Monthly Environmental Reports. Copies of all completed checklists will be attached as Annexures to the EAR as required in terms of the EIA Regulations.

#### 4.4 Environmental Site Meetings

Minutes of the environmental site meetings shall be kept. The minutes must include an attendance register and will be attached to the Monthly Report that is distributed to attendees. Each set of minutes must record “Matters for Attention” that will be reviewed at the next meeting.

#### 4.5 Required Method Statements

The method statements will be done in such detail that the ECOs and EOs can assess whether the contractor's proposal is in accordance with the EMPr (to be compiled once detailed designs have been completed). The method statements must be reviewed and signed off by the ECO or EO prior to the commencement of activities.

The method statement must include the following:

- Development procedures;
- Materials and equipment to be used;
- Transporting the equipment to and from the site;
- How the equipment/ material will be moved within the site;
- How and where the material will be stored;
- The containment (or action to be taken if containment is not possible) of leaks or spills of any liquid or material that may occur;
- Timing and location of activities;
- Compliance/ non-compliance with the EMPr; and
- Any other information deemed necessary by the ECO.

Unless indicated otherwise by the PM, the Contractor shall provide the following method statements to the PM no less than 14 days prior to the commencement date of the activity:

- Site establishment - Camps, Lay-down or storage areas, satellite camps, infrastructure;
- Batch plants;
- Workshop or plant servicing;
- Handling, transport and storage of Hazardous Chemical Substances;
- Vegetation management - Protected, clearing, aliens, felling;
- Access management - Roads, gates, crossings etc.;
- Fire plan;
- Traffic Management Plan;
- Waste management -transport, storage, segregation, classification, disposal (all waste streams);
- Social interaction - complaints management, compensation claims, access to properties etc.;

- Water - use (source, abstraction and disposal), access and all related information, crossings and mitigation;
- Emergency preparedness - Spills, training, other environmental emergencies;
- Dust and noise management methodologies;
- Fauna interaction and risk management - only if the risk was identified - wildlife interaction especially on game farms; and
- Heritage and palaeontology management.

The EO and ECO shall monitor and ensure that the contractors perform in accordance with these method statements. Completed and agreed method statements between the holder of the EA and the contractor must be included in the environmental file. A generic format of a method statement is supplied as Appendix B.

#### 4.6 Environmental Incident Log (Diary)

The EO is required to maintain an up-to-date and current Environmental Incident Log (environmental diary). The Environmental Incident Log is a means to record all environmental incidents and/or all non-compliance notices. An environmental incident is defined as:

- Section 30 (1) (a) of NEMA defines an incident as: *“an unexpected, sudden and uncontrolled release of a hazardous substance, including from a major emission, fire or explosion, that has caused or may cause significant harm to the environment, human life or property”*. The actual and potential pollution that the incident may cause includes, as per the definition of ‘pollution’ in NEMA, any change to the environment caused by substances, radioactive or other waves, noise, odours, dust and heat;
- Any deviation from the listed impact management actions (listed in this EMPr) that may be addressed immediately by personnel. (For example, littering or a drip tray that has not been emptied);
- Any environmental impact resulting from an action or activity by a contractor or mine personnel in contravention of the environmental stipulations and guidelines listed in the EMPr which, as a single event, would have a minor impact but which if cumulative and continuous would have a significant effect; and
- General environmental information such as road kills or injured wildlife.

The EOs must record all environmental incidents in the Environmental Incident Log. All incidents regardless of severity must be reported to the EPCM. The Log is to be kept in the EMPr file and at a minimum, the following will be recorded for each environmental incident:

- The date and time of the incident;
- Description of the incident;
- The name of the Contractor responsible;

- The incident must be classified on a scale from minor to significant;
- If the incident is listed as significant, a non-compliance notice must be issued, and recorded in the log;
- Remedial or corrective action taken to mitigate the incident; and
- Record of repeat minor offences by the same contractor or staff member.

The monthly summary of the Environmental Incident Log will be captured in the EAR.

For incidents defined under Section 30 (1) of NEMA, the incident must be immediately reported to the mine EO to follow the NEMA and NWA requirements in respect of reporting the incident to the relevant authorities.

#### **4.7 Non-compliance**

A non-compliance notice will be issued to the responsible contractor by the ECO via the DSS or PM. The non-compliance notices will be issued in writing; a copy filed in the EMPr file and will at a minimum include the following:

- Time and date of the non-compliance;
- Name of the contractor responsible;
- Nature and description of the non-compliance;
- Recommended/required corrective action; and
- Date by which the corrective action is to be completed.

The contractors shall act immediately when a notice of non-compliance is received and correct whatever is the cause for the issuing of the notice. Complaints received regarding activities on the development site pertaining to the environment shall be recorded in a dedicated register and the response noted with the date and action taken. The ECO should be made aware of any complaints. Any non-compliance with the agreed procedures of the EMPr is a transgression of the various statutes and laws that define how the environment is managed. Failure to redress the cause shall be reported to the relevant CA for them to deal with the transgression, as it deems fit. The contractor is deemed not to have complied with the EMPr if, inter alia, there is a deviation from the environmental conditions, impact management outcomes, and impact management actions activities, as approved in generic and site-specific EMPr as relevant as set out in the EMPr, which deviation has, or may cause an environmental impact.

#### **4.8 Corrective Action Records**

For each non-compliance notice issued, a documented corrective action must be recorded. On receiving a non-compliance notice from the DSS, the contractor's cEO (or other appointed responsible party) will ensure that the corrective actions required take place within the stipulated



timeframe. On completion of the corrective action, the cEO is to issue a Corrective Action Report in writing to the ECO. If satisfied that the corrective action has been completed, the ECO is to sign off on the Corrective Action Report and attach the report to the non-compliance notice in the EMPr file.

Corrective action is considered complete once the report has been signed off by the ECO.

#### **4.9 Photographic Record**

A digital photographic record will be kept. The photographic record will be used to show before, during, and post-rehabilitation evidence of the project as well as used in cases of damages claims if they arise. Each image must be dated, and a brief description note attached. The Contractor shall:

- Allow the ECO and EOs access to take photographs of all areas, activities, and actions.
- The EOs shall keep an electronic database of photographic records which will include:
  - Photographs of all areas designated as work areas, camp areas, development sites, and storage areas taken before these areas are set up;
  - All bunding and fencing;
  - Road conditions and road verges;
  - Condition of all fences;
  - Topsoil storage areas;
  - All areas to be cordoned off during construction;
  - Waste management sites;
  - Ablution facilities (inside and out);
  - Any non-conformances deemed to be “significant”;
  - All completed corrective actions for non-compliance;
  - All required signage;
  - Photographic recordings of incidents and corrective actions;
  - All areas before, during, and post-rehabilitation; and
  - Include relevant photographs in the Final Environmental Audit Report.

#### **4.10 Complaints Register**

The ECOs shall keep a current and up-to-date complaints register. The complaints register is to be a record of all complaints received from communities, stakeholders, and individuals. The Complaints Record shall:

- Record the name and contact details of the complainant;
- Record the time and date of the complaint;
- Contain a detailed description of the complaint;

- Where relevant and appropriate, contain photographic evidence of the complaint or damage (ECOs to take relevant photographs); and
- Contain a copy of the ECOs written response to each complaint received and keep a record of any further correspondence with the complainant. The ECO's written response will include a description of any corrective action to be taken and must be signed by the Contractor, ECO, and affected party. Where a damage claim is issued by the complainant, the ECOs shall respond as described below.

#### **4.11 Claims for Damages**

If a Claim for Damages is submitted by a community, landowner, or individual, the EOs shall:

- Record the full details of the complaint as described above;
- The PM will evaluate the claim and associated damage and submit the evaluation to the Senior Site Representative for approval;
- Following consideration by the PM, the claim is to be resolved and settled immediately, or the reason for not accepting the claim is communicated in writing to the claimant. Should the claimant not accept this, the ECO shall, in writing report the incident to the Developer's negotiator and legal department; and
- A formal record of the response by the EOs to the claimant as well as the rectification of the method of making payments, not the amount will be recorded in the EMPr file.

#### **4.12 Interactions with I&APs**

Open, transparent, and good relations with affected landowners, communities, and regional staff are an essential aspect of the successful management and mitigation of environmental impacts.

The EO shall:

- Ensure that all queries, complaints, and claims are dealt with within an agreed timeframe;
- Ensure that any or all agreements are documented, and signed by all parties and that a record of the agreement is kept in the EMPr file;
- Ensure that complaints telephone numbers are made available to all landowners and affected parties; and
- Ensure that contact with affected parties is courteous at all times.

#### **4.13 Environmental Audits**

Internal environmental audits of the activity and implementation of the EMPr must be undertaken. The findings and outcomes are included in the EMPr file and submitted to the CA at intervals as indicated in the EA.

The ECO must prepare a monthly EAR. The report will be tabled as the key point on the agenda of the Environmental Site Meeting. The Report is submitted for acceptance at the meeting and the final report will be circulated to the PM and filed in the EMPr file. At a frequency determined by the EA, the ECOs shall submit the monthly reports to the CA. At a minimum, the monthly report is to cover the following:

- Weekly Environmental Checklists;
- Deviations and non-compliances with the checklists;
- Non-compliances issued;
- Completed and reported corrective actions;
- Environmental Monitoring;
- General environmental findings and actions; and
- Minutes of the Environmental Site Meetings.

#### **4.14 Final Environmental Audits**

On completion of the rehabilitation and/or requirements of the EA, a final EAR is to be prepared and submitted to the CA. The EAR must comply with Appendix 7 of the EIA Regulations.

#### **4.15 Environmental Awareness Plan**

The Contractor, sub-contractors, and all personnel involved in all project phases require an appropriate level of environmental awareness and competence to ensure continued compliance with environmental legislation, conditions of the EA, and the provisions in the EMPr. Training needs should be identified based on the available and existing capacity of all site personnel to undertake the required management actions and monitoring activities. All personnel must be adequately trained to perform their designated tasks to an acceptable standard. Environmental awareness methods should include inter alia:

- Induction: All contractor personnel should be provided with the mine's environmental and safety induction before being allowed to work at the site;
- Contractor's Pack" Each contractor must be provided with copies of the EMPr, EA, and Water Use Licence to ensure that they are cognisant of all environmental commitments and conditions;
- Monthly talk topics: Monthly environmental talk topics should be distributed by email and posted on notice boards around the site;
- Toolbox talks: Daily toolbox talks held by contractors must include a minimum of one environmental topic per week. Signed registers must be filed as evidence and should be audited by the ECO;

- On-the-job training: This must be undertaken by each contractor and should include the correct use of spillkits and fire-fighting equipment; and
- External training: All personnel who handle hazardous material should have the requisite certification.

Training will be offered in the main languages spoken in the area.

## 5 PROPOSED IMPACT MANAGEMENT ACTIONS

This section outlines aspects related to the development of the proposed WWTP, CDF, and associated infrastructure, and for each aspect, a set of prescribed impact management outcomes and associated impact management actions have been identified. Holders of EAs are responsible for ensuring the implementation of these outcomes and actions for all projects as a minimum requirement, to mitigate the impact of such aspects.

This must be signed and dated on each page by both the contractor and the holder of the EA prior to the commencement of the activity. The method statements are prepared and agreed to by the holder of the EA (to be compiled once detailed designs have been completed - a generic format is supplied as Appendix B). Each method statement must also be duly signed and dated on each page by the contractor and the holder of the EA. This template, once signed and dated, is legally binding. The holder of the EA will remain responsible for its implementation.

Appendix 4 of the 2014 NEMA EIA Regulations requires that the EMPr aim to achieve the following through the proposed impact management actions:

- Avoid, modify, remedy, control, or stop any action, activity, or process that causes pollution or environmental degradation;
- Comply with any prescribed environmental management standards or practices;
- Comply with any applicable provisions of the Act regarding the closure, where applicable; and
- Comply with any provisions of the Act regarding financial provision for rehabilitation, where applicable.



ASPECT: ENVIRONMENTAL TRAINING - PRE-CONSTRUCTION PLANNING, CONSTRUCTION AND DECOMMISSIONING PHASE						
Impact management outcome	Impacts on the environment and sensitive receptors are minimised by influencing the behaviour of personnel					
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
<ul style="list-style-type: none"> <li>- All personnel must undergo environmental and safety induction prior to the commencement of the activities.</li> <li>- Voluntary refresher environmental awareness training is available as and when required.</li> <li>- Compulsory refresher induction training to be provided on the anniversary of the training attended by the staff member.</li> <li>- All personnel handling hazardous materials or using specialised materials to provide proof of external training or certification where necessary.</li> </ul>	PM Contractor Human Resources Department (HRD)	<p>Induction schedule induction for all contractor personnel</p> <p>Request and retain records of all external training and/or certification</p>	<p>Prior to the start of construction activities and prior to any new staff entering the site.</p> <p>Thereafter on the anniversary of the first induction training.</p>	PM EO	<p>Prior to the start of construction activities and prior to any new staff entering the site.</p> <p>Thereafter on the anniversary of the first induction training.</p>	<p>Induction record signed off by the Training Officer and HRD Manager.</p> <p>Records of all external training and/or certification kept in the personnel files.</p>
<ul style="list-style-type: none"> <li>- The Contractor must erect and maintain information boards and post environmental and safety talk topics on a monthly basis. This should include snake awareness, the prohibition of littering, and fires, management of spills, etc.</li> <li>- On-the-job training to be provided in respect of the management of fires and spills.</li> <li>- Toolbox talks must be undertaken regularly, with at least one environmental toolbox talk being undertaken per week.</li> <li>- On-the-job training to be provided in respect of the management of fires and spills.</li> <li>- Toolbox talks must be undertaken regularly, with at least one environmental toolbox talk being undertaken per week.</li> <li>- Environmental awareness (toolbox talks and talk topics) must include as a minimum the following:</li> </ul>	EO cEO DSS	<p>Provide all contractors with a Contractor's Pack which includes copies of the EA, EMP, and WUL. Contractors must sign a declaration of understanding.</p> <p>Create a schedule of talk topics and toolbox talks.</p>	Prior to the start of construction activities	EO	Once a month	<p>Toolbox talk and Training registers.</p> <p>Information posters</p> <p>Training materials</p> <p>Photographic record of notice boards.</p>

ASPECT: ENVIRONMENTAL TRAINING - PRE-CONSTRUCTION PLANNING, CONSTRUCTION AND DECOMMISSIONING PHASE						
Impact management outcome	Impacts on the environment and sensitive receptors are minimised by influencing the behaviour of personnel					
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
<ul style="list-style-type: none"> <li>a) Description of significant environmental impacts, actual or potential, related to their work activities.</li> <li>b) Mitigation measures to be implemented when carrying out specific activities.</li> <li>c) Emergency preparedness and response procedures.</li> <li>d) Procedures to be followed when working near or within sensitive areas.</li> <li>e) Wastewater management procedures.</li> <li>f) Water usage and conservation.</li> <li>g) Solid waste management procedures;</li> <li>h) Sanitation procedures.</li> <li>i) Fire prevention and the prohibition of starting fires at the site.</li> <li>j) Disease prevention.</li> <li>k) Prevention and containment of spills, leaks, and other impacts to watercourses.</li> <li>- A record of all environmental awareness training courses undertaken as part of the EMPr must be available.</li> <li>- Educate workers on the dangers of open and/or unattended fires.</li> <li>- A staff attendance register of all staff to have received environmental awareness training must be available.</li> <li>- Course material must be available and presented in appropriate languages that all staff can understand.</li> </ul>		Create a schedule of training sessions.				

ASPECT: SITE ESTABLISHMENT - PRE-CONSTRUCTION AND PLANNING PHASE						
Impact management outcome	Impacts on the environment are minimised during site establishment and the development footprint is kept to the demarcated development area.					
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
<ul style="list-style-type: none"> <li>- Notify CA prior to the start of construction as per the timeframe stipulated in the EA.</li> <li>- Establish and monitor additional required monitoring points to establish the baseline conditions before construction commences.</li> <li>- Schedule the bulk of the initial construction (vegetation clearing, topsoil removal, and earthworks during the dry season where possible to reduce the risk of erosion and sedimentation.</li> <li>- EPCM to develop a detailed construction schedule.</li> <li>- Contractors must provide detailed method statements, which must be approved and signed off by the PM, EO, and any other representative of the authorisation holder before construction commences.</li> <li>- Method statements must include a layout plan showing the location of roads to be used, the location of the contractor's laydown, storage areas, parking areas, ablution facilities, and construction areas, to name a few.</li> <li>- The EPCM must provide an initial Traffic Management Plan for the construction site, which must be updated as required.</li> <li>- A suitably qualified specialist must develop an Alien Plant Management Plan which must: <ul style="list-style-type: none"> <li>• Identify alien species which are likely to be found at the site, including photographs.</li> </ul> </li> </ul>	PM EO cEO	<p>Submit construction notification to CA</p> <p>EO to approve method statements (to be compiled once detailed designs have been completed)</p> <p>Approved method statements to be included in the updated EMPr (refer to generic format under Appendix B)</p> <p>EO to provide feedback to PM regarding construction schedule, proposed routes and Traffic</p>	Prior to the start of construction activities	EO PM	Prior to construction	<p>Proof of submission of construction notification letter</p> <p>Monitoring reports</p> <p>Approved method statements included in updated EMPr</p> <p>Electronic files of date photographs taken at all sites prior to site establishment.</p> <p>Copies of the Waste Management Plan and Alien Invasive Management Plan in Contractor's Files.</p> <p>Follow up Terrestrial Biodiversity report with recommendations</p>

ASPECT: SITE ESTABLISHMENT - PRE-CONSTRUCTION AND PLANNING PHASE						
Impact management outcome	Impacts on the environment are minimised during site establishment and the development footprint is kept to the demarcated development area.					
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
<ul style="list-style-type: none"> <li>Identify areas for action (if applicable).</li> <li>Prescribe the necessary removal methods and frequencies to be applied;</li> <li>Prescribe a monitoring plan and be updated as/when new data is collated.</li> </ul> <ul style="list-style-type: none"> <li>A stormwater management plan must be developed by a qualified engineer.</li> <li>Develop a waste management plan prior to the commencement of construction. The plan must designate collection areas, define the separation of waste, prescribe removal measures and frequencies from the areas, and prescribe a monitoring plan.</li> <li>Develop a Chance Finds Protocol for the protection of Archaeological and Heritage resources.</li> <li>The EO must inspect and approve the location of the contractor's camp/laydown areas, storage areas and proposed stockpiling areas prior to establishment.</li> <li>Sites must be located within the specified development footprint and on previously disturbed areas where possible.</li> <li>The contractors camp/laydown and stockpiling areas must be located away from sensitive areas.</li> <li>Any new/temporary roads must be approved by the EO prior to establishment.</li> <li>Identification of access restricted areas is to be informed by the environmental assessment, site walkthrough, and any</li> </ul>		<p>Management Plan.</p> <p>EO to take dated photographs of all sites prior to site establishment.</p> <p>EO to approve Alien Plant Management Plan and Waste Management Plan</p> <p>Follow up Terrestrial Biodiversity Assessment to be undertaken to identify potential conservation important species.</p>				Stormwater Management Plan report and design drawings

ASPECT: SITE ESTABLISHMENT - PRE-CONSTRUCTION AND PLANNING PHASE						
<b>Impact management outcome</b>	Impacts on the environment are minimised during site establishment and the development footprint is kept to the demarcated development area.					
<b>Impact Management Actions</b>	<b>Implementation</b>			<b>Monitoring</b>		
	<b>Responsible Person</b>	<b>Method of Implementation</b>	<b>Timeframe for Implementation</b>	<b>Responsible Person</b>	<b>Frequency</b>	<b>Evidence of Compliance</b>
additional areas identified during development.						



ASPECT: SITE DISTURBANCE: VEGETATION CLEARING, EARTHWORKS AND DEMOLITION- CONSTRUCTION AND DECOMMISSIONING PHASES						
Impact management outcome	Footprint and extent of disturbance is minimised, impacts on flora, fauna and the nearby water resources is minimised					
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
<ul style="list-style-type: none"> <li>- Retain as much indigenous vegetation as possible.</li> <li>- Limit the area disturbed by clearly demarcating all footprint areas prior to vegetation clearing and prohibiting any clearing outside of designated/approved areas.</li> <li>- A 40m buffer zone must be established around the aquatic systems and demarcated as 'no-go' zones.</li> <li>- The EO must ensure that all activities take place within the approved boundaries and must issue non-conformance notices to any contractors that do not comply.</li> <li>- The EO must undertake an inspection and sign a clearing/excavation permit before any clearing may take place.</li> <li>- Contractors that begin clearing without a permit will be issued a non-compliance notice.</li> <li>- Prior to vegetation clearing activities, the area to be cleared should be walked on foot by 1-2 individuals to create a disturbance in order for fauna to move off.</li> </ul>	PM EO Contractor	<p>Implement quality control system for contractors. All contractors must obtain and file document such as excavation permits.</p> <p>Implement detailed construction schedule</p> <p>Construction layout drawings to include "no-go" areas</p> <p>Regular (Weekly or bi-monthly) project meetings for PM, contractors and EO</p> <p>Regular inspections by the EO and feedback in the form of Non-compliance notices and monthly reports</p>	Ongoing during construction and decommissioning phases	Ongoing during construction and decommissioning phases	EO	<p>Contractor's Files include all required signed document</p> <p>Up-to-date construction schedule</p> <p>Construction project meeting minutes</p> <p>EO records of non-compliances and monthly reports including environmental incident log and photographic evidence.</p>

ASPECT: SITE DISTURBANCE: VEGETATION CLEARING, EARTHWORKS AND DEMOLITION- CONSTRUCTION AND DECOMMISSIONING PHASES						
Impact management outcome	Footprint and extent of disturbance is minimised, impacts on flora, fauna and the nearby water resources is minimised					
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
<ul style="list-style-type: none"> <li>- Any holes/deep excavations must be done in a progressive manner on a needs basis only. No holes/excavations may be left open overnight. In the event holes/excavations are required to remain open overnight, these areas must be covered to prevent fauna falling into these areas.</li> <li>- The timing between clearing of an area and subsequent development must be minimized to avoid fauna from re-entering the site to be disturbed and to reduce the amount of time over which surfaces are exposed. Sites should be disturbed only prior to the area having to be cleared, not more than 1 day in advance.</li> <li>- Any new roads must be identified and approved by the EO prior to establishment. These must be kept to the minimum width.</li> <li>- Road crossings over watercourses in areas where no existing crossing is apparent should be unnecessary, but if it is essential crossings should be made at right angles and must be authorised by a Water Use Licence.</li> </ul>		Avail personnel to implement Alien Plant Management Plan				

ASPECT: SITE DISTURBANCE: VEGETATION CLEARING, EARTHWORKS AND DEMOLITION- CONSTRUCTION AND DECOMMISSIONING PHASES						
Impact management outcome	Footprint and extent of disturbance is minimised, impacts on flora, fauna and the nearby water resources is minimised					
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
<ul style="list-style-type: none"> <li>- Erosion control measures must be implemented prior to the commencement of vegetation clearing.</li> <li>- Sediment controls such as sandbags and temporary berms must be implemented prior to vegetation clearing to manage stormwater runoff (if storms do occur).</li> <li>- Implement the Alien Plant Management Plan from the onset of construction. The plan must be updated as/when new data is collated.</li> </ul>						

ASPECT: POST-CONSTRUCTION AND ONGOING REHABILITATION: CONSTRUCTION AND OPERATIONAL PHASEs						
Impact management outcome	Footprint and extent of disturbance is minimised, impacts on flora, fauna and the nearby water resources is minimised					
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
<ul style="list-style-type: none"> <li>- It should be made an offence for any staff to /take bring any plant species into/out of any portion of the project area. No plant species whether indigenous or exotic should be brought into/taken from the project area, to prevent the spread of exotic or invasive species or the illegal collection of plants.</li> <li>- A Rehabilitation Strategy and Implementation Plan (RSIP) must be compiled and implemented. This must include timing for the rehabilitation activities to improve the chances of successful vegetation establishment.</li> <li>- Rehabilitation of the area must be initiated from the onset of the project.</li> <li>- All disturbed areas must be rehabilitated as soon as possible.</li> <li>- Exposed and compacted areas must be ripped and vegetated with indigenous species to increase surface roughness.</li> <li>- Compacted areas must be ripped (perpendicularly) to a depth of 300 mm.</li> <li>- Stockpiled topsoil should be used for rehabilitation efforts.</li> </ul>	PM Contractor EO	<p>Induction and ongoing environmental awareness.</p> <p>Specialist to compile RSIP</p> <p>A site close-out inspection must be undertaken by the PM and EO once construction at an area has been finalised.</p> <p>Avail personnel to undertake alien plant removal.</p> <p>Inspections by EO</p>	Ongoing (Construction and operational phases).	EO	Ongoing (Construction and operational phases).	<p>Induction records and signed toolbox talk registers</p> <p>RSIP (approved by the DWS)</p> <p>Close-out form signed by EO and PM</p> <p>Monthly EO EAR</p> <p>Final EAR</p> <p>Monthly EO inspection reports.</p>

ASPECT: POST-CONSTRUCTION AND ONGOING REHABILITATION: CONSTRUCTION AND OPERATIONAL PHASEs						
<b>Impact management outcome</b>	Footprint and extent of disturbance is minimised, impacts on flora, fauna and the nearby water resources is minimised					
<b>Impact Management Actions</b>	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
<ul style="list-style-type: none"> <li>- Where hydroseeding is required, the contractor must provide the detailed seed mix list for approval by the EO. Only plants indigenous to the site may be used.</li> <li>- All rehabilitated areas must be regularly monitored to determine the success of vegetation establishment and the presence of invasive plants. This can be recorded through monthly dated photographs.</li> <li>- Implement Alien Plant Management Plan.</li> <li>- Progressive rehabilitation will enable topsoil to be returned more rapidly, thus ensuring more recruitment from the existing seedbank. Surplus rehabilitation material can be applied to other areas in need of stabilisation and vegetation cover.</li> <li>- Any gullies or dongas must also be backfilled, shaped, and rehabilitated.</li> </ul>						



ASPECT: TOPSOIL STRIPPING, HANDLING, AND STOCKPILING: CONSTRUCTION, OPERATIONAL, AND DECOMMISSIONING PHASES						
Impact management outcome	Soil quality, quantity, and integrity is preserved.					
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
<ul style="list-style-type: none"> <li>- Soil stripping should be suspended during and following periods of significant rainfall.</li> <li>- The topsoil (first 200mm to 500mm layer) should be stripped first with overlying vegetation and stockpiled separate to the subsoils.</li> <li>- Disturbed soil must be stored in the same sequence it was excavated to maintain the natural soil profile. Once construction activities have been completed, the soil must be returned to the excavation, where necessary.</li> <li>- Soil stockpiles should be properly demarcated and indicated on maps and layouts</li> <li>- Exposed and stockpiled soils are to be stabilised using a suitable covering (rock cladding or vegetative) to protect against erosion and contamination.</li> <li>- Stockpiles must not exceed 5m in height and should not be established within 32m from any aquatic system.</li> <li>- Berms should be placed around soil stockpiles to secure them.</li> <li>- Cover excavated soils with a temporary liner to prevent contamination.</li> </ul>	PM Contractor EO Survey Department	<p>Soil management measures must be incorporated into the approved Method Statements</p> <p>Soil stockpile locations to be approved by EO prior to construction</p> <p>Surveyor for Kangra to include long term soil stockpile on the mine plan.</p> <p>EO to undertake audits of soil management and conservation practices.</p> <p>EO to continue soil audits of</p>	Ongoing (all phases)	EO	Ongoing (all phases)	<p>Approved Method Statements</p> <p>Approved layouts and excavation permits</p> <p>Updated mine layout plan</p> <p>Monthly EO EAR</p> <p>Final EAR</p> <p>Monthly EO inspection reports.</p>

ASPECT: TOPSOIL STRIPPING, HANDLING, AND STOCKPILING: CONSTRUCTION, OPERATIONAL, AND DECOMMISSIONING PHASES						
Impact management outcome	Soil quality, quantity, and integrity is preserved.					
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
<ul style="list-style-type: none"> <li>- Backfill the material in the same order it was excavated to reduce contamination of deeper soils with shallow oxidised soils.</li> <li>- Have emergency fuel and oil spill kits on site.</li> <li>- Soil quality visual assessments must be undertaken monthly. If obvious pollution is noted (visually) then it is advised that soil screening be undertaken.</li> <li>- Placing a suitable geotextile in areas near or on-top of watercourses/wetlands, before placement of the soils, may help maintain some sub-surface soil processes.</li> <li>- Compact and revegetate infilled areas to prevent erosion.</li> <li>- Soil management plans should be in place which will include the use of correct stockpiling methods.</li> </ul>		stockpiles and soil conditions after construction.				

ASPECT: USE OF PLANT, EQUIPMENT AND VEHICLES AND MOVEMENT OF PERSONNEL: CONSTRUCTION AND DECOMMISSIONING PHASES						
Impact management outcome	Impacts on the surrounding environment are reduced.					
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
<ul style="list-style-type: none"> <li>- Fire management plan must be in place for the project area and surrounding areas.</li> <li>- Minimise construction duration by implementing the construction schedule.</li> <li>- Limit all activities to standard hours/daytime as far as possible.</li> <li>- Erect signs to warn all personnel to avoid sensitive/"no-go" areas.</li> <li>- Specifically demarcate working areas to discourage movement of personnel into the surrounding environments.</li> <li>- Erect speed limit signs on all roads in accordance with the MQE speed limits.</li> <li>- Restrict vehicle movement to designated construction areas.</li> <li>- Wet suppression on exposed surfaces, unpaved roads, and materials handling areas-where feasible.</li> <li>- Continue dust fallout monitoring.</li> <li>- Prohibit fires, the burning of waste materials or any debris.</li> <li>- Service and maintain of vehicles, plant and machinery in accordance with a maintenance schedule.</li> <li>- Use high efficiency generators.</li> </ul>	PM EO Contractor	<p>Implement quality control system for contractors. All contractors must obtain and file document such as excavation permits.</p> <p>Implement detailed construction schedule</p> <p>Construction layout drawings to include "no-go" areas</p> <p>Regular (Weekly or bi-monthly) project meetings for PM, contractors and EO</p>	Ongoing during construction and decommissioning phases	Ongoing during construction and decommissioning phases	EO	<p>Contractor's Files</p> <p>Up-to-date construction schedule</p> <p>Construction project meeting minutes</p> <p>EO records of non-compliances and monthly reports including environmental incident log and photographic evidence.</p>

ASPECT: USE OF PLANT, EQUIPMENT AND VEHICLES AND MOVEMENT OF PERSONNEL: CONSTRUCTION AND DECOMMISSIONING PHASES						
Impact management outcome	Impacts on the surrounding environment are reduced.					
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
<ul style="list-style-type: none"> <li>- Use of low carbon and sulphur fuels.</li> <li>- Equipment that is used intermittently must be switched off when not in use.</li> <li>- Poaching must be prohibited, and offenders must be fined.</li> <li>- This prohibition of poaching must be communicated via erecting of signs, an anti-poaching policy, and environmental awareness as described in this EMPr.</li> <li>- Ensure that unwanted construction material is stored in the correct manner and out of sight of surrounding receptors.</li> </ul>		<p>Regular inspections by the EO and feedback in the form of Non-compliance notices and monthly reports</p> <p>Avail personnel to implement Alien Plant Management Plan</p>				
<ul style="list-style-type: none"> <li>- Provide designated areas for parking of vehicles and storage of equipment and erect signs to indicate these areas.</li> <li>- Park heavy machinery on lined areas and place drip trays under vehicles at the site.</li> <li>- Routine visual inspections of infrastructure and parking areas for signs of soil contamination.</li> <li>- Provide spillkits and implement Spill Management Procedure.</li> <li>- Spills must be reported to the EO.</li> </ul>	PM Contractor EO	<p>Ensure that are sufficient spillkits at the site at all times</p> <p>EO to undertake daily/weekly inspections and issue non-compliance notices</p>	Ongoing during Construction and Decommissioning Phases.	EO	Ongoing during Construction and Decommissioning Phases	<p>EO records of non-compliances, monthly EAR and photographic evidence.</p> <p>Toolbox talk registers</p>

ASPECT: USE OF PLANT, EQUIPMENT AND VEHICLES AND MOVEMENT OF PERSONNEL: CONSTRUCTION AND DECOMMISSIONING PHASES						
Impact management outcome	Impacts on the surrounding environment are reduced.					
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
<ul style="list-style-type: none"> <li>- Hydrocarbon contaminated soil must be removed and disposed of as hazardous waste.</li> <li>- Undertake regular visual inspections for soil contamination.</li> <li>- Cleaning of vehicles, machines and equipment must only take place at designated areas (e.g. washbay) and must be strictly prohibited at the construction site.</li> <li>- No servicing of machines, vehicles and equipment at the construction areas. All servicing must take place at designated workshop areas.</li> <li>- Continued groundwater monitoring to detect potential impacts.</li> <li>- All plant and equipment that make use of petrochemical substances must be checked leakages on a daily basis before activities commence.</li> <li>- All plant and equipment that are found to be leaking must be removed to a designated workshop and only returned once the leakages have been addressed.</li> </ul>		Provide refresher toolbox talks				



ASPECT: PROTECTION OF ANIMALS: CONSTRUCTION, OPERATIONAL AND DECOMMISSIONING PHASE						
Impact management outcome	Impacts on wetland fauna re reduced.					
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
<ul style="list-style-type: none"> <li>- Lighting should face away from the wetlands.</li> <li>- Workers should be discouraged from walking on the bed and banks of the wetlands.</li> <li>- Lighting should be kept to a minimum to avoid disturbing crepuscular and nocturnal species. Lighting fixtures should be fitted with baffles, hoods or louvres and directed downward, to minimize light pollution which could attract night migrating species.</li> <li>- Lighting should be directed towards to footprint area and avoid unnecessary illumination of the adjacent undeveloped areas.</li> <li>- Where feasible, motion detection lighting must be used to minimise the unnecessary illumination of areas.</li> <li>- Avoid using any road during the night.</li> <li>- As far as reasonably practicable avoid using full beam headlights to minimise light pollution to as it may distract animals and increase the chances of road kill."</li> </ul>	PM Contractor EO	<p>Lighting and fences to be installed after approval by EO.</p> <p>Signage for sensitive areas to be erected.</p> <p>EO to undertaken regular inspections</p>	Prior to construction, then ongoing (all phases)	EO	Ongoing phases) (all	EO monthly EAR with photographic evidence.

ASPECT: PROTECTION OF ANIMALS: CONSTRUCTION, OPERATIONAL AND DECOMMISSIONING PHASE						
Impact management outcome	Impacts on wetland fauna re reduced.					
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
- Fences must have 30 x 30 cm holes in at the bottom at every 250m to allow for free movement of fauna.						

ASPECT: HANDLING AND STORAGE OF HAZARDOUS SUBSTANCES- CONSTRUCTION PHASE						
Impact management outcome	Contamination of soils and water resources, and the generation of hazardous waste is minimised.					
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
<ul style="list-style-type: none"> <li>- All hazardous substances to be stored separately in appropriately bunded and demarcated facilities well outside of the 40m buffer of any wetland features.</li> <li>- Bunded areas to be suitably lined with a South African Bureau of Standards (SABS) approved liner.</li> <li>- The bund capacity must be 110% of the storage volume. For diesel storage, a capacity of 130% of the total capacity of all the storage tanks/bowsers (110% statutory requirement plus an allowance for rainfall) is recommended.</li> <li>- Bunds must be built with a camber towards a sump or outlet to drain liquids.</li> <li>- Bund capacities must be displayed at the storage areas.</li> <li>- No smoking signs must be displayed at the hazardous storage areas.</li> <li>- The SDS for each substance stored must be kept at the storage areas.</li> <li>- All hazardous substances must be stored in the appropriate containers, tanks, bowsers , etc. in accordance with the SDS.</li> <li>- No SDS may be older than 5 years as per the 2021 Regulations for Hazardous Chemical Agents published the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993) (OHSA).</li> </ul>	PM Contractor EO	<p>EO to approve layout of contractor's laydown areas prior to construction.</p> <p>Compile ERAP prior to the commencement of construction</p> <p>Compile HCS control sheet</p> <p>Audit the availability and applicability of SDS</p> <p>Demarcation of sensitive habitats prior to construction</p> <p>Safe disposal certificates</p>	All phases (ongoing)	EO cEO	All phases (ongoing)	<p>Complaints register</p> <p>Training register</p> <p>ERAP</p> <p>HCS control sheet and updates</p> <p>SDS</p> <p>Spill kits available on site</p> <p>Environmental incident register</p> <p>Monthly EAR/EO monthly reports with photographic evidence.</p>

ASPECT: HANDLING AND STORAGE OF HAZARDOUS SUBSTANCES- CONSTRUCTION PHASE						
Impact management outcome	Contamination of soils and water resources, and the generation of hazardous waste is minimised.					
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
<ul style="list-style-type: none"> <li>- An Alphabetical Hazardous Chemical Substance (HCS) control sheet must be drawn up and kept up to date continuously.</li> <li>- A serviced fire extinguisher must be kept at the storage area.</li> <li>- Refuelling must take place at designated areas within the catchment on hard standing or lined area. Where refuelling is required away from the designated areas, a drip tray must be used.</li> <li>- Provide emergency spill kits on site and implement Spill Management Procedure. The spillkits must have sufficient absorbent material based on the volume of substances stored.</li> <li>- Remove hydrocarbon contaminated soil and disposed of as contaminated waste.</li> <li>- All used oils must be stored in a designated surfaced and bunded area for removal. The used oil contractor must supply a safe disposal certificate.</li> <li>- Continued surface water and groundwater quality monitoring</li> <li>- Undertake routine visual assessment for soil contamination.</li> <li>- All employees handling hazardous substances must be appropriately trained to do so, i.e. the employees must be aware of the risks involved and must be trained to use firefighting equipment and a spillkit.</li> </ul>		<p>Record spills/ discharges and environmental incidents</p> <p>Report spills to the EO immediately.</p> <p>Provide sufficient spill kits, dip trays and liners.</p> <p>Provide required signage.</p> <p>Regular inspections by EO</p>				

ASPECT: HANDLING AND STORAGE OF HAZARDOUS SUBSTANCES- CONSTRUCTION PHASE						
<b>Impact management outcome</b>	Contamination of soils and water resources, and the generation of hazardous waste is minimised.					
<b>Impact Management Actions</b>	<b>Implementation</b>			<b>Monitoring</b>		
	<b>Responsible Person</b>	<b>Method of Implementation</b>	<b>Timeframe for Implementation</b>	<b>Responsible Person</b>	<b>Frequency</b>	<b>Evidence of Compliance</b>
- All personnel must be provided with the appropriate Personal Protective Equipment (PPE).						



ASPECT: STORMWATER, GROUNDWATER AND WASTEWATER MANAGEMENT - PRE-CONSTRUCTION, CONSTRUCTION, OPERATIONAL AND DECOMMISSIONING PHASES						
Impact management outcome	Impacts on the environment caused by stormwater and wastewater discharges.					
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
<ul style="list-style-type: none"> <li>- Discharge dewatered / rainwater collected into the nearby stream over vegetated areas and not directly into the watercourse. If water is contaminated, discharge to the closest greywater system (depending on the extent of contamination).</li> <li>- No stormwater discharge will be allowed to be made directly in any wetland feature from the construction footprint.</li> <li>- Sediment control structures such as sandbags and temporary berms should be implemented during construction, to manage stormwater runoff (if storms do occur).</li> <li>- Clean and dirty water separation structures must be constructed in accordance with the approved stormwater management plan designed by a qualified engineer.</li> <li>- Ensure that clean stormwater is attenuated back to the natural environment, directly downstream of the development. The release of stormwater will offset the rainfall infiltration reduction impacts on soil</li> </ul>	PM Contractor EO	<p>Regular inspections by EO.</p> <p>Maintenance/cleaning schedule for stormwater structures.</p> <p>Undertaken surface and groundwater monitoring in accordance with the approved monitoring programme.</p> <p>Testing of WWTP produce water in accordance with WUL parameters, limits and frequencies.</p> <p>Ongoing monitoring of freeboard in PCDs.</p> <p>Existing roads to be assessed for stormwater management</p>	Ongoing phases) (all	EO	Ongoing (all phases)	<p>Updated construction schedule</p> <p>EO monthly EAR</p> <p>EO monthly inspection reports</p> <p>Surface water and groundwater monitoring reports.</p> <p>Lab test results for WWT product water.</p> <p>Competency certificates of WWTP and Brine Treatment</p>

ASPECT: STORMWATER, GROUNDWATER AND WASTEWATER MANAGEMENT - PRE-CONSTRUCTION, CONSTRUCTION, OPERATIONAL AND DECOMMISSIONING PHASES						
Impact management outcome	Impacts on the environment caused by stormwater and wastewater discharges.					
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
<p>interflow and may benefit downstream watercourses and wetland units.</p> <ul style="list-style-type: none"> <li>- Inspect stormwater management structures monthly for erosion, sedimentation and blockages. Address erosion observed without delay.</li> <li>- Regularly maintain stormwater management structures to ensure the system functions effectively.</li> <li>- Install a temporary cut-off trench (if required) to contain poor-quality runoff.</li> <li>- Continued surface water and groundwater quality monitoring and routine visual assessment for contamination.</li> <li>- Routine hydraulic monitoring of the stormwater system (monthly).</li> <li>- Cover soil stockpiles with a temporary liner to prevent contamination (where required and visually determined).</li> <li>- Access roads should have run-off control features to redirect water flow and dissipate any energy in the water, which may pose an erosion risk.</li> <li>- Washing of vehicles or machinery must be limited to designated areas within the dirty water catchment.</li> </ul>		<p>requirements by EO and Contractor.</p> <p>Undertake concurrent rehabilitation in accordance with the RSIP.</p> <p>Installation of liners in accordance with WUL conditions.</p> <p>EO to assess compliance with the WUL and WML conditions in respect of the liner requirements and monitoring requirements.</p> <p>Ensure enough spillkits are available.</p> <p>Appoint qualified, competent operators to operate and manage the WWTP</p>				Plant operators.

ASPECT: STORMWATER, GROUNDWATER AND WASTEWATER MANAGEMENT - PRE-CONSTRUCTION, CONSTRUCTION, OPERATIONAL AND DECOMMISSIONING PHASES						
Impact management outcome	Impacts on the environment caused by stormwater and wastewater discharges.					
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
<ul style="list-style-type: none"> <li>- Maintain sufficient freeboard in PCDs in accordance with the WUL requirements.</li> <li>- Concurrent rehabilitation of the CDF(capping, application of topsoil and planting of grass cover) to reduce the infiltration of rainwater.</li> <li>- Soil covers in areas where erosion is noted, and dust suppression of the landfill to prevent dust migration onto soils.</li> <li>- Ensure CDF slopes are shaped to prevent erosion.</li> <li>- Ensure the CDF is lined in accordance with the WML and the WUL.</li> <li>- Continued groundwater monitoring to detect potential seepage from the CDF and PCDs.</li> <li>- Provide spillkits and implement Spill Management Procedures. Remove hydrocarbon contaminated soil and dispose of as contaminated waste.</li> <li>- Commission the Brine Treatment Plant to reduce the volume of brine in the Brine PCD.</li> <li>- Brine filter cake loading area to be constructed in accordance with the</li> </ul>		<p>and the Brine Treatment Plant.</p> <p>CDF to be overseen by qualified engineer.</p> <p>Use of signage and environmental awareness to keep all personnel within designated footprint.</p>				

ASPECT: STORMWATER, GROUNDWATER AND WASTEWATER MANAGEMENT - PRE-CONSTRUCTION, CONSTRUCTION, OPERATIONAL AND DECOMMISSIONING PHASES						
Impact management outcome	Impacts on the environment caused by stormwater and wastewater discharges.					
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
<p>requirements stipulated in the WUL and WML.</p> <ul style="list-style-type: none"> <li>- Operate WWTP &amp; BTP in accordance with Standard Operating Procedures.</li> <li>- The SOP of the WWTW &amp; BTP must make provision for regular monitoring of the facilities and pipelines to ensure that there are no leakages, or to repair any leaks timeously.</li> <li>- The design of the WWTW must make provision for the discharge of any overflow effluent into the associated PCDs to ensure that the no untreated effluent is released from the works area.</li> <li>- No untreated effluent will be allowed to be discharge from the WWTW.</li> <li>- The SOP should also make provision for the actions that must be taken in the event of an accidental spill form the works area. These should make provision for: <ul style="list-style-type: none"> <li>- Containment of the leakage;</li> <li>- Collection of the effluent and possible contaminated soils;</li> <li>- Storage of the contained material; and</li> </ul> </li> </ul>						

ASPECT: STORMWATER, GROUNDWATER AND WASTEWATER MANAGEMENT - PRE-CONSTRUCTION, CONSTRUCTION, OPERATIONAL AND DECOMMISSIONING PHASES						
<b>Impact management outcome</b>	Impacts on the environment caused by stormwater and wastewater discharges.					
<b>Impact Management Actions</b>	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
<ul style="list-style-type: none"> <li>- Removal and disposal from the site by registered service provider.</li> <li>- Test WWTW &amp; BTP produce water in accordance with WUL parameters, limits and frequencies. If the discharge limits cannot be met, the discharge should be ceased up until such time as the limits associated with the licence can be produced.</li> <li>- Prohibit movement or parking of vehicles outside of dirty water catchment.</li> <li>- Inspect and maintain the liners and drainage system.</li> </ul>						



ASPECT: FINAL REHABILITATION: DECOMMISSIONING PHASE						
Impact management outcome	Footprint and extent of disturbance is minimised, impacts on flora, fauna and the nearby water resources is minimised					
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
<ul style="list-style-type: none"> <li>- Implement RSIP and decommissioning EMP.</li> <li>- All disturbed areas must be rehabilitated after demolition, reclamation and waste removal.</li> <li>- Any gullies or dongas must also be backfilled, shaped and rehabilitated.</li> <li>- Exposed and compacted areas must be ripped and vegetated with indigenous species to increase surface roughness.</li> <li>- Compacted areas must be ripped (perpendicularly) to a depth of 300 mm.</li> <li>- Rehabilitate disturbed areas as soon as possible and monitor progress until vegetation establishment is successful.</li> <li>- Implement silt interception such as the placement of silt nets where necessary.</li> <li>- Stockpiled topsoil should be used for rehabilitation efforts.</li> <li>- Where hydroseeding is required, the contractor must provide the detailed seed mix list for approval by the EO. Only plants indigenous to the site may be used.</li> <li>- Implement Alien Plant Management Plan.</li> </ul>	PM Contractor EO	Specialist to compile RSIP  Compile Decommissioning EMP  Regular inspections by EO.	Decommissioning Phase	EO	Decommissioning Phase	RSIP  Decommissioning EMP  Monthly inspection reports

ASPECT: FINAL REHABILITATION: DECOMMISSIONING PHASE						
<b>Impact management outcome</b>	Footprint and extent of disturbance is minimised, impacts on flora, fauna and the nearby water resources is minimised					
<b>Impact Management Actions</b>	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
<ul style="list-style-type: none"> <li>- Maintain stormwater management structures until runoff water is no longer contributing to surface water contamination.</li> <li>- The PCD can be rehabilitated during closure if area is considered non-polluting.</li> <li>- Continue drainage and collection of polluted seepage water.</li> <li>- Edge effects of decommissioning activities need to be actively managed.</li> <li>- Vegetation outside of the designated footprint area must be left undisturbed.</li> <li>- Restrict the movement of personnel and vehicles to the footprint.</li> <li>- Upon completion of decommissioning activities, it must be ensured that no bare areas remain.</li> <li>- Prohibit fires, the burning of waste materials or any debris.</li> <li>- Constant monitoring through the appointed EO.</li> <li>- Surface water and groundwater monitoring must continue.</li> <li>- Ensure that no material is dumped outside of the designated areas.</li> </ul>						

ASPECT: FINAL REHABILITATION: DECOMMISSIONING PHASE						
Impact management outcome	Footprint and extent of disturbance is minimised, impacts on flora, fauna and the nearby water resources is minimised					
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
<ul style="list-style-type: none"> <li>- Ripping and reinstatement of soil should not be done earlier than required.</li> <li>- Plan drainage paths and soil conservation measure to prevent soil erosion .</li> <li>- Where possible, sandbags (or similar) must be placed at the bases of any stockpiled material to prevent erosion of the material.</li> <li>- Final capping and vegetation of the CDF to reduce recharge into the landfill.</li> <li>- Routine inspections and water quality monitoring of the boreholes and surface water streams downstream of the site (quarterly) should be sufficient to determine closure objectives.</li> </ul>						

ASPECT: SANITATION AND SOLID WASTE MANAGEMENT- CONSTRUCTION, OPERATIONAL AND CLOSURE/ DECOMMISSIONING PHASES						
Impact management outcome	Waste streams are appropriately stored, handled and safely disposed of at a recognised waste facility.					
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
<ul style="list-style-type: none"> <li>- Audit the implementation of the Waste Management Plan and ensure it is updated where required.</li> <li>- Suitable waste receptacles must be positioned throughout the site and should be wind and scavenger proof.</li> <li>- A designated eating area must be established within the contractor site, equipped with a scavenger proof bin.</li> <li>- Designated smoking areas must be provided with receptacles for cigarette butts.</li> <li>- Provide sufficient bins and waste skips for the separation of waste streams (e.g. general, hazardous, scrap metal, rubble and demolition waste).</li> <li>- Waste bins and skips should be labelled, or colour coded to facilitate waste separation.</li> <li>- Monitor littering and housekeeping around the site and the waste bins and skips.</li> <li>- Contractors must monitor the capacity of bins and skips daily. Bins must be emptied into skips as required to prevent overflows.</li> <li>- Skips must be emptied according to a weekly schedule, or more often if required to prevent overflows.</li> <li>- Organic waste should be removed from site weekly to prevent pest species from becoming a problem.</li> </ul>	PM Contractor EO	<p>Contractors to provide bins and skips.</p> <p>Waste disposal contractor to be appointed.</p> <p>EO to undertake inspections and communicate non-compliances.</p> <p>EO to audit compliance with Waste Management Plan</p> <p>EO to monitor Contractor files and waste manifests.</p>	Ongoing	PM EO	Ongoing	<p>EO records of non-compliance, monthly EAR, and photographic evidence.</p> <p>Waste disposal certificates</p>

ASPECT: SANITATION AND SOLID WASTE MANAGEMENT- CONSTRUCTION, OPERATIONAL AND CLOSURE/ DECOMMISSIONING PHASES						
Impact management outcome	Waste streams are appropriately stored, handled and safely disposed of at a recognised waste facility.					
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
<ul style="list-style-type: none"> <li>- All waste must be disposed of at suitably licensed facilities and safe disposal certificates must be provided and filed.</li> <li>- All hazardous substances are to be stored separately in appropriately bunded and demarcated facilities.</li> <li>- Storage of potential contaminants in bunded areas.</li> <li>- Prevent dumping and/or burial of waste within the project site or in the surrounding areas through regular inspections, environmental awareness, and non-conformance notices.</li> <li>- Strict adherence to the construction/decommissioning EMP.</li> </ul>						
<ul style="list-style-type: none"> <li>- Ablution facilities may not be placed within 40m of any wetland features, or 50m of a watercourse or the 1:50 year floodline. Whichever is furthest will apply.</li> <li>- Appropriate sanitary facilities must be provided at a minimum of 1 toilet per 15 users.</li> <li>- Ablution facilities with sanitary/SHE bins to be provided in areas where there are female employees.</li> <li>- Hand washing facilities to be provided.</li> <li>- Only portable chemical toilets with a sealed reservoir will be allowed on site.</li> <li>- A contractor must be appointed to provide and service the chemical toilets regularly (weekly or more frequently if required).</li> </ul>	PM Contractor EO	<p>Approval from EO is required prior to site establishment</p> <p>Certificates of safe disposal are to be provided to PM and EO</p> <p>Record spills/ discharges and environmental incidents</p>	All phases (ongoing)	cEO EO	All phases (ongoing)	<p>Approval from EO for site establishment</p> <p>Safe disposal certificates</p> <p>EO reports, non-compliance notices and environmental incident log</p>



ASPECT: SANITATION AND SOLID WASTE MANAGEMENT- CONSTRUCTION, OPERATIONAL AND CLOSURE/ DECOMMISSIONING PHASES						
<b>Impact management outcome</b>	Waste streams are appropriately stored, handled and safely disposed of at a recognised waste facility.					
<b>Impact Management Actions</b>	<b>Implementation</b>			<b>Monitoring</b>		
	<b>Responsible Person</b>	<b>Method of Implementation</b>	<b>Timeframe for Implementation</b>	<b>Responsible Person</b>	<b>Frequency</b>	<b>Evidence of Compliance</b>
<ul style="list-style-type: none"> <li>- The contractor must be supervised/observed where necessary to prevent spillages when servicing chemical toilets.</li> <li>- The contractor must provide safe disposal certificates for the disposal of sewage at a suitably licensed facility.</li> <li>- Toilets must be emptied and locked before site closure over weekends or holidays.</li> <li>- Chemical toilets must be secured to the ground to prevent being toppled during heavy wind/storms.</li> <li>- Enforce the use of provided ablution facilities and prevent the use of the veld for ablutions.</li> </ul>		<p>EO to undertake weekly inspections of ablution facilities.</p> <p>Toolbox talk to be given on the appropriate use of ablution facilities.</p>				Toolbox talk register

ASPECT: PROTECTION OF HERITAGE RESOURCES - PRE-CONSTRUCTION PLANNING AND DESIGN, CONSTRUCTION, OPERATIONAL AND CLOSURE/DECOMMISSIONING PHASES						
Impact management outcome	Impact on heritage resources is minimised.					
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
<ul style="list-style-type: none"> <li>- Implement a Chance Finds Protocol during construction.</li> <li>- Demarcate footprint areas clearly and ensure site clearance remains within the footprint area only.</li> <li>- Provide toolbox talk on the restriction movement of construction employees outside of construction areas and the procedure to be followed if archaeological or heritage resources are unearthed during construction.</li> <li>- Impose penalties for movement outside of designated areas, e.g. driving outside of designated roadways.</li> <li>- Regular monitoring by the EO.</li> <li>- In the event that any sub-surface paleontologically or cultural heritage resources or graves are unearthed during the construction process all work has to be stopped and the finding reported to the EO.</li> <li>- The EO must engage the services of an appropriately qualified practitioner with the necessary archaeological/paleontological background to inspect the site before any work in that area may resume.</li> <li>- The mine and heritage specialist must report heritage findings to the SAHRA and/or the South African Police Services [SAPS] in accordance with the Chance Finds Protocol.</li> </ul>	EO PM Contractor	<p>Appointment of a specialist to undertake an investigation</p> <p>Reporting of heritage findings to SAHRA</p> <p>Reporting of graves/ human remains to SAPS</p>	All phases (ongoing)	EO cEO EO	All phases (ongoing)	<p>Environmental incident register</p> <p>Training register</p> <p>Training materials</p> <p>Permits for damage or repairs to heritage sites</p> <p>Records of reports to heritage agencies/ SAPS</p>

ASPECT: EMERGENCY PROCEDURES - PRE-CONSTRUCTION PLANNING AND DESIGN, CONSTRUCTION, OPERATIONAL AND CLOSURE/ DECOMMISSIONING PHASES						
<b>Impact management outcome</b>	Emergency procedures are in place to enable a rapid and effective response to all types of environmental emergencies.					
<b>Impact Management Actions</b>	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
<ul style="list-style-type: none"> <li>- Update the mine's Emergency Response Action Plan (ERAP) prior to the commencement of the proposed project.</li> <li>- The Emergency Plan must deal with accidents, potential spillages and fires in line with relevant legislation.</li> <li>- All staff must be made aware of emergency procedures as part of induction.</li> <li>- Fire extinguishers must be used for small fires at the site.</li> <li>- The mine proto team must be informed of any fires.</li> <li>- In the event of an emergency, necessary mitigation measures to contain the spill or leak must be implemented.</li> <li>- All spills must be reported to the EO and must be investigated and recorded. The clean-up undertaken and the measures to avoid a similar incident must be recorded.</li> </ul>	PM Contractor EO	<p>Update ERAP prior to the commencement of construction</p> <p>Certificates of safe disposal for general, hazardous and recycled waste</p> <p>Record spills/ discharges and environmental incidents</p>	All phases (ongoing)	cEO EO	All phases (ongoing)	<p>Complaints register</p> <p>Training register</p> <p>ERAP</p> <p>Environmental incident registers with photographic evidence.</p>

ASPECT: TEMPORARY CLOSURE OF SITE - CONSTRUCTION, OPERATIONAL AND DECOMMISSIONING PHASES						
Impact management outcome	Minimise the risk of environmental impact during periods of site closure greater than five days.					
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
<ul style="list-style-type: none"> <li>- Bunds must be emptied (where applicable) and need to be undertaken in accordance with the impact management actions included in Hazardous substances and Workshop, equipment maintenance and storage.</li> <li>- Waste bins and skips are to be emptied and the waste removed from the site.</li> <li>- Hazardous storage areas must be well ventilated;</li> <li>- Fire extinguishers must be serviced and accessible. Service records are to be filed and audited at the last service.</li> <li>- Emergency and contact details displayed must be displayed.</li> <li>- Security personnel must be briefed and have the facilities to contact or be contacted by relevant management and emergency personnel.</li> <li>- Night hazards such as reflectors, lighting, traffic signage, etc. must have been checked.</li> <li>- Fire hazards identified, and the local authority must have been notified of any potential threats e.g. large brush stockpiles, fuels, etc.</li> <li>- Structures vulnerable to high winds must be secured.</li> </ul>	PM Contractor EO	<p>Implementation of SWMP</p> <p>Certificates of safe disposal for general, hazardous, and recycled waste</p> <p>Record spills/ discharges and environmental incidents</p> <p>Site close-out checklist must be completed and signed by the EO before the Contractor may leave</p> <p>Update HCS Sheet</p> <p>Ensure all required SDS are available</p>	All phases (ongoing)	EO cEO	All phases (ongoing)	<p>Complaints register</p> <p>Training register</p> <p>Environmental incident register</p> <p>ERAP</p> <p>HCS control sheet</p> <p>SDS</p>

ASPECT: TEMPORARY CLOSURE OF SITE - CONSTRUCTION, OPERATIONAL AND DECOMMISSIONING PHASES						
<b>Impact management outcome</b>	Minimise the risk of environmental impact during periods of site closure greater than five days.					
<b>Impact Management Actions</b>	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
<ul style="list-style-type: none"> <li>- Wind and dust mitigation must be implemented.</li> <li>- Cement and materials stores must be secured.</li> <li>- Toilets must have been emptied and secured.</li> <li>- Drip trays must be emptied and secured.</li> </ul>						



ASPECT: SOCIO-ECONOMIC- PRE-CONSTRUCTION PLANNING AND DESIGN, CONSTRUCTION, AND DECOMMISSIONING PHASES						
Impact management outcome	Negative socio-economic impacts are reduced, and positive impacts are enhanced.					
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
<ul style="list-style-type: none"> <li>- Contractor must be required to employ local labour by using any existing skills/employment database provided by Kangra in accordance with Kangra's applicable policies and commitments.</li> <li>- Apply the existing Kangra HRD and Procurement Policies.</li> <li>- Maintain clear and decisive labour and recruitment policies that promote the interests of residents and discourage opportunity seekers from settling in the area.</li> <li>- Maintain the open and transparent recruitment procedures that are disclosed to community members.</li> <li>- Use mechanisms approved by Kangra to advertise employment opportunities before the commencement of construction.</li> <li>- Provide or facilitate training of local people, through internships, scholarships, and/or vocational and skills training programmes.</li> <li>- Grant skills development opportunities to community members and local job seekers, where needed.</li> <li>- Capture all project relevant skills in the project area to ensure maximum local employment.</li> </ul>	PM Contractor HR Manager	<p>Obtain labour requests from Contractors prior to the start of construction/decommissioning activities.</p> <p>Update skills/labour database.</p> <p>All appointments must be approved by the Kangra HR Department.</p> <p>Develop and implement Skills Development/Training</p>	Prior to the construction and decommissioning phases	HR Manager Social Labour Manager and Plan External auditor	Prior to the construction and decommissioning phases	<p>Contractor's personnel files</p> <p>Training certificates for completion of training/skills development programme.</p>

ASPECT: SOCIO-ECONOMIC- PRE-CONSTRUCTION PLANNING AND DESIGN, CONSTRUCTION, AND DECOMMISSIONING PHASES						
<b>Impact management outcome</b>	Negative socio-economic impacts are reduced, and positive impacts are enhanced.					
<b>Impact Management Actions</b>	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
<ul style="list-style-type: none"> <li>- Communicate the limitations of opportunities created by the project through established communication channels.</li> <li>- Integrate aspects of an influx management strategy into existing social management plans (i.e. SLP and Stakeholder Engagement Plan).</li> </ul>						

ASPECT: SENSITIVE RECEPTORS- PRE-CONSTRUCTION PLANNING AND DESIGN, CONSTRUCTION, OPERATIONAL AND CLOSURE/ DECOMMISSIONING PHASES						
Impact management outcome	Minimise the impacts on sensitive receptors.					
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
<ul style="list-style-type: none"> <li>- Adhere to the work schedule which limits activities during all phases of the project to standard working hours/daytime as far as possible.</li> <li>- Maintain complaints register. Investigate complaints and keep a record of the investigation undertaken and results thereof and provide feedback to the complainant.</li> <li>- Construction and delivery vehicles will be required to adhere to all traffic rules with penalties imposed for non-compliance.</li> <li>- Construction and delivery vehicles are to use approved routes.</li> <li>- All drivers must undergo induction and be required to have a valid driver's licence before being allowed to drive construction or mine vehicles.</li> <li>- Wet suppress haul roads and stockpiles.</li> <li>- Rehabilitate all disturbed areas and monitor until vegetation establishment is successful.</li> <li>- Undertake concurrent rehabilitation of the CDF.</li> </ul>	PM Contractor EO	<p>Implement policy relating to the use of vehicles and driving.</p> <p>Investigate complaints and record results thereof.</p> <p>Ensure the dust suppression truck is available and in good working order.</p> <p>EO to undertake regular inspections</p> <p>Undertake concurrent rehabilitation during the construction phase.</p> <p>Install lights with the approval of the EO</p>	Ongoing (all phases)	EO	Ongoing (all phases)	<p>Toolbox talk registers and signed acknowledgement of vehicle policy by licenced drivers.</p> <p>EO monthly EAR, non-compliance reports and photographic evidence.</p> <p>Dust and Noise monitoring reports.</p> <p>Service Records for vehicles and equipment.</p>

ASPECT: SENSITIVE RECEPTORS- PRE-CONSTRUCTION PLANNING AND DESIGN, CONSTRUCTION, OPERATIONAL AND CLOSURE/ DECOMMISSIONING PHASES						
Impact management outcome	Minimise the impacts on sensitive receptors.					
Impact Management Actions	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
<ul style="list-style-type: none"> <li>- Continued monitoring of air quality and noise levels according to the monitoring programme.</li> <li>- Ensure all equipment and vehicles are serviced in accordance with the maintenance schedule.</li> <li>- Equipment and machinery used must comply with manufacturer's specifications and should not exceed regulated limits.</li> <li>- Constant monitoring and appointment of an ECO.</li> <li>- Choose suitable types of lighting that minimise glare and sky glow.</li> <li>- Only focus light sources on where it is needed and utilize motion sensor lights where possible.</li> <li>- Consult a qualified lighting engineer or lighting specialist, should it be required.</li> <li>- No spotlights should be used, if possible.</li> <li>- Monitor rehabilitated areas to ensure that rehabilitation has been effective.</li> <li>- Implement further rehabilitation measures where rehabilitation has not been effective.</li> </ul>		<p>Undertake monitoring in accordance with the monitoring programme.</p> <p>Implement a service and maintenance schedule for vehicles and equipment.</p>				

ASPECT: SENSITIVE RECEPTORS- PRE-CONSTRUCTION PLANNING AND DESIGN, CONSTRUCTION, OPERATIONAL AND CLOSURE/ DECOMMISSIONING PHASES						
<b>Impact management outcome</b>	Minimise the impacts on sensitive receptors.					
<b>Impact Management Actions</b>	Implementation			Monitoring		
	Responsible Person	Method of Implementation	Timeframe for Implementation	Responsible Person	Frequency	Evidence of Compliance
<ul style="list-style-type: none"> <li>- Constant monitoring and appointment of an ECO.</li> <li>- CDF rise to be undertaken in accordance with the design and to be overseen by an engineer.</li> <li>- Undertaken concurrent rehabilitation in accordance with the RSIP.</li> <li>- Use suitable building finishes/colours that blend in with the surrounding landscape.</li> <li>- Rehabilitate exposed areas and monitor until vegetation establishment is successful.</li> </ul>						



## 6 PROPOSED ENVIRONMENTAL MONITORING PROGRAMME

A comprehensive monitoring programme assists in determining whether mitigation and management measures are being implemented and/or if they are effective. Monitoring of the environment prior to the start of activities (establishment of baseline conditions) and continued monitoring throughout the life of the operation will help identify environmental impacts by identifying and tracking potential pollution trends. The monitoring data collected will also provide input into the planning for closure at the end of the life of the facility.

### 6.1 Surface Water Monitoring

Kangra Coal has an existing surface water monitoring system in place. The monitoring network is considered sufficient for the large scale, but may not be sensitive enough to verify local impacts associated with the proposed co-disposal facility. The WTP is considered a lower-risk infrastructure when compared to the co-disposal facility and hence will not require dedicated surface water monitoring.

It is proposed that at least 3 additional surface water monitoring points be added to the existing water monitoring network. The proposed additional surface monitoring points are listed in Table 10 and the positions are shown in Figure 4.

**Table 10: Proposed additional surface water monitoring points.**

SITE	TYPE	LATITUDE	LONGITUDE
GCS-SW1	Surface Water	-27.014373	30.380725
GCS-SW2	Surface Water	-27.007210	30.383816
GCS-SW3	Surface Water	-26.997385	30.394284

### 6.2 Groundwater Monitoring

According to the 2022 Geohydrological Investigation undertaken by GCS, based on a review of the existing monitoring network and data generated, for the Maquasa and Kusipongo Operations, no further improvements are proposed.

This geohydrological assessment finds the existing monitoring network sufficient. It is important to re-evaluate the monitoring network on an annual basis, to ensure that there are no monitoring gaps. This is done annually during the annual groundwater and surface water monitoring reporting.

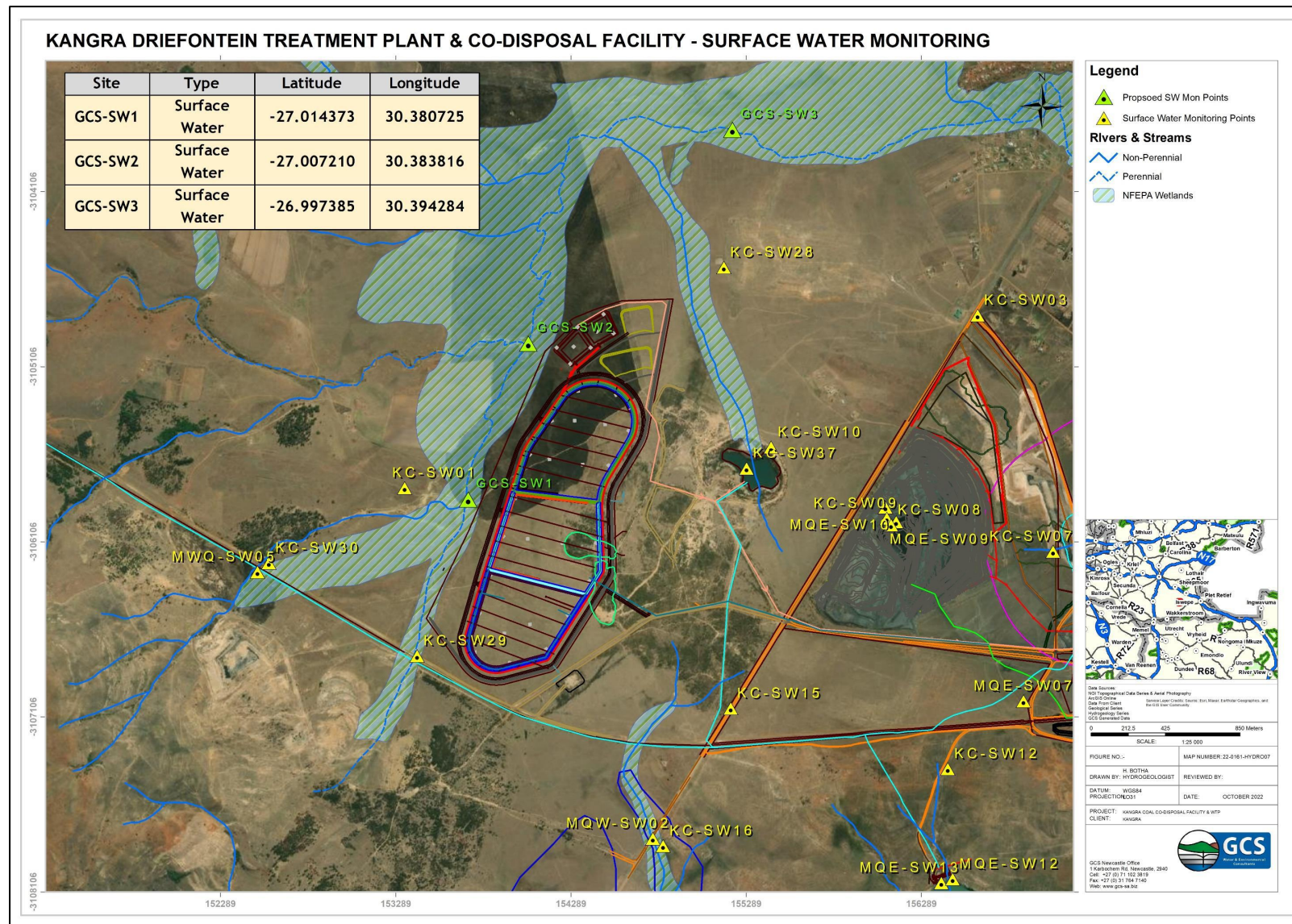


Figure 4: Proposed Surface Water Monitoring Points

### **6.3 Dust Fallout Monitoring**

There are currently 21 dust monitoring points around the MQE and Maquasa West infrastructure areas, around the Heyshope Dam and within the nearby community. These are considered sufficient and no additional dust monitoring points are recommended.

### **6.4 Aquatic Biomonitoring**

It is recommended that biannual biomonitoring be continued at the monitoring points upstream and downstream of MQE, as indicated on the biomonitoring map on Figure 5.

Furthermore, it is recommended that monthly water quality monitoring be undertaken on the discharge point from the mine into the Heyshope Dam.



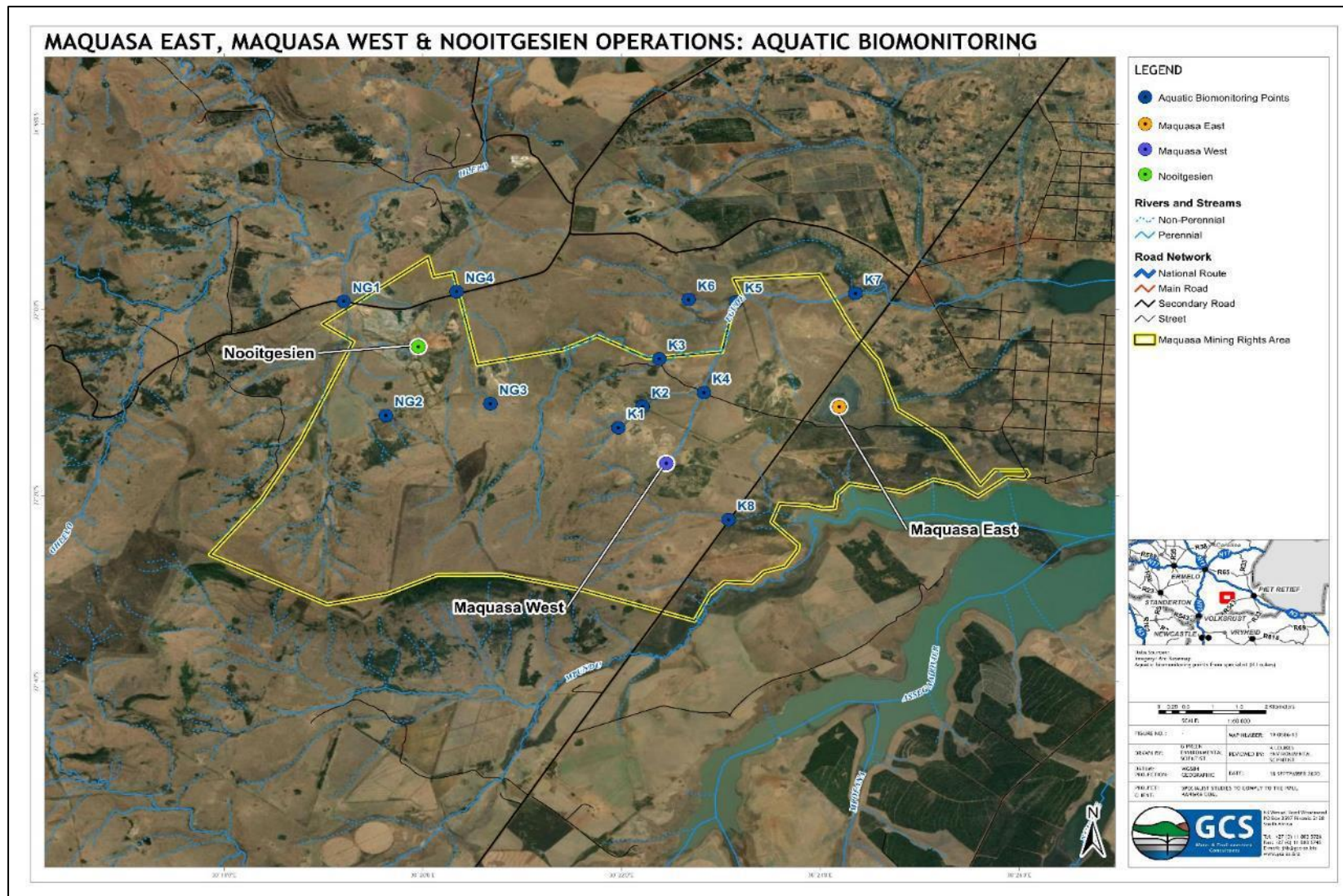


Figure 5: Current MQE Aquatic Biomonitoring Points

**APPENDIX A: CURRICULUM VITAE OF EAP**





## GCS Group Environmental Manager

### CORE SKILLS

- Project Management
- Technical & Impact Assessment Guidance
- Environmental Assessment
- Water Use Licencing
- Waste Management Licencing
- Environmental & Waste Auditing and Compliance Monitoring

### DETAILS

#### Qualifications

- B.Sc. Microbiology (Honours) University of Pretoria 1996
- B.Sc. Biological Sciences University of Pretoria 1994

#### Memberships/ Professional Affiliations

- International Association for Impact Assessors of South Africa (IAIA)
- Institute of Waste Management of South Africa (IWMSA)
- SACNASP (No.117348) (South African Council for Natural Scientific Professionals)

#### Languages

- Afrikaans
- English

#### Countries worked in:

South Africa, Zambia, Namibia

### PROFILE

Gerda has over 25 years' experience within the environmental and waste management field and strives to deliver custom environmental services to clients.

Gerda began her career in the environmental field within the government sector, managing environmental aspects and impacts as well as reviewing environmental assessments with the view of authorizing or declining authorization of the developments.

After six years within the government sector she joined a consulting engineering firm where she was ultimately responsible for the Management of the Environmental Sub-Division. Gerda has experience in project and client management, financial management and the compilation and costing of project proposals and tenders. She has been involved in several engineering projects as the Environmental Assessment Practitioner as well as the Environmental Control Officer during construction working closely with the Occupational Health and Safety Officer. Gerda has also been involved in projects where waste licensing as well as water use licensing processes formed an integral part of the services offered. Environmental auditing and compliance monitoring of waste disposal sites also forms part of her experience gained. She also has experience in dealing with projects which involve NEC3 Contracts, the Equator Principles and World Bank IFC Principles.

Gerda has specialist skills in the following areas:

- Project proposals, planning, costing and timing
- Project and Client Management
- Authority Liaison
- Basic Assessments & Scoping/EIA Processes
- Amendment of EA's & EMP's
- S24G Applications
- Facilitation of Public Participation Processes & Stakeholder Engagement
- IWULA & IWWMP Applications
- Environmental Control Officer (ECO) duties
- Environmental Compliance Auditing (IFC Performance Standards & Equator Principles)
- Mentorship & Guidance

## Work Experience

Period	Employer	Position	Role/ Responsibility
2019 to Current	GCS Water and Environment (Pty) Ltd	Environmental Manager	Management of the environmental unit since 2019 up to January 2024 and then the GCS Group Environmental Division since February 2024. Management of applications for rectification in terms of Section 24G of the EIA Regulations, undertaking basic environmental assessment and full Scoping & EIR applications in terms of the Regulations. Management of Integrated Water Use License Applications in terms of the NWA. Undertaking of environmental compliance audits for various construction projects as well as environmental legal audit reviews and environmental due diligence investigations.
2018 to 2019	Terramanzi Group (Pty) Ltd	Senior Environmental Consultant	Management of the environmental unit within the Terramanzi Group. Management of applications for rectification in terms of Section 24G of the EIA Regulations, undertaking basic environmental assessment and full Scoping & EIR applications in terms of the Regulations. Undertaking of environmental compliance audits for various construction projects as well as environmental legal audit reviews and environmental due diligence investigations.
2014 to 2017	GIBB (Pty) Ltd	Senior Environmental Scientist	Management of applications for rectification in terms of Section 24G of the EIA Regulations, undertaking of basic environmental assessment and full Scoping & EIR applications in terms of the Regulations. Management of Integrated Water Use License Applications in terms of the NWA. Undertaking of environmental compliance audits for various construction projects as well as environmental legal audit reviews and environmental due diligence investigations.
2011 to 2013	WorleyParsons RSA	Senior Environmental Scientist & Durban Department Head Environment	Management of the environmental unit in the Durban Office. Management of applications for rectification in terms of Section 24G of the EIA Regulations, undertaking of basic environmental assessment and full Scoping & EIR applications in terms of the Regulations. Management of Integrated Water Use License Applications in terms of the NWA. Undertaking of environmental compliance audits for various construction projects as well as environmental legal audit reviews and environmental due diligence investigations.
2003 to 2011	KV3 Engineers	Senior Environmental Scientist	Management of applications for exemption from compliance with the EIA Regulations, undertaking of basic environmental assessment applications, as well as full environmental impact assessment applications.
2000 to 2003	Gauteng Department of Agriculture, Conservation & Environment	Assistant Director: Waste Management Division	Project management and environmental management pertaining to all developments within a designated area in Gauteng Province. Review of EIAs, formulation of comments and or authorisations within designated area in Gauteng Province. Liaison with waste contractors, industries and others. Management of legal interventions required in terms of environmental legislation within a designated area. Supporting environmental officers at all levels in terms of technical and environmental guidance, input into strategic decisions, resolving complex and potentially challenging issues.
1999 to 2000	Gauteng Department of Agriculture, Conservation & Environment	Senior Environmental Officer: Waste Management Division	
1997 to 1999	Gauteng Department of Agriculture, Conservation & Environment	Environmental Officer: Waste Management Division	
1996	Spartan Private School	Teacher: Natural Science & Biology	Teacher in Biology and Natural Science for Grades 7 to 12.

## Project Experience

Year	Client	Project Description	Role/ Responsibility
<b>Strategic and Environmental Guidance Projects</b>			
1999 to 2003	Gauteng Department of Agriculture, Conservation & Environment	Development of a Health Care Risk Waste Management Strategy for Gauteng.	Part of Development Team
2001 to 2003	Gauteng Department of Agriculture, Conservation & Environment	Development of Minimum Domestic Waste Collection Standards for Gauteng Province.	Part of Development Team
2002	Gauteng Department of Agriculture, Conservation & Environment	Development of new EIA guidelines and regulations for the Gauteng Province.	Part of Development Team
2005	Gauteng Department of Agriculture, Conservation & Environment	GDACE Green Procurement Project: Development of the GDACE Green Procurement Policy, Gauteng	Project Manager & Reviewer
2008	GAUTRAIN Project Engineers (i.e. KV3 Engineers)	Environmental Assistance for the Gautrain Project: Environmental Evaluation of various documentation and engineering designs in terms of their environmental compliance.	Project Manager & Reviewer
2009	Department of Environmental Affairs	Alignment of MIG Project Process with EIA Process: Evaluation of the EIA process as well as the MIG process in order to produce a process alignment guideline to the municipalities to streamline the two processes.	Part of Development Team
2021	CoalTech	Development of "A Manual for the Authorisation of Pitlakes as a Closure Option for South African Coal Mines"	Part of Development Team
<b>Environmental Feasibility and Screening</b>			
2008	Nu Way-property Developments	Management of Environmental Screening and Due Diligence Assessment for several proposed Nu Way-property Developments, Gauteng.	Project Manager
2008	Department of Water Affairs	Mokolo Croc WAP Environmental Feasibility and Screening, Limpopo.	Project Manager & Senior Environmental Assessment Practitioner (EAP)
2016	Kwadukuza Municipality	Environmental Feasibility for Civil Engineering Project Foxhill Road Alignment and Construction, Tongaat, Kwa-Zulu-Natal.	Environmental Project Leader
2016	King Sabata Dalindyebo Local Municipality (C/O OR Tambo District Municipality)	Environmental Screening Investigation of six proposed development corridors for the Mthatha Bulk Water Infrastructure Presidential Intervention - Phase 2: Secondary Bulk Infrastructure project.	Environmental Project Leader
2019 to 2020	Phumaf Holdings (Pty) Ltd	Environmental Screening for various sites within Ekurhuleni Municipality as part of the Gauteng Rapid Land Release Programme (GRLRP) project for the Provincial Department of Human Settlements	Project Manager & Senior EAP

Year	Client	Project Description	Role/ Responsibility
<b>Environmental Opinions &amp; Appeals</b>			
2019 to 2020	Tendele Coal	Environmental Review Report for the Somkhele Anthracite Mine (MR 10041) High Court Case Number 82865.	Project Manager & Senior EAP
2022	CNG Holdings	Environmental Opinion regarding the Environmental Legislative Requirements for the proposed Compressed Natural Gas Motherstation in Avoca, KwaZulu-Natal.	Project Manager & Senior EAP
2021 to 2022	Tendele Coal	Environmental support to the Somkhele Anthracite Mine for the IWULA Appeals Process.	Project Manager & Senior EAP
<b>Development Environmental Assessments</b>			
2003 to 2005	ABSA DevCO	Environmental Impact Assessment for a change of land-use from agricultural to Residential and Town Development of the farm Brakfontein 399 JR, Centurion, Gauteng.	Project Manager & Senior EAP
2005 to 2010	Air Traffic Navigation Services (ATNS)	The project entails the upgrading of existing, and the provision of new air navigation sites (27 in total) throughout South Africa. Civil and electrical infrastructure to the sites needed to be upgraded to accommodate the equipment. Various Environmental Impact Assessments for various individual projects in various provinces within South Africa.	Project Manager & Senior EAP
2006 to 2009	Amathole District Municipality	Elliotdale Rural Sustainable Human Settlement Pilot Project Environmental Impact Assessment. Responsible for the environmental assessment process which was based on a strategic approach for the Elliotdale Rural Housing Project, Elliotdale, Eastern Cape.	Project Manager & Senior EAP
2007	Elkem Ferrovel	Environmental Basic Assessment for the upgrading and expansion of the Ferrovel Plant in Ferrometals, Emalaheni, Mpumalanga.	Project Manager & Senior EAP
2008	ABSA DevCO	Environmental Impact Assessment for a change in land use from agricultural to Residential and Town development of Montana X40, Pretoria, Gauteng.	Project Manager & Senior EAP
2012	Transnet Capital Projects	Environmental Basic Assessment and technical environmental investigations for the proposed expansion of the existing tug jetty and construction of a new tug jetty for Transnet Capital Projects in the Port of Durban, KwaZulu-Natal.	Project Manager & Senior EAP
2014 to 2016	Dube TradePort	Environmental Impact Assessment for the proposed construction of the Dube TradePort TradeZone 2 in La Mercy, KwaZulu-Natal.	Project Manager & Senior EAP
2014 to 2017	Dube TradePort	Environmental Impact Assessment for the proposed Support Precinct 2 Development in La Mercy, KwaZulu-Natal.	Project Manager & Senior EAP
2016 to 2017	Areena Resort	Application for rectification in terms of S24G and associated Environmental Basic Assessment for the alleged unlawful construction activities at the Areena Resort, Great Kei Municipality, Eastern Cape.	Project Manager & Senior EAP
2016 to 2017	Areena Resort	Application for rectification in terms of S24G and associated Environmental Basic Assessment for the alleged unlawful construction activities on Hillsdrift Farm, Great Kei Municipality, Eastern Cape.	Project Manager & Senior EAP
2018 to 2019	Watchman Properties (Pty) Ltd	Environmental Basic Assessment for the proposed Vendome Residential Development on Portion 1 of Farm 1766 and Portion 2 of Farm 1766, Paarl, Western Cape, South Africa.	Project Manager & Senior EAP

## Project Experience

Year	Client	Project Description	Role/ Responsibility
2018 to 2019	Keysha Investments 213 (Pty) Ltd	Environmental Basic Assessment for the proposed River Farm Estate Development and associated infrastructure on remainder of farm Rivierplaas No. 1486, Erf 111 and Erf 197, Paarl, Western Cape, South Africa.	Project Manager & Senior EAP
2018 to 2019	Paarl Vallei Developments (Pty) Ltd	Environmental Basic Assessment for the proposed Paarl Vallei Retirement Village Development, Paarl, Western Cape, South Africa.	Project Manager & Senior EAP
2018 to 2019	Val de Vie Investments (Pty) Ltd	Parallel Substantive Amendment Application process for the authorised Pearl Valley II & Levendal Residential Developments, Paarl, Western Cape, South Africa.	Project Manager & Senior EAP
2019 to 2021	Phumaf Holdings (Pty) Ltd	Environmental Services for: <ul style="list-style-type: none"> <li>• Full Environmental Impact Assessment for the proposed Unitas Park Ext 16 Mixed Use Development;</li> <li>• Basic Environmental Impact Assessment for the proposed Evaton West F Mixed Use Development; and</li> <li>• Basic Environmental Impact Assessment for the proposed Evaton West I Mixed Use Development.</li> </ul>	Project Manager & Senior EAP
<b>Renewable Energy Environmental Assessments</b>			
2011	Farmsecure Carbon	Environmental Basic Assessment and Water Use License Application process for a proposed Biogas Waste to Energy project for a pig farm, Mooiriver, KwaZulu-Natal.	Project Manager & Senior EAP
2018 to 2019	GPIPD - Doornfontein Solar Farm (Pty) Ltd	Environmental Impact Assessment for the proposed 230 MW Doornfontein Photovoltaic Solar Energy Facility (PVSEF) located on Remainder of Farm 118, Doornfontein, Piketberg, Bergervier Local Municipality, Western Cape.	Project Manager & Senior EAP
2018 to 2019	GPIPD - Kruispad Solar Farm (Pty) Ltd	Environmental Impact Assessment for the proposed 150 MW Kruispad Photovoltaic Solar Energy Facility (PVSEF) located on Remainder of Farm 120, Kruispad, Piketberg, Bergervier Local Municipality, Western Cape.	Project Manager & Senior EAP
2018 to 2019	Brandvalley Wind Farm (Pty) Ltd	Part 2 Amendment Application for the authorised 140 MW Brandvalley Wind Energy Facility (WEF) located within the Karoo Hoogland, Witzenberg and Laingsburg Local Municipalities in the Northern and Western Cape Provinces.	Project Manager & Senior EAP
2018 to 2019	Copperton Wind Farm (Pty) Ltd	Non-Substantive Amendment Application to update the information of the Holder of the Environmental Authorisation & an EMPr Amendment Process to update the Airstrip Alignment and to provide an updated "outcomes based" EMPr for the Copperton Wind Energy Facility near Copperton in the Northern Cape.	Project Manager & Senior EAP
2018 to 2019	WKN Windcurrent SA (Pty) Ltd	Environmental Impact Assessment for the proposed 150 MW Haga Haga Wind Energy Facility (WEF) & Environmental Basic Assessment for the associated Haga Haga Overhead Powerline (OHPL) in Haga Haga, Great Kei Local Municipality, Eastern Cape.	Project Manager & Senior EAP
2021 to 2022	Cennerg Holdings	Environmental Impact Assessment and Water Use License Application (GA) process for the proposed 100MW Lephalale Solar Plant located mainly on the Farm Appelvlakte 448 within the Lephalale Local Municipality, Limpopo.	Project Manager & Senior EAP



Year	Client	Project Description	Role/ Responsibility
<b>Mining Environmental Assessments</b>			
2007	Chris Hani Municipality	Environmental Assessment and DME Licence Application on behalf of Chris Hani Municipality. Responsible for exemption application from Mining Permit and Environmental Management Programmes for 17 borrow pits in Middelburg, Eastern Cape.	Project Manager & Senior EAP
2010	Samancor Chrome Limited	The Lwala Greenfields Mine and Smelter EIA and EMP. Responsible for the Environmental impact assessment and technical investigations for the waste management issues for the proposed development of a new chrome smelter project in the Steelpoort area, Limpopo.	Project Manager & Senior EAP
2011	Xtrata Alloys	Xtrata Alloys Western Mines PSV application for authorization in terms of the MPRDA. Responsible for the undertaking of the EIA and compilation of the amended EMPr and technical environmental investigations for the proposed development of an open cast mine in Rustenburg, North West.	Project Manager & Senior EAP
2019 to 2021	Harmony Gold	Environmental Assessment process to obtain environmental authorisation for the proposed expansion of the existing Kareerand Tailings Storage Facility, Dr Kenneth Kaunda District Municipality, North-West Province.	Project Manager & Senior EAP
2019 to 2021	Zululand Anthracite Colliery	Environmental Basic Assessment for the proposed New Mngeni Adit & Associated Infrastructure, Mandlakazi Traditional Authority, KwaZulu-Natal.	Project Manager & Senior EAP
2021 to 2022	Sibanye-Stillwater	Part 2 Amendment Application for the approved Burnstone Gold Mine EA/EMPr located near Balfour within the Dipalaseng Local Municipality, Mpumalanga.	Project Manager & Senior EAP
2021 to 2022	Exxaro Resources	Section 34 EMPr Amendment Application for the approved Grootegeluk Mine EMPr located near Lephalale within the Lephalale Local Municipality, Limpopo.	Project Manager & Senior EAP
2021 to 2022	Boysendal Northam Platinum	Part 2 Amendment Applications for the Boysendal Mine located near Lydenburg, across both Mpumalanga and Limpopo provinces: <ul style="list-style-type: none"> <li>Boysendal North Mine: New Emergency Escape Portal and two new Ventilation Shafts and associated Infrastructure; and</li> <li>Boysendal South Mine: New Ventilation Shafts and associated infrastructure.</li> </ul>	Project Manager & Senior EAP
2022 to 2023	Boysendal Northam Platinum	Integrated Environmental Authorisation Application for the Boysendal South Phase III Expansion, Lydenburg, Mpumalanga: <ul style="list-style-type: none"> <li>Boysendal South Tailings Storage Facility Expansion;</li> <li>Boysendal South Run of Mine Stockyard Stockpile Expansion; and</li> <li>Boysendal South New Merensky Plant.</li> </ul>	Project Manager & Senior EAP
2022 to 2023	Kangra Coal	Integrated Environmental Authorisation Application for the establishment of a Co-Disposal Discard Facility and Wastewater Treatment Plant at the Maquasa East Operations, Piet Retief, Mpumalanga.	Project Manager & Senior EAP
2023	Kangra Coal	Integrated Environmental Authorisation Application for the Umgala/Knights Hill Mining Application, Utrecht, KwaZulu-Natal.	Project Manager & Senior EAP

Year	Client	Project Description	Role/ Responsibility
<b>Waste Management Environmental Assessments</b>			
2003	Assmang Chrome Machadodorp	Environmental Impact Assessment for the permitting of the H:H Hazardous Waste Disposal Facility at Assmang Chrome, Machadodorp.	Senior EAP
2004	Emfuleni Local Municipality	Environmental Impact Assessment for the closure of the Zuurfontein Landfill site for the Emfuleni Local Municipality, Sedibeng, Gauteng	Senior EAP
2004	Ekurhuleni Municipality	Environmental Impact Assessment for the closure of the Sebenza Landfill Site for the Ekurhuleni Municipality, Gauteng.	Senior EAP
2004	Tzaneen Local Municipality	Application for authorisation and EIA for the permitting of an existing solid waste disposal site for the Tzaneen Local Municipality, Mpumalanga.	Senior EAP
2006	Samancor Chrome Middelburg	Environmental Basic Assessment for the permitting of the existing Slag Waste Disposal facility for Samancor Chrome Middelburg, Mpumalanga.	Senior EAP
2006	Samancor Chrome Ferrometals	Environmental Basic Assessment for the permitting of the existing Slag Waste Disposal facility for Samancor Chrome Ferrometals Witbank, Mpumalanga.	Senior EAP
2007	Steve Tshwete Municipality	Environmental Impact Assessments for four Solid waste Transfer Stations for the Steve Tshwete Municipality, Mpumalanga.	Senior EAP
2008	Assmang Chrome Machadodorp	Environmental Impact Assessment for the expansion of the existing Slag Waste Disposal Facility at Assmang Chrome. Responsible for the EIA application for authorization for the proposed expansion project in Machadodorp, Mpumalanga.	Project Manager & Senior EAP:
2010	ArcelorMittal	ArcelorMittal BOF Slag Disposal site licensing of new site and closure of old site, Newcastle, KwaZulu-Natal.	Project Manager & Senior EAP:
2010	Lekwa Municipality	Waste Management License Application for authorization and the conducting of an EIA and technical environmental investigation for the proposed development of two landfill sites for the Lekwa Municipality, Mpumalanga.	Project Manager & Senior EAP:
2015 to 2017	Umgungundlovu Municipality	Advanced Solid Waste Management Project for Umgungundlovu Municipality for proposed Materials Recovery Facilities located in various Local Municipalities, Umgungundlovu Municipality, KwaZulu-Natal.	Project Manager & Senior EAP:
2019 to 2022	Buffalo Coal	Magdalena Colliery Waste Management License Application, Dundee, KwaZulu-Natal.	Project Manager & Senior EAP:
<b>Water and Wastewater Environmental Assessments</b>			
2004	Msukaligwa Municipality	Environmental Impact Assessment for the installation of a water reticulation system at Nganga for the Msukaligwa Municipality, Mpumalanga.	Senior EAP
2006 to 2010	eThekweni Municipality: Water and Sanitation	Proposed upgrading of the WWTW capacity in the Northern Areas of the eThekweni Municipality. Responsible for EIA application for authorization, technical environmental investigations, and waste management license application for the proposed expansion of the WWT capacity in Northern eThekweni, KwaZulu-Natal.	Project Manager & Senior EAP

## Project Experience

Year	Client	Project Description	Role/ Responsibility
2008	Johannesburg Water	Environmental Management Services for Johannesburg Water: Environmental Impact Assessment (Exemption) for various individual projects related to the upgrading of the Bryanston Water Mains, Gauteng.	Project Manager & Senior EAP
2014 to 2017	eThekweni Municipality: Water and Sanitation	Environmental Basic Assessment and Water Use License Application for the Northern Aqueduct Water Augmentation Project (Phase 5), Durban, KwaZulu-Natal.	Project Manager & Senior EAP
<b>Electrical and Linear Environmental Assessments</b>			
2005	Magallies Water	Application for (exemption) authorisation on behalf of Magallies Water for the installation of the Rising Main from the Roodeplaas Waterworks to the Wallmannsthal Reservoir, in Wallmannsthal, Gauteng.	Senior EAP
2010	Moloto Rail Corridor Development	EIA for the Moloto Rail Corridor Development. Responsible for the EIA application for authorization and technical environmental investigations for the proposed Moloto Rail Corridor Development, Moloto, Gauteng.	Project Manager & Senior EAP
2010	ESKOM	Environmental Basic Assessment of for the ESKOM Honingklip 88kV & ESKOM Randjiesfontein 88kV overhead line and Sub-Stations, Johannesburg, Gauteng.	Project Manager & Senior EAP
2010	ESKOM	Environmental Basic Assessment of for the ESKOM Ubertas Strategic Servitude Sub-Station, Johannesburg, Gauteng	Project Manager & Senior EAP
2014 to 2017	Msunduzi Municipality	Environmental Impact Assessment for the proposed Msunduzi IRPTN project, Pietermaritzburg, KwaZulu-Natal	Project Manager & Senior EAP
<b>Environmental and Waste Management Compliance Monitoring and Auditing</b>			
2005 to 2009	Sedibeng District Municipality	Auditing of Zuurfontein and Boitshepi Landfill sites for the Sedibeng District Municipality, Gauteng.	Part of Audit Team
2006 to 2009	ABSA DevCO	Environmental Compliance monitoring in accordance with relevant authorisation conditions and environmental management plans for the Amberfield Development on the farm Brakfontein 399 JR, Centurion, Gauteng.	Project Manager & Environmental Control Officer (ECO)
2007 to 2009	ABSA DevCO	Environmental Compliance monitoring in accordance with relevant authorisation conditions and environmental management plans for the Zambezi Estate Development, Montana, Gauteng.	Project Manager & ECO
2008 to 2009	Steve Tshwete Municipality	Auditing of Middelburg Landfill Site for the Steve Tshwete Municipality, Mpumalanga.	Part of Audit Team
2008 to 2009	ABSA DevCO	Environmental Compliance monitoring in accordance with relevant authorisation conditions and environmental management plans for the Cedar Creek Development, Fourways, Gauteng.	Project Manager & ECO
2017 to 2018	Dube TradePort	Environmental Compliance monitoring in accordance with relevant authorisation conditions and environmental management plans for the construction of TradeZone 2, Dube TradePort, La Mercy, KwaZulu-Natal.	Project Manager & ECO
2017	Richards Bay Minerals	Environmental Legal Compliance Audit to determine the level of compliance of Richards Bay	Project Manager &

## Project Experience

Year	Client	Project Description	Role/ Responsibility
		Minerals' to their various mining, water and waste licenses and environmental authorisations and permits, Richards Bay, KwaZulu-Natal.	Environmental Auditor
2017 to 2018	eThekweni Municipality	Environmental Compliance monitoring in accordance with relevant authorisation conditions and environmental management plans for the construction of the Northern Aqueduct Phase 5, Durban, KwaZulu-Natal.	Project Manager & ECO
2019	Buffalo Coal	Annual EMPr and WUL audits for Coalfields, Aviemore and Magdalena Operations, Dundee, KwaZulu-Natal.	Project Manager & Lead Auditor
2020	Buffalo Coal	Annual EMPr and WUL audits for Coalfields, Aviemore and Magdalena Operations, Dundee, KwaZulu-Natal.	Project Manager & Lead Auditor
2020	Samancor Eastern Chrome Mines	Annual Performance Assessment Audits for the following mines in Limpopo: <ul style="list-style-type: none"> <li>• Doornbosch, Steelpoort and Montrose Mines;</li> <li>• Quartz Mine;</li> <li>• Lwala Mine;</li> <li>• Lannex Mine;</li> <li>• Spitskop Mine; and</li> <li>• Tweefontein Mine.</li> </ul>	Project Manager & Technical Review
2020	ESKOM	ESKOM Biennial PCB Phase-out Compliance Audit, various sites within South Africa.	Project Manager & Lead Auditor
2020	ESKOM	Majuba Power Station Legal Compliance Audit, Volksrust, Mpumalanga.	Project Manager & Lead Auditor
2021	Zululand Anthracite Colliery	Annual IWUL Audit for 2020, Mandlakazi Traditional Authority, KwaZulu-Natal	Project Manager & Technical Review
2021	ESKOM	Kendal Power Station Legal Compliance Audit, eMalahleni Local Municipality, Mpumalanga.	Project Manager & Lead Auditor
2021	Coalition Trading	External Compliance Audit for the Humberdale Landfill Site, in terms of the Waste Management Permit, KwaZulu-Natal	Project Manager & Auditor
2021	Tronox KZN Sands (Pty) Ltd	NEM: WA Norms and Standards External Waste Compliance Audit for the Tronox Central Processing Complex located in Empangeni, KwaZulu-Natal	Project Manager & Lead Auditor
Integrated Water Use License Applications			
2010	FOSKOR	Integrated Water Use License Application for a new storage dam for FOSKOR, Richards Bay, KwaZulu-Natal.	Part of Project Team
2014 to 2015	SANRAL	Integrated Water Use License Applications as required for the proposed SANRAL N2 Road upgrade from Mthunzini to Empangeni, KwaZulu-Natal.	Project Manager & Senior EAP
2014	eThekweni Municipality: Roads	Integrated Water Use License Application for the proposed Realignment of Inanda Arterial Road, Durban, KwaZulu-Natal.	Project Manager & Senior EAP

## Project Experience

Year	Client	Project Description	Role/ Responsibility
2015 to 2017	SMEC (Umzimkhulu Municipality)	Integrated Water Use License Application for the proposed Licensing of the existing Umzimkhulu Waste Water Treatment Works, Umzimkhulu, KwaZulu-Natal.	Project Manager & Senior EAP
2014 to 2016	eThekweni Municipality: Roads	Water Use License Application for the proposed eThekweni BRT Route C1A, Durban, KwaZulu-Natal.	Project Manager & Senior EAP
2019 to 2020	Zululand Anthracite Colliery	Integrated Water Use License Application for the new Mngeni Adit and associated infrastructure, Mandlakazi Traditional Authority, KwaZulu-Natal.	Project Manager & Senior EAP
2019 to 2021	South32 SA Coal Holdings	Integrated Water Use License Application for the Roy Point Mine, Newcastle, KwaZulu-Natal.	Project Manager & Senior EAP
2020 to 2022	Buffalo Coal	Integrated Water Use License Amendment Application for the Magdalena Colliery, Dundee, KwaZulu-Natal.	Project Manager & Senior EAP
2020 to 2022	Buffalo Coal	Integrated Water Use License Application for the Coalfields Processing Plant, Dundee, KwaZulu-Natal.	Project Manager & Senior EAP
<b>Management and Master Plans</b>			
2005	Livingstone Municipality	Development of the Livingstone Integrated Development Plan, Zambia.	Part of the Project Team
2008	Steve Tshwete Municipality	Development of an Integrated Waste Management Plan for the Steve Tshwete Municipality, Mpumalanga.	Part of the Project Team
2008	Kungwini Local Municipality	Development of an EMP (Framework) for Kungwini Local Municipality, Mpumalanga.	Part of the Project Team
2010	KZN Department of Public Works - Southern Region	Compilation of an Environmental Management Plan for the Fort Napier sewage upgrading project, Pietermaritzburg, Kwa-Zulu Natal.	Project Manager & Senior EAP






## Declaration

---

### DECLARATION

I, Gerda Bothma hereby declare that the details furnished above are true and correct to the best of my knowledge and belief and I undertake to inform you of any changes therein, immediately. In case any of the above information is found to be false or untrue or misleading or misrepresenting, I am aware that I may be held liable for it.

Signature:  Date: 21/02/2024



# University of Pretoria

The Council and Senate hereby declare that  
at a congregation of the University the degree

## Baccalaureus Scientiae with specialization in Biological Sciences

with all the associated rights and privileges  
was conferred on

**GERDA DE LANGE**

in terms of the Act and Statute of the University

On behalf of the Council and Senate  
(Sgd) P Smit  
Vice-Chancellor and Principal

On behalf of the Faculty of  
Science  
(Sgd) N Sauer  
Dean

(Sgd) CR de Beer  
Registrar

Date of Conferment  
8 December 1994

Certified a true translation of the original Certificate

  
Registrar

Signed at Pretoria on the third day of September, 2008



# University of Pretoria

The Council and Senate hereby declare that  
at a congregation of the University the degree

## Baccalaureus Scientiae Honores with specialization in Microbiology

with all the associated rights and privileges  
was conferred on

**GERDA DE LANGE**

in terms of the Act and Statute of the University

On behalf of the Council and Senate  
(Sgd) P Smit  
Vice-Chancellor and Principal

On behalf of the Faculty of Biological  
and Agricultural Sciences  
(Sgd) J van Zyl  
Dean  
(Sgd) JA Boon  
Registrar

Date of Conferment  
27 March 1996

Certified a true translation of the original Certificate

*A. Smit*  
Registrar

Signed at Pretoria on the third day of September, 2008



**herewith certifies that**

**Gerda Bothma**

Registration Number: 117348

**is a registered scientist**

in terms of section 20(3) of the Natural Scientific Professions Act, 2003  
(Act 27 of 2003)

in the following field(s) of practice (Schedule 1 of the Act)

Environmental Science (Professional Natural Scientist)

Effective **15 November 2017**

Expires **31 March 2024**



A handwritten signature in black ink, appearing to read 'S. Neph', is written over a horizontal line.

Chairperson

A handwritten signature in black ink, appearing to read 'N. S. S. S.', is written over a horizontal line.

Chief Executive Officer



## CORE SKILLS

- Project Management
- Environmental Impact Assessment
- Environmental Impact Management
- Water Use Licencing
- Waste Management Licencing
- Integrated Water and Waste management Plans
- Environmental & Waste Auditing and Compliance Monitoring

## DETAILS

### Qualifications

- BSc (Honours) Environmental Monitoring and Modelling University of South Africa, 2020
- BSc Zoology University of KwaZulu-Natal, 2006

### Memberships/ Professional Affiliations

- International Association for Impact Assessors of South Africa (IAIA)
- SACNASP (No.008920) (South African Council for Natural Scientific Professionals)
- Environmental Assessment Practitioners Association of South Africa: Registered Environmental Assessment Practitioner (Reg. No. 2022/4847)

### Languages

- Afrikaans
- English

### Countries worked in:

South Africa

## PROFILE

Ms Reneé Steele has 15 years' experience in the environmental field and strives to provide quality consulting services to client to meet their environmental legislative obligations.

Renee has been involved in a wide range of projects for clients across the industrial, residential, agricultural and mining sectors. These projects have included environmental impact assessments; mining right, mining permit, prospecting permit applications; environmental due diligence; water use licence applications; environmental performance auditing and Environmental Control Officer (ECO) work.

In addition to two formal degrees, Reneé has completed accredited training in respect of the implement of the ISO9001:2015, ISO 14001:2015 and ISO 45001:2018 standards.

Renee has specialist skills in the following areas:

- Project proposals, planning, costing and timing
- Project and client management
- Authority Liaison
- Basic Assessments & Scoping/EIA Processes
- Amendment of Environmental Management Programmes
- Facilitation of Public Participation Processes & Stakeholder Engagement
- Water Use Licence Applications
- Integrated Water and Waste Management Plan compilation
- Environmental Control Officer (ECO) duties
- Environmental Compliance Auditing



## Project Experience

Period	Employer	Position	Role/ Responsibility
2017 to present	Steele Environmental Consulting	Director and Principal Environmental Consultant	<ul style="list-style-type: none"> <li>• Management of projects to ensure projects are completed within the agreed upon or legislated timeframe.</li> <li>• Managing project budgets.</li> <li>• Management of interdisciplinary specialist teams.</li> <li>• Environmental Control Officer duties.</li> <li>• Marketing to new clients and compiling proposals.</li> <li>• Environmental auditing and consulting.</li> <li>• Environmental Impact Assessments.</li> </ul>
2007- 2016	GCS Water and Environmental Consultants	Senior Environmental Consultant	<ul style="list-style-type: none"> <li>• Management of project timeframes to ensure projects were completed within the agreed upon or legislated timeframe.</li> <li>• Liaison with clients, provincial and national authorities, and the public.</li> <li>• Management of interdisciplinary specialist teams.</li> <li>• Managing project budgets.</li> <li>• Undertaking Environmental Impact Assessments, Water Use Licence Applications, Environmental Performance Audits, Water Use Licence audits, Environmental Management Programme amendments and permit applications.</li> <li>• Marketing and compilation of proposals.</li> </ul>

Year	Client	Project Description	Role/ Responsibility
<b>Water Use Licensing &amp; IWWMPs</b>			
2015	Kangra Coal	Ballengeich and Shanduka Siding Remediation IWULA/IWWMP, Newcastle, KwaZulu-Natal	IWWMP Compilation, liaison with authorities.
2014	Exxaro	Glisa Coal Mine Water Treatment Plant: Belfast, Mpumalanga	IWULA/IWWMP compilation.
2012	Exxaro	Matla Colliery Water Treatment Plant: Kriel, Mpumalanga	Review of IWULA submitted, follow up and submission of outstanding information.
2012	Assmang Chrome	Assmang Dwarsrivier GN704 Exemption application: Steelpoort, Limpopo	GN704 inspection, compilation of exemption application.
2012	Transvaal Gold Mining Estates (Pty) Limited	TGME Glynn's Lydenburg and Rietfontein IWULA follow up: Lydenburg and White River	Follow up with the DWS and submission of additional information.
2012	Magaliesberg Water	Magaliesberg Water, Brits, North West Province	WULA compilation.
2012	Mpumalanga Provincial Government: Department of Roads and Transport	P166/R40 Link Road WULA: Nelspruit, Mpumalanga Province	IWULA compilation
2011	Exxaro	Glisa Colliery North Block Complex IWULA amendment: Belfast, Mpumalanga Province	IWULA and IWWMP compilation.
2010	Gold Fields	Gold Fields Centralised Tailings Storage Facility- Integrated Water Use Licence Application (IWULA), Carletonville, Gauteng Province	IWULA and IWWMP compilation.
2010	Total Coal	Forzando North IWULA separation and update: Bethal, Mpumalanga Province	IWULA amendment report compilation.
2010	Assmang Chrome	Dwarsrivier Chrome Mine: Tailings Storage Facility: Steelpoort, Limpopo Province	Public consultation and IWUL compilation.
2009	Namakwa Diamonds	Namakwa Diamonds Water Use Licence Applications, Northern Cape: Various locations within the Northern Cape Province	IWULA compilation.
2009	Rainbow Farms (Pty) Ltd	Rainbow Farms (Pty) Ltd: Water Use Registrations and Licensing: Gauteng, Mpumalanga, KwaZulu-Natal, Eastern Cape, Western Cape	Registration and IWULA Report compilation and follow up.
2008	Mpumalanga Provincial Government: Department of Roads and Transport	P166 Bypass Road: Water Use Licence Application: Nelspruit, Mpumalanga Province	IWULA compilation.
2008	Mpumalanga Provincial Government: Department of Roads and Transport	R40 Road upgrade Water Use Authorisation Application: Nelspruit, Mpumalanga Province	GA application report compilation.
2008	Anglo Platinum	Richmond Mine IWULA, Limpopo Province	IWULA compilation.

## Project Experience

Year	Client	Project Description	Role/ Responsibility
2008	Schamach Wildlife Estate cc	Schamach Wildlife Estates: Water Use Authorisation Application: Modimolle, Limpopo Province	General authorisation application report compilation.
<b>EIA and EMP</b>			
2014	South 32	Roypoint Mine Remediation Project Newcastle, KwaZulu-Natal	Project management, compilation of EIA, EMP and IWULA (handed over before completion due to retrenchment in August 2016).
2013	Kangra Coal	Kangra Coal Maquasa East Discard Dump: Piet Retief, Mpumalanga	Project Manager, public consultation, and compilation of EIA, EMP and IWULA.
2014	Namaqua Nickel Mining (Pty) Ltd	Jacomynspan Mining Right Application: Putsonderwater, Northern Cape Province	Environmental Scoping Report and EIA Report compilation.
2013	Two Rivers Platinum	Two Rivers Platinum New Tailings Storage Facility: Steelpoort, Limpopo	NEMA EIA/EMP Report compilation.
2013	Northam Zondereinde	Northam Zondereinde Mine MPRDA EMP consolidation: Northam, Limpopo	Project management, MPRDA EMP compilation
2013	Northam Zondereinde	Northam Zondereinde Mine NEM: WA Basic Assessment: Northam, Limpopo	Project management, NEM:WA Basic Assessment process (including public consultation).
2012	Total Coal	Coal Briquetting Plant EMP Addendum for Total Coal Forzando North Coal Mine: Bethal, Mpumalanga Province	Compilation of EMP addendum.
2012	Kgosana Mineral and Construction	Mining Permit Environmental Management Plans for Coal Mining Permit Applications: Witbank, Mpumalanga Province	Project management, mining permit application, public consultation and EMP compilation.
2012	Main Street 778 (Pty) Ltd	Mukulu Project EMP & NEMA Process: Hotazel, Northern Cape Province	Project management, NEMA and MPRDA process, including report compilation and public consultation.
2012	Transworld Energy and Mineral Resources South Africa	Kwanyana Block Prospecting Right Application: Bizana, Eastern Cape Province	Report compilation and public consultation.
2012	Transworld Energy and Mineral Resources South Africa	Tormin Mineral Sands Resources Prospecting Right Application: Lutzville Western Cape Province	Report compilation and public consultation.
2011	Witkop Exploration and Mining	Witkop Exploration and Mining- Mining Permit Application: Viljoenskroon, Free State Province	Public notification and ESR compilation.
2010	Assmang Iron Ore	Assmang Iron Ore, Beeshoek Mine: Road Diversion: Beeshoek, Northern Cape Province	Public consultation and EIA/EMP report compilation.

## Project Experience

Year	Client	Project Description	Role/ Responsibility
2010	African Exploration Mining and Finance Corporation	African Exploration Mining and Finance Corporation Prospecting Permit, Cape Town, and Stellenbosch: Cape Town and Stellenbosch, Western Cape Province	Public consultation, compilation of EMP and Stakeholder Engagement Report.
2010	ArcelorMittal South Africa	ArcelorMittal South Africa Vanderbijlpark Works Temporary Storage Area: Vanderbijlpark, Gauteng Province	Compilation of Basic Assessment Report.
2009	Rand Refinery	Rand Refinery Cadmium Furnace Project, Exemption Application: Germiston, Gauteng Province	Public consultation, compilation of exemption application and EMP.
2009	Booyseendal Platinum Limited	Northam Booyseendal Mine: Environmental Authorisation: Roosenekal, Limpopo Province	Environmental Scoping Report compilation.
2009	Moshutwa Trading	Moshutwa Trading Prospecting Permit Application, Lephalale: Lephalale, Limpopo Province	Prospecting right application, public notification, and compilation of EMP and stakeholder engagement report.
2009	NFT Quarries	NFT Quarries Mining Permit Application, East London (Council for Geoscience): East London, Eastern Cape Province	Prospecting right application, public notification, and compilation of EMP and stakeholder engagement report.
<b>Environmental Control Officer</b>			
2017-2023	Booyseendal Platinum Limited	Booyseendal Platinum Mine South Expansion Project	Environmental Control Officer duties
<b>Environmental Performance Audits</b>			
2023	Sitatunga Manganese	East Manganese Mine, Hotazel, Northern Cape	PAR and WUL Audit
2023	Canyon Coal	Rietkuil Siding, IWUL audit, Mpumalanga (2023)	IWUL performance audit
2023	Canyon Coal	Pan Siding, IWUL audit, Mpumalanga (2023)	IWUL performance audit
2023	Menar (Pty) Ltd	Menar Riverside Anthracite Colliery, PAR, Vryheid, KwaZulu-Natal	NEMA Regulation 34 Performance Assessment
2022	Steynol (Pty) Ltd	Steynol Welgedacht siding IWUL Audit	IWUL performance audit
2021	Canyon Coal	Canyon Coal Hakhano Colliery, Middleburg Mpumalanga	IWUL performance audit and NEMA PAR.
2020	Canyon Coal	Rietkuil Siding, IWUL audit, Mpumalanga (2019 and 2021)	IWUL performance audit
2020	Canyon Coal	Pan Siding, IWUL audit, Mpumalanga (2019 and 2021)	IWUL performance audit
2019	Canyon Coal	Canyon Coal Hakhano Colliery, Middleburg Mpumalanga (2019)	IWUL performance audit and NEMA PAR.

## Project Experience

Year	Client	Project Description	Role/ Responsibility
2019	Canyon Coal	Canyon Coal Argent Siding, Mpumalanga	IWUL performance audit
2017	Assmang Chrome	Assmang Chrome Machadadorp Works, Machadorp, Mpumalanga	IWUL, Waste Licence, EMP and environmental authorisation performance audits
2017	Kathu Solar Park	Kathu Solar Park, Kathu, Northern Cape	EMP and IWUL performance audits.
2013	Anglo Coal	Anglo Lephalale Coal Bed Methane GA: Lephalale, Limpopo	Reporting on General Authorisation compliance.
2013	Anglo Platinum Limited	Anglo Platinum Limited: Polokwane Metallurgical Complex (PMC), Polokwane, Limpopo	IWUL compliance audit and reporting.
2012	Northam Zondereinde	Northam Zondereinde Mine Environmental Performance Assessment; Northam, Limpopo	Environmental Performance Assessment (EMP)
2009	SNS Bricks	SNS Bricks, Vereeniging, Environmental Performance Audit: Vereeniging, Gauteng Province (2009).	Environmental Performance Assessment (Environmental Authorisation)
2009	Xstrata	Xstrata Horizon Mine Waste Licence Audit: Rustenburg, North West Province	Environmental Performance Assessment (Waste Licence)
2008	SNS Bricks	SNS Bricks, Vereeniging, Environmental Performance Audit: Vereeniging, Gauteng Province (2008).	Environmental Performance Assessment (Environmental Authorisation)
<b>Due Diligence</b>			
2012	Assmang Iron Ore	Assmang Beeshoek Mine Environmental Legal Gap Analysis: Beeshoek, Northern Cape Province	Environmental Due Diligence Assessment process and report compilation.
2011	Lonmin Platinum	Lonmin Platinum Limpopo: Gap Analysis and Due Diligence Assessment: Lebowakgomo, Limpopo Province	Due diligence assessment and report compilation.
<b>Other</b>			
2009	ArcelorMittal South Africa	ArcelorMittal South Africa Vanderbijlpark Works Dam 10 and CETP Dams Remediation: Vanderbijlpark, Gauteng Province	Compilation of Remediation Alternatives Report.
2009	ArcelorMittal South Africa	ArcelorMittal South Africa- Dunswart Waste Site Remediation: Benoni, Gauteng Province	Site Remediation Alternatives Report compilation.
2010	Department of Water Affairs	Groundwater Information Project: KwaZulu-Natal	Review and capture borehole data and attend monthly feedback meetings with the DWS.



### DECLARATION

I, Reneé Steele hereby declare that the details furnished above are true and correct to the best of my knowledge and belief and I undertake to inform you of any changes therein, immediately. In case any of the above information is found to be false or untrue or misleading or misrepresenting, I am aware that I may be held liable for it.

Signature: \_\_\_\_\_

Date: 20/02/2024



**Environmental Assessment  
Practitioners Association  
of South Africa**



Registration No. 2022/4847

***Herewith certifies that***

**Renee Lynneil Steele**

***is registered as an***

**Environmental Assessment Practitioner**

***Registered in accordance with the prescribed criteria of Regulation 15. (1)  
of the Section 24H Registration Authority Regulations  
(Regulation No. 849, Gazette No. 40154 of 22 July 2016, of the  
National Environmental Management Act (NEMA), Act No. 107 of 1998, as  
amended).***

Effective: 01 March 2023

Expires: 29 February 2024

Chairperson

Registrar







**herewith certifies that**  
**Renee Lynneil Steele**  
Registration Number: 008920  
**is a registered scientist**

in terms of section 20(3) of the Natural Scientific Professions Act, 2003  
(Act 27 of 2003)  
in the following field(s) of practice (Schedule 1 of the Act)  
Environmental Science (Professional Natural Scientist)

Effective    **23 October 2013**

Expires      **31 March 2024**



A handwritten signature in black ink, appearing to read 'S. Neph', is positioned above a horizontal line.

Chairperson

A handwritten signature in black ink, appearing to read 'N. S. S.', is positioned above a horizontal line.

Chief Executive Officer





*We certify that*

**RENEE LYNNEIL FRANCIS**


*having complied with the requirements of the Higher Education Act  
and the Institutional Statute, was admitted to the degree of*

**BACHELOR OF SCIENCE HONOURS**  
*in Environmental Monitoring and Modelling*

*at a congregation of the University  
on 5 October 2020*



Vice Chancellor



Executive Dean



University Registrar

29810355037437G05702





# UNIVERSITY OF KWAZULU-NATAL

The Universities of Durban-Westville and Natal merged  
to become the University of KwaZulu-Natal on 1 January 2004

*This is to certify that*

***Renee Lynneil Francis***

*was admitted this day  
at a congregation of the University  
to the degree of*

***Bachelor of Science  
(Zoology)***

*having satisfied the conditions prescribed for the degree.*



M W Makgoba  
Vice-Chancellor

E Mneney  
Registrar

J A Cooke  
Dean

21 April 2007

LIV PROTECTED



## APPENDIX B: **GENERIC METHOD STATEMENT**

## **Generic Method Statement**

Information pertaining to the activity which will be undertaken:

What activity will take place?
How will the activity be undertaken (methods)?
Machinery/plant/equipment or vehicles which will be needed?
Materials required and relevant hazard status?
Where on site will the activity take place and what will the extent of the activity be?
Timeframes of activity (start and end dates)?

Impact and Risk Assessment of the Activity:

Impact sources	
Receptors	
Objective	
Risks	
Notes	

The following signatures represent a binding agreement to the Method Statement and EMPr by all Contractors and Subcontractors involved in the above activity.

Role	Name	Company	Date	Signature
Client				
Engineer/Applicant's representative				
Contractor				
ECO				