mineral resources

Department:
Mineral Resources
REPUBLIC OF SOUTH AFRICA

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

And

ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT

FOR LISTED ACTIVITIES ASSOCIATED WITH MINING RIGHT

SUBMITTED IN TERMS OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998, THE NATIONAL ENVIRONMENTAL MANAGEMENT WASTE ACT, 2008, AND THE MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT, 2002 (MPRDA) (AS AMENDED).

NAME OF APPLICANT: IMERYS REFRACTORY MINERALS SOUTH AFRICA, CYFERFONTEIN MINE
TEL NO: +27 79 898 0770
POSTAL ADDRESS: PO Box 248, Bronkhorstspruit, 1020
PHYSICAL ADDRESS: Portion 7 of the farm Cyferfontein, Modimolle
FILE REFERENCE NUMBER SAMRAD: LP30/5/1/2/3/2/1/71 EM
Application property: Portions 7, 61 & 62 of the farm Cyferfontein 457 KR

December 2017

BECS environmental

PO Box 72960, Lynnwood Ridge, 0040;
Cell: 072 191 6074, Fax: 012 361 0645
E-mail: salome@becsenv.co.za

1 IMPORTANT NOTICE

In terms of the Mineral and Petroleum Resources Development Act (Act 28 of 2002 as amended) (MPRDA), the Minister must grant a prospecting or mining right if among others the mining "will not result in unacceptable pollution, ecological degradation or damage to the environment".

Unless an Environmental Authorisation can be granted following the evaluation of an Environmental Impact Assessment (EIA) and an Environmental Management Programme report (EMP) in terms of the National Environmental Management Act (Act 107 of 1998) (NEMA), it cannot be concluded that the said activities will not result in unacceptable pollution, ecological degradation or damage to the environment.

In terms of section 16(3)(b) of the EIA Regulations, 2014, any report submitted as part of an application must be prepared in a format that may be determined by the Competent Authority and in terms of section 17 (1) (c) the competent Authority must check whether the application has taken into account any minimum requirements applicable or instructions or guidance provided by the competent authority to the submission of applications.

It is therefore an instruction that the prescribed reports required in respect of applications for an environmental authorisation for listed activities triggered by an application for a right or a permit are submitted in the exact format of, and provide all the information required in terms of, this template. Furthermore, please be advised that failure to submit the information required in the format provided in this template will be regarded as a failure to meet the requirements of the Regulation and will lead to the Environmental Authorisation being refused.

It is furthermore an instruction that the Environmental Assessment Practitioner (EAP) must process and interpret his/her research and analysis and use the findings thereof to compile the information required herein. (Unprocessed supporting information may be attached as appendices). The EAP must ensure that the information required is placed correctly in the relevant sections of the Report, in the order, and under the provided headings as set out below, and ensure that the report is not cluttered with uninterpreted information and that it unambiguously represents the interpretation of the applicant.

2 OBJECTIVES OF THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

The objective of the EIA process is to, through a consultative process—

a. determine the policy and legislative context within which the activity is located and document how the proposed activity complies with and responds to the policy and legislative context;
b. describe the need and desirability of the proposed activity, including the need and desirability of the activity in the context of the preferred location;
c. identify the location of the development footprint within the preferred site based on an impact and risk assessment process inclusive of cumulative impacts and a ranking process of all the identified development footprint alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects of the environment;
d. determine the—-
    i. nature, significance, consequence, extent, duration and probability of the impacts occurring to inform identified preferred alternatives; and
    ii. degree to which these impacts—
        aa. can be reversed;
        bb. may cause irreplaceable loss of resources, and
        cc. can be avoided, managed or mitigated;
e. identify the most ideal location for the activity within the preferred site based on the lowest level of environmental sensitivity identified during the assessment;
f. identify, assess, and rank the impacts the activity will impose on the preferred location through the life of the activity;
g. identify suitable measures to manage, avoid or mitigate identified impacts; and
h. identify residual risks that need to be managed and monitored.

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ABBREVIATIONS

ABI	Avifaunal biodiversity index
AQMP	Air Quality Management Plan
CBA	Critical Biodiversity Areas
DD	Data deficient
DMR	Department of Mineral Resources
DRDLR	Department of Rural Development and Land Reform
DWS	Department of Water and Sanitation
EA	Environmental authorisation
EAP	Environmental Assessment Practitioner
ECA	Environmental Conservation Act 73 of 1989 as amended
EDD	Expanded Durov diagram
EIA	Environmental Impact Assessment
EIA/EMP	Environmental Impact Assessment Report/Environmental Management Programme
EIA	Early Iron Age
EIS	Ecological Importance and Sensitivity
ESA	Ecological Support Areas
ESA	Earlier Stone Ages
ESR	Environmental scoping report
FEL	Front End Loader
GA	General authorisation
HIA	Heritage Impact Assessment
I&APs	Interested and affected parties
IDP	Integrated Development Plan
IEA	Integrated environmental authorisation
IWUL	Integrated Water Use License
IWULA	Integrated Water Use License Application
LED	Local Economic Development
LHRA	Limpopo Heritage Resources Agency
LSA	Later Stone Ages
MA	Minerals Act no 50 of 1991
MLM	Modimolle Local Municipality
MPRDA	Mineral and Petroleum Resources Development Act No 28 of 2002 (as amended)
MPRDR	Mineral and Petroleum Resources Development Regulations, GN 527 of 2004 (as amended) i.t.o. the Mineral and Petroleum Resources Development Act No 28 of 2002 (as amended)
MSA	Middle Stone Ages

MWP	Mining works programme
NDEA	National Department of Environmental Affairs
NEMA	National Environmental Management Act No 107 of 1998 (as amended)
NEMAQA	National Environmental Management: Air Quality Act No 39 of 2004 (as amended)
NEMBA	National Environmental Management Biodiversity Act No 10 of 2004 (as amended)
NEMWA	National Environmental Management Waste Act 59 of 2009 (as amended)
NFA	National Forest Act No 84 of 1998
NHRA	National Heritage Resources Act No 25 of 1999
NT	Near Threatened
NVFFA	National Veld Fires and Forest Act No 101 of 1998 (as amended)
NWA	National Water Act no 36 of 1998 (as amended)
RoD	Record of decision
RoM	Run of Mine
SAHRA	South African Heritage Resources Agency
SLP	Social and labour plan
TDS	Total dissolved solids
WDM	Waterberg District Municipality
WSA	Water Services Authority
WSDP	Water Services Development Plan

Executive summary

Applicant

BECS Environmental has been appointed by Imerys Refractory Minerals South Africa (Pty) Ltd Cyferfontein Mine (Cyferfontein Mine) to apply for an integrated environmental assessment for the extension of the mine in terms of Section 102 of the MPRDA; as well as an integrated water use license application (IWULA) in terms of. the National Water Act No 36 of 1998 (as amended) (NWA). Cyferfontein Mine has an existing mining right on portion 7 of the farm Cyferfontein 457 KR, in Limpopo Province, with reference number LP30/5/1/2/3/2/1/71 EM (refer to the mining right attached as Addendum 5A).

The existing Cyferfontein Mine, mines clay with an annual production rate of 133,000T of product per annum. The current mine has reserves until the year 2018, where after these reserves are depleted. The mine applied for a prospecting right in 2014 on portions 61, 62 and 3 of the farm Cyferfontein 457 KR. This prospecting right was granted in April 2017 with file reference number LP30/5/1/1/2/12071PR (refer to the prospecting right attached as Addendum 5B). Please note, this mining right extension application does not include portion 3 of the farm Cyferfontein 457 KR.

Refer to Table 1 below for a description of the applicant, and Figure 1 for an organogram of the applicant. Portion 7 of the farm Cyferfontein 457 KR is owned by Johannes Petrus Nortje; and portions 61 and 62 of the farm Cyferfontein 457 KR are owned by Morula Tona Boerdery CC. Adriaan Jooste and Maria Johanna Jooste are the directors of Morula Tona Boerdery CC. These title deeds and registration certificate are attached as Addendum 4I to this report.

Table 1: Description of the applicant

Project applicant	Imerys Refractory Minerals South Africa (Pty) Ltd
Trading name	Cyferfontein Mine
Contact person	Kallie Roos
Designation	Mine Manager – Refractory Minerals (which includes Cyferfontein Mine)
Telephone number	+27 79 898 0770
E-mail address	Kallie.Roos@imerys.com

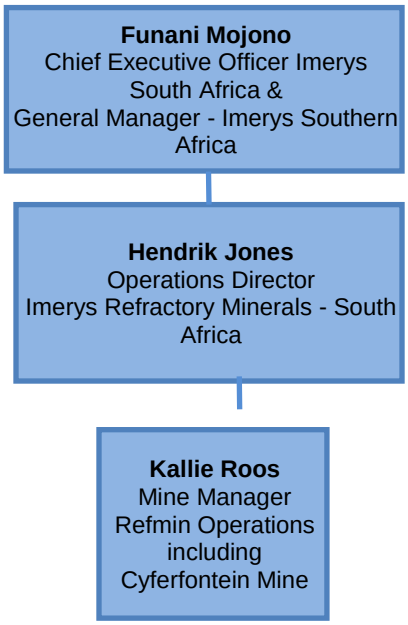


Figure 1: Cyferfontein Mine organogram

Project description

The existing activities are as follow:

- Mining and concurrent roll-over of two quarries, namely the North and South Quarries, with associated haul road and overburden dumps.
- Ore is transported by heavy machinery from the quarries to the screening plant and material stockpile dumps. The final product is transported to the client via trucks on the linked road.
- Additional infrastructure includes a contractor's camp and security gate, access road to the site and associated weigh bridge, and a dam containing water from the quarry.

The proposed extension activities are as follow:

- Extension of haul road;
- Proposed new quarry.

Alternatives to the proposed mining extension are as follow:

Two red data trees were found on the site of the proposed quarries. Alternative 1 (preferred option) is to obtain a permit for the removal of sensitive indigenous tree species from the Department of Forestry and Conservation Department with management measures to propagate, move or replant trees in rehabilitated areas. Alternative 2 is to conserve these trees *in situ* with a 50m buffer.

Mr. Jooste requested that a farm dam (final void) be retained on his farm instead of a depression over the entire quarry area.

Legal requirements

According to Section 24(2) and 24(5) of the NEMA:

'The Minister, or an MEC with the concurrence of the Minister, may identify (a) activities which may not commence without EA from the competent authority; (b) geographical areas based on environmental attributes, and as specified in spatial development tools adopted in the prescribed manner by the Minister or MEC, with the concurrence of the Minister, in which specified activities may not commence without EA from the competent authority.

The Minister, or an MEC with the concurrence of the Minister, may make regulations consistent with subsection (4) laying down the procedure to be followed in applying for, the issuing of and monitoring compliance with EAs.'

According to Section 19(1) of the National Environmental Management Waste Act No 59 of 2008 (as amended) (NEMWA):

The Minister may by notice in the Gazette publish a list of waste management activities that have, or are likely to have, a detrimental effect on the environment.

Furthermore, *a person who wishes to commence, undertake or conduct a waste management activity listed under Category B, must conduct a scoping and environmental impact reporting process set out in the EIA Regulations made under section 24(5) of the NEMA as part of a waste management licence application contemplated in section 45 read with section 20(b) of NEMWA.*

Summary of impacts

The summarised impacts are as follow:

- Total abstraction of the ore.
- Stripping of all topsoil at the open pit footprint.
- Deterioration in post-mining soil quality and land capability if soils are stripped too deep and are subsequently mixed with underlying, lower quality overburden materials, which adversely affect infiltration rates, permeability and soil stability.
- Soil erosion at rehabilitated areas where exposed soil surfaces are highly vulnerable to erosion initiation without a vegetation cover that serves as a buffer against erosion.
- Potential soil pollution by hydrocarbons caused by leaking vehicles and machinery that are used for stripping and replacement of topsoil

- A final void will occur at the end of the mining process due to a shortage of overburden material in the total pit area.
- The construction of the haul road will involve placement of a thick layer of overburden on the soil surface which will cause all productive soil functions to cease and the current land capability and land use will also cease completely until the overburden material are removed, the soil surface loosened and revegetated.
- Total destruction of indigenous vegetation in footprint areas.
- Destruction and removal of protected tree species in mining footprint areas.
- Destruction and removal of Red data tree species in mining footprint areas. Note, only for the alternative options.
- **Positive** effect of eradication of these species in mining footprint areas.
- Total destruction of faunal habitat in mining footprint areas.
- Damage to infrastructure and/or excessive inflow into open quarry. Financial/production loss and/or surface water contamination
- Nett loss in material will create depression. Surface runoff affected permanently by preventing natural drainage.
- Erosion of steep slopes accompanied by siltation of downstream receiving environment. Loss of soil with reduced capacity downstream.
- Removal of topsoil and vegetation can lead to an increase in groundwater recharge to the aquifer. It also leads to an increase of surface runoff.
- The quarry will form a depression as a result of ore that is removed, and therefore a decrease in volume of material placed back in the quarry. This could lead to impact on groundwater quality.
- It is anticipated that, if the groundwater quality is affected (not expected) by the mining operation, the quality will improve away from the quarry, as the dilution effect of the entire aquifer increases further away from the quarry.
- The construction of **haul roads** will cause a very small reduction in recharge due to the compaction of the surface of the roads.
- Air quality impact.
- Noise Disturbance.
- Change in topography leading to visible intrusions in the rural area.
- Unearthing of any heritage materials which may lead to damage or destruction of these resources.
- Safety to community.
- Game safety in quarries.
- Dust on Eersbewoond road.
- Clay in roads.

- Sirens used for mining.
- Road over wetland.

PART A

SCOPE OF ASSESSMENT AND ENVIRONMENTAL IMPACT ASSESSMENT REPORT

a) Details of the Environmental Assessment Practitioner

This section includes the following: Details of the environmental assessment practitioner (EAP); expertise of the EAP, which includes the qualifications of the EAP (with evidence) and a summary of the EAP's experience - in carrying out the EIA Procedure; and a declaration that the EAP is independent in a form as may be specified by the competent authority

BECS Environmental was appointed as an independent consultant (EAP) to meet the requirements as set out in regulation 13 of the EIA Regulations. Refer to Table 2 below to a description of the EAP, and refer to Addendum 2 for a detailed CV of the EAP, which includes the expertise including qualifications and experience.

Table 2: Description of the EAP

Name of company	BECS Environmental
Postal address	PO Box 72960, Lynnwood Ridge, 0040
Telephone number	012 361 9970
Cell phone number	072 191 6074
Facsimile number	012 361 0645
E-mail address	salome@becsenv.co.za
Name of responsible EAP	Salome Beeslaar
Expertise of EAP	B.Sc Environmental Science (UP), B.Sc Honours Geography (UP), M.Sc Geography (UP), Professional Scientist (Environmental Science)

I, Salome Beeslaar (8310190032081), hereby declare that I have no conflict of interest related to the work of this report. Specially, I declare that I have no business, personal, or financial interests in the property and/or mining right being assessed in this report, and that I have no personal or financial connections to the relevant property owners, or mine. I declare that the opinions expressed in this report are my own and a true reflection of my professional expertise and that there are no circumstances that may compromise my objectivity in performing such work.

_____

Salome Beeslaar
MSc – Geography, SACNASP (400385/14)
1 December 2017

b) Description of the property

Refer to Table 3 below for a description of the property. A locality map of the Cyferfontein Mine is provided below in Figure 2.

Table 3: Farm names, 21-Digit Surveyor General codes, and coordinates

Farm names of existing mine	Portion 7 of the farm Cyferfontein 457 KR	
Farm names of extension area of the mine	Portions 7, 61 & 62 of the farm Cyferfontein 457 KR	
Local municipality	Modimolle Local Municipality (MLM)	
District Municipality	Waterberg District Municipality (WDM)	
Province	Limpopo Province	
Distance and direction from nearest town	Approximately 12km from Modimolle and 16km from Bela-Bela	
21-digit Surveyor General Code and extent for each farm portion	<u>Portion 7 of Cyferfontein 457 KR:</u> T00KR00000000045700007 118.516ha <u>Portion 61 of Cyferfontein 457 KR:</u> T00KR00000000045700061	233.496ha <u>Portion 62 of Cyferfontein 457 KR:</u> T00KR00000000045700062 114.244ha
Coordinates	<u>Portion 7 of Cyferfontein 457 KR:</u> 24° 48' 46.48187" S, 28° 26' 2.57158" E 24° 48' 39.75065" S, 28° 26' 11.22331" E 24° 50' 20.84849" S, 28° 27' 41.75752" E 24° 50' 25.19476" S, 28° 27' 33.56927" E <u>Portion 61 of Cyferfontein 457 KR:</u> 24° 48' 59.94401" S, 28° 25' 45.26811" E 24° 48' 46.62211" S, 28° 26' 2.72607" E 24° 50' 25.33496" S, 28° 27' 33.26028" E	24° 50' 33.60678" S, 28° 27' 16.57480" E <u>Portion 62 of Cyferfontein 457 KR:</u> 24° 49' 9.19899" S, 28° 25' 33.21748" 24° 49' 0.22447" S, 28° 25' 45.42261" E 24° 50' 33.74698" S, 28° 27' 16.26581" E 24° 50' 38.23332" S, 28° 27' 8.07756" E 24° 49' 12.14372" S, 28° 25' 41.40573" E 24° 49' 11.16214" S, 28° 25' 36.61638" E

c) Locality map

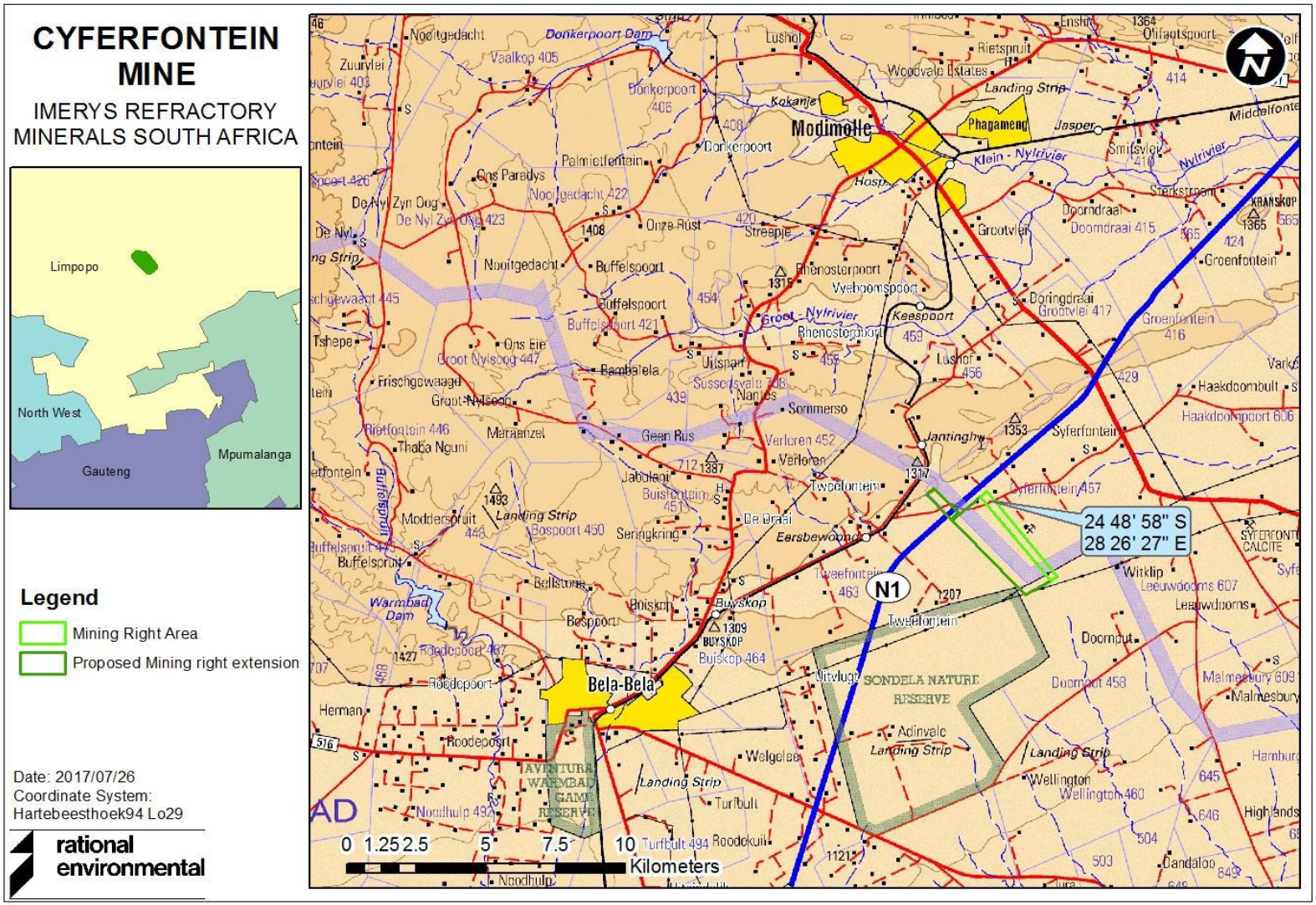


Figure 2: Locality map of Cyferfontein Mine

d) Description of the scope of the proposed overall activity

(i) Listed and specified activities

Refer below to Table 4 for all listed activities.

Table 4: All listed activities

Name of activity	Aerial extent of the activity	Listed activity	Applicable listing notice	Waste management authorisation
EIA: See below for trigger of GN 985 Any process or activity identified in terms of section 53(1) of the National	N/A	30	GNR 983	
EIA: Water will be pumped from the quarries, as necessary, for the safe continuation of mining. This requires a Section 21j water use licence under the NWA. Roll-over mining in WMA B31E is excluded from a General Authorisation, therefore S21g water use licence under the NWA. 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.	N/A	6	GNR 984	
EIA: Approximately 25ha of indigenous vegetation will be removed for the new quarries and haul road. The clearance of an area of 20ha or more of indigenous vegetation	±25ha	15	GNR 984	
EIA: A haul road 860m long and 10m wide. The haul road will cater for traffic in both directions. The development of a road catering for more than one lane of traffic in both directions.	0.86ha	27	GNR 984	
EIA: A haul road 860m long and 10m wide. The development of a road wider than 4m with a reserve less than 13.5m. In Limpopo outside urban	0.86ha	4	GNR 985	

Name of activity	Aerial extent of the activity	Listed activity	Applicable listing notice	Waste management authorisation
areas, in Critical biodiversity areas (CBA) as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans.				
EIA: Approximately 25ha of indigenous vegetation will be removed for the new quarries and haul road. The clearance of an area of 300m² or more of indigenous vegetation. In Limpopo outside urban areas, in CBAs as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans.	±25ha	12	GNR 985	

The mine will also apply for an Integrated Water Use License (IWUL) with the Department of Water and Sanitation (DWS) for the existing mine as well as the proposed new extension. The pre-application meeting was held on 18 August 2017. Refer to Addendum 5D for the minutes of this meeting.

(ii) Description of the activities to be undertaken

The proposed activities include the construction of a new quarry, which will stretch over portion 7, 61 and 62 of Cyferfontein:

- The quarry has a total footprint of 26.1ha and will be mined out in two phases. Refer to Addendum 6 which indicates the material movement as discussed here below.
- Topsoil will be stripped and directly replaced for rehabilitation. Refer to Section 2(h)(v) below for the management measures to ensure topsoil is used for rehabilitation of the quarries.
- Phase 1 will have a surface area of 99,057m²; and a volume of 1,275,950m³ topsoil and overburden material will be removed.
- Phase 2 will have a surface area of 161,943m²; and a volume of 2,004,312m³ topsoil and overburden material will be removed.
- Overburden and topsoil from Phase 1 will be replaced as part of roll-over mining into the existing North and South Quarries; for rehabilitation purposes. A total volume of 124,299m³ will be used to rehabilitate South Quarry and a total volume of 268,607 m³ will be used to rehabilitate North Quarry. Both of these quarries will have a recess of 3m.
- A total volume of 517,756 m³ will be transferred inside Phase 1 of the quarry for rehabilitation. This will lead to a void of 58,859m².

- A total of 1,599,000m^3 will be transferred inside Phase 2 of the quarry for roll-over mining. This will lead to a void of 50,869m^2.
- The final void will be 10,8ha where no topsoil will be replaced, and the current arable land capability and grazing land use will change to a farm dam, which will probably be partly filled with water during certain periods of the year. The landowner did request that a farm dam be created instead of a depression over the entire area.

A haul road 860m long and 10m wide will be constructed from the existing quarry, to the new proposed quarry.

No additional infrastructure will be constructed.

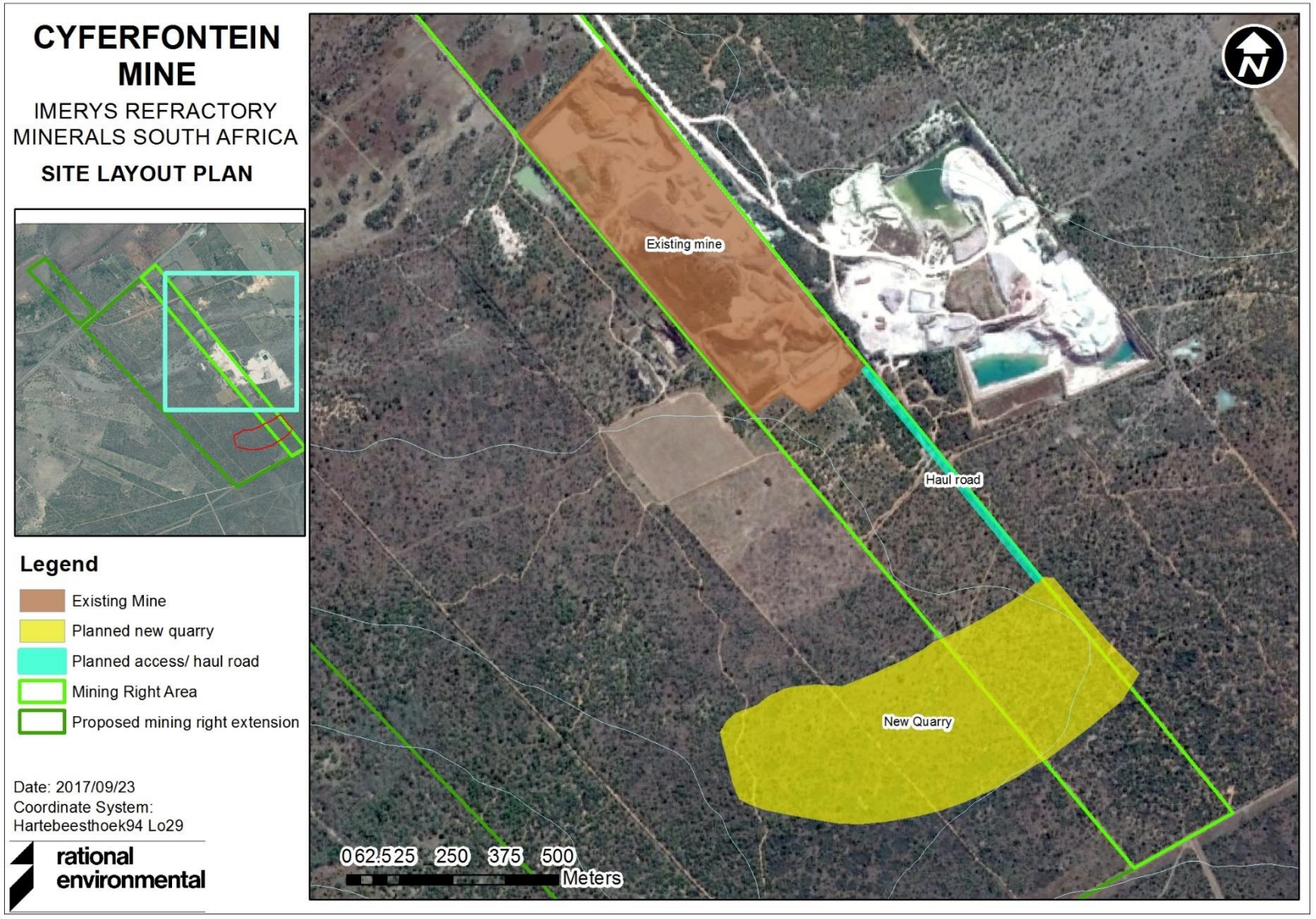


Figure 3: Surface layout plan indicating the listed activities

e) Policy and legislative context

Information for this section was extracted from the Environmental Management Programme for Cyferfontein Mine (Shangoni Management Services, 2014), GN704 Compliance Audit (Rational Environmental, 2017); as well as all the specialist studies. Please note that due to the rapid changes in legislation, this table is only applicable on date of compilation.

Applicable legislation and guidelines used to compile the report	Description of legislation and guidelines used to compile the report	Reference where applied	How does this development comply with and respond to the policy and legislative context
Authorisation applications			
MPRDA	According to the MPRDA, Cyferfontein Mine must have a mining right as well as an approved EMP. Due to changes from the Minerals Act no 50 of 1991 (MA) to the MPRDA in 2002, all mining rights had to be converted in 2009 from the old MA to the new MPRDA. Any mining right application submitted after 8 December 2014 must be done in terms of NEMA and not MPRDA. This application will include the listed activities pertaining to mining (i.e. Activity 17 of GN 984 of the EIA Regulations). These applications are still submitted to Department of Mineral Resources (DMR). Furthermore, any changes in the mining right, EMP, mining works programme (MWP), or EA, must be authorised through a Section 102 (in terms of the MPRDA) amendment.	Mining right: Addendum 5A Acceptance of Application Addendum 5C	The mine has an approved mining right. This mining right has also been converted to the new MPRDA requirements. The mining right was applied for and approved prior to 8 December 2014, therefore the requirements pertaining to a new mining right is not applicable. The mine is applying for a section 102 amendment (i.t.o. MPRDA). All associated listed activities are included in this application.
NEMA and the Environmental Conservation Act 73 of 1989 as amended (ECA)	The first listed activities which required an EA (referred to as a record of decision (RoD) in the past) commenced in 1998. These activities were	Acceptance of application: Addendum 5C	This environmental impact assessment / environmental management programme

Applicable legislation and guidelines used to compile the report	Description of legislation and guidelines used to compile the report	Reference where applied	How does this development comply with and respond to the policy and legislative context
	published in the EIA Regulations of 1998 (GN1183). In 2006, the ECA activities and EIA Regulations were replaced by the first NEMA EIA Regulations. The second set of NEMA EIA activities replaced the first set of NEMA EIA activities in 2010. The ECA activities as well as the first and second NEMA EIA activities excluded the application for an EIA when applying for a mining right; however, there are various other activities that could potentially trigger an EIA. The third set of NEMA EIA activities commenced on 8 December 2014. According to these listings, an applicant must apply for both a mining right as well as an EA for any new mine (see section 4.1.1 above), and a prospecting right as well as an EA for any new prospecting activities.		(EIA/EMP) forms part of an integrated environmental application.
NWA	Section 21 of the NWA sets out the water uses for which a IWUL is required. These water uses commenced in 1 October 1998, and include permissible water uses (water uses for which no licencing or registration is necessary), general authorisations (GA) (water uses for which registration only is required), and water use licences (water used for which both registration and licencing is required). An existing lawful water use is any water use that commenced 2 years or more prior to the NWA and authorised under the old Act. These	Pre-application meeting Addendum 5D	The mine is also applying for an IWUL at DWS.

Applicable legislation and guidelines used to compile the report	Description of legislation and guidelines used to compile the report	Reference where applied	How does this development comply with and respond to the policy and legislative context
	water uses are deemed lawful. In 1999, the GN 704 Regulations i.t.o. NWA were published. These Regulations pertained to all mining rights, and exemptions of water uses if necessary.		
NEMWA	Waste management permits for certain waste activities were required form 1989 i.t.o. the ECA. These permits were repealed by the publishing of the first listed waste management activities licensing in 2009 (GN 718 of 2009 i.t.o. NEMWA). These listings were replaced by new listings in 2013 (GN 921 of 2013 i.t.o. NEMWA). If a site has a permit under ECA, this is still applicable until the National Department of Environmental Affairs (NDEA) requests an update under the new legislation (NEMWA).	N/A	Not applicable. Roll-over mining to take place and not backfilling.
National Heritage Resources Act no 25 of 1999 (NHRA)	All required permits as per the Act.	Part A(g)(iv)(13) Addendum 3E	A heritage study was undertaken for the mine extension. No heritage resources were discovered.
Section 15(1) of the National Forest Act No 84 of 1998 (NFA)	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 forest product derived from a protected tree, except under a licence granted by the Minister.	Section Part A(g)(iv)(6) Addendum 3B	The specialist study refers to protected trees, as well as red data trees. The relevant environmental departments must indicate which management measures they prefer. In the event of tree removal, the correct permits must be obtained.
Mining			

Applicable legislation and guidelines used to compile the report	Description of legislation and guidelines used to compile the report	Reference where applied	How does this development comply with and respond to the policy and legislative context
Mine residue management: Regulation 73 of the Mineral and Petroleum Resources Development Regulations (GN 349 of 2011 i.t.o. MPRDA) (MPRDR), GN 632 of 2015 i.t.o. NEMWA.	The assessment of impacts relating to the management of residue deposits must form part of the EMP. Mine residue must be characterised to identify any potentially significant health or safety hazard and environmental impact that may be associated with the residue when deposited. The design of the residue stockpile and deposit shall be undertaken by a competent person. The process of investigation and selection of a site for residue stockpiling and residue deposits must entail several factors as per the legislation. This will include geotechnical investigations and groundwater investigations. From these investigations, a preferred site must be identified. Further investigation on the preferred site are also necessary. This must be carried out by a competent person. A competent person must be qualified by virtue of his or her knowledge, expertise, qualifications, skills and experience; and is familiar with the provisions of the Act and other related legislation; and has been trained to recognise any potential or actual problem in the performance of the work.	Part A(g)(v) Addendum 3D	A registered engineer is appointed as the competent person mine residue. Roll-over mining to take place. The impacts of the mine residue are contained within this EIA/EMP. A leaching test of the overburden, material stockpile and quarry water is underway.
Rehabilitation and closure:	A closure plan must be submitted 5 years before closure to DMR and NDEA. An EMP and rehabilitation plan must be submitted 5 years before	Part B(d)	In the event of extension, the LoM will be more than 5 years. A closure plan forms part of this EIA/EMP to follow.

Applicable legislation and guidelines used to compile the report	Description of legislation and guidelines used to compile the report	Reference where applied	How does this development comply with and respond to the policy and legislative context
Section 24R of NEMA, Appendix 5 of the EIA Regulations, sections 43 & 56 of MPRDA	commencing with closure to DWS. Closure objectives form part of the draft EMP, and must identify the key objectives for mine closure to guide the project design, development and management of environmental impacts; provide broad future land use objective(s) for the site; and provide proposed closure costs. Imerys must ensure that details of rehabilitation of the residue deposit are provided in the EMP.		
Financial provision: Section 24P of the NEMA, Regulations pertaining to financial provisioning for prospecting, exploration, mining, or production operations (GN 1147 of 2015 i.t.o. NEMA	The EMP must address the requirements as determined in the regulations, pertaining to the financial provision for the rehabilitation. The mine must annually update and review the quantum of the financial provision in consultation with a competent person, as required in terms of the approved EMP, or as requested by the Minister.	Part A(s) & Part B(k)(1)	The financial provision is updated annually. The financial provision is included in this EIA/EMP.
Water management			
Water management and pollution control: GN 527 of 2004 i.t.o. MPRDA	An assessment of impacts relating to water management and pollution control at mining operations must form part of the EMP. No mine residue shall be established on the bank of any stream, river, dam, pan, wetland or lake without written permission and upon such conditions as determined and as approved in the EMP. Toilet facilities shall be located in such a manner that no water or other pollution is caused. GN 704	Part A(g)(v) Addendums 3D & 3G	The impacts of water pollution are contained within this EIA/EMP. A geohydrological study was conducted for the mine extension. A GN 704 audit was also conducted in 2017. The North Quarry falls within 100m of the wetland boundary. Some of the infrastructure are also within 100m of the wetland boundary.

Applicable legislation and guidelines used to compile the report	Description of legislation and guidelines used to compile the report	Reference where applied	How does this development comply with and respond to the policy and legislative context
	Regulations of 1999 i.t.o. NWA place: restrictions on locality; restrictions on use of material; capacity requirements of clean and dirty water systems; protection of water resources; and security and additional measures.		
Biodiversity management			
Protection of threatened or protected species: Sections 56-58 & 87-93 of National Environmental Management Biodiversity Act No 10 of 2004 (as amended) (NEMBA), section 12 of NFA	The Minister may, by notice in the Gazette, publish a list of critical endangered, endangered, vulnerable and/or protected species. No person may (a) cut, disturb, damage, destroy or remove any protected tree; or (b) collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a licence granted by the Minister.	Part A(g)(v) Addendum 3B	The mine has conducted specialist studies for the mine extension. Protected trees and red data trees have been identified. The relevant environmental departments must indicate which management measures they prefer. In the event of tree removal, the correct permits must be obtained.
Alien and invasive species: GN 1048 of 1984 i.t.o. CARA, GN 507, GN 508 & GN 509 of 2013, & GN 598 & GN 599 of 2014 i.t.o. NEMBA, sections 65-77 of NEMBA	Category 1a Listed Invasive Species must be combatted or eradicated. Category 1b Listed Invasive Species must be controlled. Category 2 Listed Invasive Species require a permit to carry out a restricted activity within an area specified in the Notice or an area specified in the permit. Category 3 Listed Invasive Species are subject to exemption.	Part A(g)(v) Addendum 3B	Alien invasive species are included in a specialist study.
Soil management			
Contaminated land: GN 527 of 2004 i.t.o. MPRDA, and sections 35-41 of NEMWA	The assessment of impacts relating to soil pollution and erosion control, must form part of both the EMP. The acidification, salination and mineralisation of soils through seepage of polluted water must take	Part A(g)(v) Addendum 3F	The impacts on soil are contained within this EIA/EMP.

Applicable legislation and guidelines used to compile the report	Description of legislation and guidelines used to compile the report	Reference where applied	How does this development comply with and respond to the policy and legislative context
	place as approved in the EMP. The spillage of hazardous chemicals onto soils or its escape or migration into surrounding soils from the approved deposition area, must be prevented. Oils, grease and hydraulic fluids must be disposed of. Oils, grease and hydraulic fluid spills must be cleaned up by removing all contaminated soil and disposing such soil in a waste disposal receptacle or at a licensed facility. The chemical and physical properties of topsoil to be used for the purposes of rehabilitation must not be changed by introducing foreign material, gravel, rock, rubble or mine residue to such soil. An owner of land that is significantly contaminated, or a person who undertakes an activity that caused the land to be significantly contaminated, must notify the department of that contamination as soon as that person becomes aware, of that contamination		
Heritage resources management			
Section 52 of MPRDA, and Sections 34 & 35 of NHRA	An EMP must include impacts on heritage aspects. No person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the relevant provincial heritage resources authority. Any person who discovers archaeological or palaeontological objects or material or a meteorite must immediately	Part A(g)(v) Addendum 3E	A heritage study was undertaken for the mine extension. No heritage resources were discovered.

Applicable legislation and guidelines used to compile the report	Description of legislation and guidelines used to compile the report	Reference where applied	How does this development comply with and respond to the policy and legislative context
	report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.		
Emergency incidents			
Section 30 of NEMA, section 20 of NWA S20, and Section 18 of the National Veld Fires and Forest Act No 101 of 1998 (as amended) (NVFFA)	In the event of an emergency, the mine must: report through the most effective means reasonably available; take all reasonable measures to contain and minimise the effects of the incident, including its effects on the environment and any risks posed by the incident to the health, safety and property of persons; undertake clean-up procedures; remedy the effects of the incident; and assess the immediate and long-term effects of the incident on the environment and public health. Any owner who has reason to believe that a fire on his or her land or the land of an adjoining owner may endanger life, property or the environment, must immediately notify the fire protection officer or, any member of the executive committee of the fire protection association, if one exists for the area; and the owners of adjoining land; and do everything in his or her power to stop the spread of the fire.	Part B(k)(2)	The mine will compile an environmental emergency procedure. This procedure will be implemented on the mine.

f) Need and desirability of the proposed activities

As per the Guideline on Needs and Desirability in terms of the EIA Regulations (published 20 October 2014), the following table has been compiled:

Table 5: Need and Desirability of the proposed project

Guideline requirement	Comments on requirement
1. How will this development (and its separate elements/aspects) impact on the ecological integrity of the area?	
1.1 How were the following ecological integrity considerations taken into account?	
1.1.1 Threatened Ecosystems,	A Flora Assessment, Mammals and Habitat Assessment, Avifaunal Habitat Assessment, and Herpetofaunal Habitat Assessment were conducted by (Galago Environmental Biodiversity and Aquatic Specialists). These reports took all these ecological integrity considerations into account. Where these ecological integrity considerations are not specified in the reports, it will be included in the final EIA/EMP.
1.1.2 Sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands, and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure,	
1.1.3 CBAs and Ecological Support Areas (ESAs),	
1.1.4 Conservation targets,	
1.1.5 Ecological drivers of the ecosystem,	
1.1.6 Environmental Management Framework,	
1.1.7 Spatial Development Framework, and	
1.1.8 Global and international responsibilities relating to the environment (e.g. RAMSAR sites, Climate Change, etc.).	
1.2 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?	Refer to Part A(g)(v) for a complete description of the impacts on the biodiversity.
1.3 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?	Refer to Part A(g)(v) for a complete description of the impacts on the environment.

Guideline requirement	Comments on requirement
1.4 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?	No additional non-mining waste than that already generated by the mine. The mine has an approved EMP which includes management of waste.
1.5 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?	Refer to Part A(g)(v)
1.6 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?	Refer to Part A(g)(v) for a complete description of the impacts on the environment. The EMP part of the EIA/EMP will include how 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; and what measures were explored to enhance positive impacts.
1.7 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?	Refer to Part A(g)(v) for a complete description of the impacts on the environment. The EMP part of the EIA/EMP will include how 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; and what measures were explored to enhance positive impacts.
1.7.1 Does the proposed development exacerbate the increased dependency on increased use of resources to maintain economic growth or does it reduce resource	Mining is not a sustainable activity. Mineral resource is removed as part of mining. All other resources are replaced during rehabilitation.

Guideline requirement	Comments on requirement
dependency (i.e. de-materialised growth)? (note: sustainability requires that settlements reduce their ecological footprint by using less material and energy demands and reduce the amount of waste they generate, without compromising their quest to improve their quality of life)	
1.7.2 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?)	
1.7.3 Do the proposed location, type and scale of development promote a reduced dependency on resources?	
1.8 How were a risk-averse and cautious approach applied in terms of ecological impacts?	Specialist studies were undertaken and included into this process.
1.8.1 What are the limits of current knowledge (note: the gaps, uncertainties and assumptions must be clearly stated)?	All gaps in knowledge, the adequacy of predictive methods and underlying assumptions, and uncertainties encountered in compiling the required information will be included in the EIA/EMP.
1.8.2 What is the level of risk associated with the limits of current knowledge?	
1.8.3 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?	
1.9 How will the ecological impacts resulting from this development impact on people's environmental right in terms following	Specialist studies were undertaken and included into this process. Refer to Part A(g)(v)
1.9.1 Negative impacts: e.g. access to resources, opportunity costs, loss of amenity (e.g. open space), 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?	
1.9.2 Positive impacts: e.g. improved access to resources, improved amenity, improved air or water	

Guideline requirement	Comments on requirement
quality, etc. What measures were taken to enhance positive impacts?	
1.10 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 impacts (e.g. on livelihoods, loss of heritage site, opportunity costs, etc.)?	
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?	
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?	The preferred alternative will relocate the red data trees.
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?	There is no strategic environmental assessment for the area, which will include the impacts of all the activities in the area. The cumulative impacts are only assumptions from the EAP. The quarries are surrounded by the rest of the mine and its mining activities as well as other land uses.
2.1 What is the socio-economic context of the area, based on, amongst other considerations, the following considerations?	Refer to Part A(g)(v) The IDP, Spatial priorities and desired spatial patterns, Spatial characteristics, and Municipal Economic Development Strategy will be discussed in the final EIA/EMP.
2.1.1 The Integrated Development Plan (IDP) (and its sector plans' vision, objectives, strategies, indicators and targets) and any other strategic plans, frameworks of policies applicable to the area,	
2.1.2 Spatial priorities and desired spatial patterns (e.g. need for integrated of segregated communities, need to upgrade informal settlements, need for densification, etc.),	
2.1.3 Spatial characteristics (e.g. existing land uses, planned land uses, cultural landscapes, etc.), and	

Guideline requirement	Comments on requirement
2.1.4 Municipal Local Economic Development Strategy (LED Strategy).	
2.2 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?	There will be no additional employment due to activities. All concerns raised by the registered Interested and affected parties (I&APs) and stakeholders will be included to assess the socio-economic context.
2.2.1 Will the development complement the local socio-economic initiatives (such as local economic development (LED) initiatives), or skills development programs?	
2.3 How will this development address the specific physical, psychological, developmental, cultural and social needs and interests of the relevant communities?	
2.4 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?	
2.5 (Not applicable)	
2.6 How were a risk-averse and cautious approach applied in terms of socio-economic impacts?	
2.6.1 What are the limits of current knowledge (note: the gaps, uncertainties and assumptions must be clearly stated)?	
2.6.2 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?	
2.6.3 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?	
2.7 How will the socio-economic impacts resulting from this development impact on people's environmental right in terms following:	
2.7.1 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?	

Guideline requirement	Comments on requirement
2.7.2 Positive impacts. What measures were taken to enhance positive impacts?	
2.8 Considering the linkages and dependencies between human wellbeing, livelihoods and ecosystem services, describe the linkages and dependencies applicable to the area in question and how the development's socioeconomic impacts will result in ecological impacts (e.g. over utilisation of natural resources, etc.)?	
2.9 What measures were taken to pursue the selection of the "best practicable environmental option" in terms of socio-economic considerations?	Specialist studies were undertaken and included into this process. Refer to Part A(g)(v)
2.10 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, particularly vulnerable and disadvantaged persons (who are the beneficiaries and is the development located appropriately)? 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?	
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?	
2.13 What measures were taken to:	
2.13.1 ensure the participation of all I&APs,	Refer to Part A(g)(ii)
2.13.2 provide all people with an opportunity to develop the understanding, skills and capacity necessary for achieving equitable and effective participation,	The mine has a social and labour plan (SLP) in place.
2.13.3 ensure participation by vulnerable and disadvantaged persons	

Guideline requirement	Comments on requirement
2.13.4 promote community wellbeing and empowerment through environmental education, the raising of environmental awareness, the sharing of knowledge and experience and other appropriate means	
2.13.5 ensure openness and transparency, and access to information in terms of the process	
2.13.6 ensure that the interests, needs and values of all I&APs were taken into account, and that adequate recognition were given to all forms of knowledge, including traditional and ordinary knowledge, and	
2.13.7 ensure that the vital role of women and youth in environmental management and development were recognised and their full participation therein were be promoted	
2.14 Considering the interests, needs and values of all the I&APs, 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)?	
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?	All contractors, sub-contractors and workers will continue to attend compulsory environmental awareness training and inductions. This training will highlight the dangers associated with the workplace. Procedures relating to environmental risks will also be put in place and will be regularly updated.
2.16 Describe how the development will impact on job creation in terms of, amongst other aspects:	
2.16.1 the number of temporary versus permanent jobs that will be created,	No additional jobs will be created.
2.16.2 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),	
2.16.3 the distance from where labourers will have to travel,	

Guideline requirement	Comments on requirement
2.16.4 the location of jobs opportunities versus the location of impacts (i.e. equitable distribution of costs and benefits), and	
2.16.5 the opportunity costs in terms of job creation (e.g. a mine might create 100 jobs, but impact on 1000 agricultural jobs, etc.).	
2.17 What measures were taken to ensure:	
2.17.1 that there were intergovernmental coordination and harmonisation of policies, legislation and actions relating to the environment, and	DMR is the only applicable authority for the proposed integrated environmental authorisation (IEA) and thus the only organ of state. DWS is, however the competent authority for the IWULA. All other organs of state and stakeholders will receive the ESR as well as the EIA/EMP for review.
2.17.2 that actual or potential conflicts of interest between organs of state were resolved through conflict resolution procedures?	
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?	Refer to Part A(g)(ii)
2.19 Are the mitigation measures proposed realistic and what long-term environmental legacy and managed burden will be left?	Impacts and mitigation measures were obtained from various specialists. It is assumed that the mitigation measures proposed are realistic.
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?	The mine has an updated financial provision.
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?	The preferred alternative will relocate the red data trees.
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?	All concerns raised by the registered I&APs and stakeholders will be included to assess the socio-economic context.

g) Motivation for the preferred development footprint within the approved site including a full description of the process followed to reach the proposed development footprint within the approved site

Various specialist studies were conducted to assess the environmental features of the site. The proposed quarry extension was also discussed with the relevant landowners. The Biodiversity Habitat Assessment (Galago Environmental Biodiversity and Aquatic Specialists, 2017) indicated that there are various protected trees on site as well as two red date tree species (two individual trees of the same species). The location of the two red data trees was taken into consideration for the alternatives.

Mr. Jooste is the landowner of portions 61 and 62 of Cyferfontein (he is one of the two directors of Morula Tona Boerdery CC, which is the registered landowner). Mr. Jooste requested that the quarry be divided into 3 smaller quarries. A landowners' meeting will be held on 10 November 2017 whereby this will be further dicsused. This alternative will not influence the impact assessment.

He further stated that the mine must rather leave a final void to be used as a farm dam, instead of leaving a depression over the entire quarry area. The creation of a depression is therefore not considered as an alternative to the final void.

i) Details of the development footprint alternatives considered

The following definition of "alternatives" is given in the EIA Regulations: *"alternatives", in relation to a proposed activity, means different means of meeting the general purpose and requirements of the activity, which may include alternatives to the -*

(a) property on which or location where the activity is proposed to be undertaken;

(b) type of activity to be undertaken;

(c) design or layout of the activity;

(d) technology to be used in the activity; or

(e) operational aspects of the activity; and

(f) includes the option of not implementing the activity;"

Please note the term preferred alternative is the preferred activity whereby the second alternative is the alternative to the preferred alternative.

(a) The property on which or location where it is proposed to undertake the activity

There is no alternative property or location to this project.

(b) The type of activity to be undertaken

There is no alternative type of activity to this project.

(c) The design or layout of the activity

The alternative depends on the feedback from the relevant environmental departments regarding the red data trees as well as communication with the landowner of portions 61 and 62 of Cyferfontein. Refer to Figure 3 for the preferred layout plan. This will be amended if requested by any department or DMR. Also refer to Figure 4 below for the environmental features associated with the layout plan.

(d) The technology to be used in the activity

There is no technology alternative to this project.

(e) The operational aspects of the activity

There is no alternative to the operational aspects of this project.

(f) The option of not implementing the activity

The no-go option must always be included in a new project. In this case the mine will deplete its resources in 2018.

ii) Details of the public participation process followed

According to the Publication of Participation Guideline (NEMA), an I&AP is:

"(a) any person, group or persons or organisations interested in or affected by an activity, and (b) any organ of state that may have jurisdiction over any aspect of the activity".

This definition is more detailed in the Guideline for consultation with communities and I&APs (MPRDA):

"I&APs include, but are not limited to; (i) Host Communities, (ii) Landowners (Traditional and Title Deed owners), (iii) Traditional Authority, (iv) Land Claimants, (v) Lawful land occupier, (vi) The Department of Land Affairs, (vii) Any other person (including on adjacent and non-adjacent properties) whose socio-economic conditions may be directly affected by the proposed prospecting or mining operation (viii) The Local Municipality, (ix) The relevant Government Departments, agencies and institutions responsible for the various aspects of the environment and for infrastructure which may be affected by the proposed project."

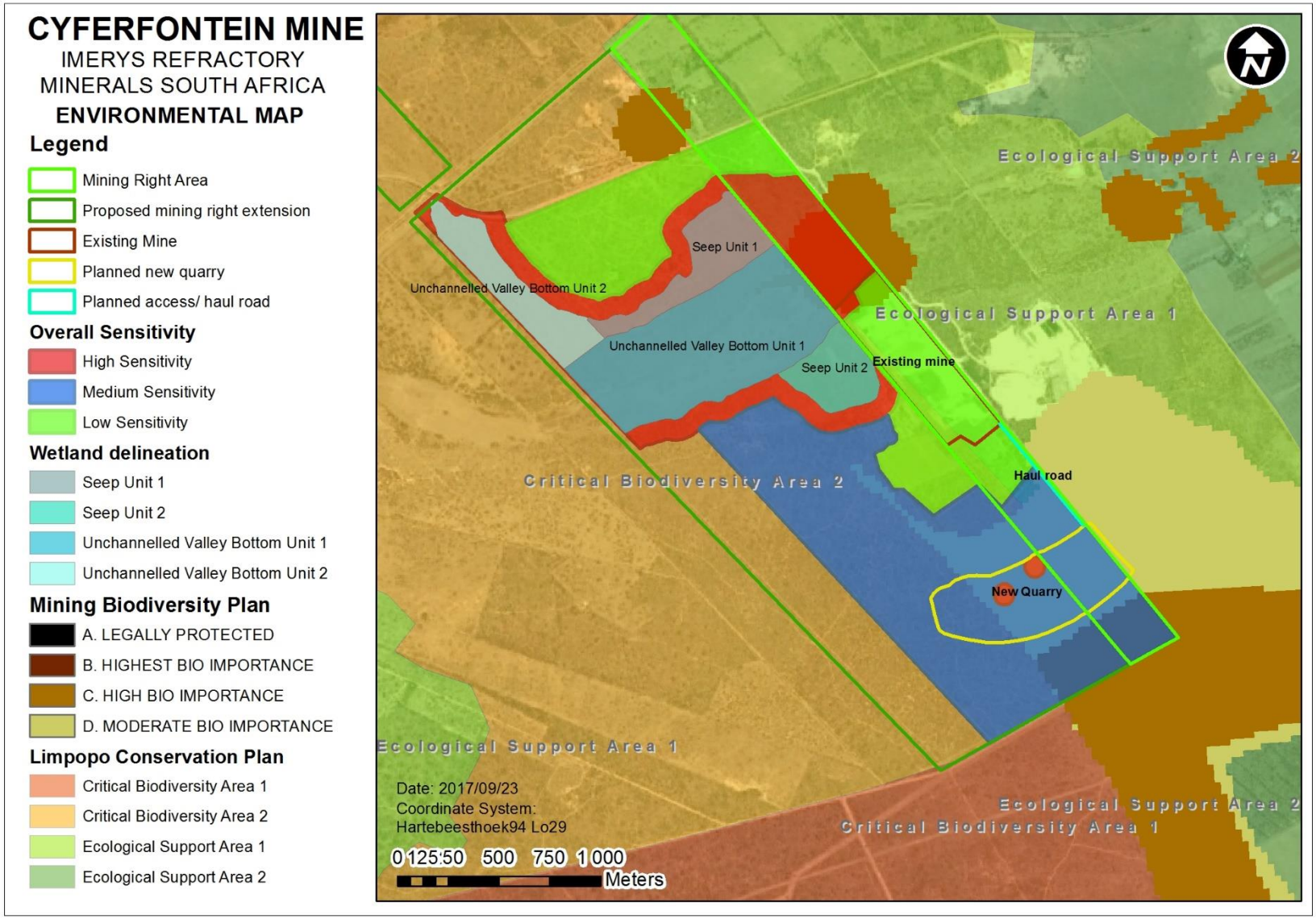


Figure 4: Environmental features associated with the layout plan

iii) Summary of issues raised by interested and affected parties

1 Identification of interested and affected parties

This EIA/EMP was sent to all registered I&APs and stakeholders prior to submission to DMR. Refer to Addendum 5E for correspondence to and from the Department of Rural Development and Land Reform (DRDLR) regarding land claims. Refer to Table 6 below for all I&APs and stakeholders identified. All of these I&APs and stakeholders were in fact consulted. Refer to Addendum 4 for the proof of the public participation as well as Section 2(h)(iii)(2) below for process that was followed.

Table 6: I&APs and stakeholders identified

Interested and Affected Parties	Date comments received	Issues raised	EAPs response to issues as mandated by the applicant	Section reference in this EIA/EMP where issues and or response were incorporated
Affected parties				
Landowner/s				
Portion 7: Johannes Petrus Nortje	29 September 2017	Compensation to landowner.	A meeting was held on 10 November 2017. A follow-up meeting is scheduled for 8 December 2017.	Final decisions will be forwarded to DMR if requested.
		No flow of natural water therefore does not want a dam as final void.	Final landscaping will be done in such a way to prevent forming of a dam.	Addendum 6 Part B(1)(d)(4)
		Concerned about trucks that throw clay onto dirt road.	Concern was taken up with the transport companies and clay will be picked up by mine.	Part A(g)(v)
		Road leading to mine is higher than wetland area and leads to damming of water.	Pipes/culverts were put in place.	Part A(g)(v)
		Shepperd's Trees cannot be relocated	SANBI to aid in germination and replanting of trees.	Part A(g)(v)

Interested and Affected Parties	Date comments received	Issues raised	EAPs response to issues as mandated by the applicant	Section reference in this EIA/EMP where issues and or response were incorporated
Portion 61 and 62: Morula Tona Boerdery CC	Prior to this application & 29 September 2017	Layout of quarry. One large pit or three smaller pits.	A meeting was held on 10 November 2017. A follow-up meeting is scheduled for 8 December 2017.	Final decisions will be forwarded to DMR if requested.
	29 September 2017	Final void should be a farm dam.		
		Dust is an issue.	This impact will be further discussed.	Part A(g)(v) Further discussions to follow
		Enquired whether Imerys will put game/electric fencing around the mining area.	This will be done.	Part A(g)(v)
		Asked where will they start with the mining.	Start on portion 7 and work their way westwards.	N/A
Lawful occupier/s of the land				
Portion 7 is currently occupied by the landowner and the mine. Portions 61 and 62 are currently occupied by the landowner.	Refer above			
Landowners or lawful occupiers on adjacent properties				
RE Cyferfontein: Ceramic Industries Ltd (SAMCA)	1 September 2017	Requested to be registered as an I&AP	Landowner is hereby registered as an I&AP	Addendum 4E & 4G
Portion 3 Cyferfontein:	29 September 2017	Asked why prospecting has not yet been done on portion 3 of Cyferfontein	Due to budget constraints.	N/A

Interested and Affected Parties	Date comments received	Issues raised	EAPs response to issues as mandated by the applicant	Section reference in this EIA/EMP where issues and or response were incorporated
Nicolene De Beer (van Zyl) Frik van Zyl		Asked why the prospecting (drilling) stopped at a certain distance.		
		Asked whether Imerys uses any methods to help the establishment of natural vegetation	Do use seeding methods and that they also plant indigenous trees on the area that are being rehabilitated.	Part B(1)(d)(4)
		The air pollution model produced by the specialist studies indicated similar pollution on the Eersbewoond road than on the mine's haul road and that they cannot just apply dust suppression on their haul road and not on the extent of the affected areas	This impact will be further discussed.	Part A(g)(v) Further discussions to follow
		Concerned about trucks that throw clay onto dirt road.	Concern was taken up with the transport companies and clay will be picked up by mine.	Part A(g)(v)
		Asked if the mine cannot apply for an exemption from the sirens used on the mine vehicles. This is especially disturbing during night time and early morning.	This is not possible.	N/A
		Asked how long it takes to get a water use licence	WUL usually takes a year or more.	N/A
		What does the mine do with the trees that are removed?	Trees are either thrown into the	N/A

Interested and Affected Parties	Date comments received	Issues raised	EAPs response to issues as mandated by the applicant	Section reference in this EIA/EMP where issues and or response were incorporated
			quarries or the wood is given to the landowner	
		What will Imerys do with regards to fencing?	Gates will be put in place to keep the fences.	Part A(g)(v)
		Asked a copy of the prospecting boreholes logs.	Imerys did sent logs.	To be followed up.
	28 November 2017	Commented that borehole logs were not complete. Requested complete set.	This must still be answered by Imerys	To be followed up.
Portion 15 Cyferfontein: Joachom Petrus Georg Prinsloo	29 September 2017	Attended the public meeting	Landowner is registered as an I&AP	N/A
Portion 16 Cyferfontein: Rudolf Boris Lang	29 September 2017	Dust problem on the R33 due to the trucks.	This impact will be further discussed.	Part A(g)(v) Further discussions to follow
		Asked whether the mine can also water the dirt road (Eersbewoond Road).	This impact will be further discussed.	Part A(g)(v) Further discussions to follow
Portion 30 Cyferfontein: Pieter Renier Wagner	29 September 2017	Asked that Imerys negotiate with the relevant department to have the dirt road (Eersbewoond Road) tarred.	Imerys will join discussions with the department.	Discussions will be joined if the landowners decide to speak to the department.
		Raised his concern regarding the Nylsvley Area	The mine will adhere to all management pertaining to the Nylsvley Area.	Part A(g)(v)

Interested and Affected Parties	Date comments received	Issues raised	EAPs response to issues as mandated by the applicant	Section reference in this EIA/EMP where issues and or response were incorporated
Portion 43 Cyferfontein: SANRAL	None	None	N/A	N/A
Portion 63 Cyferfontein: Dawid Izak van der Merwe	4 September 2017	Requested to be registered as an I&AP	Landowner is registered as an I&AP	
	29 September 2017	WUL will be subject to the treatment / processing of mine effluent by incorporating a facility / infrastructure for said treatment. How far is the progress on it?	Water results were sent to I&AP.	Part A(g)(v)
		How does use of surface water within the licenced catchment impact the wetland which is 500m away from the envisaged mine site		
		Dust on tar road.	This impact will be further discussed.	Part A(g)(v) Further discussions to follow
		How is the water from process dam treated before effecting dust management	Water results were sent to I&AP.	N/A
		What other deleterious chemical composition, total suspended solids and / or salt loads are present in the dirty water?		
		How and by whom will regulation be applied with regards to the water testing?	The sampling for analyses were done by Aquatico.	N/A

Interested and Affected Parties	Date comments received	Issues raised	EAPs response to issues as mandated by the applicant	Section reference in this EIA/EMP where issues and or response were incorporated
		Who will be conducting water testing (Labs) and who will regulate these results?		
		What was the outcome of the groundwater impact assessment, particularly dirty water seepage and run off?	Refer to the geohydrological study.	Addendum 3D
		Who is the Environmental officer on the mine and is he/she full time employee or contractor?	Environmental officer on the mine is Lucky Sithole and he is a full-time employee of IMERYS Refractory Minerals SA	Part A(g)(v)
		Wants to see last 3 x DMR visits findings and recommendations to existing mine controls on dust and water usage.	There are no DMR findings available relating to dust and water usage, despite numerous visit from the DMR (latest took place on 15 September 2017).	N/A
		Dust and noise pollution from trucks.	Refer to the impact assessment aand specialist studies.	Addendums 4A & 4C Part A(g)(v)
		Low cost no frills mining operation and might be so due to business model but might point to cash flow constraints.	Noted	N/A
		Rehab of mined out areas.	EIA/EMP will indicate the money set aside for rehabilitation.	Part A(s) & Part B(1)(k)(1)
		What is budgeted for such rehab strategy?		

Interested and Affected Parties	Date comments received	Issues raised	EAPs response to issues as mandated by the applicant	Section reference in this EIA/EMP where issues and or response were incorporated
		How big is fund currently in trust for the final stages of mine?	The bank guarantee with BNP is currently 991 665 ZAR.	N/A
		Who regulate the fine not visible dust that are actually the dangerous ones?	Refer to specialist study. Name of the specialist is SHE SERVICES.	Addendum 4A.
		What is monitoring strategy and how often is it measured?	Refer to specialist study.	Addendum 4A. Part B(1)(h)
		Who will conduct the monitoring?	SHE SERVICES	N/A
		How often will it be done?	Measured ambient dust fallout rates should be recorded monthly.	Addendum 4A. Part B(1)(h)
		Will landowners and stakeholders get insight in review packs?	Yes. This will be implemented as per applicable regulation.	Part A(g)(v)
		What department will ensure accountability or will it be some state regulator?	DMR	N/A
	17 November 2017	Requested a follow-up meeting	Meeting is scheduled for 26 January 2018.	N/A
Portion 1 Doornput: Doornput Farm Pty Ltd	None	None	N/A	N/A
Portion 11 Doornput: Japnine Boerdery	None	None	N/A	N/A
Municipal ward councillor – ward 8				
Cllr. Rufus Mahoro	None	None	N/A	N/A
MLM - Municipal manager				

Interested and Affected Parties	Date comments received	Issues raised	EAPs response to issues as mandated by the applicant	Section reference in this EIA/EMP where issues and or response were incorporated
Cllr Mr Sebola	None	None	N/A	N/A
WDM – Environmental department				
Nozi Molteno	None	None	N/A	N/A
Organs of state				
DWS Limpopo	None	IWULA in progress		
Communities				
None	N/A	N/A	N/A	N/A
DRDLR				
Tshilidzi Ratshisusu Lorraine Mosebedi MRMonyamane Monyamane Tlou Sylvia Mashamaite Pleasant Gavhi	None	None	N/A	N/A
Traditional Leaders				
None	N/A	N/A	N/A	N/A
Limpopo Department of Economic Development, Environment and Tourism				
Nicoline Gulwakon	3 October 2017	Ensure that the no-go alternative is also assessed in terms of the physical and social attributes of the environment.	The no-go alternative will be assessed as part of the EIA/EMP.	Part A(k)
Other Competent Authorities affected				
South African Heritage Resources Agency (SAHRA)	None	None	N/A	N/A
Limpopo Heritage Resources Agency (LHRA)	None	None	N/A	N/A
Limpopo Department of Agriculture and Rural Development	8 November 2017	Site visit was conducted with Ben Greeff. He will send an official letter to DMR.	N/A	N/A

Interested and Affected Parties	Date comments received	Issues raised	EAPs response to issues as mandated by the applicant	Section reference in this EIA/EMP where issues and or response were incorporated
Department of Environmental Affairs (District)	None	None	N/A	N/A
Other affected parties				
Historical disadvantaged communities				
None identified	N/A	N/A	N/A	N/A
Land claimants				
There are three existing land claims against Cyferfontein. These claims will not be processed until all previous land claims have been processed.	None	None	N/A	N/A
Interested parties				
Waterberg Sakekamer	None	None	N/A	N/A
Waterberg Distrikslandbou Unie	None	None	N/A	N/A
Friends of Nylsvley Marion Mengell, Ron Mengell & John Sparrow	4 September 2017	Requested to be registered as an I&AP	Friends of Nylsvley is registered as an I&AP	N/A
	29 September 2017	Enquired regarding the water quality limits used to determine whether a water use licence is necessary.	Presumes it is the limits for general authorisations.	Will follow up with Aquatico regarding the limits they used.
		Requested that the edges of the final void (farm dam) on AJ1's property be shallow enough for the establishment of birds. It will also be appreciated if a hide could be put in place.	The final void will be shaped to ensure shallow edges.	Part B(1)(d)(4) The idea of a hide must be discussed with AJ1.

Interested and Affected Parties	Date comments received	Issues raised	EAPs response to issues as mandated by the applicant	Section reference in this EIA/EMP where issues and or response were incorporated
		Will follow up regarding the Shepperd's Tree and whether anyone can help with management of these trees.	Will also follow up with specialists.	Further investigations to follow
		What happens if the mine goes bankrupt?	Financial provision	Part A(s) & Part B(1)(k)(1)

2 The details of the engagement process

An advertisement was published in the local newspaper "Die Pos" on 8 September 2017. Refer to Addendum 4B for a copy and proof of this advertisement. Three site notices were placed at and around the site on 31 August 2017. One site notice was placed at the entrance from the R33 onto Eersbewoond Road, one site notice was placed at the entrance to the mine and one site notice was placed at the gate to portion 61 of Cyferfontein. Refer to Addendum 4C for a copy and proof of the site notices placed, as well as a map of the placement of these site notices.

A public and stakeholders meeting was held on 29 September 2017, at 10h00, on the mine. Refer to Addendum 4D for the meeting presentation, attendance register and the minutes of the meeting. Mr van der Merwe, an adjacent landowner, sent a letter regarding the public meeting later that afternoon. This letter and the response thereto forms part of the public meeting. Refer to Addendum 4D for this letter. Also refer to Addendum 4F for all comments received, the response thereto, action plans on the comments, and two updates sent regarding these action plans.

Letters were sent to all adjacent landowners and stakeholders on 31 August 2017. One letter was sent to Mr. van der Merwe on 4 September 2017. Refer to Addendum 4A for this letter as well as proof of the letter sent.

The environmental scoping report was sent to all LEDET, DWS, DAFF, and DMR on 26 September 2017. Refer to Addendum 4E for proof of these submissions. An electronic version was emailed to all other stakeholders on 2 October 2017. Refer to Addendum 4E for proof of these emails. An electronic copy on a cd was submitted to Marion Mengell from 'Friends of Nylsvley' on 3 October 2017. Seven electronic copies

on a cd were submitted to F van Zyl, who then distributed it to all other landowners. One hard copy for Mr Nortje was also given to Mr van Zyl to be given to him. Refer to Addendum 4E for proof this submission.

This EIA/EMP was sent to all stakeholders and registered I&APs. Refer to Addendum 4G for proof this submission. The official from DAFF received a cd with the final EIA/EMP. Refer to Addendum 4G for proof of this. This final EIA/EMP is submitted to DWS and LEDET on the same day as the submission to DMR. This will be forwarded to DMR.

3 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

Refer to Table 6 above for 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.

iv) The Environmental attributes associated with the development footprint alternatives

The environmental attributes described below include socioeconomic, social, heritage, cultural, geographical, physical and biological aspects. Refer below for the following:

a. Type of environment affected by the proposed activity - its current geographical, physical, biological, socio- economic, and cultural character;
b. Description of the current land uses;
c. Description of specific environmental features and infrastructure on the site; and
d. Environmental and current land use map - which shows all environmental, and current land use features.

1 Geology

Information for this section was extracted from the Groundwater Impact Assessment (Groundwater Complete, 2017).

All geological information provided in this document was interpreted from the 1:250 000 scale geological map of the project area provided in Figure 5.

The proposed quarry area is underlain by rocks of the Transvaal Supergroup, more specifically rhyolite from the Schrikkloof Formation (Rooiberg Group). Rhyolite is an igneous volcanic rock type of felsic composition. The existing operations are underlain by sandstones from the Swaershoek Formation (Waterberg Group) (Figure 5). No prominent geological structures (i.e. faults and dykes) are indicated in

Figure 5. These structures may occur in the area and should therefore not be excluded entirely from the conceptual understanding of the geohydrological environment.

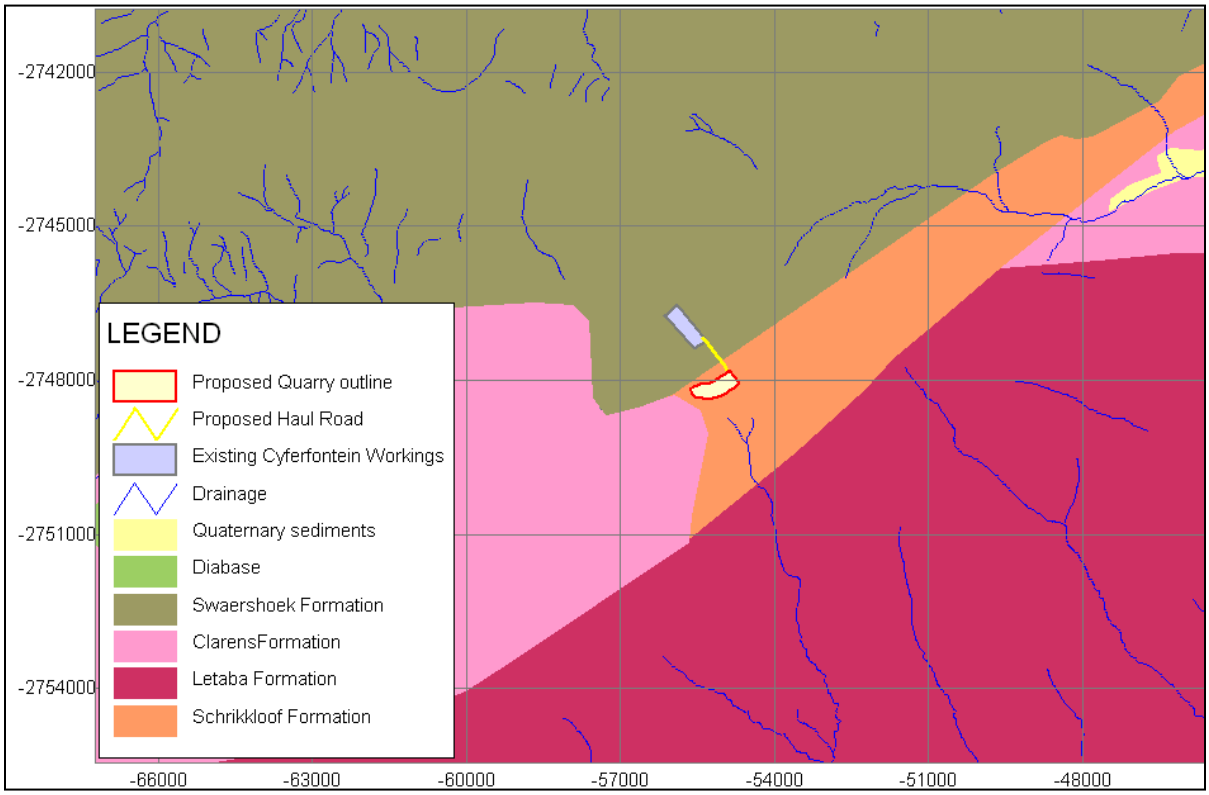


Figure 5: 1:250 000 scale geological map of the project area (AGIS)

2 Climate

Information for this section was extracted from the Groundwater Impact Assessment (Groundwater Complete, 2017), Air Quality Impact Assessment (Airshed Planning Professionals, 2017), and Storm Water Management Plan (Rational Environmental, 2017).

2.1 Regional climate

The project area is located within a summer rainfall region that receives the major part of its annual rainfall during the warm summer months of October through to March.

2.2 Temperature

A monthly-average ambient temperature trend (Figure 6), for 2014 to 2016, shows temperatures typically range between the July average (7.1°C) and January average (28.6°C), with daily-averages in the range 1.1°C (July) and 35.1°C (January). The long-term temperature trends recorded for Polokwane (1951 - 1984) and Mokopane (1956 – 1984) are shown in Table 7.

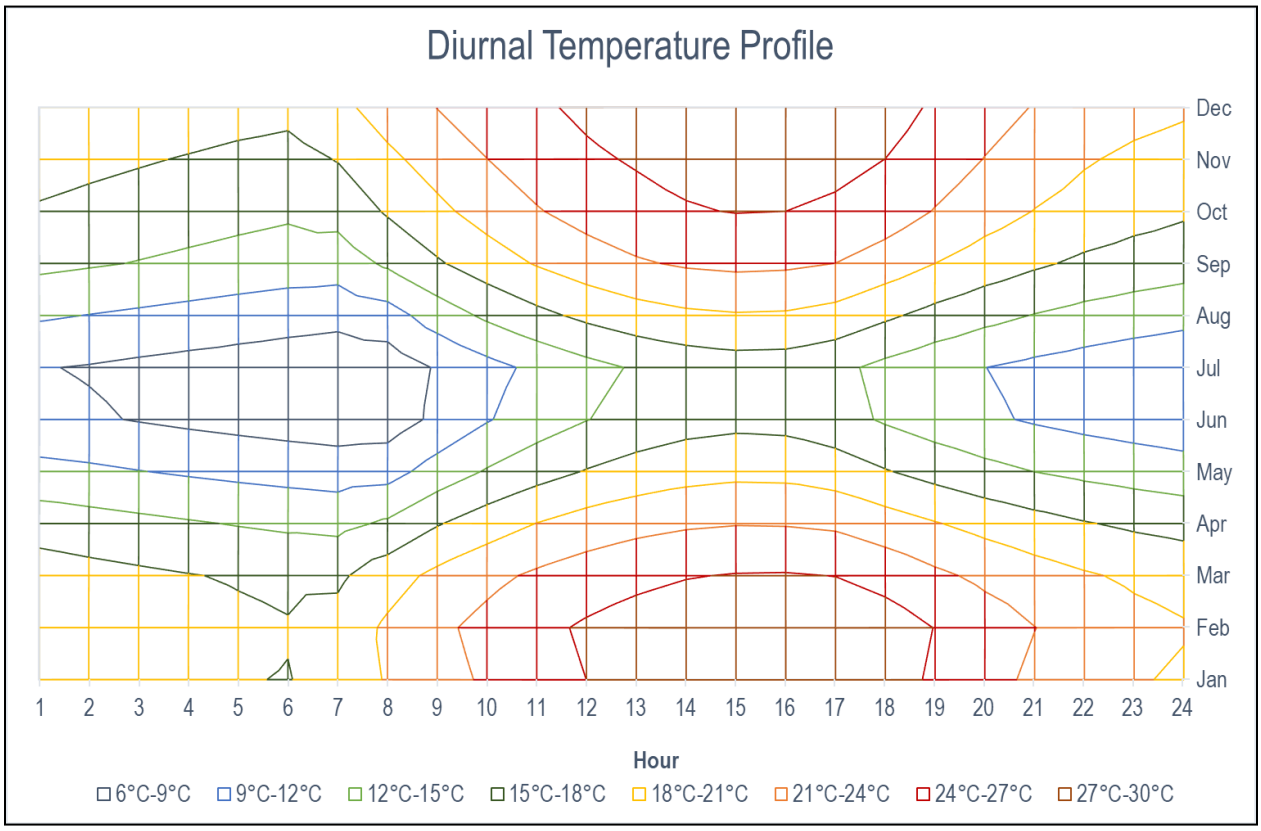


Figure 6: Diurnal temperature profile at the Cyferfontein Mine for 2014 – 2016, based on MM5 modelled data

Table 7: Long-term minimum, maximum and mean temperature for Polokwane (1951 - 1984) and Mokopane (1956 - 1984) (Schulze, 1986)

Station	Criteria	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Polokwane	Maximum	27.8	27.4	26.3	24.5	22.4	19.6	19.8	22.2	25.2	26.4	26.6	27.2
	Mean	22.4	22.0	20.7	18.3	15.0	12.0	12.1	14.3	17.6	19.9	20.9	21.8
	Minimum	16.9	16.6	15.1	12.1	7.7	4.5	4.3	6.4	10.1	13.4	15.2	16.3
Mokopane	Maximum	29.6	29.1	28.1	26.0	23.6	20.9	21.3	23.8	27.2	28.4	28.3	29.0
	Mean	23.8	23.3	22.1	19.6	16.3	13.2	13.8	16.2	19.9	21.9	22.5	23.2
	Minimum	18.0	17.5	16.0	13.1	9.0	5.7	6.1	8.5	12.6	15.3	16.7	17.4

2.3 Precipitation

The long-term average total annual rainfall for Polokwane is ~500 mm and ~600 mm for Mokopane (Table 8). Long-term monthly average rainfall data shows that rain falls mainly in summer from November

to March with the peak being in January (Schulze, 1986). MM5 modelled data for 2014 to 2016 shows higher than average annual rainfall for all three years (Figure 7).

Table 8: Long-term average monthly rainfall (mm) for Polokwane (1904-1984) and Mokopane (1956-1984) (Schulze, 1986)

Station	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Polokwane	91	72	61	31	11	4	5	4	14	41	80	91	505
Mokopane	123	90	68	37	11	6	2	5	19	45	96	107	609

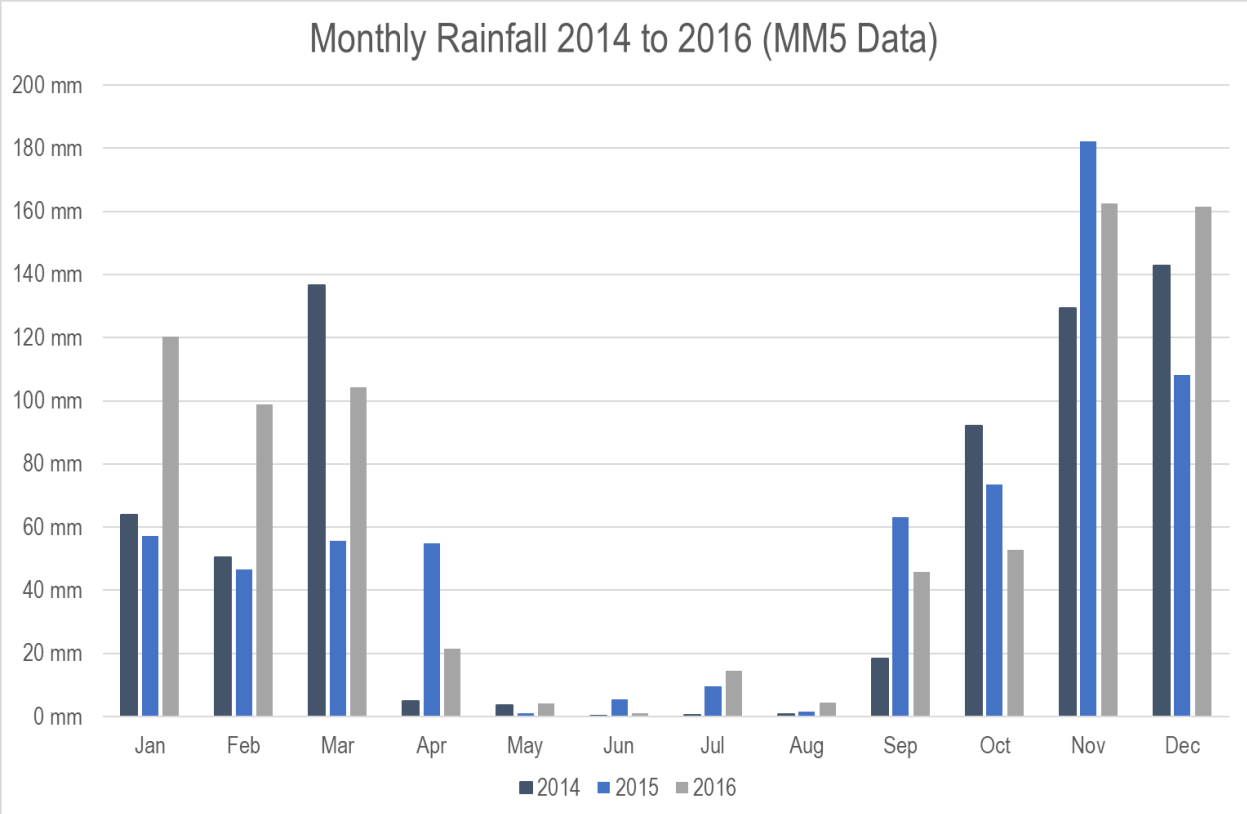


Figure 7: Monthly precipitation (mm) at the Cyferfontein Mine, based on MM5 modelled data, for the period 2014 – 2016. Annual average rainfall for the three years is 697 mm

2.4 Surface Wind Field

Because on-site measured meteorological data were unavailable, AERMET ready MM5 modelled meteorological data (2014 to 2016) for an on-site location at the Cyferfontein Mine was used to describe the dispersion potential of the study area and conduct dispersion modelling simulations. The MM5 meteorological data set was used to generate wind roses based on 16 spokes, representing the directions from which winds blew during the period (Figure 8). The colours reflected the different categories of wind

speeds with the dotted circles indicating the frequency of occurrence. The flow field is dominated by winds from the easterly sector. During day-time conditions winds from the south-easterly sector is more frequent, while winds from the northerly sector are more common at night.

Some seasonal variation in wind direction is also evident (Figure 9) with winds from the easterly sector dominating during summer and spring. Winds in autumn winter show the greatest variation in direction. The highest wind speeds, as well as a higher frequency of high wind speed events occur in summer and spring compared to autumn and winter.

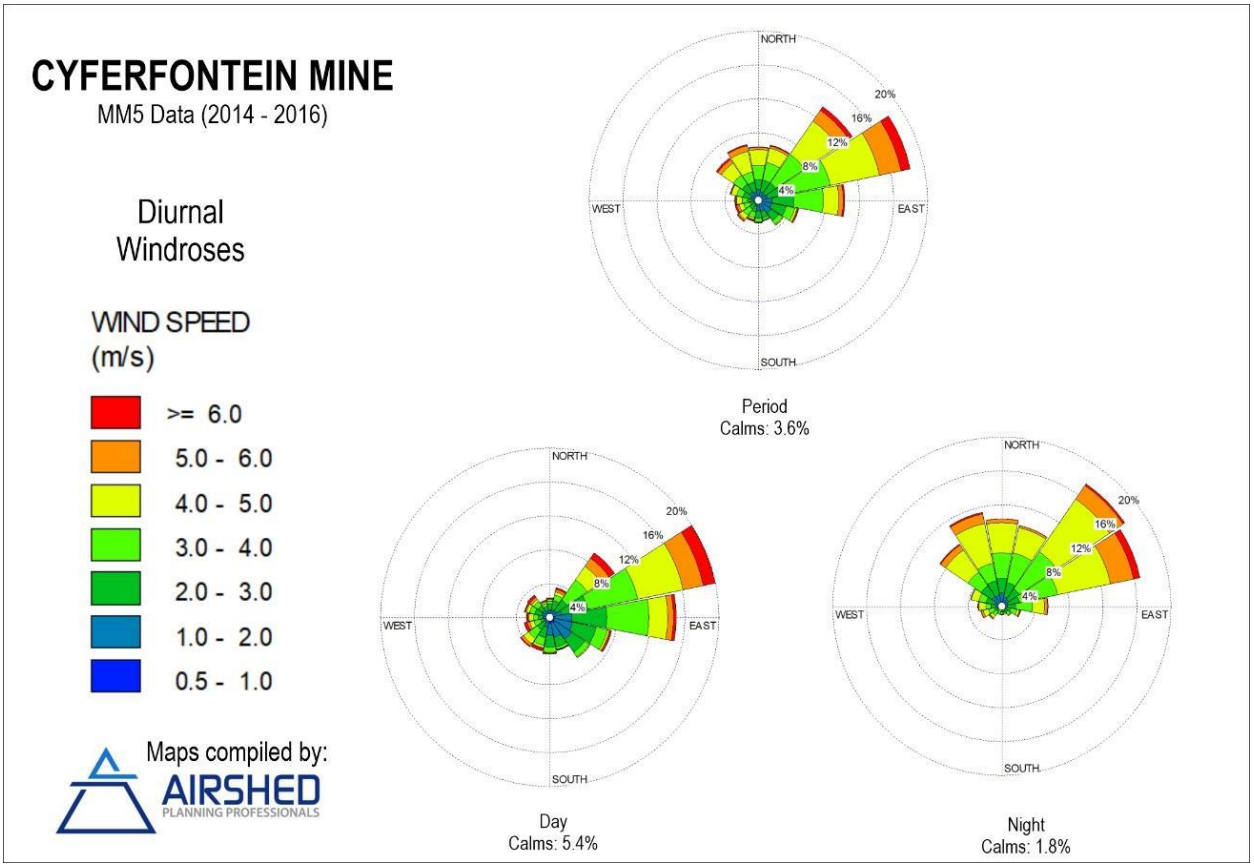


Figure 8: Period, day and night wind roses for the Cyferfontein Mine for the period 2014 – 2016, based on MM5 modelled data

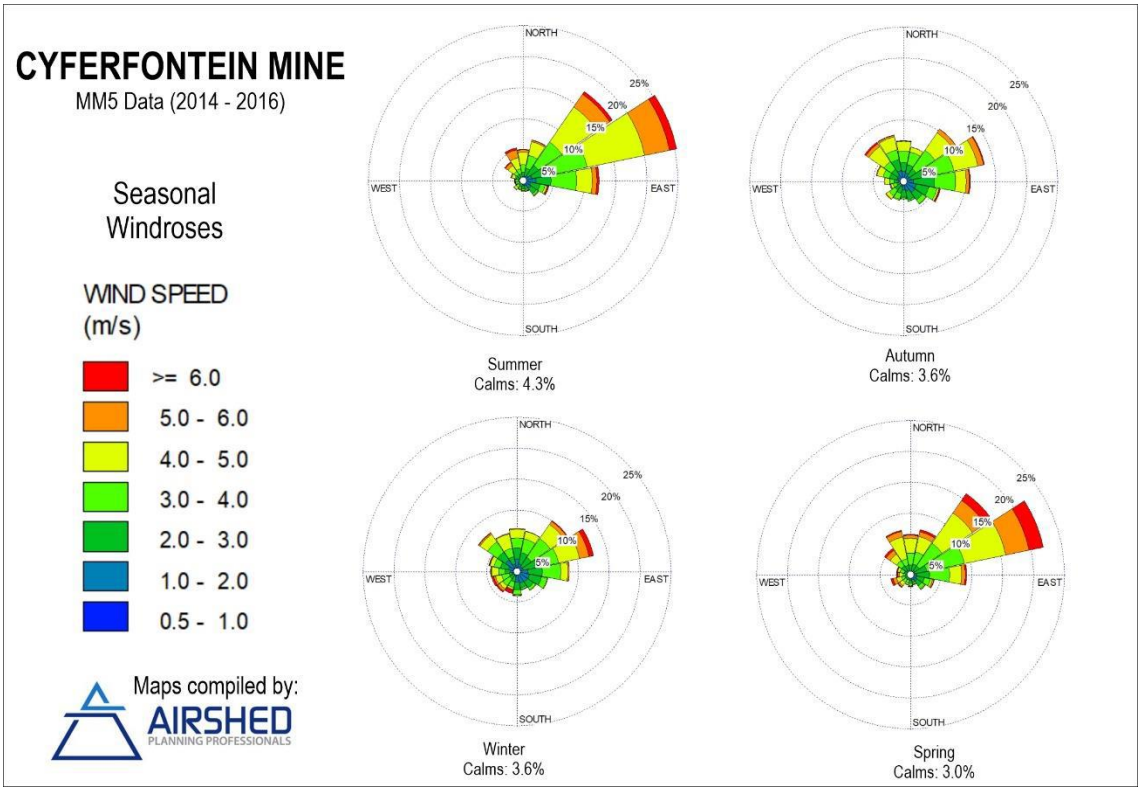


Figure 9: Seasonal wind roses for the Cyferfontein Mine for the period 2014 – 2016, based on MM5 modelled data

2.5 Evaporation

A-class pan evaporation has an annual average of 2,188mm for the same area.

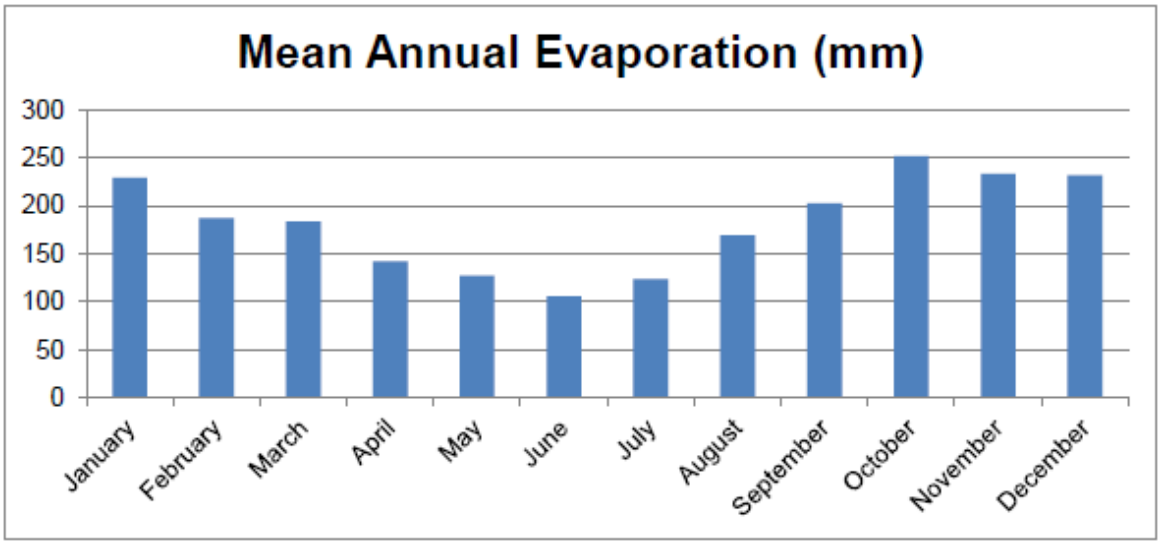


Figure 10: Mean annual evaporation for S-class pan

3 Topography

Information for this section was extracted from the Groundwater Impact Assessment (Groundwater Complete, 2017), and Storm Water Management Plan (Rational Environmental, 2017).

The area is characterized by plains and lowlands with a moderate relief. The existing Cyferfontein mine is located in the B31E catchment and drainage from the site is towards the east. The proposed new mining area straddles two catchment areas, namely A61C and B31E. The surface drainage from the site will therefore be both to the north-east and south.

The highest surface elevations in the catchment area are around 1,360mamsl to the north-west of the A61C catchment, while the lowest elevations are at 1,080mamsl to the south-east of the B31E catchment. In the Cyferfontein area itself, the topography is relatively flat, varying with only 2m over the area (Figure 11). Higher run-offs can be expected from the hill slope areas than from the drier plains. The topography over the A61C catchment area decreases from 1,200mamsl to 1,150mamsl over a distance of 13.7km, thus at a low gradient of 0.4% to the north-east. The topography from the proposed mine pit to the south is higher and decreases from 1,560mamsl to 1,100mamsl over a distance of 7.9km, thus a gradient of 5.8%.

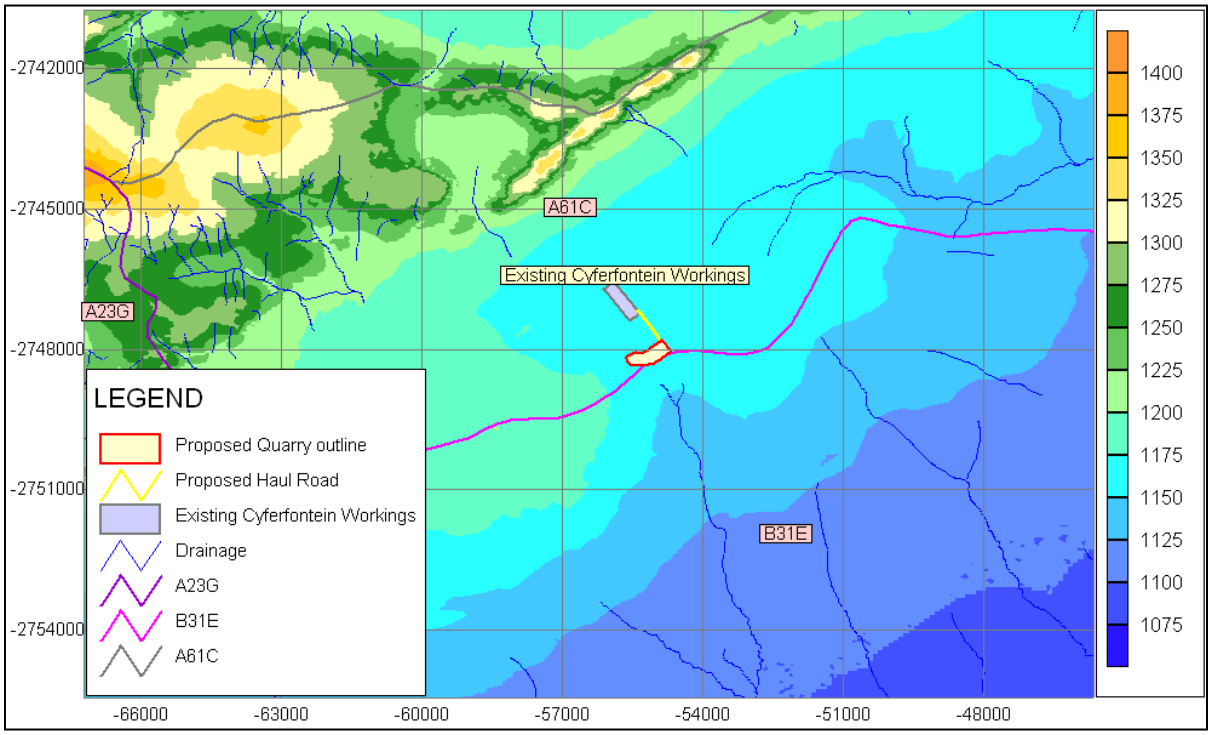


Figure 11: Surface elevations, catchment areas and water courses

Drainage within the existing site is mainly towards the two lowest points of the excavated quarry in the north and southern points. The rehabilitated area has a depression where wetland vegetation is established.

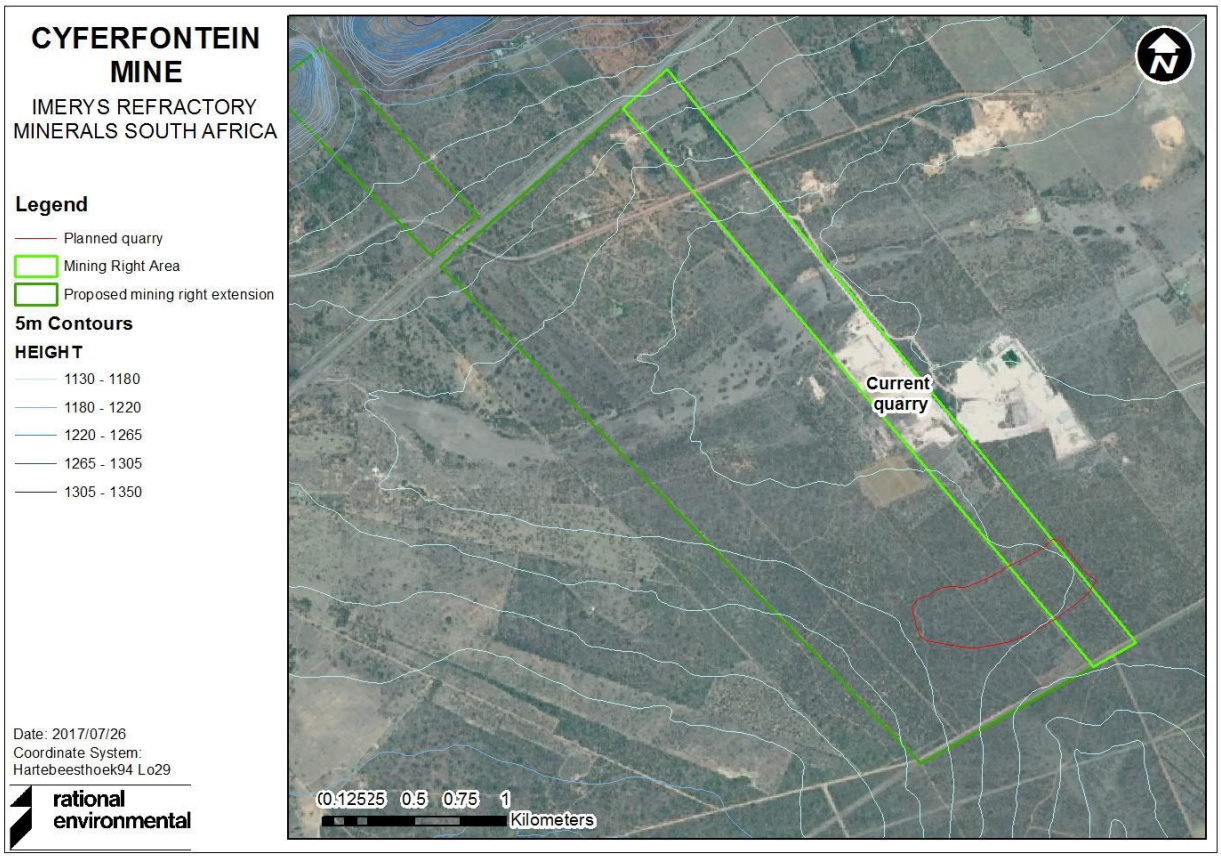


Figure 12: Site layout plan and general topography

4 Soil

Information for this section was extracted from the Soil, land capability and land use assessment (Rehab Green, 2017):

A total of 2 homogeneous soil units, based on dominant soil form, effective soil depth, internal drainage, terrain unit and slope percentage were identified during field observations and were symbolised as Hu and Bd. The homogeneous units are referred to as soil types and are shown in Figure 13, which contains an abbreviated soil legend. A comprehensive soil legend is provided in Table 9, which described the soils in terms of the following aspects.

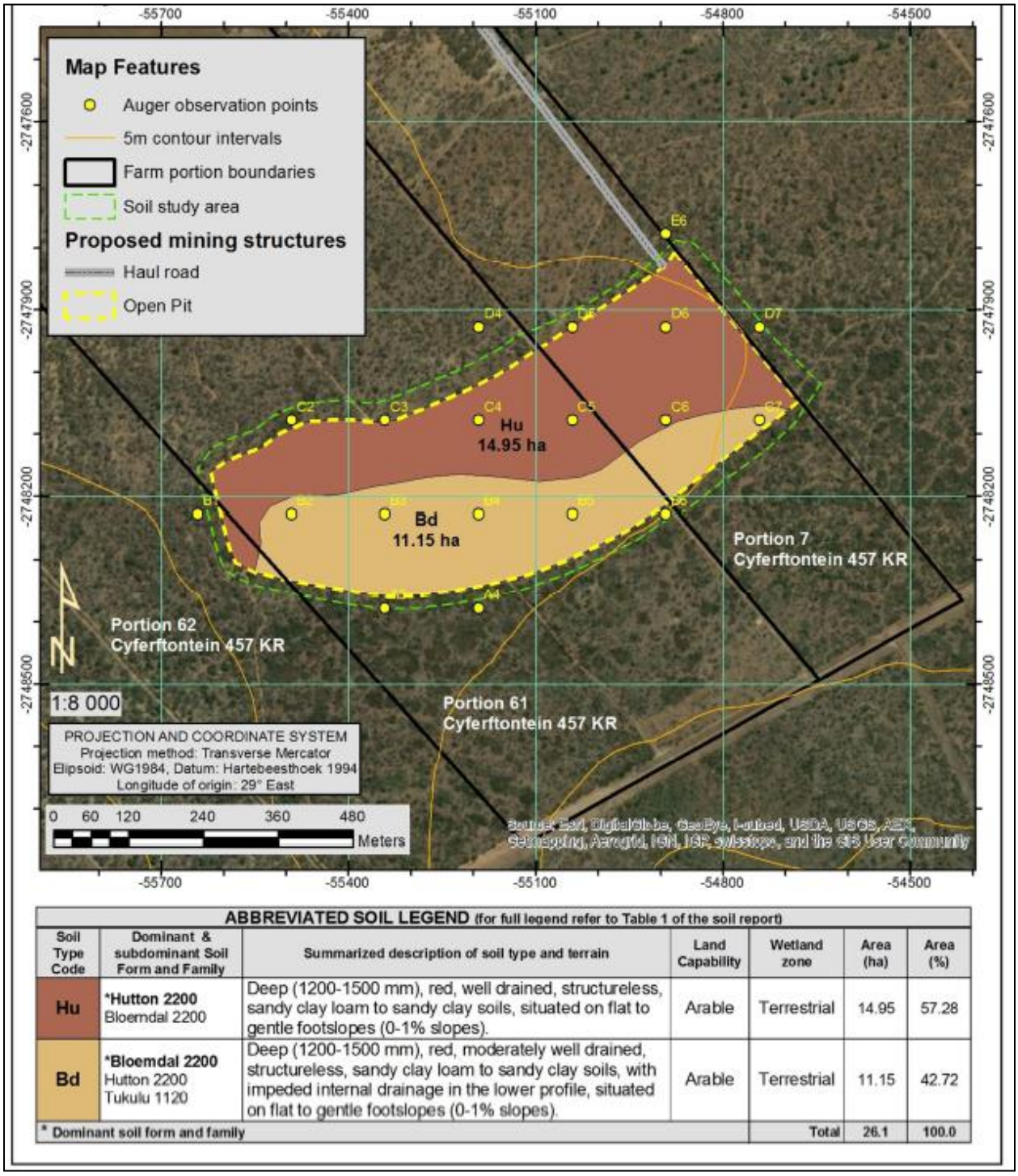
- Dominant soil forms and families and subdominant soil forms;
- The estimated clay content of the A and B or E or G-horizons;

- A broad description of the dominant soil form and terrain in terms of the effective soil depth, internal drainage, soil colour, soil texture class, terrain unit and average slope percentage range;
- A description of the soil horizon sequences;
- The derived erodibility class and dry land crop production potential;
- The land capability and wetland zone classification; and
- The area and percentage comprised by each soil type.

Soil type Hu, dominated by the Hutton soil form, covers 14.95ha and consists of deep (1,200-1,500mm), red, well-drained, sandy clay loam to sandy clay soils and is situated on flat to gentle midslopes (0-1% slopes). The land capability was classified as arable land and the dry land crop production potential as high.

Soil type Bd, dominated by the Bloemdal soil form, covers 11.15ha and consists of deep (1,200-1,500mm), red, moderately well-drained, sandy clay loam to sandy clay soils and is situated on flat to gentle midslopes (0-1% slopes). The land capability was classified as arable land and the dry land crop production potential as high.

Soil type Hu differs from soil type Bd in terms of the internal drainage in the lower soil profile. Soil type Bd are characterised by impeded internal drainage lower in the soil profile, which is evident by prominent mottling.



ABBREVIATED SOIL LEGEND (for full legend refer to Table 1 of the soil report)

Soil Type Code	Dominant & subdominant Soil Form and Family	Summarized description of soil type and terrain	Land Capability	Wetland zone	Area (ha)	Area (%)
Hu	*Hutton 2200 Bloemdal 2200	Deep (1200-1500 mm), red, well drained, structureless, sandy clay loam to sandy clay soils, situated on flat to gentle footslopes (0-1% slopes).	Arable	Terrestrial	14.95	57.28
Bd	*Bloemdal 2200 Hutton 2200 Tukulu 1120	Deep (1200-1500 mm), red, moderately well drained, structureless, sandy clay loam to sandy clay soils, with impeded internal drainage in the lower profile, situated on flat to gentle footslopes (0-1% slopes).	Arable	Terrestrial	11.15	42.72
* Dominant soil form and family				Total	26.1	100.0

Figure 13: Soil map of the proposed open quarry

Table 9: Detailed soil legend

Soil legend										
Soil Type Code	**Dominant & subdominant Soil Form and Family**	**% Clay per horizon A, E, G, B**	**Summarized Description of Dominant Soil Forms in terms of effective depth, soil colour, soil texture and terrain unit**	**Description of soil horizon sequences of dominant soil forms**	**Erodibility**	**Dry land crop production potential**	**Land Capability**	**Wetland/ Terrestrial zone**	**Area (ha)**	**Area (%)**
Hu	*Hutton 2200 Bloemdal 2200	A: 30-35 B: 40-45	Deep (1200-1500 mm), red, well drained, structureless, sandy clay loam to sandy clay soils, situated on flat to gentle footslopes (0-1% slopes).	Brown to reddish brown, sandy clay loam Orthic A-horizions underlain orange red, sandy clay apedal B1 horizons, which gradually fade in to a reddish yellow apedal B2 horizon.	Low	High	Arable	Terrestrial	14.95	57.28
Bd	*Bloemdal 2200 Hutton 2200 Tukulu 1120	A: 30-35 B: 40-45	Deep (1200-1500 mm), red, moderately well drained, structureless, sandy clay loam to sandy clay soils, situated on flat to gentle footslopes (0-1% slopes).	Brown, sandy clay loam Orthic A-horizons underlain orange red, sandy clay apedal B1 horizons, which gradually fade in to a reddish yellow apedal B2 horizons, underlain by greyish, mottled material with signs of wetness.	Low	High	Arable	Terrestrial	11.15	42.72
* Dominant soil form and family										

5 Pre-mining land capability, land use and existing infrastructure

Information for this section was extracted from the Soil, land capability and land use assessment (Rehab Green, 2017):

The location and extent of land capability classes within the proposed open pit area are shown in Figure 14. The land capability of the proposed open pit footprint is summarized in Table 10, which shows the soil types grouped into each land capability class, a broad description of the soil group, the number of units per land capability class, and the area and percentage comprised by each land capability class. Table 10 and Figure 14 show that the total open pit area was classified as arable land.

Table 10: Land capability classes

Legend: Land capability						
Land Capability Code	**Land Capability Class**	***Soil Types**	**Broad Soil Description**	**Unit Count**	**Area (ha)**	**Area (%)**
A	Arable	Hu, Bd	Deep (1200-1500 mm), red, well and moderately well drained, structureless, sandy clay loam to sandy clay soils.	1	26.11	100
W	Wetland	-	-	0	0	0
G	Grazing	-	-	0	0	0
WDN	Wilderness	-	-	0	0	0
* See soil map						

5.1 Wetland and riparian delineation

Land capability was assessed in categories of arable land, grazing land, wetlands and wilderness land. Wetland zones were therefore delineated as part of the soil and land capability assessment based on soil properties. Auger observations were made systematically throughout the open pit footprint in order to locate areas where soil properties reflect signs of wetness within 500mm from the surface. No wetlands occurred in the open quarry footprint.

5.2 Derived dry land crop production potential and long-term potential yields

The dry land crop production potential and potential crop yields was estimated based on soil properties for each soil type within the proposed infrastructure area and is summarised in Table 11.

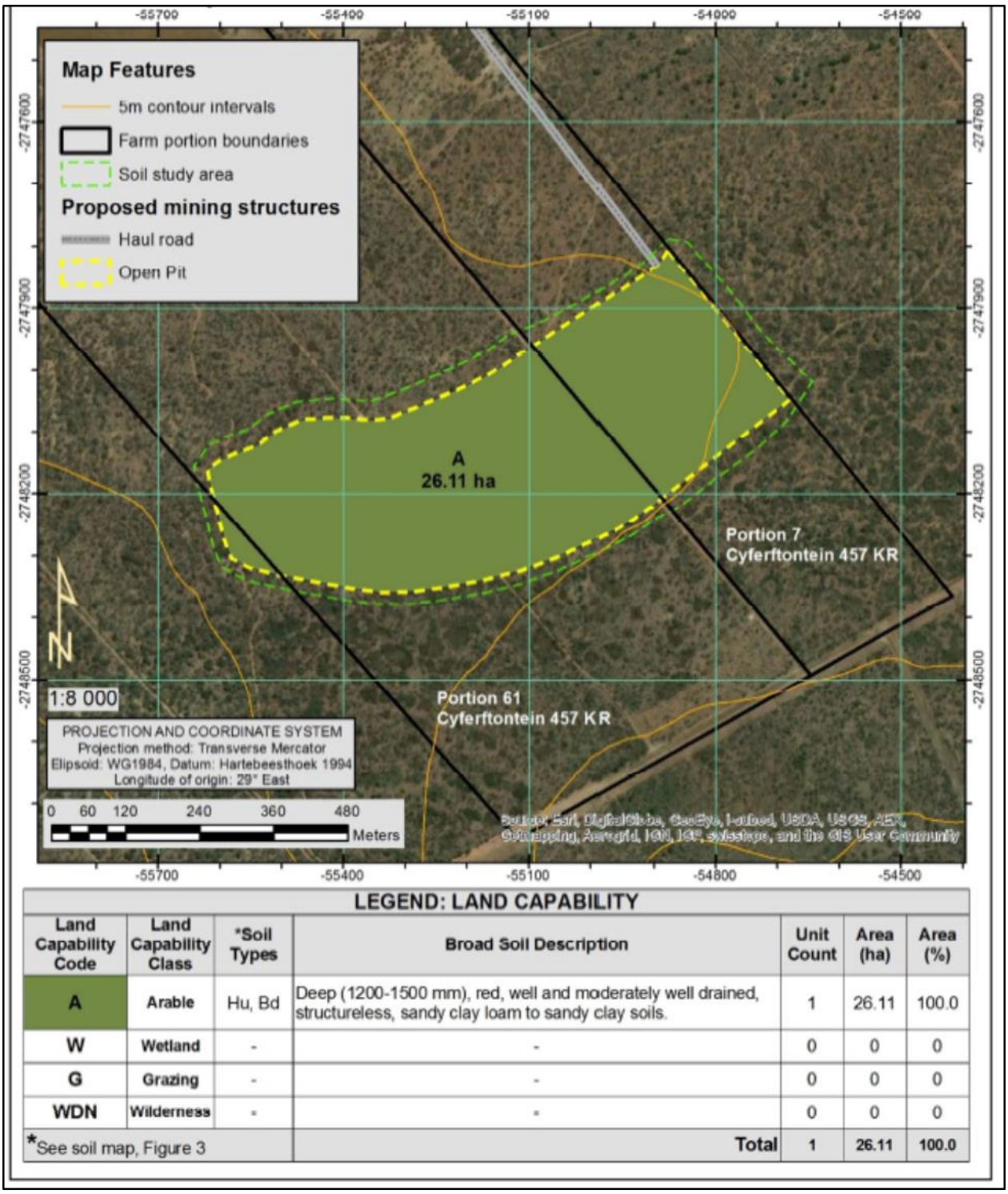
Table 11: Derived dry land crop potential and long-term potential yields

Soil type	Dry land crop production potential class	Potential long-term yields for dry land maize (t/ha/a)
Hu	High	3-6
Bd	High	3-6

The localities and extents of pre-mining land uses within the proposed open pit area are shown in Figure 14 and are summarised in Table 12. total open pit footprint was utilised for commercial cattle and wildlife farming.

Table 12: Pre-mining land use

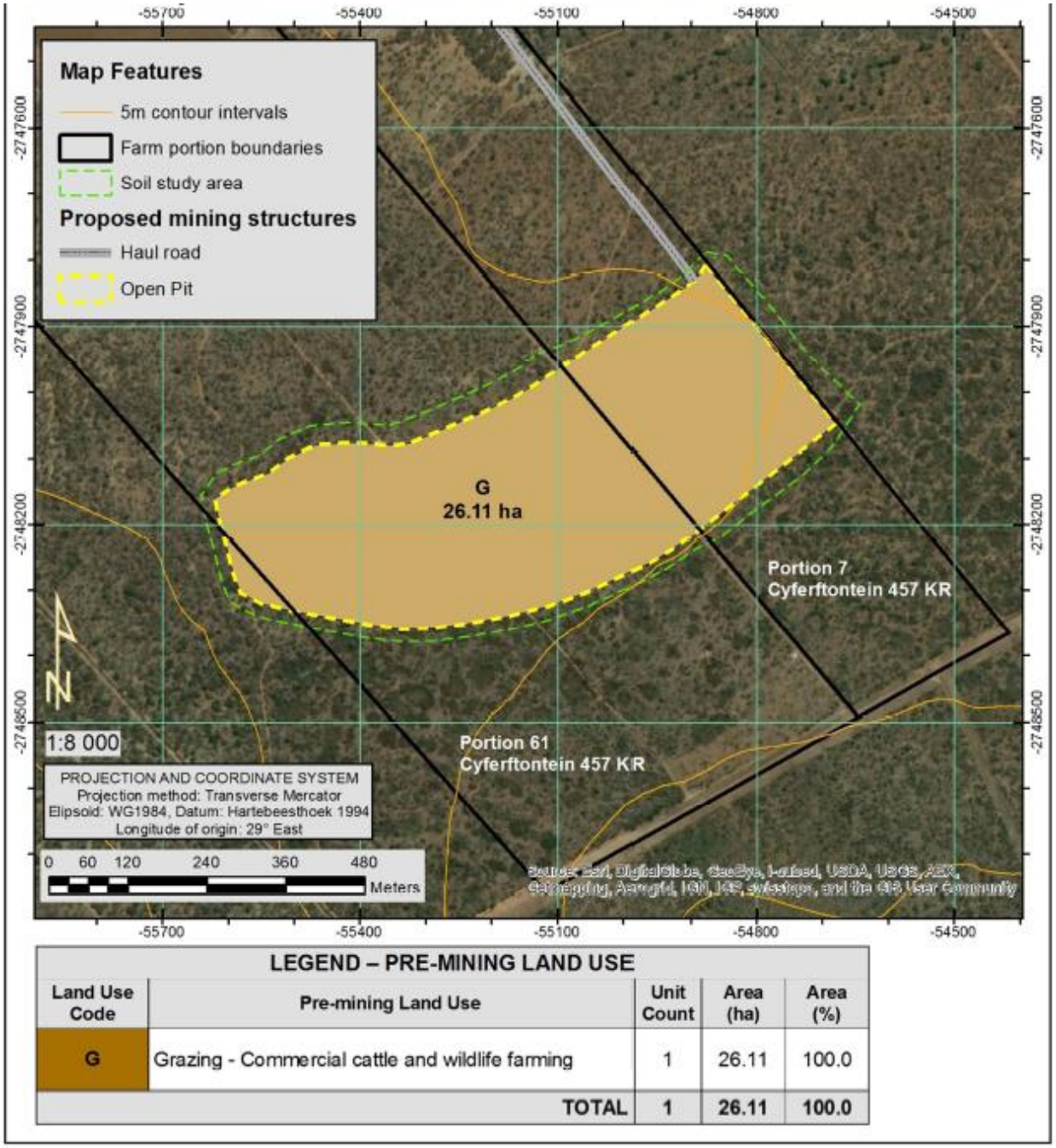
Legend: Pre-mining land use				
Land Use Code	**Pre-mining Land Use**	**Unit Count**	**Area (ha)**	**Area (%)**
G	Grazing - Commercial cattle and wildlife farming	1	26.11	100



LEGEND: LAND CAPABILITY

Land Capability Code	Land Capability Class	*Soil Types	Broad Soil Description	Unit Count	Area (ha)	Area (%)
A	Arable	Hu, Bd	Deep (1200-1500 mm), red, well and moderately well drained, structureless, sandy clay loam to sandy clay soils.	1	26.11	100.0
W	Wetland	-	-	0	0	0
G	Grazing	-	-	0	0	0
WDN	Wilderness	-	-	0	0	0
*See soil map, Figure 3			Total	1	26.11	100.0

Figure 14: Land capability map of the proposed new quarry



LEGEND – PRE-MINING LAND USE

Land Use Code	Pre-mining Land Use	Unit Count	Area (ha)	Area (%)
G	Grazing - Commercial cattle and wildlife farming	1	26.11	100.0
	TOTAL	**1**	**26.11**	**100.0**

Figure 15: Land use map of the proposed new quarry

6 Vegetation

Information for this section was extracted from the Flora Assessment (Galago Environmental Biodiversity and Aquatic Specialists, 2017).

6.1 Regional vegetation

The study site lies in the quarter degree square 2428CD (Warmbad). According to Mucina & Rutherford (2006), the area lies within two vegetation units, *viz* Central Bushveld Sandy and Springbokvlakte Thornveld. The authors describe the Central Sandy Bushveld as having low undulating areas and sandy plains and catenas supporting tall, deciduous *Terminalia sericea* and *Burkea africana* woodland on deep sandy soils and low broad-leaved Combretum woodland on shallow rocky or gravelly soils. Species of *Acacia, Ziziphus* and *Euclea* are found on flats and lower slopes on eutrophic sands and some less sandy soils. Acacia tortilis may dominate some areas along valleys. There is a grass-dominated herbaceous layer with relatively low basal cover on dystrophic soils. The southern and eastern parts of the area are underlain by granite of the Lebowa Granite Suite and some granophyre of the Rashoop Granophyre Suite. In the north, the sedimentary rocks of the Waterberg Group are most important.

The Central Bushveld Sandy vegetation unit is considered vulnerable. Its conservation target is 19%. Less than 3% of this unit is statutorily conserved, spread thinly across many nature reserves, e.g. Doorndraai dam and Skuinsdraai Nature Reserves. An additional 2% is conserved in other reserves including the Wallmansthal SANDF property and a grouping of private reserves that include most of the Nylsvlei freshwater wetlands. Almost 24% of the unit is already transformed including 19% cultivated and 4% urbanization.

Mucina & Rutherford (2006) described the Springbokvlakte Thornveld as open to dense low thorn savanna dominated by *Acacia* species or shrubby grassland with a very low shrub layer. The vegetation unit occurs on flat to slightly undulating plains. The rocks are part of the volcano-sedimentary Karoo Supergroup. Soils are red-yellow apedal, freely drained with high base status and self-mulching, black vertic clays. The vertic soils, with a fluctuating water table, experience prolonged periods of swelling and shrinking during wet and dry periods, considerable soil-cracking when dry, a loose soil surface, high calcium carbonate content and gilgai micro-relief.

The Springbokvlakte Thornveld vegetation unit is considered endangered. Its conservation target is 19%. Only 1% is statutorily conserved, mainly in the Mkombo Nature Reserve. Roughly three times this area is conserved in a number of other reserves. At least 49% of the unit is already transformed, including about 45% cultivated and 3% urban and built-up. There are dense rural populations in parts of the southern and eastern side of the unit as well as scattered alien plants over wide areas. Erosion is low to moderate.

6.2 Pit area

6.2.1 Vegetation study units in the Pit area

One vegetation study unit, *Acacia – Euclea undulata* woodland, was identified in the pit area. Table 14 lists the plants recorded in the proposed pit area.

6.2.2 Medicinal plants recorded in the proposed pit area

The names of known medicinal plants are marked with numbers, which appear as footnotes at the end of Table 14. Of the 77 plant species recorded in the proposed pit area, 17 species with medicinal properties were recorded.

6.2.3 Alien plants

Alien plants are not listed separately, but are included in the list in Table 14, as they form part of the Pit area study unit. Their names are marked with an asterisk in Table 14. Four alien plant species, of which three species are Category 1b invasive species, were recorded in the proposed pit area of the site. Invasive species are controlled by the NEMBA – Alien and Invasive Species Regulations which became law on 1 October 2014.

Category 1b Invasive species must be controlled, and wherever possible, removed and destroyed. Any form of trade or planting is strictly prohibited.

6.2.4 Species in the Pit area that are considered threatened

Species listed in the Red List of South African plants (2009) as Critically endangered, Endangered and Vulnerable are considered threatened species. One plant species that is considered a threatened species, is known to occur in the 2428CD quarter degree square. The proposed pit area does not have suitable habitat for this species (Annexure A.1 of specialist study).

6.2.5 Species in the Pit area that are deemed not threatened but of conservation concern

Species listed in the Red List of South African plants (2009) as Near Threatened (NT), Declining, Rare and Data Deficient (DD) are considered not threatened, but of conservation concern. Eleven plant species that are considered not threatened, but of conservation concern are known to occur in the 2428CD quarter degree square. The proposed pit area has suitable habitat for three of these species, one of which was found (Annexure A.2 of specialist study).

6.2.6 Protected trees and other protected species

Five Protected trees, listed in terms of the NFA, are known to occur in the 2428CD quarter degree square. The proposed pit area has suitable habitat for four of these species, two of which were found (Annexure B of specialist study).

One plant, that is a Protected species in terms of the NEMBA is known to occur in the 2428CD quarter degree square, but the proposed pit area does not have suitable habitat for this species (Annexure C of specialist study).

6.2.7 Acacia – Euclea undulata woodland

6.2.7.1 Compositional aspects and Connectivity

This study unit comprises woodland dominated by several Acacia species (Table 13). Dense Northern spike thorn (Kraalpendoring) and Small-leaved Sickle bush (Sekelbos) encroachment occurs as a result of not burning the veld for many years. A thick mat of dried vegetation, especially grasses, most of which could not be identified owing to winter dormancy, occurs between the trees. A severe infestation of Queen of the Night occurs throughout the study site. Connectivity with natural vegetation exists to the south.

Seventy-seven plant species were recorded in the proposed pit area of the study site. Of these 73 are indigenous species. The following number of species in each growth form was noted:

Table 13: Species in each growth form

Growth form	**Number of species**
Annual & perennial herbaceous species	20
Tree species	15
Shrubs and dwarf shrubs	14
Grasses	18
Geophytes	3
Succulents	7
Total No. of species	77

6.2.7.2 Species in the proposed pit area that are considered threatened, or not threatened, but of conservation concern

The *Acacia – Euclea undulata* woodland study unit does not have suitable habitat for the threatened species *Cullen holubii*, but has suitable habitat for three species that are considered not threatened but of conservation concern (see Annexure A.2 of specialist study). Two of these specimens of one of them, the NT species *Elaeodendron transvaalensis*, were recorded in the proposed pit area.

6.2.7.3 Protected trees and other protected species

The *Acacia – Euclea undulata* woodland study unit has suitable habitat for two of the protected tree species listed in terms of the NFA Two specimens of *Elaeodendron transvaalensis* (also listed as NT in terms of the Red List of South African plants, 2009) and several specimens of *Boscia albitrunca* (Shephards tree / Witgat) were recorded in the proposed pit area. In terms of the NFA, these trees should be conserved *in situ*. The pit area in the *Acacia – Euclea undulata* woodland study unit does not have suitable habitat for the protected species listed in terms of the NEMBA (Annexure C of specialist study).

6.2.7.4 Medicinal and alien species

Seventeen medicinal species were recorded in the pit area of the *Acacia – Euclea undulata* woodland study unit. Four alien species, of which three species are Category 1b invasive species, were recorded in the proposed pit area of this study unit.

6.2.7.5 Sensitivity

The pit area of the *Acacia – Euclea undulata* woodland study unit is considered sensitive owing to the presence of the two species of protected trees, the one species of which is also of conservation concern. The presence of large numbers of Northern Spike thorn, Sickle bush and Queen of the Night ruins the pristine nature of this study unit.

Table 14: Plants recorded in the *Acacia – Euclea undulata* woodland

Scientific name	**Inv cat**	**Common names**
Acacia karroo		Sweet thorn
Acacia mellifera subsp. *detinens*		Black thorn
Acacia nigrescens		Knob-thorn
Acacia nilotica subsp. *kraussiana*		Scented pod
Acacia rehmanniana		Silky thorn
Acacia robusta subsp. *robusta*		Broad-pod robust thorn
Acacia tortilis subsp. *heteracantha*		Umbrella thorn
Albuca setosa		Slymuintjie
Aloe greatheadii var. *davyana*		Kleinaalwyn
Aloe zebrina		
Anthephora pubescens		
Antisoma angustifolia		
Aristida congesta subsp. *barbicollis*		Spreading three-awn grass
Aristida congesta subsp. *congesta*		Tassle three-awn grass
Aristida scabrivalvis subsp. *scabrivalvis*		Purple three-awn
Asparagus buchananii		

Scientific name	Inv cat	Common names
Asparagus suaveolens		Wild asparagus
Barleria macrostegia		
Boscia albitrunca		Shepherd tree / Witgat
Carissa bispinosa		Num-num
Cenchrus ciliaris		Blue buffalo grass
*Cereus jamacaru**	1b	Queen of the night
Cheilanthes viridis var. *glauca*		Blue cliff brake
Clematis brachiata		Traveler's joy
Commelina africana var. cf *krebsiana*		
Crabbea angustifolia		
*Cymbopogon pospischilii**		
Cynodon dactylon		Couch grass / Kweek
Dichrostachys cinerea subsp. *africana* var. *africana*		Small-leaved sickle bush
Diospyros lycioides subsp. *guerkei*		Bushveld bluebush
Elaeodendron transvaalensis		Bushveld saffron
Eragrostis chloromelas		Curly leaf
Eragrostis curvula		Weeping love grass
Eragrostis plana		Tough love grass
Eragrostis rigidior		Broadleaved curly leaf
Eragrostis trichophora		Hairy love grass
Eriospermum flagelliforme		
Euclea undulata		Small-leaved guarri
Felicia muricata subsp. *muricata*		White felicia
Gnidia capitata		Kerrieblom
Grewia flava		Velvet raisin bush
Grewia flavescens		Sandpaper raisin / Skurwerosyntjie
Grewia occidentalis var. *occidentalis*		Cross berry
Gymnosporia buxifolia		Spike-thorn
Gymnosporia polyacantha subsp. *vaccinifolia*		Northern spike thorn / Kraalpendoring
Heteropogon contortus		Spear grass
Ipomoea obscura var. *obscura*		Wild petunia
Justicia flava		
Kalanchoe lanceolata		
Kyphocarpa angustifolia		
*Lantana camara**	1b	Lantana
Lantana rugosa		Bird's brandy
Leucas neuflizeana		
Lippia cf *wilmsii*		

Scientific name	Inv cat	Common names
Lotononis cf *laxa*		
Melinis repens subsp. *repens*		Red top grass
*Opuntia ficus-indica**	1b	Sweet prickly pear
Ornithogalum tenuifolium subsp. *tenuifolium*		Bosui

Inv cat=Invasive species category

6.3 The larger study site

6.3.1 Vegetation study units

Three vegetation study units were identified on the larger study site:

- *Acacia – Euclea undulata* woodland;
- Disturbed area; and
- Floodplain.

6.3.2 Acacia – Euclea undulata woodland

The species composition of this study unit on the larger site appears to be the same as that in the pit area. Large patches of Northern spike thorn and Sickle bush and thick mats of dried grasses occur. Connectivity with natural vegetation exists to the south.

The medicinal plants and alien plant species recorded in the pit area were also observed in the *Acacia – Euclea undulata* woodland study unit. The infestation by Queen of the Night appears to be severe.

This study unit on the larger site does not have suitable habitat for the threatened species known to occur in the 2428CD quarter degree square (Annexure A.1 of specialist study). The species considered not threatened but of conservation concern in terms of the Red List of South African plants, 2009, (Annexure A.2 of specialist study) and the Protected trees (Annexure B of specialist study) that were recorded in the pit area, were also observed in *the Acacia – Euclea undulata* woodland study unit of the larger site.

6.3.3 Disturbed area

This study unit comprises natural vegetation disturbed by excavations, ploughing, roads, clearing of Sickle bush and areas of old human habitation (near the main gravel road). The three Category 1b invasive species recorded in the pit area were also observed in this study unit. The species considered not threatened but of conservation concern in terms of the Red List of South African plants, 2009, (Annexure A.2 of specialist study) and the Protected trees (Annexure B of specialist study) that were recorded in the pit area, were also observed in the areas of old human habitation near the main gravel road. In addition, a

very large specimen of the protected tree *Sclerocarya birrea* subsp. *caffra* (Marula) occurs at the entrance of Portion 61 of the farm.

6.2.4 Floodplain

This study unit on the larger study site is considered a wetland in a shallow and wide drainage line. It consists mostly of moisture-loving grasses, presently dried out as a result of the winter season. At least three small impoundments occur in in the floodplain, one of which is kept full using borehole water for the use of the cattle and game. Typical wetland plant species occur in and around this dam. The Floodplain study unit has suitable habitat for at least one species of conservation concern, *viz. Crinum macowanii*, a Declining species.

The only obvious medicinal species observed in the Floodplain study unit is *Gomphocarpus fruticosus* subsp. *Fruticosus*, which was not recorded in the pit area. As wetlands form biological filters and drainage lines form corridors for the movement of species, which include pollinators of plant species, this study unit is considered sensitive.

7 Animal life

Information for this section was extracted from the Mammals and Habitat Assessment, Avifaunal Habitat Assessment, and Herpetofaunal Habitat Assessment (Galago Environmental Biodiversity and Aquatic Specialists, 2017).

7.1 Mammals

The conservation of the footprint for the mining site is ranked as “Very Good”. Connectivity for larger animals is marred by a game fence.

7.1.1 Mammal habitat assessment

The local occurrences of mammals are closely dependent on broadly defined habitat types, in this instance particularly terrestrial, arboreal (tree-living), and wetland-associated vegetation cover (rupiculous habitat type is absent from this site). It is thus possible to deduce the presence or absence of mammal species by evaluating the habitat types within the context of global distribution ranges.

7.1.2 Expected and Observed Mammal Species Richness

The study site is located in the midst of a cattle-farming district; as such it is a large area of unadulterated woodland savanna. Environmentally the study site is therefore relatively unaltered, since it is being grazed by cattle; as such it maintains a high ecological conservation ranking. Sixty-seven species are deemed to be residents, or at least occasional vagrants to the study site. This high species richness is furthermore the

result of the fact that three habitat types are represented, as well as the fact that a number of herbivores have been re-introduced. The new mine will entirely displace arboreal and terrestrial habitats on its footprint, whereas it is assumed that the wetland habitat and its associated fauna will not be directly affected. The right-hand column in Table 15 denotes the habitat preference of species.

The study site is primarily managed to graze cattle, but the larger herbivores listed in Table 15 were reintroduced and are commercially hunted on a sustainable basis. Other than cattle (which are basically grazers), most of the herbivores are browsers; -as such increasing the biomass sustained on the property. Duiker and steenbok has always been naturally-occurring ruminants.

Other than the larger antelopes and carnivores, all other species of the assemblage are natural occupants that persisted as a result of the 'light' land-use practice of grazing livestock within the limits of carrying capacity.

Table 15 lists the mammals that were observed or deduced to occupy the site, or to be occasional visitors.

Most of the species of the resident diversity (Table 15) are common and widespread. With the possible exception of the two dwarf shrews, all the species listed in Table 15 are robust (some with strong pioneering capabilities). The reason for their survival success is predominantly seated in their remarkable reproduction potential (*viz*. multimammate mice species capable of producing ca. 12 pups per litter at intervals of three weeks), and to a lesser extent their reticent and cryptic nature (scrub hares, genets and mongooses). The two mongoose species and two genet species are very resilient and have a remarkable ability to persist, even close to human settlement. The key to their persistence lie in their reticent nature, and in the case of the genets, also their nocturnal lifestyles.

The species richness is near-natural, with only large herbivores (viz. buffalo, eland) and carnivores (viz. lion, spotted hyenas) displaced to enhance grazing for domestic stock.

7.1.3 Threatened and red listed mammal species flagged

By the Scientific Community:

The ecology and population dynamics of DD small mammal species listed in Table 15 have not been adequately studied to provide quantitative field data to empirically assign a conservation ranking, and are thus as a precaution considered as DD Red Data species. Shrews and the short-snouted elephant shrew operate at the apex of the food pyramid via an invertebrate trophic sublevel, which means that their population numbers are significantly lower than that of their prey species in order to maintain sustainable prey population levels. Because of their diet, they are furthermore not readily trapped with conventional bait

or traps, which may mean that their numbers are under-estimated. Specimen collection of shrews using drift fences and pitfalls invariable yield better acquisition results than live-trapping, which reiterate the sentiment that shrew numbers are more often than not under-estimated and that many species' conservation status are misconstrued.

Hedgehogs are NT as a result of interference by humans and their pets. Under natural conditions, the passive defence mechanisms of these rather docile insectivores are sufficient to maintain breeding populations in a healthy condition. Considering the size of the district and unimpaired connectivity towards especially the south and west it is considered possible that a small population of hedgehogs persists.

Marsh rats along the wetland and dam will not be affected in any way, since their presence is some distance from the intended environmental disturbance. Bushveld gerbils and robust rodents are common, and displacing these rodents from the site will not bring their conservation ranking in contention. Ground pangolins and honey badgers occur in very low population densities throughout their ranges, and these are therefore merely vagrants that can be expected to occasionally venture on-site.

The NT brown hyena is traditionally persecuted by stock framers, but they manage to persist as a result of their cryptic nature and nocturnal lifestyle. Although their numbers are probably under-estimated, these animals are nevertheless under survival threat and will further decline on their way to local extinction in the face of burgeoning regional urbanization.

No other Red Data or sensitive species are deemed present on the site, either since the site is too disturbed, falls outside the distributional ranges of some species, or does not offer suitable habitat(s).

<u>By the Biodiversity Act No 10 of 2004:</u>
Protected Species: African hedgehog.

<u>Formally Prohibited Invasive and Prohibited Species:</u>
Nil

Table 15: Mammal species observed or deduced to occupy the site

	Scientific name	**English name**	**Habitat**
	Order Macroscelididae		
	Family Macroscelididae		
DD√	*Elephantulus brachyrhynchus*	Short-snouted elephant shrew	Terrestrial
	Order Tubulidentata		

	Scientific name	English name	Habitat
	Family Orycteropodidae		
√	*Orycteropus afer*	Aardvark	Terrestrial
	Order Lagomorpha		
	Family Leporidae		
√	*Lepus saxatilis*	Scrub hare	Terrestrial
	Order Rodentia		
	Family Bathyergidae		
√	*Cryptomys hottentotus*	African mole rat	Terr./Subterr.
	Family Hystricidae		
√	*Hystrix africaeaustralis*	Cape porcupine	Terrestrial
	Family Tryonomyidae		
*	*Thryonomys swinderianus*	Greater cane rat	Wetland
	Family Pedetidae		
√	*Pedetes capensis*	Springhare	Terrestrial
	Family Sciuridae		
*	*Paraxerus cepapi*	Tree squirrel	Arboreal
	Family Myoxidae		
*	*Graphiurus murinus*	Woodland dormouse	Arboreal
	Family Muridae		
√	*Rhabdomys pumilio*	Four-striped grass mouse	Terrestrial
NT*	*Dasymys incomtus*	African marsh rat	Wetland
√	*Mus minutoides*	Pygmy mouse	Terrestrial
√	*Mastomys natalensis*	Natal multimammate mouse	Terrestrial
√	*Mastomys coucha*	Southern multimammate mouse	Terrestrial
*	*Thallomys paedulcus*	Acacia rat	Arboreal
√	*Aethomys ineptus*	Tete veld rat	Terrestrial
*	*Otomys angoniensis*	Angoni vlei rat	Wetland
*	*Otomys irroratus*	Vlei rat	Wetland
DD√	*Gerbilliscus leucogaster*	Bushveld gerbil	Terrestrial
√	*Saccostomus campestris*	Pouched mouse	Terrestrial
*	*Dendromus melanotis*	Grey pygmy climbing mouse	Terrestrial
*	*Dendromus mesomelas*	Brants' climbing mouse	Terrestrial
*	*Steatomys pratensis*	Fat mouse	Terrestrial
	Order Primates		
	Family Galagidae		
√	*Galago moholi*	South African galago	Arboreal
	Family Cercopithecidae		
√	*Cercopithecus pygerythrus*	Vervet monkey	Terr./Arboreal

	Scientific name	English name	Habitat
	Order Eulipotypha		
	Family Soricidae		
DD*	*Myosorex varius*	Forest shrew	Wetland
DD*	*Suncus lixus*	Greater dwarf shrew	Terrestrial
DD*	*Suncus infinitesimus*	Least dwarf shrew	Terrestrial
DD√	*Crocidura cyanea*	Reddish-grey musk shrew	Terr./Wetland
DD√	*Crocidura hirta*	Lesser red musk shrew	Terr./wetland
	Family Erinaceidae		
NT*	*Atelerix frontalis*	Southern African hedgehog	Terr.
	Order Chiroptera		
	Family Embalonuridae		
*	*Taphozous mauritianus*	Mauritian tomb bat	Volant
	Family Molossidae		
*	*Tadarida aegyptiaca*	Egyptian free-tailed bat	Volant
	Family Vespertilionidae		
√	*Neoromicia capensis*	Cape serotine bat	Volant
√	*Scotophilus dinganii*	African yellow house bat	Volant
√	*Scotophilus viridis*	Greenish yellow house bat	Volant
	Order Pholidota		
	Family Manidae		
V?	*Manis temminckii*	Ground pangolin	Terrestrial
	Order Carnivora		
	Family Hyaenidae		
√	*Proteles cristatus*	Aardwolf	Terrestrial
NT*	*Parahyaena brunnea*	Brown hyena	Terrestrial
	Family Felidae		
√	*Panthera pardus*	Leopard	Terr./Arboreal
√	*Caracal caracal*	Caracal	Terrestrial
√	*Letailurus serval*	Serval	Terrestrial
	Felis silvestris	African wild cat	Terrestrial
	Family Viverridae		
*	*Civettictis civetta*	African civet	Terr./Wetland
√	*Genetta genetta*	Small-spotted genet	Terrestrial
√	*Genetta tigrina*	SA large-spotted genet	Terrestrial
	Family Herpestidae		
√	*Cynictis penicillata*	Yellow mongoose	Terrestrial
√	*Galerella sanguinea*	Slender mongoose	Terrestrial
*	*Ichneumia albicauda*	White-tailed mongoose	Terr./Wetland

	Scientific name	English name	Habitat
*	*Atilax paludinosus*	Marsh mongoose	Terr./Wetland
√	*Mungos mungo*	Banded mongoose	Terrestrial
	Family Canidae		
√	*Canis mesomelas*	Black-backed jackal	Terrestrial
	Family Mustelidae		
NT√	*Mellivora capensis*	Honey badger	Terrestrial
DD*	*Poecilogale albinucha*	African weasel	Terrestrial
*	*Ictonyx striatus*	Striped polecat	Terrestrial
	Order Perissodactyla		
	Family Equidae		
√	*Equus quagga*	Plains zebra	Terrestrial
	Order Suiformes		
	Family Suidae		
√	*Potamochoerus larvatus*	Bushpig	Terr./Wetland
√	*Phacochoerus africanus*	Common warthog	Terrestrial
	Order Ruminanta		
	Family Bovidae		
√	*Tragelaphus strepsiceros*	Kudu	Terrestrial
√	*Tragelaphus scriptus*	Bushbuck	Terrestrial
√	*Tragelaphus scriptus*	Bushbuck	Terrestrial
√	*Tragelaphus angasii*	Nyala	Terrestrial
√	*Connochaetes taurinus*	Blue wildebeest	Terrestrial
√	*Damaliscus p. phillipsi*	Blesbok	Terrestrial
√	*Sylvicapra grimmia*	Grey duiker	Terrestrial
√	*Kobus ellipsiprymnus*	Waterbuck	Terrestrial
√	*Raphicerus campestris*	Steenbok	Terrestrial
√	*Aepyceros melampus*	Impala	Terrestrial

(Systematics and taxonomy as proposed by Bronner et.al [2003], Skinner & Chimimba [2005], Apps [2012] and Stuart & Stuart [2015]).

√ Definitely there or have a high probability to occur;

* Medium probability to occur based on ecological and distributional parameters;

? Low probability to occur based on ecological and distributional parameters.

Terrestrial

Red Data species rankings as defined in Friedmann and Daly's S.A. Red Data Book / IUCN (World Conservation Union) (2004) are indicated in the first column: CR= Critically Endangered, En = Endangered, Vu = Vulnerable, LR/cd = Lower risk conservation dependent, LR/nt = Lower Risk near threatened, DD = Data Deficient. All other species are deemed of Least Concern.

Table 16: Mammal species positively confirmed from the study site, observed indicators and habitat

Scientific name	English name	Observation indicator	Habitat
O. afer	Aardvark	Damage to termitaria	Grassveld
L. saxatilis	Scrub hare	Faecal pellets	Short grassveld
C. hottentotus	African mole rat	Tunnel systems	Universal
G. brantsii	Highveld gerbil	Tunnel systems	Sandy grassland

It was somewhat of a surprise to encounter proof of the occurrence of aardvark. Scrub hares and the mole rats are outstandingly widespread in the Subcontinent and common within their distribution ranges. Both are reproductively fecund. The scrub hare thrives on short grass (which is normally the result of overgrazing or environmental manipulation), and is rarely seen since they are nocturnal and are exceptionally cryptic during day where they lie up in forms constructed at the base of grass clumps or shrubs. The subterranean life-style of rodent moles renders them virtually untouchable by humans unless specialised traps are deployed. Highveld gerbils are fairly common in sandy veld where they can excavate colonial tunnel systems; they are often encountered at the edges of tilled fields.

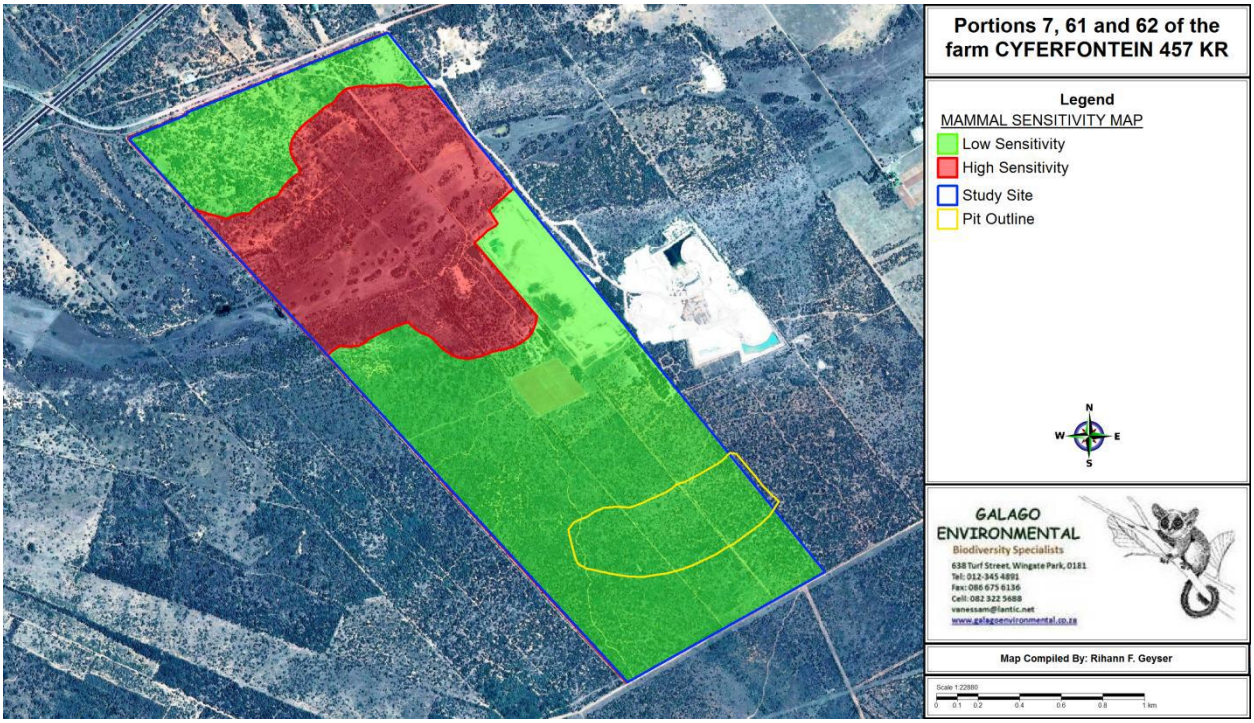


Figure 16: Mammal sensitivity map of the study area

7.2 Avifauna

7.2.1 Avifaunal habitat assessment

Three major avifaunal habitat systems were identified within the study area (Figure 17). These habitat systems are as follows:

- Floodplain Area (open savanna) and man-made impoundments
- Acacia dominated woodland
- Disturbed and Transformed Area

Table 17 indicated the habitat-system composition of the study area in terms of surface area and percentage.

Table 17: Avifaunal habitat composition of the study area

Avifaunal Habitat Systems	Area (ha)	%
Floodplain Area (open savanna) and man-made impoundments	±92.8475	10
Acacia dominated woodland	±694.1401	75
Disturbed and Transformed	±144.0641	15
Total surface Area:	±931.0517	

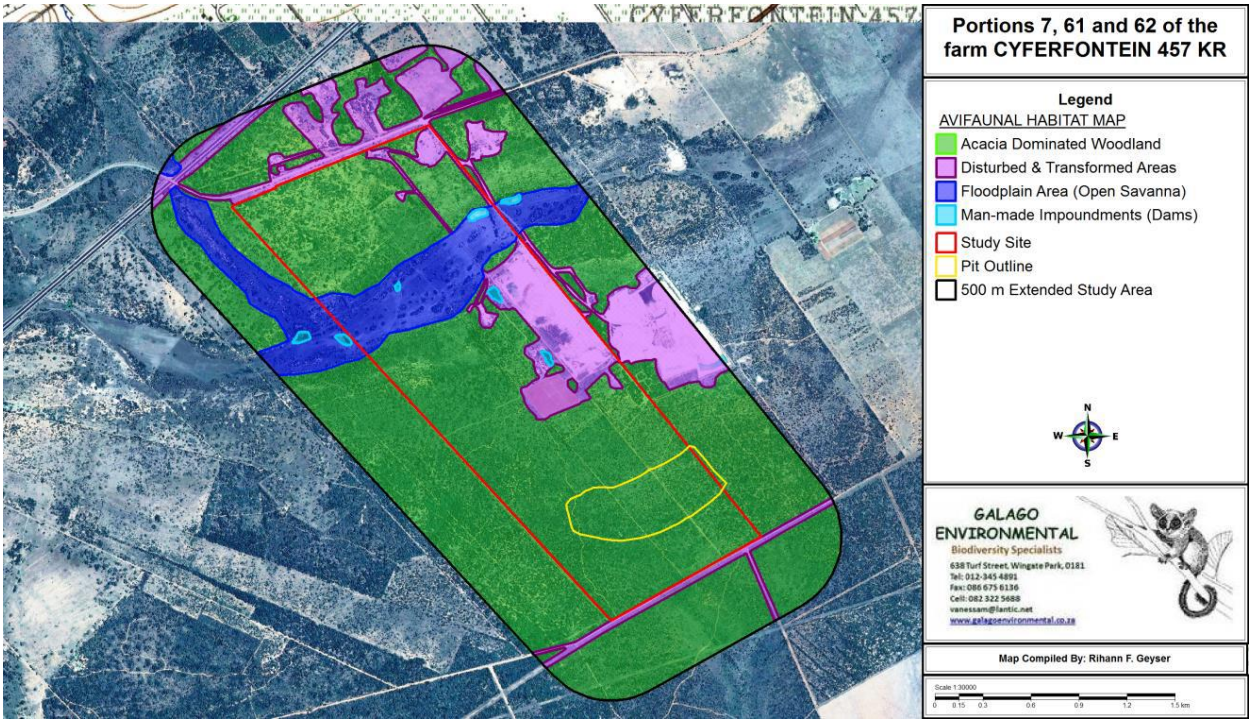


Figure 17: Avifaunal species habitat systems identified on the study site and within the study area

A short description of each habitat systems follows, ranked from most to least important.

Floodplain Area and man-made impoundments

A total of ±10% of the total surface area of the study area consists of a floodplain area with dams or man-made impoundments.

This floodplain area resembles open savanna woodland. The open grassland areas between the dense woodland stands become flooded in times of very high rainfall during summer months and hold suitable wetland habitat for a variety of aquatic and semi-aquatic avifaunal species. During winter or during below average rainfall seasons the floodplain area becomes dry and will favour avifaunal species associated with open savanna habitat, which will also favour avifaunal species associated with the Acacia dominated woodland habitat. Several man-made impoundments are constructed within the floodplain area creating more permanent sources of water for aquatic and semi-aquatic avifaunal species.

Acacia dominated woodland

A total of ±75% of the total surface area of the study area consists of *Acacia* dominated woodland that varies from areas with dense thickets to areas with more open woodland or areas with tall trees and sparse vegetation underneath them on sandy soils.

The avifaunal species diversity in this habitat system generally includes a great variety of arboreal passerines, such as drongos, warblers, flycatchers, shrikes, sunbirds, waxbills and weavers, and arboreal non-passerines, such as doves, cuckoos, barbets, hoopoes, hornbills and woodpeckers. Many of these species make use of the thorny nature of these trees to build their nests. Acacia trees generally attract many insects and in turn attract a good diversity of typical “Bushveld” bird species. Aerial-feeding avifaunal species such as swallows and swifts will hunt for insects between the trees that grow within this habitat system.

Disturbed and Transformed Areas:

The rest of the study area, ±15%, is disturbed and has been transformed by past and present human activities. These areas include graded and cleared areas, roads, areas transformed due to mining activities, farm houses surrounded by mixed alien and indigenous vegetation and areas overgrown by alien and invasive trees and vegetation.

Only the more common avifaunal species that are able to adapt to areas changed by man will make use of this habitat system. None of these species that occur within these habitat systems are threatened.

7.2.2 Observed and expected species richness

Of the 361 avifaunal species recorded for the 2428CD q.d.g.c. during the SABAP1 period (Harrison et al. 1997) and the current SABA2 period, 316 (87%) are likely to occur on the study site and 67 (21%) of these avifaunal species were actually observed within the study area during the time of the survey.

To date 330 avifaunal species were recorded for the q.d.g.c. during the current SABAP2 project compared with 313 species recorded during the SABAP1 period.

Of all the avifaunal species that occur or that are likely to occur within the study area 48% (n=151) of the species indicate a decrease in reporting rate, 48% (n=152) an increase in reporting rate and 4% (n=13) remained stable.

The avifaunal biodiversity index (ABI) indicates that the largest avifaunal species diversity is likely to occur within the floodplain area with open savanna habitat system within the study area, with an avifauna biodiversity index (ABI) of 935, followed by the Acacia dominated woodland (ABI 774) and the disturbed and transformed areas (ABI 602).

The avifaunal species listed in Table 1 in the Avifaunal Habitat Assessment (Galago, 2017) are in the species order according to Roberts - Birds of Southern Africa (Hockey et al, 2005). These comprise the 316 species that are likely to occur within the specific habitat systems on and within 500m extended study area, with those actually observed in bold. This does not include overflying birds or rare vagrants. The reporting rate for each species is the percentage for the q.d.g.c. according to the SABAP 1 atlas (Harrison et al. 1997), and is represented by colour codes as follows: Yellow = Very Low, Light Orange = Low, Dark Orange = Medium and Red = High. The colour codes of the SABAP2 reporting rate indicate the following; Red = decrease in reporting rate, Green = increase in reporting rate and Yellow = stable reporting rate compared to the SABAP1 data. The habitat preference scores for each species are shown under the recognised habitat types on site: FP = Flood Plain area and open savanna, AW = Acacia dominated Woodland and DT = Disturbed and Transformed, with their possibility of occurrence in these specific habitats rated as 5 = present, 4 = High, 3 = Medium, 2 = Low, 1 = Very low and 0 = Not likely to occur.

7.2.3 Threatened and red listed bird species

Red Data avifaunal species that were recorded for the 2428CD q.d.g.c. according to the SABAP1 data (Harrison et al. 1997) and the SABAP2 data for the 2428CD q.d.g.c. and more specifically the 2445_2825 and 2450_2825 pentads in which the study area is situated (sabap2.adu.org.za June 2017) are included in Table 2 in the Avifaunal Habitat Assessment (Galago, 2017).

A total of 21 Red Data avifaunal species have been recorded within the 2428CD q.d.g.c. during the SABAP1 period (Harrison et al. 1997) and the current SABAP2 period, 16 during the SABAP1 period, 15 during the current SABAP2 period and 3 and 9 Red Data species for the 2445_2825 and 2450_2825 pentads respectively (SABAP2) in which the study area is situated (sabap2.adu.org.za June 2017) (Table 2 in the Avifaunal Habitat Assessment (Galago, 2017)).

A total of 62% (n=13) of the Red Data Species recorded for the 2428CD q.d.g.c. indicate a decrease in reporting rate, 33% (n=7) an increase in reporting rate and 5% (n=1) remains stable.

7.2.4 Summary of the red data avifaunal species

Table 18 provides a list of the Red Data avifaunal species recorded for the 2428CD q.d.g.c. according to the SABAP1 data (Harrison et al. 1997) and the current SABAP2 data and an indication of their likelihood of occurrence within the study area based on actual sightings, habitat and food availability.

Table 18: Red Data avifaunal species assessment for the study site and study area according to the SABAP1 and SABAP2 data for the 2428CD q.d.g.c

Species name*	**Presence of suitable habitat and habitat requirements**	**Likelihood of occurrence on study site**
Coracias garrulus (European Roller) (LC/NT)	**YES** Closed to very open savanna. Most common in open, broadleaved and Acacia woodlands with grassy clearings; least common in areas with less-developed woody cover.	Unlikely Might only pass through the area on rare occasions to and from more suitable habitat surrounding the study site.
Alcedo semitorquata (Half-collared Kingfisher) (NT/NT)	**NONE** Requires fast-flowing streams, rivers and estuaries, usually with dense marginal vegetation (Maclean, 1993), especially perennial streams and smaller rivers with overhanging riparian vegetation on their banks. Nests in sand/earth banks (Tarboton et al. 1987) and requires riverbanks in which to excavate nest tunnels (Harrison et al. 1997a). Most typically occurs along fast-flowing streams with clear water and well-wooded riparian growth, often near rapids. It most frequently favours broken escarpment terrain and requires at least 1 km up and down stream of undisturbed river and riparian vegetation while breeding. It occurs from sea-level to 2000 m a.s.l. in southern Africa. Usually perches low down on the	Highly unlikely Due to a lack of suitable river and riparian habitat.

Species name*	Presence of suitable habitat and habitat requirements	Likelihood of occurrence on study site
	banks of rivers and streams, often on exposed roots, as well as exposed rock and low overhanging tree branches.	
Tyto capensis (African Grass Owl) (VU/VU)	**SUBOPTIMAL** Occurs predominately in rank grass, typically but not always at fairly high altitudes. Breeds mainly in permanent and seasonal vleis, which it vacates while hunting or during post-breeding although it will sometimes breed in any area of long grass, sedges or even weeds (Van Rooyen, pers comm.) and not necessarily associated with wetlands (Tarboton et al. 1987), although this is more the exception than the rule. Foraging mainly confined to tall grassland next to their wetland vegetation and rarely hunts in short grassland, wetlands or croplands nearby (Barnes, 2000). Mainly restricted to wet areas (marshes and vleis) where tall dense grass and/or sedges occur. Prefers permanent or seasonal vleis and vacates the latter when these dried up or are burnt. Roosts and breeds in vleis but often hunt elsewhere e.g. old lands and disturbed grassland although this is suboptimal habitat conditions (Tarboton et al. 1987). May rarely occur in sparse Acacia woodland where patches of dense grass cover are present (Harrison et al. 1997a).	Unlikely The floodplain area could, during times of high rainfall and when the floodplain area is flooded, offer suboptimal habitat for African Grass Owl. If suitable habitat is created due to flooding it will only be temporarily since it is unlikely that the floodplain area will hold water for long periods at a time.
Neotis denhami (Denham's Bustard) (VU/VU)	**NONE** In the grassland biome, its habitat is high-rainfall open, exposed, hilly, sour grassland during its breeding season (Tarboton et al. 1987). They move into cultivated pastures and cereal cropland in the nonbreeding season, where they prefer harvested fields; ploughed fields and fields with growing cereal crops are avoided (Herhold 1988; Allan 1993).	Highly unlikely Due to a lack of suitable river and riparian habitat.
Anthropoides paradiseus (Blue Crane) (VU/NT)	**NONE** Midlands and highland grassland, edge of karoo, cultivated land and edges of vleis (Maclean, 1993). Nests in both moist situations in vleis which have short grass cover and in dry sites far from water,	Highly unlikely Due to a lack of suitable habitat.

Species name*	Presence of suitable habitat and habitat requirements	Likelihood of occurrence on study site
	usually exposed places such as on hillsides; forages in grassland and cultivated and fallow lands; roosts communally in the shallow water of pans and dams (Tarboton et al. 1987). Short dry grassland, being more abundant and evenly disturbed in the eastern "sour" grassland, where natural grazing of livestock is the predominant land use. Prefers to nest in areas of open grassland (Barnes, 2000) In the fynbos biome it inhabit cereal croplands and cultivated pastures and avoids natural vegetation. By contrast, it is found in natural vegetation in the Karoo and grassland biomes, but it also feeds in crop fields (Harrison et al. 1997a).	
Glareola nordmanni (Black-winged Pratincole) (NT/NT)	**SUBOPTIMAL** A non-breeding overland migrant to southern Africa. In southern Africa winter quarters, prefers open grassland, edges of pans and cultivated fields, but most common in seasonally wet grasslands and pan systems. Attracted to damp ground after rains, also to agricultural activities, including mowing and ploughing, and to newly flooded grassland (Hockey et al. 2005).	Unlikely Might only pass through the area on rare occasions when the floodplain area is flooded.
Gyps africanus (White-backed Vulture) (**VU/EN**)	**YES** Their presence is dependent on the availability of food. Lightly wooded arid savanna, including Mopane *Colophospernum mopane* woodland; but absent from forest, true deserts, and the treeless grass- and shrubland of the south and central Karoo (Hockey et al. 2005).	Unlikely Might only pass through the area on rare occasions when carrion is available.
Aegypius tracheliotus (Lappet-faced Vulture) (**VU/EN**)	**YES** Predominately a bird of semi-arid regions (rainfall less than 600mm and often less than 400mm), it has a marked preference for arid woodland, Mopane, dry bush country as in the Kalahari, and in the arid parts of Namibia, particularly the Namib Desert itself. Even in well-wooded country it prefers open areas with scattered short trees (Harrison et al. 1997a).	Unlikely Might only pass through the area on very rare occasions when carrion is available.

Species name*	Presence of suitable habitat and habitat requirements	Likelihood of occurrence on study site
Gyps coprotheres (Cape Vulture) (VU/EN)	**YES** They mostly occur in mountainous country, or open county with inselbergs and escarpments; less commonly as visitors to savannah or desert (Maclean, 1993). Forage over open grassland, woodland and agricultural areas; usually roosts on cliffs, but will also roost on trees and pylons (Barnes, 2000). It is reliant on tall cliffs for breeding but it wanders widely away from these when foraging. It occurs and breeds from sea level to 3 100 m.a.s.l. Current distribution is closely associated with subsistence communal grazing areas characterised by high stock losses and low use of poisons and, to a lesser extent, with protected areas (Harrison et al. 1997a), but their presence is ultimately dependent on the availability of food.	Unlikely Although this species was observe flying from a wooded area south of the study site they are only likely to pass through the area on rare occasions when carrion is available.
Aquila rapax (Tawny Eagle) (VU/EN)	**YES** Occurs in lightly wooded savanna; absent from dense forests and highlands. Able to colonise Nama Karoo and treeless grasslands by breeding on pylons and alien trees (Hockey et al. 2005).	Unlikely Might only pass through the area on rare occasions to more suitable and less disturbed areas surrounding the study site.
Aquila verreauxii (Verreaux's Eagle) (**LC/VU**)	**NONE** Mountains and rocky areas with cliffs.	Highly unlikely Due to a lack of suitable habitat.
Polemaetus bellicosus (Martial Eagle) (VU/EN)	**YES** Tolerates a wide range of vegetation types, being found in open grassland, scrub, Karoo, agricultural lands and woodland. It relies on large trees (or electricity pylons) to provide nest sites (Barnes, 2000) as well as windmills and even cliffs in treeless areas . It occurs mainly in flat country and is rarer in mountains, and it also avoids extreme desert, and densely wooded and forested areas (Harrison et al. 1997a & Barnes, 2000).	Unlikely Might only pass through the area on rare occasions to more suitable and less disturbed areas surrounding the study site.
Sagittarius serpentarius (Secretarybird) (NT/VU)	**SUBOPTIMAL** Open grassland with scattered trees, shrubland, open Acacia and Combretum savanna (Hockey et al. 2005). Restricted to large conservation areas in the	Unlikely Might on rare occasions forage on the open savanna habitat represented by the floodplain area.

Species name*	Presence of suitable habitat and habitat requirements	Likelihood of occurrence on study site
	region. Avoids densely wooded areas, rocky hills and mountainous areas (Hockey et al. 2005 & Barnes, 2000). Requires small to medium-sized trees with a flat crown for nesting, and often roosts in similar locations. Nesting density only about 150 km²/pair (n = 4, Kemp, 1995).	
Falco naumanni (Lesser Kestrel) (**VU/LC**)	**YES** Non-breeding Palaearctic migrant. Forages preferentially in pristine open grassland but also hunts in converted grassland such as small scale pastures provided the conversion is not as total as in plantation forestry or in areas of consolidated agricultural monoculture (Barnes, 2000; Hockey et al. 2005) such as maize, sorghum, peanuts, wheat, beans and other crops (Tarboton & Allan 1984) where they hunt for large insects and small rodents, but avoid wooded areas except on migration. They roost communally in tall trees, mainly Eucalyptus, in urban areas (Barnes, 2000), often in towns or villages, but also in farm lands (pers. obs). Favour a warm, dry, open or lightly wooded environment, and are concentrated in the grassy Karoo, western fringes of the grassland biome and southeast Kalahari. Generally, avoids foraging in transformed habitats, but occurs in some agricultural areas, including croplands, in fynbos and renosterveld of the Western Cape (Hockey et al. 2005). Large numbers congregate in sweet and mixed grasslands of the highveld regions.	Unlikely Might on rare occasions forage on the open savanna habitat represented by the floodplain area.
Falco vespertinus (Red-footed Falcon) (**VU/LC**)	**YES** Gregarious; on non-breeding grounds (southern Africa), spends much of day in air, often at high altitude, but lower in mornings and evenings when hawking emergent insects. Frequently perches on dead trees, telephone poles and wires, and fence lines. Aggregates in late evening at communal roosts, sometimes containing 1 000+ birds. Settles at dusk, dispersing to foraging area at first light. In east of region, small numbers associate with large flocks of	Highly unlikely Might on rare occasions forage on the open savanna habitat represented by the floodplain area.

Species name*	Presence of suitable habitat and habitat requirements	Likelihood of occurrence on study site
	Amur Falcons and/or Lesser Kestrels. Flight graceful, with much gliding and soaring. European breeding population reduced by habitat loss and pesticide spraying.	
Falco biarmicus (Lanner Falcon) (**NT/VU**)	**YES** Most frequent in open grassland, open or cleared woodland, and agricultural areas. Breeding pairs generally favour habitats where cliffs are available as nest and roost sites, but will use alternative sites such as trees, electricity pylons and building ledges if cliffs are absent (Hockey et al. 2005). Mountains or open country, from semi desert to woodland and agricultural land, also cities (Maclean, 1993), even on forest-grassland ecotones. Generally, a cliff nesting species and its wider distribution is closely associated with mountains with suitable cliffs. Able to breed on lower rock faces than Peregrine Falcon (*Falco peregrinus*) and also utilises the disused nests of other species, such as crows, other raptors and storks, on cliffs, in trees and on power pylons, and also quarry walls (Tarboton et al. 1987). Generally, prefers open habitats e.g. alpine grassland and the Kalahari, but exploits a wide range of habitats – grassland, open savanna, agricultural lands, suburban and urban areas, rural settlements – in both flat and hilly or mountainous country. Also breeds in wooded and forested areas where cliffs occur (Harrison et al. 1997a).	Unlikely Might only pass through the area on rare occasions to more suitable and less disturbed areas surrounding the study site.
Mycteria ibis (Yellow-billed Stork) (**NT/EN**)	**SUBOPTIMAL** Utilises diverse wetlands and permanent and seasonal habitats, including alkaline and freshwater lakes, river, dams, pans, flood plains, large marshes, swamps, estuaries, margins of lakes or rivers, flooded grassland and small pools or streams where there are areas of shallow water free of emergent vegetation (Tarboton et al., 1987); less often marine mudflats and estuaries (Hockey et al., 2005). Nests colonially	Unlikely Might only pass through the area on rare occasions when the floodplain area is flooded.

Species name*	Presence of suitable habitat and habitat requirements	Likelihood of occurrence on study site
	on large trees adjacent to productive wetlands, but only locally and erratically during ideal conditions.	
Ciconia nigra (Black Stork) (NT/VU)	**SUBOPTIMAL** Dams, pans, flood plains, shallows of rivers, pools in dry riverbeds, estuaries and sometimes on marshland and flooded grassland; uncommon at seasonal pans lacking fish. Associated with mountainous regions (Hockey et al., 2005) where they nest (Maclean, 1993) on cliffs (Harrison et al. 1997a). Feeds in shallow water, but occasionally on dry land, in streams and rivers, marshes, floodplains, coastal estuaries and large and small dams; it is typically seen at pools in large rivers.	Unlikely Might only pass through the area on rare occasions when the floodplain area is flooded.
Ciconia abdimii (Abdim's Stork) (NT/NT)	**SUBOPTIMAL** Grassland, savanna woodland, pan edges, pastures, cultivated land and suburban areas. On migration and after good rains, in semi-desert habitats, including Kalahari. Generally, absent from wetlands, but uses rice paddies and marshes near Beira, Mozambique (Hockey et al., 2005).	Unlikely Might only pass through the area on rare occasions when the floodplain area is flooded.
Leptoptilos crumeniferus (Marabou Stork) (NT/NT)	**YES** Both aquatic and terrestrial habitats, favouring open and semi-arid areas; largely absent from forest areas and true desert. Common at wetlands, including dams, pans and rivers, and in wildlife reserves and ranching areas.	Unlikely Might only pass through the area on rare occasions to more suitable and less disturbed areas surrounding the study site.
Buphagus erythrorhynchus (Red-billed Oxpecker) (**NT/LC**)	**YES** Open savanna, up to 3 000 m a.s.l. (Hockey et al., 2005). Uses mammal feeding hosts in a variety of woodlands, all in rainfall zones of more than 400 mm/annum. Needs holes in trees for nesting and uses Ilala Palms, tree Aloes, reed beds and rarely larger game to roost on at night (Harrison et al. 1997a). Their presence is highly dependent on the availability of tick on large game species and cattle.	Likely Highly likely to occur on the study site due to the presence of their mammal hosts (cattle and game) on the study site.

*Red data status according to Barnes (2000)/Red Data status according to Taylor et al (2015)

Latest bird names according to BirdLife South Africa Checklist of Birds in South Africa (2016)

Red Data avifaunal species Categories: EX= Extinct (regionally), CR = Critically Endangered EN = Endangered, VU = Vulnerable, NT = Near-threatened, LC = Least Concern, DD = Data Deficient, NR = Not Recognised by BirdLife International, NA = Not Assessed (Taylor et al 2015).

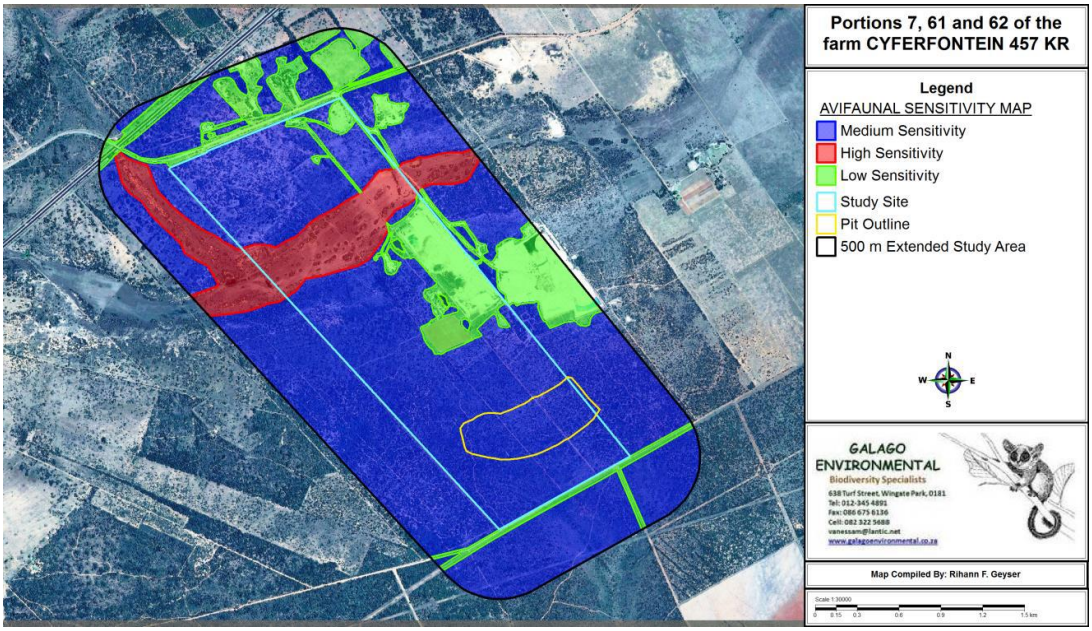


Figure 18: Avifaunal sensitivity map

7.3 Herpetofauna

7.3.1 Herpetofauna habitat assessment:

The local occurrences of reptiles and amphibians are closely dependent on broadly defined habitat types, in particular terrestrial, arboreal (tree-living), rupicolous (rock-dwelling) and wetland-associated vegetation cover. It is thus possible to deduce the presence or absence of reptile and amphibian species by evaluating the habitat types within the context of global distribution ranges. From a herpetological habitat perspective, it was established that mainly three of the four major habitats are naturally present on the study site, namely terrestrial, arboreal and wetland-associated vegetation cover.

Most of the study site consists of fairly pristine *Acacia-Euclea* Bushveld. The site was first transformed for agricultural purposes, such as grazing and later by anthropogenic influences such as invasive plants, roads and prospection holes for mining. On other parts of the site there are houses, a few bridges and maize or fodder fields. The study site is thus ecologically disturbed only in some parts. Moribund termitaria were recorded on the study site. These structures are good indicators of the occurrence of small herpetofauna. Accordingly, it is estimated that the reptile and amphibian population density for the study site is higher. At

the time of the site visit the basal cover was good in many places and would provide adequate cover for small terrestrial herpetofauna.

There are no natural rupicolous habitats on the study site, but good manmade rupicolous habitat exists in the form of bridges and buildings. These man-made habitats offer nooks and crannies as refuge for common rupicolous herpetofauna. Due to the absence of natural rupicolous habitat, such species as the common giant plated lizard, dwarf flat lizard, rainbow skink, common girdled lizard and rock agama were omitted from the species list in Table 1 of the specialist study.

Natural arboreal habitat consists of indigenous *Acacia- Euclea* Bushveld trees. The larger Acacia trees may offer refuge to such tree-living reptiles as boomslang, tree agamas and flap-neck chameleons, to mention but a few. There are many dead logs on site, which provide shelter and food for several herpetofauna.

There is no aquatic habitat in the pit area on the study site, but permanent and temporary water sources occur on the rest of the study area. The study area has a drainage line, quite similar to the Nylsvlei, which is very important and should be protected at all cost. Man-made structures such as bridges have been built over the drainage line in some places. During the site visit this shallow but wide drainage line was dry. Permanent water fill dams, due to boreholes occur on the study site.

These water sources provide habitat for frogs and water-dependent reptiles. Although some wetlands are artificial, they are functional, with several wetland plant species and wetland fauna. All rivers, streams and wetlands are protected and are regarded as sensitive. Most of the surrounding properties are used for game farming, and with the exception of the gravel road north of the site and some areas of the adjacent mine east of the site, connectivity is good. Real opportunities for migration exist along the drainage line.

Sight records were also used to compile this herpetofauna report.

7.3.2 Threatened and red listed reptile and amphibian species

Eastwood's long-tailed seps is extinct and the study site also falls outside the natural range of this species.

The study site falls outside the natural range or has no suitable habitat for the following species: the Nile crocodile, woodbush flat gecko, Muller's velvet gecko, granite dwarf gecko, Methuen's dwarf gecko, cryptic dwarf gecko, Makgabeng dwarf gecko, Soutpansberg dwarf gecko, Waterberg dwarf gecko, Soutpansberg rock lizard, coppery grass lizard, large-scaled grass lizard, northern crag lizard, unexpected flat lizard, orange-throated flat lizard, Fitzsimons' flat lizard, stripe-bellied legless skink, Richard's legless skink,

Woodbush legless skink, white-bellied dwarf burrowing skink, striped harlequin snake and northern forest rain frog. These species should not occur on the study site.

The study site falls inside the natural range of the Southern African python. According to Bradley (1990), Southern African pythons favour moist, rocky, well-wooded valleys, plantations or bush country, but seldom if ever stray far from permanent water. The study site thus provides suitable habitat for the Southern African python and the study site is large enough to support a viable population. It is often estimated that a single python needs at least a 100ha area to forage. A small population of Southern African pythons may live on the study site and may migrate to and from the study site via the distribution corridors of the drainage line or the nearby rocky outcrops.

The Southern African python's national status has changed from Vulnerable (Branch, 1988) to regional Least Concern (Alexander, 2014), although it is currently still a ToPS-listed species (Threatened or Protected Species).

According to Du Preez and Cook (2004), giant bullfrogs were recorded pre-1996 in the general area. There is a small possibility that giant bullfrogs may occur on the study site. The study site contains temporary dams, which are potential breeding places for giant bullfrogs. Giant bullfrogs prefer warm, stagnant water, which giant bullfrog tadpoles need for rapid development (Van Wyk, Kok & Du Preez, 1992). Bullfrog breeding sites are mostly temporary, in order to avoid predation from fish. Some of the dams on the study site have gentle slopes, which giant bullfrogs prefer. A gentle slope allows for shallow water (less than 10cm deep), which enables the female bullfrog to stand when she lays her eggs outside the water for the male to fertilise. Many parts of the study site consist of sandy soil and are very suitable as dispersal areas, which combine feeding and aestivation. It is essential that the soil be suitable for burrowing on a daily basis during the short activity period at the beginning of the rainy season and for deeper retreats during the resting periods.

It is important to note that in the latest literature (Measey (ed.) 2011 and Carruthers & Du Preez 2011); the giant bullfrog's status has changed officially from NT (Minter et al, 2004) to Least Concern in South Africa.

7.3.3 Expected and observed herpetofauna species richness:

Of the 73 reptile species which may occur on the study site (Table 19), two were confirmed during the site visit (Table 20) and of the 20 amphibian species which may possibly occur on the study site (Table 19), one was confirmed during the site visit (Table 20).

Table 19 lists the reptiles & amphibians which were observed on or deduced to occupy the site.

The American red-eared terrapin (*Trachemys scripta elegans*) and the Brahminy blind snake (*Ramphotyphlops braminus*) are the only two feral reptile or amphibian species known to occur in South Africa (De Moor and Bruton, 1988; Picker and Griffiths, 2011), but with only a few populations, they are not expected to occur on this particular site.

The species assemblage is typical of what can be expected of habitat that is severely disturbed, but with sufficient habitat to sustain populations. Most of the species of the resident diversity (Table 19) are fairly common and widespread (viz. common house snake, mole snake, puff adder, Mozambique spitting cobra, boomslang, common flap-neck chameleon, savanna lizard speckled rock skink, common dwarf gecko, Transvaal gecko, southern rock monitor, guttural toad, Boettger's caco, common platanna and the common river frog).

The species richness is fair due to the three habitat types occurring on the study site.

Table 19: The Reptile and Amphibian species observed on or deduced to occupy the site

	Scientific name	**English name**
	CLASS: REPTILIA	REPTILES
	Order: TESTUDINES	TORTOISES & TERRAPINS
	Family: Pelomedusidae	Family: Pelomedusidae
√	*Pelomedusa subrufa*	Marsh Terrapin
	Family: Testudinidae	Tortoises
*	*Kinixys spekii*	Speke's Hinged-Back Tortoise
?	*Psammobates oculifer*	Serrated Tent Tortoise
√	*Stigmochelys pardalis*	Leopard Tortoise
	Order: SQUAMATA	SCALE-BEARING REPTILES
	Suborder: LACERTILIA	LIZARDS
	Family: Gekkonidae	Geckos
√	*Chondrodactylus turneri*	Turner's Gecko
√	*Hemidactylus mabouia*	Common Tropical House Gecko
√	*Homopholis wahlbergi*	Wahlberg's velvet Gecko
√	*Lygodactylus capensis capensis*	Common Dwarf Gecko
√	*Pachydactylus affinis*	Transvaal Gecko
*	*Pachydactylus capensis*	Cape Gecko
	Family: Amphisbaenidae	Amphisbaenians
*	*Monopeltis infuscata*	Dusky Worm Lizard

	Scientific name	English name
?	*Zygaspis quadrifrons*	Kalahari Dwarf Worm Lizard
	Family: Lacertidae	Old World Lizards or Lacertids
√	*Ichnotropis capensis*	Ornate Rough-Scaled Lizard
√	*Meroles squamulosus*	Savanna Lizard
√	*Nucras holubi*	Holub's Sandveld Lizard
√	*Nucras intertexta*	Spotted Sandveld Lizard
√	*Pedioplanis lineoocellata lineoocellata*	Spotted Sand Lizard
*	*Pedioplanis lineoocellata pulchella*	Common Sand Lizard
	Family: Gerrhosauridae	Plated Lizards
√	*Gerhosaurus flavigularis*	Yellow-throated Plated Lizard
	Family: Scincidae	Skinks
?	*Acontias occidentalis*	Savanna Legless Skink
√	*Afroablepharus wahlbergii*	Wahlberg's Snake-Eyed Skink
√	*Mochlus sundevallii sundevallii*	Sundevall's Writhing Skink
√	*Trachylepis capensis*	Cape Skink
√	*Trachylepis punctatissima*	Speckled Rock Skink
?	*Trachylepis varia*	Variable Skink
	Family: Varanidae	Monitors
√	*Varanus albigularis albigularis*	Southern Rock Monitor
*	*Varanus niloticus*	Nile Monitor
	Family Chamaeleonidae	Chameleons
√	*Chamaeleo dilepis dilepis*	Common Flap-Neck Chameleon
	Family: Agamidae	Agamas
√	*Agama aculeate distanti*	Eastern Ground Agama
√	*Acanthocerus atricollis atricollis*	Southern Tree Agama
	Suborder: SERPENTES	SNAKES
	Family: Typhlopidae	Blind Snakes
*	*Afrotyphlops bibronii*	Bibron's Blind Snake
?	*Megatyphlops schlegelii*	Schlegel's Giant Blind Snake
*	*Phinotyphlops lalandei*	Delalande's Beaked Blind Snake
	Family: Leptotyphlopidae	Thread Snakes
*	*Leptotyphlops distanti*	Distant's Thread Snake
√	*Leptotyphlops scutifrons scutifrons*	Peter's Thread Snake
	Family: Pythonidae	Pythons
√	*Python natalensis*	Southern African Python
	Family: Viperidae	Adders
√	*Bitis arietans*	Puff Adder
?	*Bitis caudalis*	Horned Adder

	Scientific name	English name
?	*Causus defilippii*	Snouted night Adder
√	*Causus rhombeatus*	Rhombic Night Adder
	Family: Lamprophiidae	
√	*Amblyodipsas polylepis polylepis*	Common Purple-Glossed Snake
*	*Aparallactus capensis*	Black-headed Centipede Eater
*	*Atractapis bibronii*	Bibron's Stiletto Snake
?	*Atractapis duerdeni*	Duerden's Stiletto Snake
?	*Xenocalamus bicolour australis*	Waterberg Quill-Snouted Snake
√	*Boaedon capensis*	Common House Snake
*	*Gonionotophis capensis capensis*	Common File Snake
?	*Gonionotophis nyassae*	Black File Snake
?	*Lycodonomorphus inornatus*	Olive Ground Snake
?	*Lycodonomorphus rufulus*	Brown Water Snake
?	*Lycophidion capensis capensis*	Cape Wolf Snake
*	*Psammophis angolensis*	Dwarf Sand Snake
√	*Psammophis brevirostris*	Short-snouted Grass
?	*Psammophis jallae*	Jalla's Sand Snake
?	*Psammophis subtaeniatus*	Western Yellow-Bellied Sand Snake
?	*Psammophylax rhombeatus rhombeatus*	Striped Grass Snake
√	*Psammophylax tritaeniatus*	Striped Grass Snake
?	*Prosymna bivittata*	Two-Striped Shovel-Snout
*	*Prosymna sundevallii*	Sundevall's Shovel-Snout
√	*Pseudaspis cana*	Mole Snake
	Family: Elapidae	Cobras, Mambas and Others
?	*Aspidelaps scutatus scutatus*	Common Shield Cobra
*	*Dendroaspis polylepis*	Black Mamba
?	*Elapsoidea sunderwallii*	Sundevall's Garter Snake
√	*Naja annulifera*	Snouted Cobra
√	*Naja mossambica*	Mozambique Spitting Cobra
	Family: Colubridae	
?	*Crotaphopeltis hotamboeia*	Red-Lipped Snake
√	*Dasypeltis scabra*	Rhombic Egg Eater
√	*Dispholidus typus*	Boomslang
?	*Philothamnus hoplogaster*	Southeastern Green Snake
?	*Philothamnus natalensis occidentalis*	Western Natal Green Snake
√	*Philothamnus semivarietiegatus*	Spotted Bush Snake
*	*Telescopus semiannulatus semiannulatus*	Eastern Tiger Snake
*	*Thelotornis capensis capensis*	Southern Twig Snake

	Scientific name	English name
	CLASS: AMPHIBIA	AMPHIBIANS
	Order: ANURA	FROGS
	Family: Pipidae	Clawed Frogs
√	*Xenopus laevis*	Common Platanna
	Family: Bufonidae	Toads
?	*Poyntonophrynus fenoulheti*	Northern Pygmy Toad
√	*Amietaophrynus gutturalis*	Guttural Toad
?	*Amietaophrynus poweri*	Western Olive Toad
?	*Amietaophrynus garmani*	Eastern Olive Toad
?	*Amietaophrynus maculatus*	Flat-backed Toad
√	*Schismaderma carens*	Red Toad
	Family: Ptychadenidae	Grass Frogs
√	*Ptychdena anchietae*	Plain Grass Frog
?	*Ptychdena mossambica*	Broad-Banded Grass Frog
	Family: Hyperoliidae	Reed Frogs
?	*Hyperolius marmoratus*	Painted Reed Frog
√	*Kassina senegalesis*	Bubbling Kassina
	Family: Breviceptidae	Rain Frogs
√	*Breviceps adspersus*	Bushveld Rain Frog
	Family: Phrynobatrachidae	Puddle Frog
√	*Phrynobatrachus natalensis*	Snoring Puddle Frog
	Family:Microhylidae	Rubber Frogs
√	*Phrynomantis bifasciatus*	Banded Rubber Frog
	Family: Pyxicephalidae	
√	*Amietia angolensis*	Common River Frog
?	*Pyxicephalus adspersus*	Giant Bullfrog
√	*Pyxicephalus edulis*	Edible Bullfrog
√	*Cocosternum boettgeri*	Boettger's Caco
√	*Tomopterna cryptotis*	Tremolo Sand Frog
*	*Tomopterna natalensis*	Natal Sand Frog

Systematic arrangement and nomenclature according to Branch (1998), Alexander & Marais (2007), Minter, et.al (2004), Du Preez & Carruthers (2009) and Bates, et.al 2014.

Red Data species rankings as defined in Branch, The Conservation Status of South Africa's threatened Reptiles': 89 – 103.In:- G.H.Verdoorn & J. le Roux (editors), 'The State of Southern Africa's Species (2002) and Minter, et.al, Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland (2004) are indicated in the first column: CR= Critically Endangered, En = Endangered, Vu = Vulnerable, NT = Near Threatened, DD = Data Deficient. All other species are deemed of Least Concern.

Table 20: Reptile and Amphibian species positively confirmed on the study site, observed indicators and habitat

Scientific name	English name	Observation indicator	Habitat
Meroles squamulosus	Savanna Lizard	Sight record an individual	Terrestrial habitat
Trachylepis punctatissima	Speckled Rock Skink	Sight record of an adult	Manmade rupicolous habitat
Amietia angolensis	Common River Frog	Sight record of few adult	Aquatic habitat

The savanna lizard, speckled rock skink and the common river frog, listed in Table 20, should be abundant or fairly common on the study site and elsewhere in its range.

8 Surface water

Information for this section was extracted from the Storm Water Management Plan (Rational Environmental, 2017), and the Synopsis: Specialist Investigation to Determine the Presence/ Absence of Wetland Habitat at the Northern Border of the Cyferfontein Clay Quarry Present on Portion 7 of the Farm Cyferfontein, MLM, Limpopo Province (Imperata Consulting, 2015).

The study area is situated in Limpopo Province. The area is characterized by plains and lowlands with a moderate relief. The existing Cyferfontein mine is located in the B31E catchment and drainage from the site is towards the east. The proposed new mining area straddles two catchment areas, namely A61C and B31E. The surface drainage from the site will therefore be both to the north-east and south.

8.1 Wetland on existing mine area

A61C is associated with a Moderately Modified Present Ecological State (Class C) and a High Ecological Importance and Sensitivity (EIS) (Middleton & Bailey 2008). Vector data from the 1:50000 topographical map 2428CD indicates the presence of drainage lines within the already existing mine (Figure 19). These drainage lines form part of the headwaters of the Nyl River, which flows into the Nylsvley Floodplain Wetland, located approximately 29km northeast of the existing mine. The Nylsvley Wetland is an internationally recognised Ramsar site that is hydrologically connected to watercourses present within the study area. The proposed new quarry and haul road does not fall within this wetland area.

The study area does overlap with two isolated patches of wetland habitat indicated on the National Freshwater Ecosystem Priority Area (NFEPA) spatial dataset, as well as a drainage line that forms part of the vector data for topographical map 2428CD (Figure 19). The November site survey confirmed the presence of well-defined wetland habitat within the study area, which incorporates and extends beyond that indicated on the NFEPA spatial dataset (Figure 20). Wetland habitat with temporary, seasonal, and permanent zones of wetness were identified based on recorded hydromorphic features and recognisable

hydrophyte species. Hydromorphic indicators and diagnostic wetland soil forms (Katspruit and Rensburg soil forms) recorded within the site are described in Appendix 1 (Imperata, 2015 study). Common hydromorphic features in the top soil profile included mottling, localised iron removal, and gleying (Appendix 1 - Imperata, 2015 study). Several hygrophyte, facultative hydrophyte and obligate hydrophyte species were recorded in wetland areas. The outer wetland zones with temporary and seasonal wetness contained more woody species compared to the central zone with seasonal and permanent wetness. Examples of common species recorded in wetland areas with temporary and seasonal wetness include the grasses: *Sporobolus pyramidalis, Cynodon dactylon, Themeda triandra, Panicum* sp.; forbs: *Gomphocarpus* cf. *fruticosa, Ledebouria* sp., *Pseudognaphalium luteoalbum, Verbena bonariensis, Tagetes minuata*; and the following shrubs and trees: *Acacia karroo, A. tortilis, Asparagus* sp., *Dichrostachys cinerea, Euclea undulata, Grewia flava, Gymnosporia buxifolia, Searsia lancea, S. pyroides*, and *Ziziphus mucronata*. The same woody shrub and tree species also occurred as small islands in the wetter central wetland zone that had seasonal to permanent wetness. Examples of grass, forb and sedge species present in the area include the grasses: *Leersia hexandra, Cynodon dactylon*, *Sporobolus pyramidalis*, cf. *Arundinella nepalensis*; forbs and sedges: *Cyperus* spp., *Denekia capensis*, and *Eleocharis cf dregeana*. A total wetland area of 21.1ha was delineated within the portion of the study area from the quarry to the northern boundary of the site. Delineated wetland habitat consisted of the following two hydro-geomorphic (HGM) wetland units: Unchannelled valley bottom HGM unit 1 of 14.33 ha, and Seep HGM unit 2 of 6.84 ha. All of the delineated wetland areas form part of the drainage network that flows towards the Nyl River and the Nylsvley Ramsar Wetland.

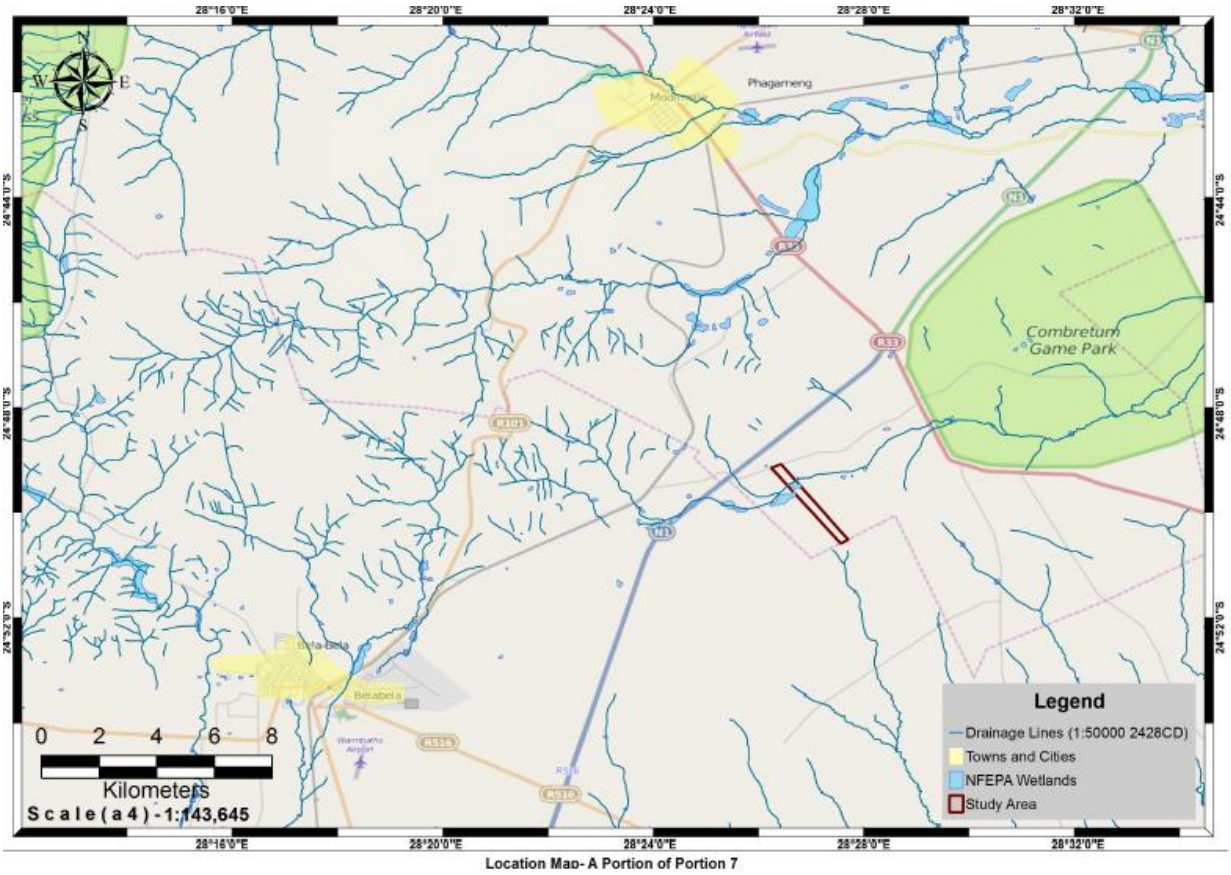


Figure 19: Location of study area along with wetlands that form part of the NFEPA dataset and drainage lines from the 1:50000 topographical map 2428CD dataset

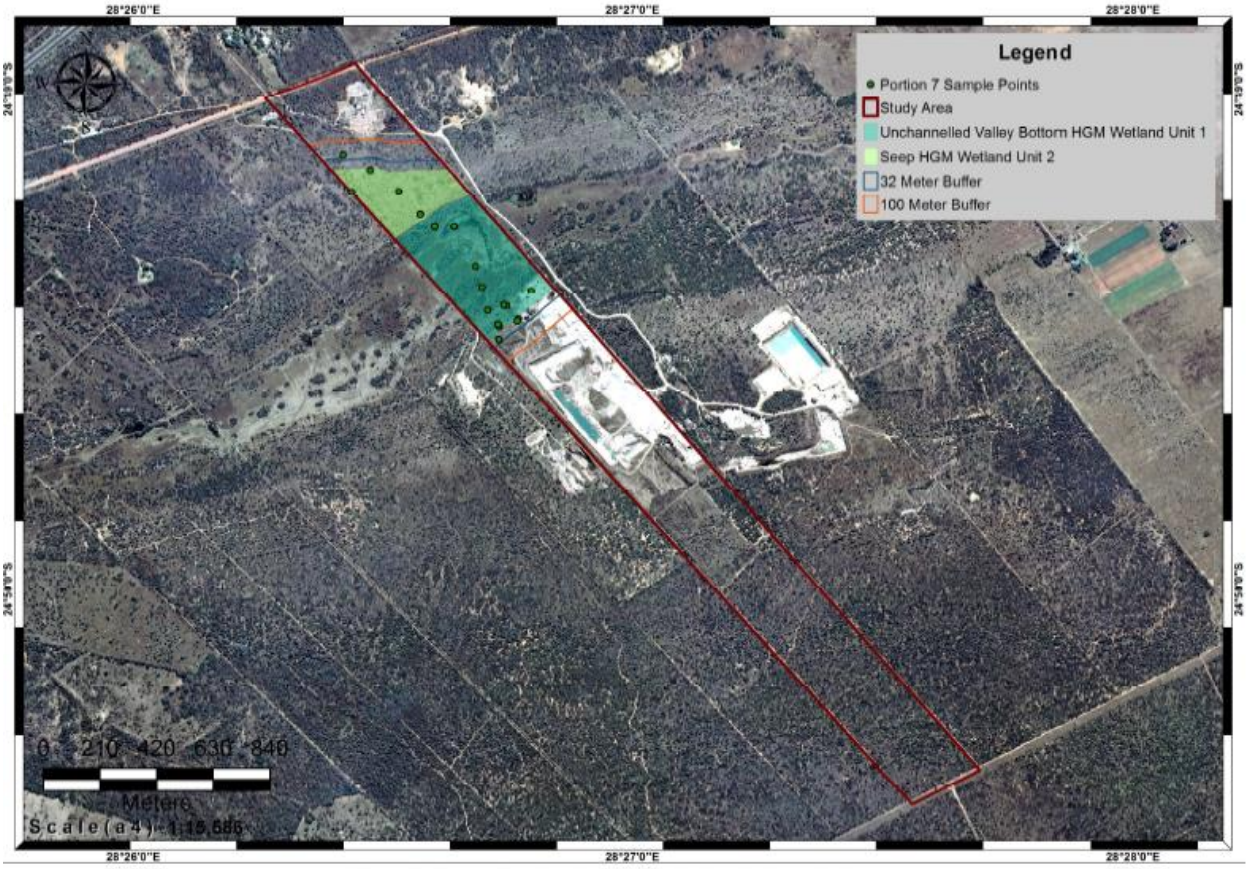


Figure 20: Delineated wetlands within a section of the existing mine, from the quarry to the northern site boundary. Delineated wetland areas consist of a unchannelled valley bottom HGM unit and a seep HGM unit. Note that the aerial image dates from 2008 and does not yet illustrate the confirmed overlap between mining activities and the unchannelled valley bottom wetland.

9 Groundwater

Information for this section was extracted from the Groundwater Impact Assessment (Groundwater Complete, 2017).

9.1 Groundwater level depth

Groundwater levels for the Cyferfontein area are available for only two boreholes. The information is too scarce to triangulate groundwater gradients. Although only 2 points, a strong correlation exists between surface topography and groundwater elevations. Groundwater elevations are expected to follow the trend of the surface topography, since this is the trend in the vast majority of shallow aquifers in South Africa. Gravity dictates that groundwater will always flow from high– to low hydraulic heads (groundwater elevations). In light of this, groundwater at the proposed new mining area is expected to migrate from the

north-west to south-east. It is also expected that the water levels will be the deepest in the higher topographical regions, while it will be closest to the surface in the lower lying regions.

The groundwater level depths in the two boreholes, Jooste-BH01 and Mine-BH01, were 40mbs and 14mbs respectively. The water level in Jooste-BH01 is significantly deeper than in Mine-BH01. The most probable reason for the deeper level is that the borehole is in use by the owner. Extraction is therefore in all probability the cause.

A map of groundwater level depths is provided in Figure 21.

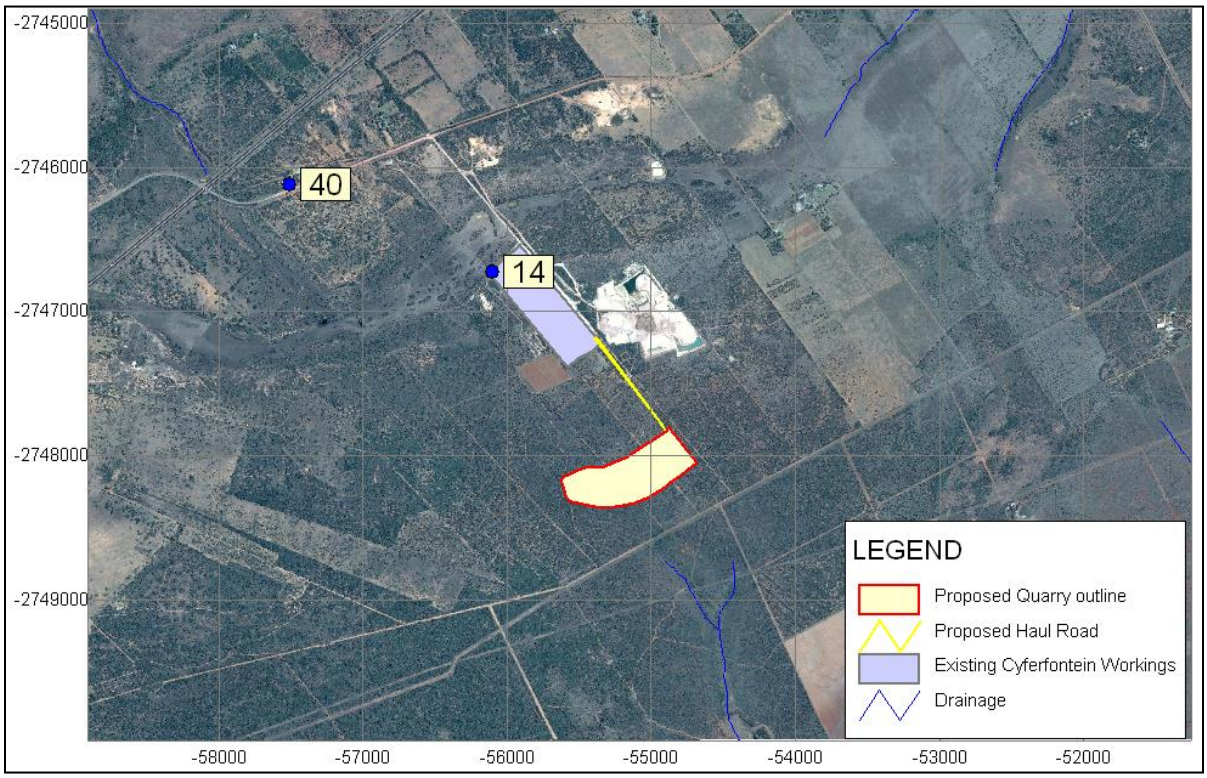


Figure 21: Groundwater depths (mbs)

The maximum depth of the proposed pit is 33m. The mine borehole is situated approximately 1,600m from the proposed pit. This is the closest available water level from the proposed pit. The depth of the water level in the proposed pit area will determine whether groundwater abstraction, and therefore a drawdown cone, will occur. With the relatively flat surface topography, it is highly likely that the groundwater level at the pit area is less than 33m and, in this case, drawdown due to dewatering is expected.

9.2 Aquifer types

It is expected that that two possible aquifer types may be present in the project area. For the purpose of this study, an aquifer is defined as a geological formation or group of formations that can yield groundwater in economically useable quantities. Aquifer classification according to the Parsons Classification system is summarised in Table 21.

The first aquifer is expected to be a shallow, semi-confined or unconfined aquifer that occurs in the transitional soil and weathered bedrock zone or sub-outcrop horizon, and often displays characteristics of a primary porosity aquifer (i.e. weathered zone aquifer). Yields in this type of aquifer are generally low (less than 0.5l/s) and the aquifer is usually not fit for supplying groundwater on a sustainable basis. Consideration of the shallow aquifer system becomes important during seepage estimations from pollution sources to receiving groundwater and surface water systems, because the lateral seepage component in this aquifer often dominates the flow. According to the Parsons Classification system, this aquifer is usually regarded as a minor – and in some cases – a non-aquifer system.

The second aquifer system is the deeper double porosity aquifer that is hosted within the igneous rocks of the Rooiberg Group (i.e. fractured hard-rock aquifer). Groundwater yields, although more heterogeneous, can be higher. This aquifer is expected to display semi-confined or confined characteristics with piezometric heads often significantly higher than the water-bearing fracture position. Fractures may occur in any of the co-existing host rocks due to different tectonic, structural and genetic processes. From discussion with the mine personnel and neighbours, and derivation from the mined material, the aquifer is poorly developed and low yielding. According to the Parsons Classification system, the aquifer could be regarded as a minor aquifer system, but also a sole aquifer system in some cases where groundwater is the only source of domestic water.

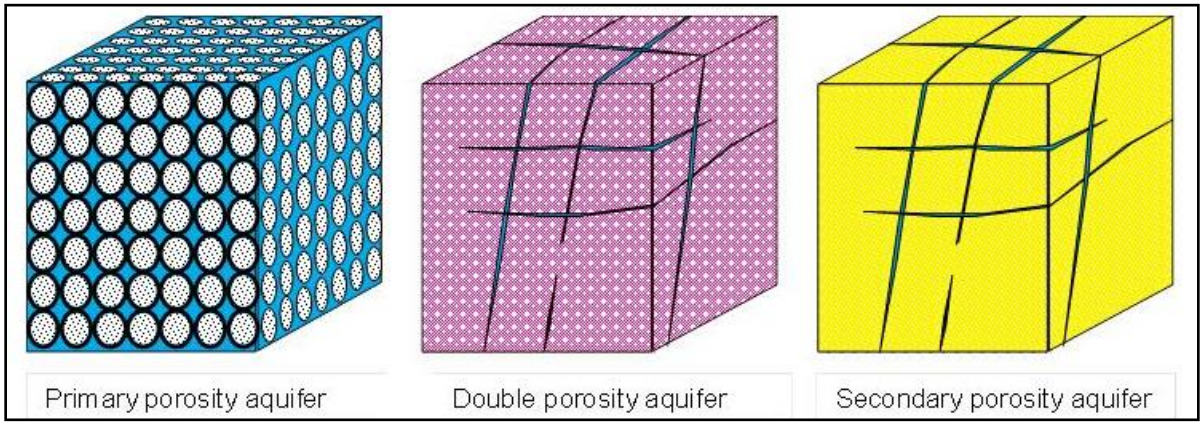


Figure 22: Types of aquifers based on porosity

Table 21: Parsons Aquifer Classification *(*Parsons, 1995)

Sole Aquifer System	An aquifer that is used to supply 50% or more of domestic water for a given area, and for which there is no reasonably available alternative sources should the aquifer be impacted upon or depleted. Aquifer yields and natural water quality are immaterial.
Major Aquifer System	Highly permeable formation, usually with a known or probable presence of significant fracturing. They may be highly productive and able to support large abstractions for public supply and other purposes. Water quality is generally very good (less than 150 mS/m).
Minor Aquifer System	These can be fractured or potentially fractured rocks that do not have a primary permeability, or other formations of variable permeability. Aquifer extent may be limited and water quality variable. Although these aquifers seldom produce large volumes of water, they are important both for local suppliers and in supplying base flow for rivers.
Non-Aquifer System	These are formations with negligible permeability that are generally regarded as not containing groundwater in exploitable quantities. Water quality may also be such that it renders the aquifer unusable. However, groundwater flow through such rocks, although impermeable, does take place, and needs to be considered when assessing the risk associated with persistent pollutants.
Special Aquifer System	An aquifer designated as such by the Minister of Water Affairs, after due process.

9.3 Aquifer Transmissivity and storativity

Aquifer transmissivity is defined as a measure of the amount of water that could be transmitted horizontally through a unit width of aquifer by the full-saturated thickness of the aquifer under a hydraulic gradient of 1. Transmissivity is the product of the aquifer thickness and the hydraulic conductivity of the aquifer, usually expressed as m^2/day ($Length^2$/Time).

Storativity (or the storage coefficient) is the volume of water that a permeable unit will absorb or expel from storage per unit surface area per unit change in piezometric head. Storativity (a dimensionless quantity) cannot be measured with a high degree of accuracy in slug tests or even in conventional pumping tests. It is expected that a value of 0.002 to 0.01 is representative for the proposed mining area.

Constant rate pump tests (among others) are usually used to calculate aquifer parameters such as transmissivity and storativity. Please note that only one short test was performed for the purpose of this investigation, leaving a considerable data gap in the conceptual model of the project area. The calculated transmissivity from this test was 0.5m^2/day and is representative of the aquifer matrix. Higher transmissivities may occur in areas where fracturing is present. Given the felsite bedrock and clay material at surface, few transmissive fractures are expected to be present.

9.4 Aquifer delineation

Because the main aquifer is a fractured rock type and fractures could assume any geometry and orientation, the physical boundary or 'end' of the aquifer is very difficult to specify or quantify. Aquifer boundary conditions that are generally considered during the delineation process are described below:

- No-flow boundaries are groundwater divides (topographic high or low areas/lines) across which no groundwater flow is possible.
- Constant head boundaries are positions or areas where the groundwater level is fixed at a certain elevation and does not change (perennial rivers/streams or dams/pans).

Topographic highs and lows were used to roughly delineate the aquifer system underlying the project area (Figure 23). The aquifer was estimated to cover an area of approximately 37.5km². Please note that geological structures such as dykes may occur within the project area, and have the ability to act as aquifer boundaries, thus subdividing the regional aquifer into various 'sub-aquifers' or compartments. No such detailed structural geological information was available at the time of submission of this report. The aquifer boundaries, as indicated in Figure 23, are therefore considered to be conceptual and are based on topographic controls alone.

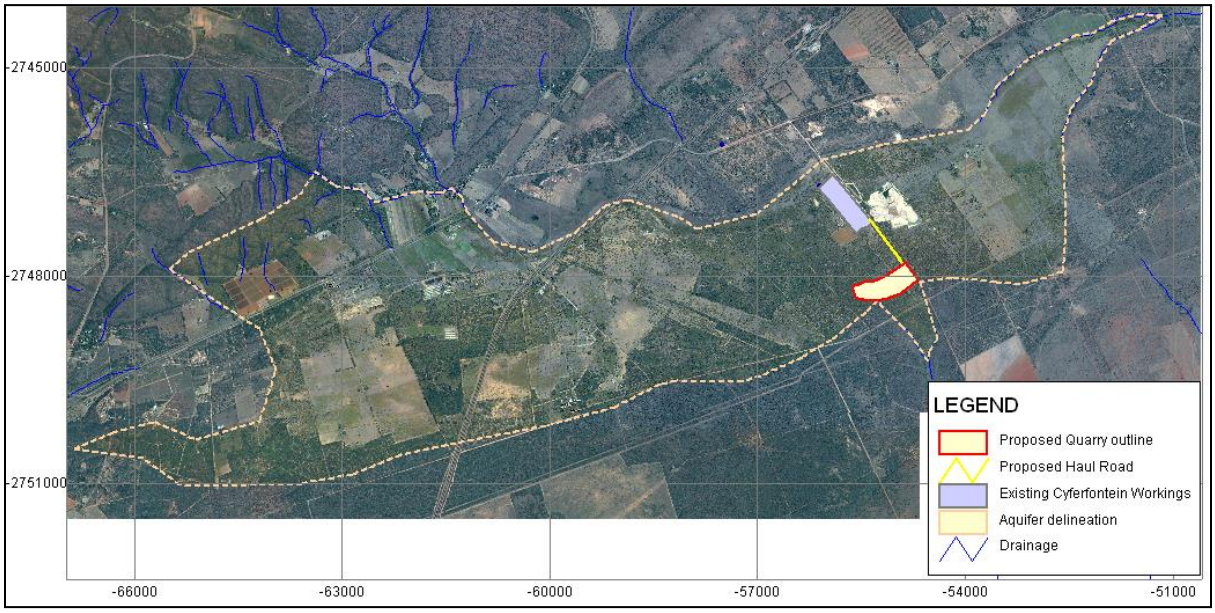


Figure 23: Aquifer delineation for project area

9.5 Aquifer recharge and discharge rates

According to Figure 24, the mean annual recharge to the hard-rock aquifer underlying the project area should be in the order of 20 to 34mm, which, based on an average rainfall of approximately 625mm/a,

translates to a recharge percentage of ± 3 to 5.5%. Where outcrop occurs or in areas where the soil cover is thin, the effective recharge percentage can be slightly higher. On the other hand, the effective recharge is expected to be lower or even zero in low-lying topographies where discharge generally occurs and thicker sediment deposition.

Based on this estimate, the mean annual recharge to the aquifer regime as defined in Figure 23 should be in the order of 0.75 to 1.3Mm³.

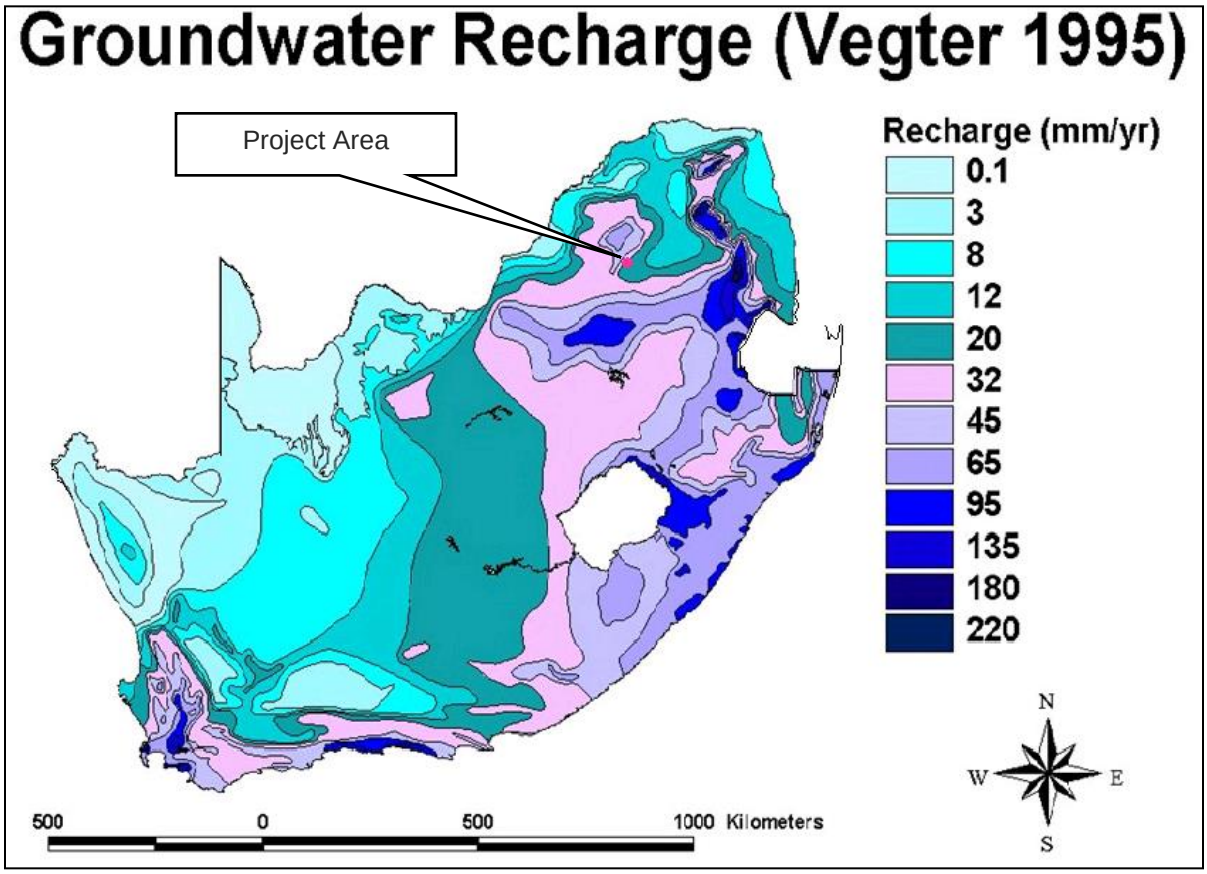


Figure 24: Mean annual aquifer recharge for South Africa *(*Vegter, 1995)

Table 22: Typical recharge to different aquifer host rocks *(*Van Tonder & Xu, 2000*)*

Geology	% Recharge (soil cover <5m)	% Recharge (soil cover >5 m)
Sandstone, mudstone, siltstone	5	2
Hard Rock (granite, gneiss etc.)	7	4
Dolomite	12	8
Calcrete	9	5
Alluvial sand	20	15

Geology	% Recharge (soil cover <5m)	% Recharge (soil cover >5 m)
Coastal sand	30	20
Alluvium	12	8

9.6 Groundwater quality conditions

Groundwater quality data is available for 3 localities in the Cyferfontein area. The groundwater and pit water samples were sent to a SANAS accredited laboratory (Aquatico Laboratories) to be analysed for a wide range of chemical and physical indicator parameters. The positions of these localities are indicated in Figure 25, while the results of the analyses are provided in Table 24.

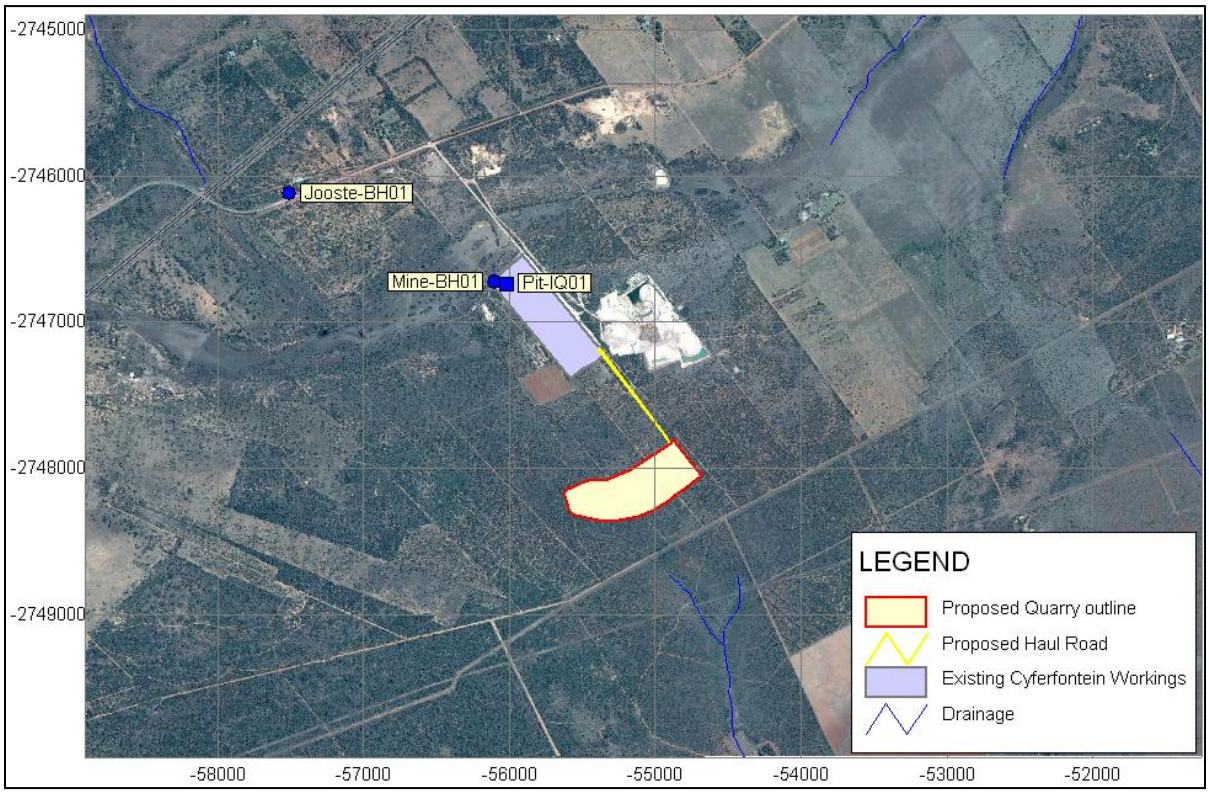


Figure 25: Distribution of groundwater and pit quality data

The data was evaluated with the aid of diagnostic chemical diagrams and by comparing the inorganic concentrations with the South African National Standards for drinking water (Table 23).

The four main factors usually influencing groundwater quality are:

- **Annual recharge** to the groundwater system,
- **Type of bedrock** where ion exchange may impact on the hydrogeochemistry,
- **Flow dynamics** within the aquifer(s), determining the water age, and

- **Source(s) of pollution** with their associated leachates or contaminant streams.

Where no specific source of groundwater pollution is present up gradient from the borehole, only the other three factors play a role.
One of the most appropriate ways to interpret the type of water at a sampling point, is to assess the plot position of the water quality on different analytical diagrams like a Piper, Expanded Durov and Stiff diagrams. Of these three types, the Expanded Durov diagram (EDD) probably gives the most holistic water quality signature. The layout of the fields of the EDD is shown in Figure 26.

Although never clear-cut, the general characteristics of the different fields of the diagram could be summarized as follows:

Field 1:
Fresh, very clean recently recharged groundwater with HCO_3 and CO_3 dominated ions.

Field 2:
Field 2 represents fresh, clean, relatively young groundwater that has started to undergo mineralization, with especially Mg ion exchange.

Field 3:
This field indicates fresh, clean, relatively young groundwater that has undergone Na ion exchange (sometimes in Na - enriched granites or felsic rocks), or because of contamination effects from a source rich in Na.

Field 4:
Fresh, recently recharged groundwater with HCO_3 and CO_3 dominated ions that has been in contact with a source of SO_4 contamination, or that has moved through SO_4 enriched bedrock.

Field 5:
Groundwater that is usually a mix of different types – either clean water from fields 1 and 2 that has undergone SO_4 and NaCl mixing/contamination, or old stagnant NaCl dominated water that has mixed with clean water.

Field 6:
Groundwater from field 5 that has been in contact with a source rich in Na or old stagnant NaCl dominated water that resides in Na rich host rock/material.

Field 7:

Water rarely plots in this field that indicates NO_3 or Cl enrichment or dissolution.

Field 8:

Groundwater that is usually a mix of different types – either clean water from fields 1 and 2 that has undergone SO_4, but especially Cl mixing/contamination or old stagnant NaCl dominated water that has mixed with water richer in Mg.

Field 9:

Old or stagnant water that has reached the end of the geohydrological cycle (deserts, salty pans etc.), or water that has moved a long time and / or distance through the aquifer or on surface and has undergone significant ion exchange because of the long distance or residence time in the aquifer.

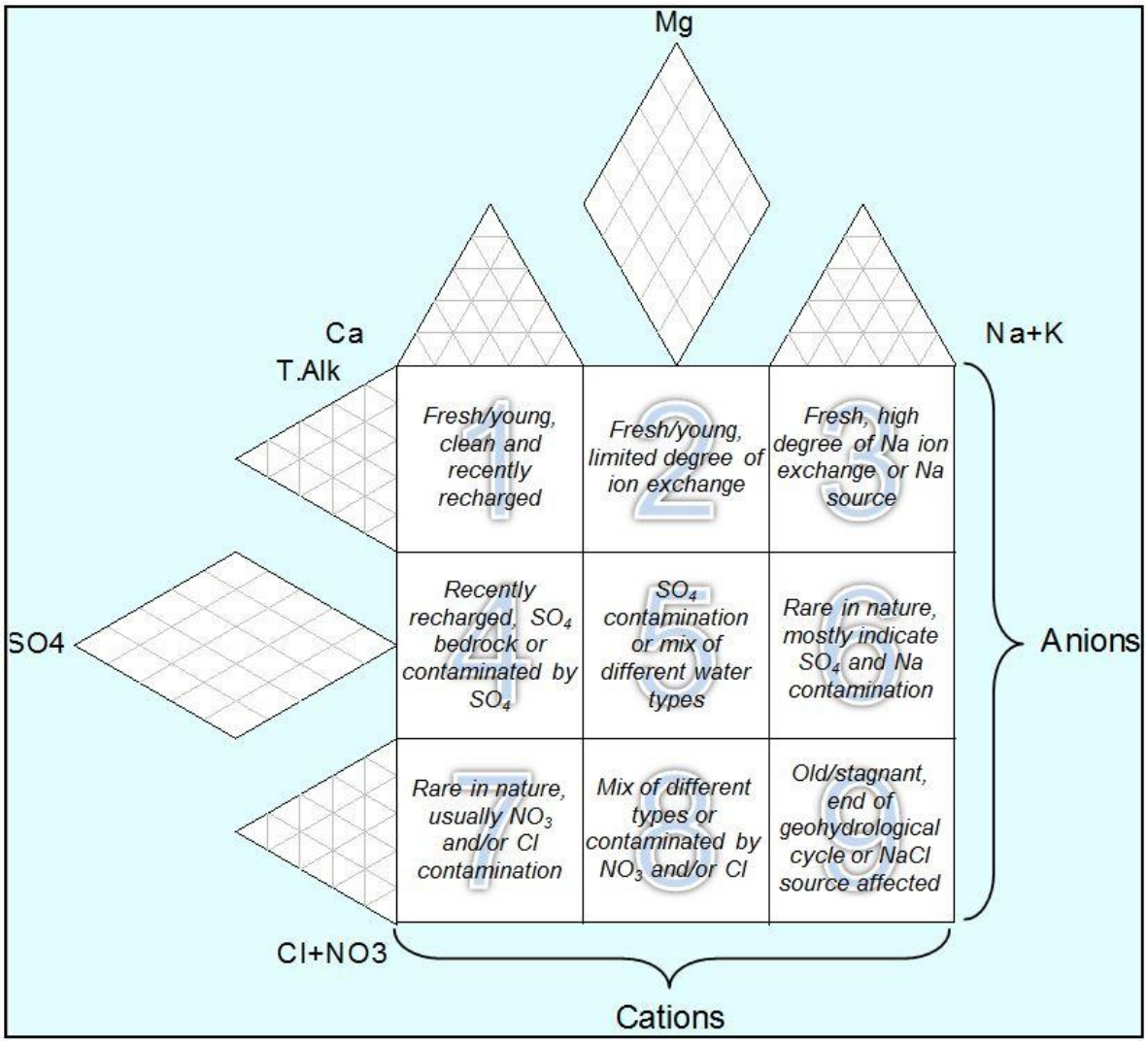


Figure 26: Layout of fields of the Expanded Durov diagram

Another way of presenting the signature or water type distribution in an area, is by means of Stiff diagrams. These diagrams plot the equivalent concentrations of the major cations and anions on a horizontal scale on opposite sides of a vertical axis. The plot point on each parameter is linked to the adjacent one, resulting in a polygon around the cation and anion axes. The result is a small figure/diagram of which the geometry typifies the groundwater composition at the point. Groundwater with similar major ion ratios will show the same geometry. Ambient groundwater qualities in the same aquifer type and water polluted by the same source will for example display similar geometries.

Table 23: South African National Standards for drinking water (SANS 241:2015)

Determinant	Risk	Unit	Standard limits
Physical and aesthetic determinants			
Free chlorine	Chronic health	mg/l	≤ 5
Monochloramine	Chronic health	mg/l	≤ 3
Conductivity at 25 °C	Aesthetic	mS/m	≤ 170
Total dissolved solids (TDS)	Aesthetic	mg/l	≤ 1 200
Turbidity	Operational	NTU	≤ 1
	Aesthetic	NTU	≤ 5
pH at 25 °C	Operational	pH units	≥ 5 to ≤ 9.7
Chemical determinants - macro-determinants			
Nitrate as N	Acute health – 1	mg/l	≤ 11
Nitrite as N	Acute health – 1	mg/l	≤ 0.9
Sulfate as SO_4^{2-}	Acute health – 1	mg/l	≤ 500
	Aesthetic	mg/l	≤ 250
Fluoride as F^-	Chronic health	mg/l	≤ 1.5
Ammonia as N	Aesthetic	mg/l	≤ 1.5
Chloride as Cl^-	Aesthetic	mg/l	≤ 300
Sodium as Na	Aesthetic	mg/l	≤ 200
Zinc as Zn	Aesthetic	mg/l	≤ 5
Chemical determinants - micro-determinants			
Aluminium as Al	Operational	µg/l	≤ 300
Antimony as Sb	Chronic health	µg/l	≤ 20
Arsenic as As	Chronic health	µg/l	≤ 10
Barium Ba	Chronic health	µg/l	≤ 700
Boron B	Chronic health	µg/l	≤ 2 400
Cadmium as Cd	Chronic health	µg/l	≤ 3
Total chromium as Cr	Chronic health	µg/l	≤ 50
Cobalt as Co	Chronic health	µg/l	≤ 500
Copper as Cu	Chronic health	µg/l	≤ 2 000
Cyanide (recoverable) as CN^-	Acute health – 1	µg/l	≤ 70
Iron as Fe	Chronic health	µg/l	≤ 2 000
	Aesthetic	µg/l	≤ 300
Lead as Pb	Chronic health	µg/l	≤ 10
Manganese as Mn	Chronic health	µg/l	≤ 400
	Aesthetic	µg/l	≤ 100
Mercury as Hg	Chronic health	µg/l	≤ 6
Nickel as Ni	Chronic health	µg/l	≤ 70

Determinant	Risk	Unit	Standard limits
Selenium as Se	Chronic health	µg/l	≤ 40
Uranium as U	Chronic health	µg/l	≤ 15
Vanadium as V	Chronic health	µg/l	≤ 200
Organic determinants			
Total organic carbon	Acute health – 1	mg/l	≤ 10

Table 24: Concentrations of chemical and physical indicator parameters

Parameter	Jooste-BH01	Pit-IQ01	Mine-BH01
pH	8.7	8.6	8.6
EC mS/m	36	50	95
TDS mg/l	217	302	600
Ca mg/l	20	6.3	40
Mg mg/l	4.4	2.5	3.2
Na mg/l	58	106	204
K mg/l	2.2	1.0	1.8
Cl mg/l	24	80	239
SO4 mg/l	2.1	8.1	7.1
NO3-N mg/l	BDL	0.47	0.26
F mg/l	1.2	3.4	0.94
Al mg/l	BDL	0.63	0.11
Fe mg/l	BDL	0.074	BDL
Mn mg/l	BDL	BDL	0.056
N_Ammonia mg/l	0.014	0.026	0.024

Notes: **Red** – Parameter value exceeds maximum concentration allowed in drinking water (SANS 241:2015).

TDS is a good indicator of the overall quality of groundwater, as it provides a measure of the total amount/weight of salts that are present in solution. An increase in TDS will therefore indicate an increase in the total inorganic content of the groundwater. Groundwater displayed groundwater TDS concentrations varying between 215mg/l and 600mg/l, which were well within the maximum permissible SANS value of 1,200mg/l **(Table 24)**.

Groundwater **pH** under natural conditions is affected by the chemical composition of the aquifer host rock/s. At very low pH levels dissolved toxic metal ions are present, which can lead to severe health problems if consumed. At low pH levels (less than ± 4.5) the water will have a sourly taste. At high pH levels, there is a health hazard due to the de-protonated species and water will have a soapy taste. Groundwater pH values varied from 8.6 to 8.7, which were within recommended SANS ranges for drinking water purposes.

Groundwater **nitrate** contamination in a rural environment may potentially originate from nitrate based fertilisers, sewage treatment facilities, pit latrines and animal feedlots or kraals. The groundwater nitrate content of uncontaminated groundwater is usually less than 2mg/l. Groundwater nitrate concentrations were below 0.5mg/l, which were well below the maximum permissible SANS value of 11mg/l.

Magnesium is an alkaline metal that occurs naturally in groundwater. Except for diarrhoea when consumed at very high concentrations (>200mg/l), no significant health risks are associated with the intake of magnesium. No guideline concentration is therefore specified for magnesium in the South African National Standards *(SANS 241:2015)* for drinking water purposes. Groundwater magnesium concentrations were low and less than ±5mg/l **(Table 24)**.

Chloride usually has no health effects when consumed at concentrations generally found in fresh groundwater. Sensitive groundwater users may experience nausea and vomiting at chloride concentrations in excess of ±1,200mg/l. Groundwater displayed chloride concentrations of between ±20mg/l and 240mg/l, which were within the maximum permissible SANS value of 300mg/l.

The **sodium** concentration in borehole Mine-BH01 just exceeded the maximum permissible SANS limit of 200mg/l at 204mg/l **(Table 24)**. The **fluoride** concentration in the pit exceeded the maximum permissible limits for drinking water. No fluoride is used or generated in the mining process and it is concluded that the elevated fluoride originates from the soil and aquifer host rock in natural ion exchange reactions.

According to the Expanded Durov (Figure 26) and Stiff (Figure 27) diagrams, the qualities in Jooste-BH01 and Pit-IQ01 is dominated by **sodium+potassium** cations, while **bicarbonate alkalinity** dominates the anion content. The groundwater in Mine-BH01 is of a different type and dominated by **sodium+potassium** and **chloride+nitrate**.

Summary:

- According to the South African National Standards for drinking water *(*SANS 241:2015), groundwater is considered to be of good to marginal quality, with only two parameters exceeding permissible limits for drinking water.
- Elevated sodium concentrations were observed in Mine-BH01, but not in the pit water. It is therefore concluded that the elevated sodium concentration does not originate from the mining activities.
- The **fluoride** concentration in the pit exceeded the maximum permissible limits for drinking water. No fluoride is used or generated in the mining process and it is concluded that the elevated fluoride originates from the soil and aquifer host rock in natural ion exchange reactions. Similar elevated

fluoride concentrations in groundwater are observed in the Waterberg Group rocks as well as in the Rooiberg felsite formations.

- Apart from the elevated fluoride content, the water in the pit is of good quality (conforms to drinking water guideline values). This clearly shows that the mined material itself is inert to the extent that it does not cause contamination of the underlying groundwater regime.
- Two types of groundwater are observed: dominated by **sodium+potassium** cations and **bicarbonate alkalinity** anions or dominated by **sodium+potassium** cations and **chloride+nitrate** anions.
- Groundwater quality data for the area is limited and additional monitoring boreholes are proposed for the existing and proposed mining areas.

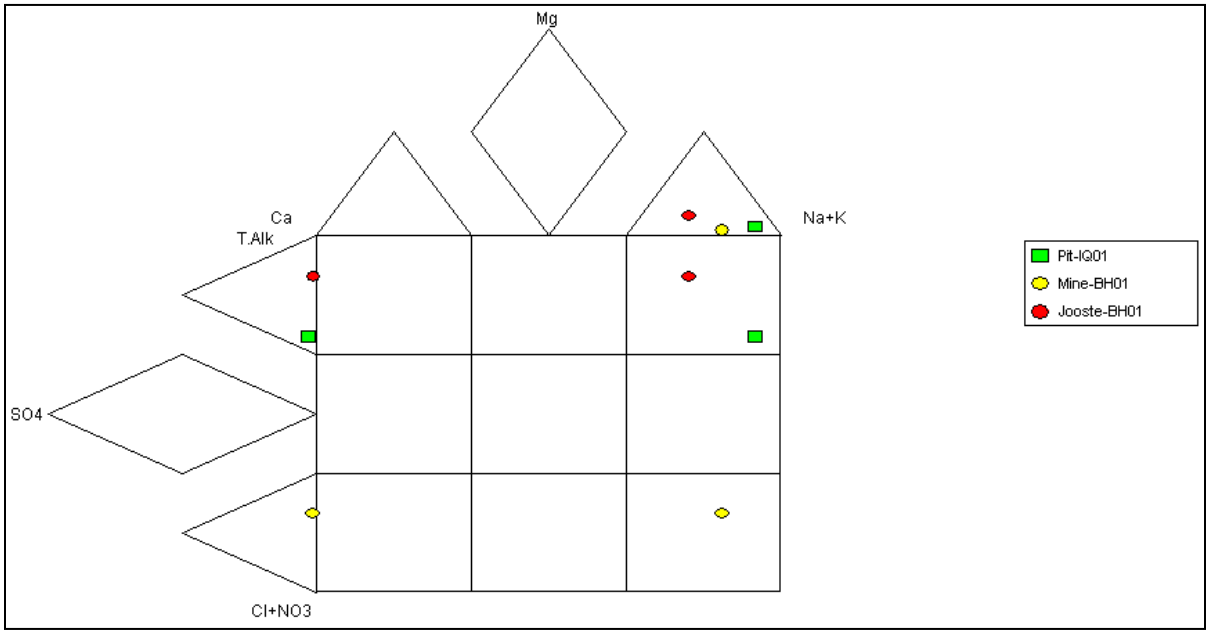


Figure 27: Expanded Durov diagram of groundwater chemistries

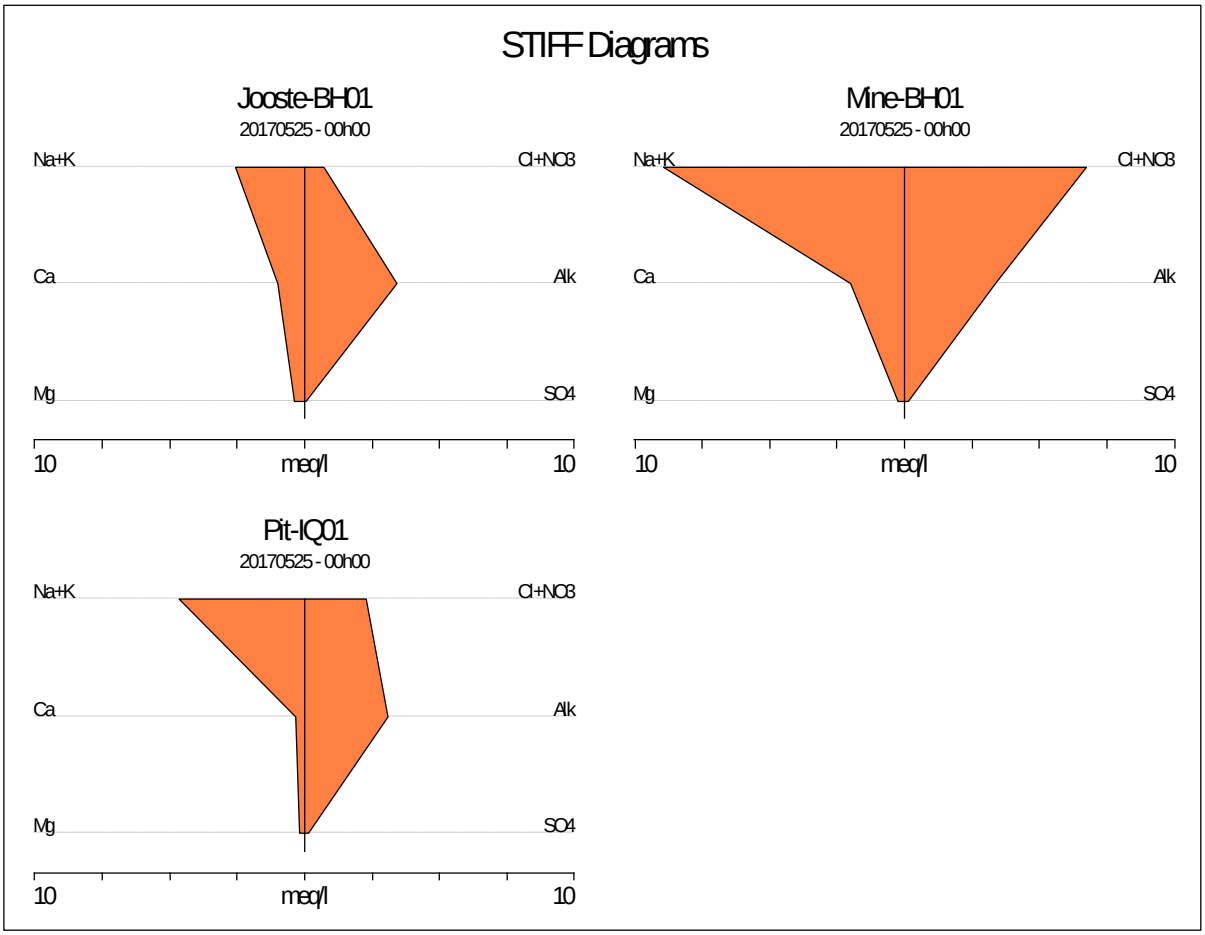


Figure 28: Stiff diagrams of groundwater chemistries

9.7 Potential Sources of Contamination

A source area is defined as an area or facility which can cause groundwater contamination through release of poor quality seepage or leachate. Source areas are subdivided into two main groups:

- Point sources

  The contamination can easily be traced back to the source.

- Diffuse sources

  Diffuse sources of groundwater contamination are typically associated with poor quality leachate formation through numerous surface sources.

No potentially hazardous materials will be handled at the proposed new facility, therefore no/little contamination of the underlying aquifer is expected. From the quality evaluation in the existing pit, only fluoride concentrations were elevated. The proposed new mine may therefore be regarded as a potential

source where fluoride may become elevated. Additional monitoring of groundwater and mine water is however required to provide a clearer picture of fluoride occurrence and variation over time and space.

9.8 Potential Pathways for Contamination

In order for contamination to reach and eventually affect a receptor/s, it needs to travel along a preferred pathway. The effectiveness of a pathway to conduit contamination is determined by three main factors, namely:

- Hydraulic conductivity of pathway,
- Groundwater hydraulic gradient, and
- Area through which flow occurs.

All three abovementioned factors have a linear relationship with the flow of contamination through a preferred pathway, meaning an increase in any one of the three will lead to an increase in flow. This concept is explained by means of the Darcy flow equation below:

$$Q = KIA$$

Where Q = Flow (m^3/d)
K = Hydraulic conductivity (m/d)
I = Hydraulic gradient
A = Area through which flow occurs (m^2)

The following potential pathways were identified in the project area:

9.8.1 Saturated Weathered Zone (weathered zone aquifer)

The weathered zone aquifer is expected to be composed of soil and weathered bedrock, which, depending on the weathering depth and depth to groundwater level, may be between 0 and approximately 20m thick.

The flow rate (Darcy flux) of groundwater and potential contamination through the weathered zone aquifer can be calculated with the following equation *(*after Fetter, 1994):

$$v = \frac{KI}{\phi}$$

Where: *v = flow velocity (m/day)*
K = hydraulic conductivity (m/day) (0.025)

I = average hydraulic gradient (0.004 and 0.058)

ϕ = probable average porosity (0.1)

Please note that the groundwater hydraulic gradient could only be calculated by assuming a similar gradient than the topography, since water level information is very scarce. The hydraulic conductivity and porosity values are educated guesstimates based on experience only.

Groundwater/contaminant flux in this aquifer is estimated to be in the order of 0.4 (NE) to 5.3 (S) m/y, which is considered to be relatively slow.

9.8.2 Geological Structures

Geological structures such as dykes and faults have the potential to serve as sufficient pathways for contamination. The crystalline nature of an igneous dyke is characteristic of an aquiclude; however, rapid cooling during intrusion caused highly transmissive fracture zones to form along the contact between the intrusive and surrounding rock.

The flow rate provided may increase by several orders of magnitude, should a transmissive geological structure be located in the down gradient groundwater flow direction, and if its orientation is parallel to the local flow direction.

9.9 Potential Receptors of Contamination

A receptor of groundwater contamination usually occurs in the form of a groundwater user that relies on groundwater for domestic, irrigation or livestock watering purposes. Surface water features (stream, river, dam, etc.) that rely on groundwater base flow for the sustainment of the aquatic environment, are also considered to be important groundwater receptors.

No groundwater user boreholes were located downgradient of the proposed facility. Also, no major water courses occur in close proximity of the proposed facility. The closest drainage system is located more than 450m downstream of the facility. These water courses are ephemeral and do not receive measurable groundwater base flow.

9.10 Summary of Conceptual Model

A vertical cross section through the project area from south to north is provided in Figure 29. Please note that this section is not drawn to scale and serves only as a simplified visual representation of the conceptual model for the project area. Based on our assessment of all groundwater related aspects, we conceptualize the hydrogeological system underlying the proposed new facility as follow:

- The proposed new facility is underlain by igneous rocks (rhyolite) of the Transvaal Supergroup's Schrikkloof Formation (Rooiberg Group).
- Two aquifer systems are present, namely a shallow aquifer composed of soil and weathered bedrock and a deeper fractured rock aquifer hosted within the solid/unweathered Rooiberg hard-rock.
- The aquifer receives on average approximately 4 to 7% recharge from rainfall.
- Natural groundwater drainage is towards the north-east at an average velocity/flux of approximately 0.4m/y, and towards the south at an average velocity/flux of approximately 5.3m/y.
- Groundwater levels are expected to be less than ±30m below surface (mbs).
- The maximum depth of the proposed pit is 33m. The mine borehole is situated approximately 1,600m from the proposed pit. This is the closest available water level from the proposed pit. The depth of the water level in the proposed pit area will determine whether groundwater abstraction, and therefore a drawdown cone, will occur. With the relatively flat surface topography, it is highly likely that the groundwater level at the pit area is less than 33m and in this case drawdown due to dewatering is expected.
- The groundwater level will recover post-closure.
- Groundwater monitoring boreholes are needed to confirm water levels and flow gradients in the area.
- Groundwater is generally considered to be of good to marginal quality according to the South African National Standards (SANS 241:2015) for drinking water.
- The proposed new facility is not regarded as a potential source of groundwater contamination
- Should contamination occur, the saturated weathered zone and possible geological structures (dykes and faults) within the project area are the most likely pathways along which groundwater and potential contamination may migrate.
- There is limited information in terms of groundwater users downgradient of the proposed facility that should be addressed to improve the level of confidence in the impact assessment.

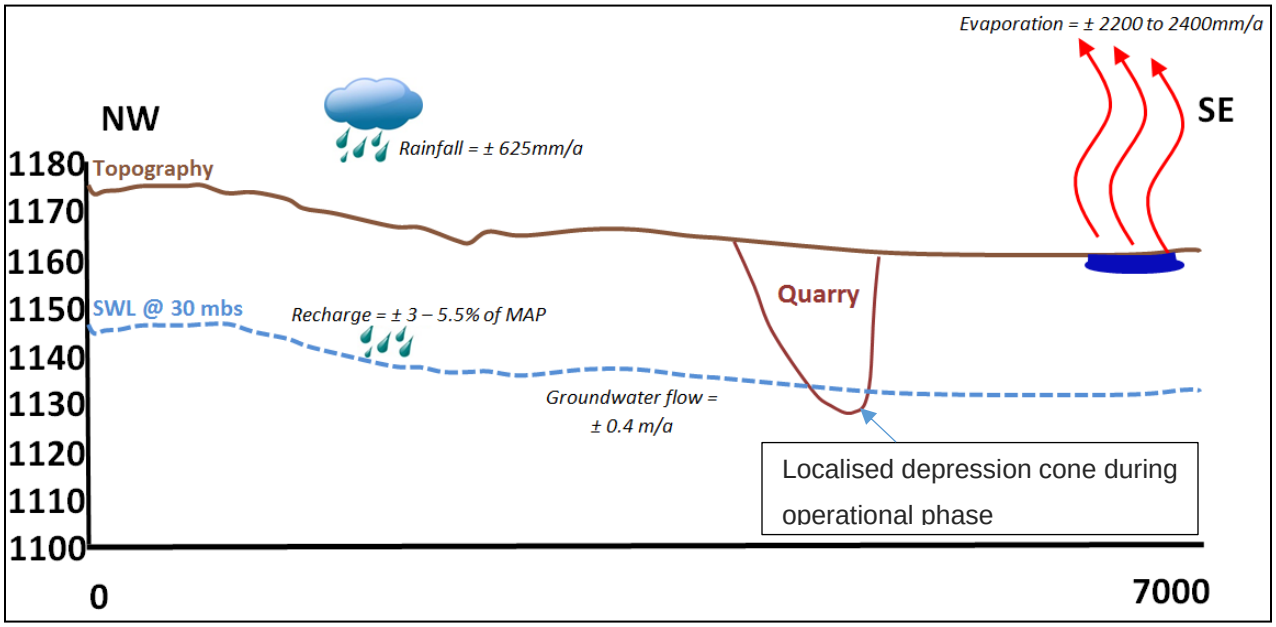


Figure 29: Summary of conceptual model

10 Air quality

Information for this section was extracted from the Air Quality Impact Assessment (Airshed Planning Professionals, 2017.

10.1 Ambient air quality monitoring data

The Cyferfontein Mine operates four dust fallout sampling locations around the current operations (locations are shown in Figure 30). During 2016 no exceedances of the SA National Dust Control Regulations GN827 of 2013 in terms of the National Environmental Management: Air Quality Act No 39 of 2004 (as amended) (NEMAQA) residential limit of 600mg/m²/day were recorded. Recorded dust fallout rates during 2016 were highest in the dry winter and windy spring months, with very low dust fallout rates recorded during the wet summer months.

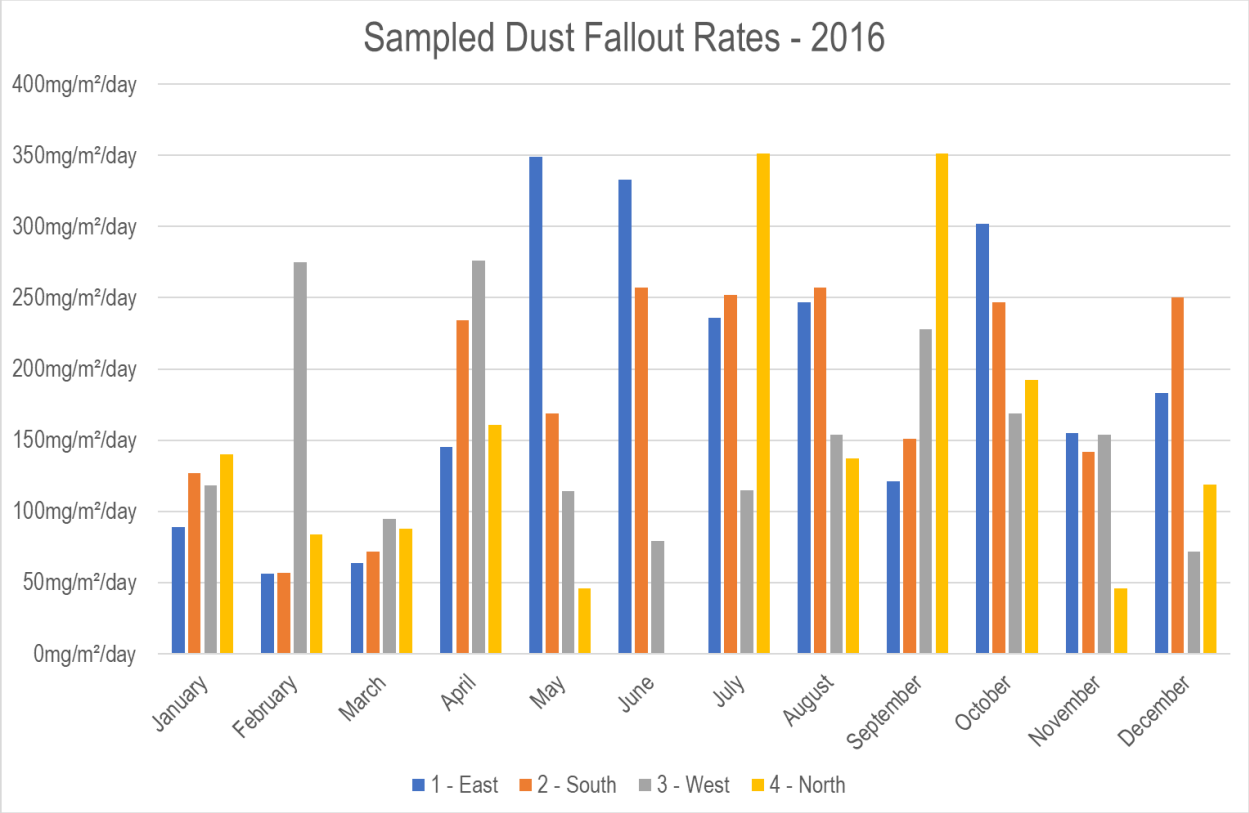


Figure 30: Sampled Dust Fallout Rates at the Cyferfontein Mine – 2016

10.2 Description existing emission sources in the study area

Existing sources of emissions in the study area include:

- Other mining activities in the area;
- Vehicle exhaust and entrainment emissions from nearby N1 freeway and unpaved roads in the vicinity of the Cyferfontein Mine.
- Wind erosion from open areas, (including wind erosion emission from disturbed areas at the Cyferfontein Mine.
- Farming and livestock rearing in the study area, including emissions form land tilling operations, fertiliser and pesticide applications, harvesting, entrainment emissions form farming vehicles and wind erosion from exposed areas.
- Domestic fuel burning in residential communities. There are no large communities located in the 8km by 8km study areas.
- Biomass burning particularly veld fires which may represent significant seasonal sources of combustion emissions.

10.3 Emissions from current mining operation

Emission sources due to current and proposed open cast pit extension sources at the Cyferfontein Mine include:

- In-pit handling of Run of Mine (RoM),
- Haulage of RoM to the processing plant (using 20 to 25t dump trucks),
- Unloading of RoM at a stockpile at the processing plant,
- Loading of RoM into a tipper with a single Front End Loader (FEL).
- A single crusher that also screens processed ROM at the processing plant with a single conveyer to transfer the crushed product onto a single stockpile,
- Loading product with a FEL onto a haul truck,
- Haulage and unloading of product at the final stockpile,
- Loading of products into 30t trucks, which then leaves through the access road.

Emissions from the Cyferfontein Mine operations were calculated using emissions factors published by the US EPA AP42 Section 11.9 (Western Surface Coal Mining) and Australian NPi Emission Estimation Technique Manual for Mining (Version 3.1). Emission rates were calculated based on a 94t/h mining and processing rate.

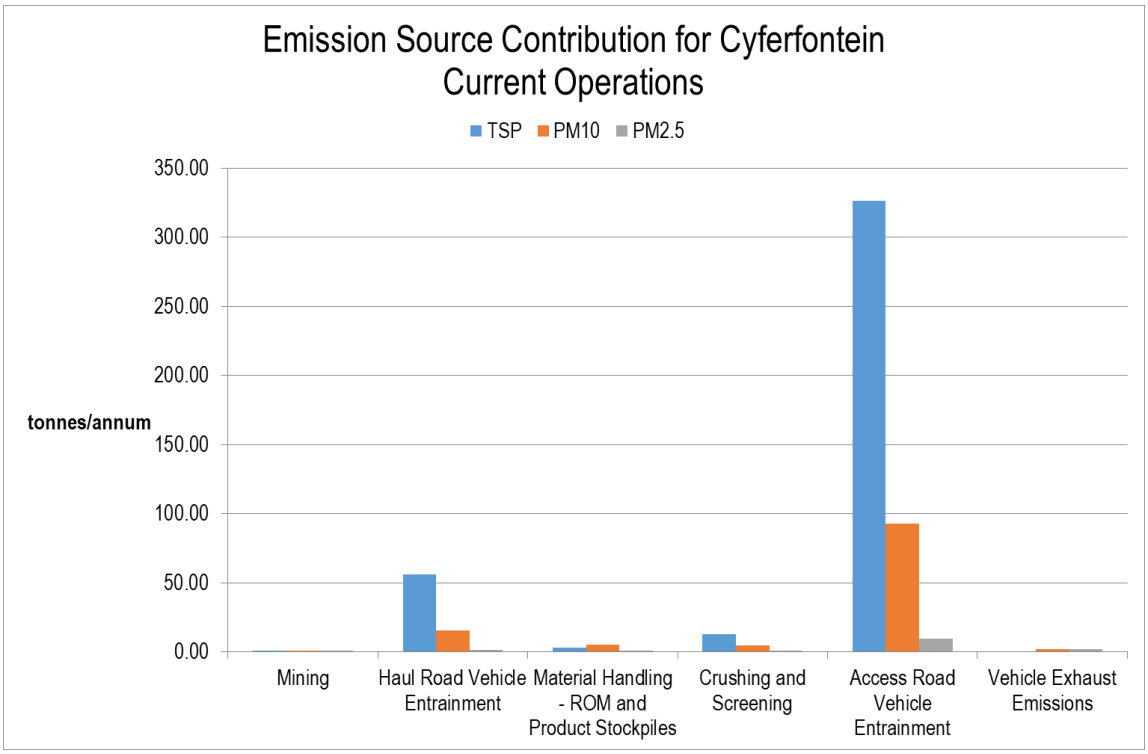


Figure 31: Particulate Emissions due to current operations

11 Environmental noise

Information for this section was extracted from the Environmental Noise Impact Assessment Report (Varicon, 2017).

Noise is defined as an unwanted, disturbing and/or physiologically damaging sound. Personal exposures to noise levels equal to, or above 85 dBA for eight hours can cause hearing loss. In terms of sound pressure levels measured in the environment around the perimeter of any operation, the definition and understanding of noise levels can be best described in terms of annoyance amongst the workers and community and not in particular the cause of hearing damage. Many characteristics are important in the generation of annoyance. As the intensity of the noise increases, the more annoying it becomes. High frequencies, above 1,000Hz, are more annoying than lower frequencies. In addition, if the noise is intermittent, irregular or rhythmic, or contains impulses or recognisable pure tones, it may be considerably more annoying than a steady noise of the same intensity or even the same perceived loudness. The noise levels all were measured within the recommended levels that could cause disturbance to any community that could be affected.

11.1 Statutory requirements/standards

The sound pressure levels were evaluated against the standards, as specified in the SABS Code of Practice 0103 of 2008 (the measurement and rating of environmental noise with respect to land use, health, annoyance and to speech communication), with reference to Code SABS 0328 of 2003 (Environmental Noise Impact Assessments).

For the purpose of this survey and according to SABS 0103 of 2008, it is probable that the noise will be annoying, or otherwise intrusive to the community, or to a group of people, if the rating level of the ambient noise under investigation exceeds the typical rating levels for the ambient noise as given in Table 25 below.

The typical rating with the consequent maximum applicable values for this operation has been highlighted in the tabulation. The measured values are compared to these standards.

Table 25: Typical rating levels for ambient noise in districts

Type of District	**Equivalent Continuous Rating Level (LReq.T) for Ambient Noise**					
	Outdoors			**Indoors, with open windows**		
	Day-night	**Day- time**	**Night-time**	**Day- night**	**Day- time**	**Night- time**
(a) Rural Districts	45	45	35	35	35	25
(b) Suburban with little road traffic	50	50	40	40	40	30

Type of District	Equivalent Continuous Rating Level (LReq.T) for Ambient Noise					
	Outdoors			Indoors, with open windows		
	Day-night	Day- time	Night-time	Day- night	Day- time	Night- time
(c) Urban Districts	55	55	45	45	45	35
(d) Urban districts with some workshops, business premises and with main roads.	60	60	50	50	50	40
(e) Central Business Districts	65	65	55	55	55	45
(f) Industrial Districts	70	70	60	60	60	50

Note: The values given are A-weighted sound pressure levels and include corrections for tonal character and impulsiveness of the noise

11.2 Test results

The daytime weather conditions were dry and sunny with fair winter temperatures with a slight breeze blowing.

The nighttime weather conditions presented cool weather with clear skies and a light breeze blowing.

The test results were compared to the typical rating levels (Category A) (assumed to be best fit), as provided in Table 25 shown above.

The results of this environmental noise impact assessment survey are presented and discussed below in Table 26.

The reflected values in the table below represent the noise levels of the relevant sampling positions, as described. All “substandard” readings are presented in **Bold and *Italic*.**

Shown below as Figure 32 is a Google Earth image that displays the sampling positions.

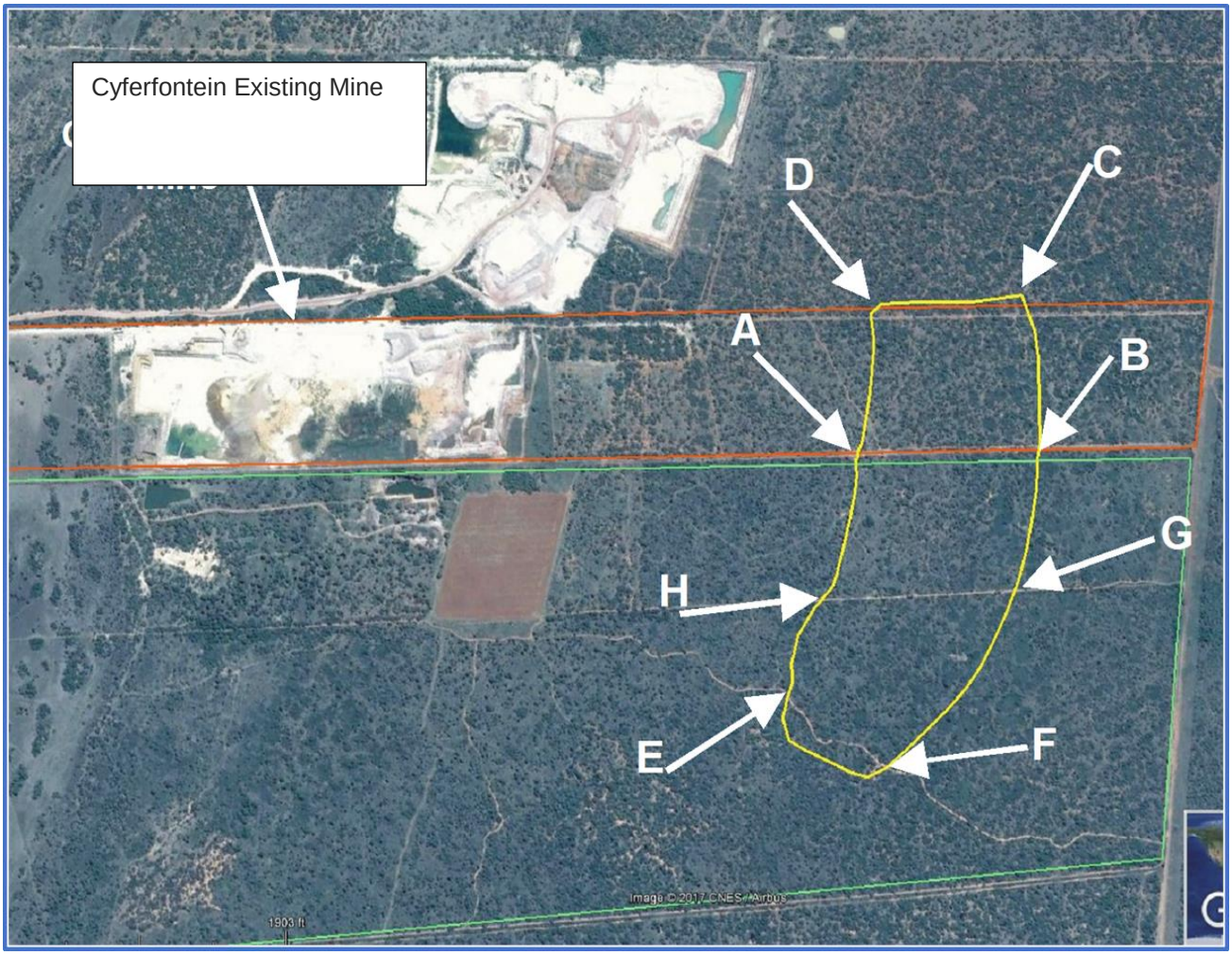


Figure 32: Noise Sampling Positions Around the new Proposed Mining Area

Table 26: Noise Levels at the Various Sampling Locations

Measuring Positions	Approximate Co-ordinates	AMBIENT NOISE (dB(A))						Remarks
		Day-time Levels (outdoors)			Night-time Levels (outdoors)			
		Average Results	Typical Rating (SABS 0103) (Category A)	Excess ΔLReq,T (dBA)	Average Results	Typical Rating (SABS 0103) (Category A)	Excess ΔLReq,T (dBA)	
Position A: Sampling point on Portion 7, owned by Mr Nortjé. Sampling point ±716 metres from the edge of the Southern Pit of the existing operations.	24°50'07.49″S 28°27'17.04″E	30.0	45	+15.0	28.0	35	+7.0	Daytime: - Normal daytime background noise, caused by slight wind through the grass, wild animals, birds. No contribution from the mining activities. Nighttime: –Night time sounds of crickets, frogs and other nighttime animals such as jackals. Slight wind blowing through the grass.
Position B: Sampling point on Portion 7, owned by Mr Nortjé. Sampling point ±1089 metres from the edge of the Southern Pit of the existing operations.	24°50'17.04″S 28°27'25.94″E	26.3	45	+18.7	26.8	35	+8.2	Daytime: - Normal daytime background noise, caused by slight wind through the grass, wild animals, birds. Nighttime: –Nighttime sounds of crickets, frogs and other nighttime animals such as jackals. Slight wind blowing through the grass.
Position C: Sampling point on Portion 7, owned by Mr Nortjé. Sampling point ±1081 metres from the edge of the Southern Pit of the existing operations.	24°50'11.45″S 28°27'33.10″E	29.8	45	+15.2	26.4	35	+8.6	Daytime: - Normal daytime background noise, caused by slight wind through the grass, wild animals, birds.

Measuring Positions	Approximate Co-ordinates	AMBIENT NOISE (dB(A))						Remarks
		Day-time Levels (outdoors)			Night-time Levels (outdoors)			
		Average Results	Typical Rating (SABS 0103) (Category A)	Excess ΔLReq,T (dBA)	Average Results	Typical Rating (SABS 0103) (Category A)	Excess ΔLReq,T (dBA)	
								Nighttime: –Nighttime sounds of crickets, frogs and other night time animals such as jackals. Slight wind blowing through the grass.
Position D: Sampling point on Portion 7, owned by Mr Nortjé. Sampling point ±740 metres from the edge of the Southern Pit of the existing operations.	24°50'02.95″S 28°27'25.56″E	33.7	45	+11.3	28.7	35	+6.3	Daytime: - Normal daytime background noise, caused by slight wind through the grass, wild animals, birds. This sampling position was closer to the actual mining activities and the reverse hooters of the vehicles was clearly audible at this point. Nighttime: –Nighttime sounds of crickets, frogs and other nighttime animals such as jackals. Slight wind blowing through the grass.
Position E: Sampling point on Portion 61&62, owned by Mr Jooste. Sampling point ±712 metres from the edge of the Southern Pit of the existing operations.	24°50'12.87″S 28°27'00.68″E	30.0	45	+15.0	28.3	35	+6.7	Daytime: - Normal daytime background noise, caused by slight wind through the grass, wild animals, birds. Nighttime: –Nighttime sounds of crickets, frogs and other nighttime animals such as jackals. Slight wind blowing through the grass.
Position F: Sampling point on Portion 61&62, owned by Mr Jooste. Sampling point ± 960 metres	24°43'50.86″S 27°14'15.36″E	29.6	45	+15.4	27.8	35	+7.2	Daytime: - Normal daytime background noise, caused by slight wind through the grass, wild animals, birds.

Measuring Positions	Approximate Co-ordinates	AMBIENT NOISE (dB(A))						Remarks
		Day-time Levels (outdoors)			Night-time Levels (outdoors)			
		Average Results	Typical Rating (SABS 0103) (Category A)	Excess ΔLReq,T (dBA)	Average Results	Typical Rating (SABS 0103) (Category A)	Excess ΔLReq,T (dBA)	
from the edge of the Southern Pit of the existing operations.								Nighttime: –Nighttime sounds of crickets, frogs and other nighttime animals such as jackals. Slight wind blowing through the grass.
Position G: Sampling point on Portion 61&62, owned by Mr Jooste. Sampling point ±1061 metres from the edge of the Southern Pit of the existing operations.	24°43'26.45″S 27°14'17.29″E	29.4	45	+15.6	28.4	35	+6.6	Daytime: - Normal daytime background noise, caused by slight wind through the grass, wild animals, birds. Nighttime: –Nighttime sounds of crickets, frogs and other nighttime animals such as jackals. Slight wind blowing through the grass.
Position H: Sampling point on Portion 61&62, owned by Mr Jooste. Sampling point ±682 metres from the edge of the Southern Pit of the existing operations.	24°43'15.78″S 27°13'21.81″E	30.2	45	+14.8	29.7	35	+5.3	Daytime: - Normal daytime background noise, caused by slight wind through the grass, wild animals, birds. Closer to the production plant Nighttime: –Nighttime sounds of crickets, frogs and other nighttime animals such as jackals. Slight wind blowing through the grass. Closer to the production plant.

Ambient Noise: The totally encompassing sound in a given situation at a given time and usually composed of sound from many sources both near and far

12 Visual aspects

There is no specialist study done for visual aspects. The comment below is based on assumptions made. The overburden dumps, topsoil dumps and the quarries of all three neighbouring mines are visible from the N1. Settlements in the area are widely dispersed and the population is sparsely distributed.

13 Cultural and heritage resources

Information for this section was extracted from the Phase I Cultural Heritage Resources Impact Assessment (African Heritage Consultants, 2017).

13.1 Background to the archaeological and history of the Waterberg

The greater region has several important Stone Age localities with deep occupation deposits and, importantly, a widespread occurrence of open-air sites. The shelter site of Olieboomspoort near Lephalale show a succession from the Earlier, Middle and Later Stone Ages (ESA, MSA and LSA), up to historic times (van der Ryst 2006). Early Iron Age (EIA) localities such as Diamant are particular important. At this locality in the western Waterberg, the facies of Diamant was first identified at the eponymous locality (Huffman 1990). This site has also delivered the earliest evidence for glass trade beads and domesticated dogs in the Limpopo Province (van der Ryst 2006). The movement of African farmers into this region is documented by their ceramics and settlements (Huffman 2007b). The later occupations of agropastoralist groups are complex (Schapera 1942, 1965; Breutz 1953, 1989; Bergh 1998). The accounts of early travellers provide important data on the fauna, flora and inhabitants of the Waterberg. The observations of travellers, missionaries and hunters who traversed the region throughout the 18th and the 19th centuries, constitute a source of implicit ethnography on the late presence of hunting and gathering groups, the African farmers and inmoving colonists (Baines 1872, 1877; Smith 1836; Schlömann 1896; Wallis [Baines] 1946; Burke [Mauch's journals] 1969). The region is also rich in rock art (Eastwood and Eastwood 2006).

13.1.1 Heritage resources

Huffman (2004, 2006a, 2007a, 2009a), in surveys for Rhino Minerals Andalusite Mine on the Farm Buffelsfontein 353 KQ, recorded an EIA village on red colluvial/alluvial deposits and several grainbins. The LIA homesteads contained several burnt houses. He ascribed the burning to a severe drought (Huffman 2009b). He also noted MSA lithics, but not of any significance. In a subsequent AIA no settlements were recorded but isolated fragments of pottery and slag suggest a buried occupation (Huffman 2009a).

Van Schalkwyk (2007), in an assessment for cultural heritage resources on sections of the farms Amandelbult 383KQ and Elandsfontein 386KQ in the Thabazimbi District, recorded surface MSA and LSA lithics. He also noted two possible EIA sites, whereas most of the others that were identified are from the Late Iron Age/Early Historical period: the latter features assigned Medium significance. A buffer zone is

already in place following on previous recommendations on Iron Age remains within this general area (Van Schalkwyk 1994, 2001, 2003, 2004; Van Schalkwyk et al. 2004).

Coetzee (2008), in a report for the PPC expansion project, recorded only a small Stone Age lithic scatter from the prehistoric period. However, 10 historical houses from the 1930s to 1940s have been documented, as well as several graves. He provides a synthesis of the Stone Age and Iron Age sequences. In the latter, the different settlement phases of the EIA are defined, namely Happy Rest, Diamant and Eiland. The LIA sequence is much more complex, with numerous groups moving into the region. The mainly stone-walled settlements are also more visible. Based on ethnographic accounts (Schapera 1942, 1965; Breutz 1953, 1989; Bergh 1998), he provides an overview of the ethnographic sequence of groups who occupied the region, such as the Bakgatla baga Kgafela, and the Batlokwa ba Kgosi and provides detail on the trust farms occupied. In the greater region. Dreyer (2011). in an assessment for proposed chrome mining developments. found no heritage remains at Hartbeestkopje 367KQ, Schilpadnest 385KQ and Moddergat 389KQ in the Northam District, but recorded historical material at Zwartkop 369KQ.

At Boikarabelo, excavations of an extensive grainbin-site and surface collections of around 12 IA settlements demonstrated Tswana settlement sequences that include a probable early Moloko (probably Icon) facies, and at least one site had been identified to the Letsibogo facies. The relative age of the sites was therefore inferred to range from the late 17th to late 18th centuries (Digby Wells Environmental 2011). A Heritage Impact Assessment (HIA) for the proposed development of the Kambaku Private School on the farm Vlakplaats 137 KQ, yielded no evidence for heritage resources (Hutten 2012). Hutten (2013a, 2013b, 2013c,) in several assessments for solar developments, noted that there was an absence of heritage resources on the farms Liverpool and Aapiesdraai near Koedoeskop, whereas a historic structure, outside the developments, was recorded at Grootkuil. Coetzee (2014), in an assessment for the Marakele Park on the northern edge of the Waterberg Plateau, similarly found no heritage resources. The area is some distance from Thabazimbi. However, the Waterberg region abounds in heritage and archaeological resources and forms part of the broader study region.

Van Vollenhoven, in an HIA for the proposed development of a limestone mine on Portion 1 of the farm Nooitgedacht 136 JQ, Portion 1 of the farm Buffelskraal 545 KQ and Portions 3, 4, 5, 6 and the Remainder of Krokodilkraal 545 KQ in the Thabazimbi District, reported that no heritage resources have been identified and that the surveyed properties have been used for cattle farming and extensive agriculture. In a draft ESR for the proposed township on Portion 20 and 22 of the farm Theunispan 293 LQ, Portion 1-4 and a portion of the remainder of the Farm Grootdoorn 292 LQ, portion 3 of the Farm Steenbokpan 295, seven heritage sites of significance or value were identified within the area proposed for the development of the

Steenbokpan Extension 3 Township. These comprise five informal cemeteries, all on portions of Grootdoorn, and two historic structures of the Harmse family homestead (Ila 2014; PGS 2014).

In an extension of a mining licence for clay extraction on the farm Nooitgedacht 436 JR Portion 25, an informal cemetery with 15 graves was identified (African Heritage Consultants 2013). African Heritage Consultants (2011, 2014), in a Phase 1 AIA, identified numerous stone-walled enclosures, a pre-colonial mine, graves, and historic structures that include a weir and bridge at the Sondagsriver. A Phase 2 mitigation was recommended.

The ESR on heritage for Project Infinity Sishen Iron Ore Thabazimbi Mine (Shangoni Management Services 2013) noted that MSA lithics were present in an area with sheet erosion. The Mine has in the past encouraged research on the IA stone-walled enclosures on their property, and further research is supported. Mitigation of historical buildings, including the Du Randt Homestead, was also addressed. The proposed mining on Wachsteenbietjesdraai 350 KQ and Kwaggashoek 345 KQ is in close proximity from the Mostert Tunnel Cave south of Thabazimbi, that has significant geological formations. Appropriate mitigation measures will be recommended (PGS 2012).

Gatkop Cave on the farm Randstephane 455 KQ ESE of Thabazimbi was also investigated. The locality lies within an area with rich iron ore deposits that are currently being explored by Aquila Resources in view of future extraction. It is an important heritage resource of high cultural significance that is still being used for ritual ceremonies and constitutes a contentious issue in view of the developments. This locality also has potentially high palaeontological heritage significance (Almond 2013). Madimatle Mountain at Donkerpoort 448 KQ and Gatkop Cave on Randstephane 455 KQ hold significant spiritual, ancestral and cultural heritage importance to the local community, local traditional healers, local traditional leaders, and persons that practice and belong to certain African Christian denominations (van Vuuren 2014; SAHRA Statement of Significance, accessed SAHRIS 11 February 2015). Acting on these recommendations, SAHRA has appointed an anthropologist who compiled a report on the significance of this locality (van Vuuren 2014). Mademate/Mletse Mountain and the Gatkop caves, described as the Remainder of the Farm Randstephne 455 KQ and the Remainder of the Farm Donkerpoort 448 KQ, have now been nominated as a Provincial Heritage Site (SAHRA 2014; SAHRIS database accessed February 2015).

Modimole (Kranskop) stands out as a beacon in the Waterberg Mountain range. It differs from all other mountains and can be seen from far away. As such it has become a beacon for black people as well as white travellers.

13.1.2 Modimolle: the mountain of God

The word “Modimolle,” according to Du Plessis (1973:126), is a combination of the words “Modimo” (meaning God or Ancestors) and “gojile” (to have eaten). “Modimolle” is not only used for one mountain. A number of other high mountains are also known as modimolle, like Modimolle in the Tšate Valley and one near Groblersdal (De Beer F.L. 1996: 2).

A number of African ethnic groups claim their association with the mountain. These include the following:

- Bakgatla claim that they were the first to name the Mountain Modimolle. It is not clear which Bakgatla group this was. De Beer is of the opinion that it was the Bakgatla ba Mmakau.
- The Bantwane a Pedi group, who now live south of Groblersdal, also claims to have lived at Modimolle. They were displaced by Mzilikazi`s regiments in 1825. Many of them were thrown down from the cliff on the northern side of the mountain during the war. These people, who had not been buried properly, turned into ghosts (setshosa) and haunt the mountain in the form of a bright light at night (De Beer 1996: 2).
- After the Matabele raids, the Ndebele of Langa, under their chiefs Mapela and Mankopane, together with other Koni groups, settled in the area, especially at the Berlin Mission Station near Modimolle (Van der Merwe 1975: 32). When the first white farmers moved into the area in the 1840`s, there was a large number of black people living at the foot of the mountain.

13.1.3 Mythological animals on Modimolle

Local informers believe that a very large snake, mamoagaša, lives on the mountain. This snake, if it is upset, creates strong winds and even tornados. Other people believe that there is a monster (mphete) on the Mountain. This monster takes children from women carrying them on their backs as food – Other also believes that there is another snake called Lejapela, which let children disappear. If a child disappears on the mountain, it is believed that modimo has eaten.

13.1.4 Sacrifices to the ancestors (badimo)

People of the Bakgatla, Bantswane and Langa believe that their ancestors (badimo) live on the mountain. Especially the Langa had an annual festival to sacrifice and to ask for rain. Individuals still sacrifice on the mountain.

13.1.5 Taboo’s

In the past, no one was allowed to climb the mountains unless they had sacrificed to the ancestors. If this is not done, the person climbing the mountain will not return. There are also people who believe that one is not allowed to burn the grass and trees on the mountain. This explains the dense vegetation at the foot of the mountain.

13.1.6 Utilization of plants

People collect medicinal plants on the mountain after first asking permission from the ancestors through sacrifice. During our visit to the mountain, we were told that a group of traditional healers now live on top of the mountain and that sheep are sacrificed there.

13.1.7 Archaeological sites

- Stone Age

  Archaeologists MPJ Moore did a survey of Modimolle rock shelters in 1987. He found that the mountain has a number of rock shelters where there are some indications that Late Stone Age people (Bushman of San) had occupied these shelters from time to time. Only a full investigation of the shelters will eventually reveal how long and when these shelters were occupied.

- Iron Age

  This period is associated with the settlement of Black people. The survey was, to a large extent, restricted because of the very dense vegetation at the foot of the mountain. This phenomenon is the result of belief that the vegetation of the mountain may not be burned. The vegetation is so thick that one can hardly walk or crawl through it.

  On the eastern side of the mountain three sites with low stone walling were recorded. All three sites consist of low stone wall circular structures up to 100m + in diameter.

  No cultural remains like pottery could be found. From the observation, it is clear that the sites were still in construction when they were abandoned.

13.2 Description of sites mapped

The proposed development site lies in a very flat area, which is part of the Springbok flats, east of the town Modimolle and south-east of Modimolle Mountain. Normally, Iron Age people settled at the foot or top of mountains in the area. This was also the case at Modimolle Mountain north-west of the site.

The proposed development area is largely undisturbed bushveld. No important cultural heritage resources or graves could be found. The owner of the farm also confirmed that there are no graves on the farm.

13.3 Description of the artefacts, fauna, botanical or other finds and features

None

13.4 Clear description of burial grounds and graves

None.

14 Sensitive landscapes

14.1 Soil, land capability sand land use

Both soil type Hu and Bd were classified as arable land and the dry land crop production potential as high.

14.2 Vegetation and animal life

Information for this section was extracted from the Biodiversity Habitat Assessment (Galago Environmental Biodiversity and Aquatic Specialists, 2017).

The biodiversity studies have shown that the study site has a low to high sensitivity (Figure 33) in terms of biodiversity. The area where the new pit area is proposed has a medium sensitivity and the floodplain area that falls in the surrounding area has a high sensitivity.

The flora study found that several specimens of two protected trees are present in both the Pit area and the larger study site. A third protected tree occurs in the larger site near the entrance gate of Portion 61. Two specimens of a species of conservation concern (Red listed species), *Elaeodendron transvaalensis*, occur in the pit area and at least one other specimen of this tree was observed in the larger site.

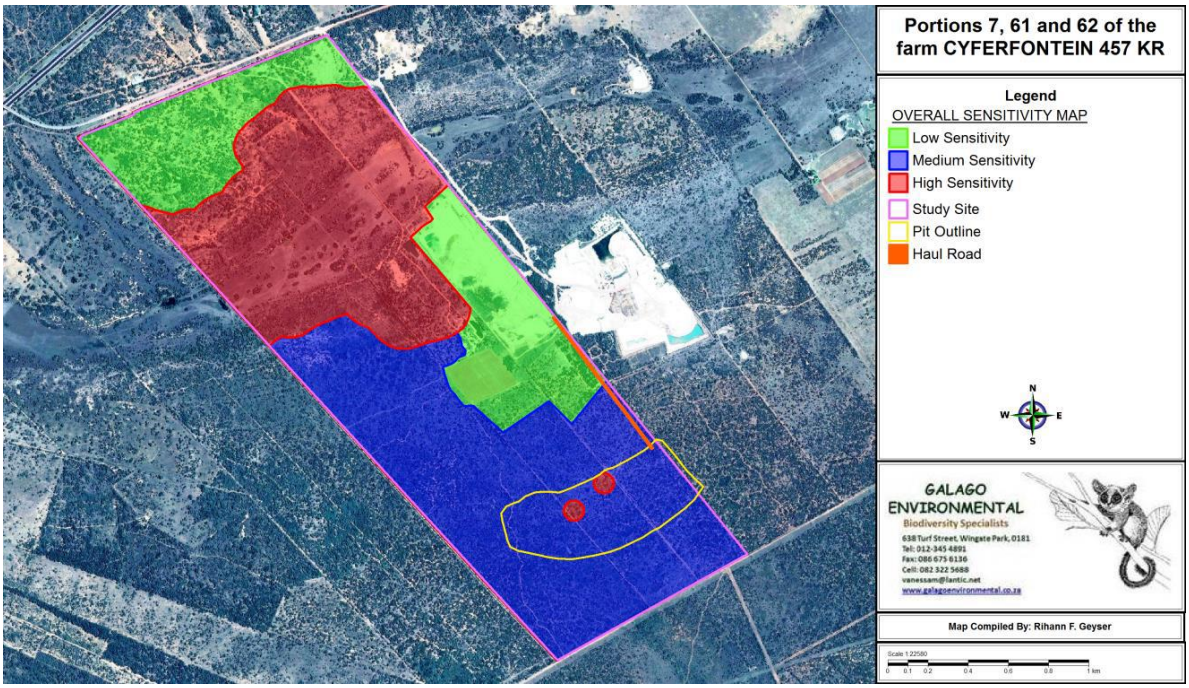


Figure 33: Combined environmental sensitivity map

Table 27: Sensitivity mapping rules

Biodiversity element	Sensitivity mapping rule
Flora	Sensitive flora habitat, Red Data plants and 50m buffer
Faunal habitat	Sensitive faunal habitat
Wetland	Wetland area and 32m buffer

14.3 Surface and groundwater

The proposed new site is not within the wetland area.

The proposed new facility is not regarded as a potential source of groundwater contamination. Should contamination occur, the saturated weathered zone and possible geological structures (dykes and faults) within the project area are the most likely pathways along which groundwater and potential contamination may migrate. There is limited information in terms of groundwater users downgradient of the proposed facility that should be addressed to improve the level of confidence in the impact assessment.

14.4 Air quality and noise

During 2016 no exceedances of the SA NDCR residential limit of 600mg/m²/day were recorded.

All noise samples were within Rural Districts limits.

14.5 Cultural and heritage resources

No cultural and/or heritage resources were discovered.

14.6 Legislative sensitivity

According to SANBIGIS (extracted 4 September 2017):

- The new proposed quarry on portion 7 of Cyferfontein is located in an area described as ESA 1 as per the Limpopo Conservation Plan, and the proposed new quarry on portions 61 and 62 of Cyferfontein is located in a CBA 2.
- The mine area falls within the Springbokvlakte Thornveld vegetation unit which is an Endangered ecosystem (Vulnerable) as per NEMBA.
- The mine falls within a ‘Moderate biodiversity importance - moderate risk for mining’ according to the Mining and Biodiversity Guidelines.

Refer to Figure 4 for en Environmental Map of the proposed mining extension.

15 Regional socio-economic aspects

Information for this section was extracted from the Final IDP Modimolle Local Municipality 2016/2017 (Modimolle Local Municipality, 2016).

15.1 Description of the municipality area

The MLM is situated in the WDM within the Limpopo Province. The municipality shares borders with all municipalities within the WMD, with Bela-Bela Local Municipality to the South, Mookgophong Local Municipality to the North, Thabazimbi Local Municipality to the South-West, Lephalale Local Municipality to the West and Mogalakwena Local Municipality to the North-West.

MLM is a regional administrative capital of government and is home to the District Municipality. MLM is a Category B local municipality within the WDM. The municipality is approximately 6,227km² in size with a total population of over 52,000. The Municipality is divided into 9 Wards.

The municipality is strategically located, with the R101 passing through it. The N1 connects Gauteng (Southern neighbouring provinces) with Limpopo, the Northern neighbouring province. The link provided by the district can creates an enabling business climate for the municipality as a distribution point to support vast growing developments in the surrounding areas. The Modimolle Town sits at the intersection of the R33 and R101 which provide added economic advantage as outlined in the Road Network System.

The municipality is consisting of urban and rural areas, with vast areas of land either under cultivation or being utilized for game farming purposes. Modimolle/Phagameng is the nodal growth point of the municipality, while Vaalwater (Mabatlane) and Alma (Mabaleng) can be described as service points. The area is characterized by:

- Prominent rivers, such as the Mokolo and Nyl Rivers which dominate the landscape, and
- Settlement patterns characterized by townships informal settlements and farms,
- Will assist in identifying the localized issues with reference to demographic and labour force dimensions.

15.2 Socio-economic profile

15.2.1 Demographic profile

MLM Population was 72,810 in 2001 and decreased to 68,513 in 2011, whereas households remained constant at 17,544 households in 2001 and 18,825 in 2011. Estimates of population at the settlement level that are compiled by the DWS for water service planning purpose suggest a population figure of 76,643 persons for MLM in 2011, comprising 19,132 households. The average size per household is 4 persons. This is probably the more accurate reflection of the local demographic situation. It could be assumed that

the average population growth rate in MLM will be similar to the provincial population growth rate of 0.94% per year. The higher population growth rate of the past decade was caused by people migrating from rural areas to Modimolle Town, but this migration process has now stabilized.

According the Statistics SA data, of 2001 and 2011, population of the district increased from 604,936 in 2001 to 679,336 in 2011, showing a 12.3% increase. The majority of the population in the District is concentrated in the Moogalakwena Municipality accounting to 49% of the population in 2001 (298,439 people) and 45,3% (307,682 people) respectively. MLM accounted for approximately 11% of the population in 2001 (69,027 people) and 10.1% in 2011 (68,513 people), which indicate a slight decrease of the population. This could be attributed to mortality or people seeking opportunities in other areas. Thabazimbi accounts for 10% in 2001 to 12,6% in 2011; Lephalale accounts for 14% in 2001 to 17% in 2011; Mookgophong accounts for 6%(both 2001 and 2011); and Bela Bela accounts for 9% in 2001 to 10% in 2011, respectively.

15.2.2 Age and gender distribution

In terms of gender distribution, the Municipality is male dominant, with males accounting to 50,8 in 2007 and 50,6% in 2011. Whereas women accounted to 49,2% of the population in 2007 and increased slightly to 49,4% in 2011.

The age composition or structure determines the kinds of economic activities within the locality. Different age groups have different economic needs and different spending patterns. About 54% of the population of MLM is made up of people aged from 20 to 64 years. This group represents the economically active section of the population. About 41% of the population is made up of children aged 19 and less, while 5% is made up of the older generation, who are 65 and above.

This trend in age composition obliges the government departments and the municipality to ensure that a large percentage of the budget is allocated to social development facilities in order to meet the needs of a youthful population and ensuring that people falling within this age acquire relevant skills and grow up to become responsible adults. The creation of more job opportunities should also be one of the key aspects of the developmental agenda by the municipality in partnership with the sector departments such as the Department of Education.

15.2.3 Education profile

It is widely accepted that the skills profile of a particular area significantly influences the economic performance and growth of that region. The education profile of the population is depicted on the table below. A large proportion of the population, about 45,1% in MLM has some primary education, while those

who completed secondary school accounts to 9,3%. On the other end of the scale, the proportion of the adult population with tertiary education remains limited with only 0.9% of the population in the municipality in possession of a certificate or diploma, and degrees approximately 9% of the population live with some kind of disability in MLM. The majority of the populations is able bodied, while 4.5% is unspecified. This can be explained by effective implementation of primary health programmes at provincial and national levels.

15.2.4 Employment profile

MLM comprises of a large majority (about 61,3%) of the population who are called the Economic Active Population. 45.1% of the population is employed. The majority of the population is employed in the area. Majority of employed population in MLM is Africans, followed by Whites. Males dominate the employment levels in all races.

15.2.5 Unemployment rate

Of the 23962 economically active (employed or unemployed and looking for work) people in the municipality, 22,2% are unemployed. 28,9% of the 11 094 economically active youth (15 – 34 years) in the area are unemployed.

15.2.6 Income levels

In excess of 23,7% of all households earn between R19 601 to R38 200 per household per month, followed by households earning between R9601 to R19 600. The proportion of households who has no income accounts to 10,4% of the population.

15.3 Basic service delivery

15.3.1 Water

Access to water:

MLM has approximately 19,804 registered households. The registered household's water usage can be summarized as follows as per the Municipal Finance System, 2011:

- 5050 households are registered indigents with access to free basic services
- The farm dwellers water supply remains the responsibility of farm owners from the private owners

A total of 17,265 households have access to water. 6,266 households have piped water inside the dwelling; while households with no access to piped water is standing at 642. Water backlog, stands at 4,7% amounting to 930 households that need water connection.

Water sources and water catchment areas:

Approximately 78,7% of the Water sources in the area is supplied by Regional/Local water scheme operated by municipality or other water services provider (Magalies Water), while 13,3% is supplied via Boreholes. MLM is supplied with surface water from the Donkerpoort Dam (Catchment area) and Pipeline from Klipdrift Purification Works (Magalies Water). Donkerpoort water purification plant supply water to a part of Modimolle Town & Phagameng, as a result, Magalies Water was appointed as service provider to supply the required amount to augment the latter:

- Plants have been upgraded to a capacity of 10ml/d but the constraint is the raw and the final water pipeline.
- The Municipality still to acquire generators for the dam to address emergency incidents (generator is used to run the plant in the instance where there is no electricity to supply reservoirs with water and to avoid the drying of the reservoirs).

The reservoir, in Vaalwater is 3Ml capacity. Sufficient water sources have been identified on private farms in Vaalwater, but the land prices are high and farmers change high amounts of money to use their boreholes.

The other source of water is generated Boreholes. There are approximately 18 Boreholes in MLM area, which are indicated below. Some of these boreholes are working while others don't.

- Perdelaagte borehole in MLM
- MLM 5 boreholes and all are working
- Mabaleng 2 boreholes and all are working
- Mabatlane 9 boreholes and all are working

Currently a water shortage exists in the Vaalwater area which solely depends on boreholes. In certain extensions (Part of Leseding Township Extension 1 and Extension 2) water carts are used (as reflection of the water shortage) to supply the community with water.

Water service providers:

MLM is both Water Service Provider and water Service Authority. Magalies Water Board supplies directly certain areas in the jurisdiction of the MLM, via Pipeline from Klipdrift Purification Works (Magalies Water)

Existing water service infrastructure:

The greater part of the MLM area is supplied with surface water from the Donkerpoort Dam (Catchment area) and Pipeline from Klipdrift Purification Works (Magalies Water). Donkerpoort water purification plant supply water to a part of Modimolle Town & Phagameng, as a result, Magalies Water was appointed as

service provider to supply the required amount to augment the latter. The Municipality has two reservoirs. The capacity of MLM reservoirs are currently at 24Ml, although there is a need for another 24Ml storage facilities to ensure sufficient water supply for current and future development. Actions have been identified to increase the capacity of the Donkerpoort Dam. The reservoir, in Vaalwater is 3Ml capacity. Sufficient water sources have been identified on private farms in Vaalwater, but the land prices are high and farmers change high amounts of money to use their boreholes Waste water infrastructure
Both bulk system and internal sewer system are the property of MLM as well as the sewer treatment works that are connected to them for purification.

MLM as a water services authority (WSA) has a duty as per the Water Services Act 108 of 1997 to have a Water Services Development Plan (WSDP) adopted by its Council and thereafter have it submitted to the Minister of DWS. MLM's adopted its WSDP. However, the WSDP, still need to be reviewed as per DWS. Requirements are being developed to cover for the next 5-year cycle. The WSDP is a plan to ensure efficient, affordable, economical and sustainable access to water and sanitation services for all. It deals with socio-economic, technical, financial, institutional and environmental issues, which pertain to water and sanitation services. The plan addresses both the capital; operational and maintenance requirement for the next five years and will be implemented and managed by the Municipality as it is a mechanism for decision making for both councillors and officials.

Blue drop certification:
The DWS initiated the drinking water quality regulation programme in 2005. The objective of the programme is to ensure that improvement of tap water quality by means of compliance monitoring of all WSA. In an attempt to implement public confidence due to many negative reporting on water quality triggered the initiation of the incentive based regulation programme termed the Blue Drop Certification which commenced on 11 September 2008.

WSA's that scored 90% and more received the Blue Drop Certification; regarded as managing drinking water quality with excellence and exceptional manner. MLM has good drinkable water, although it has be battling to attain the certification. Below is the status and scores of MLM attained.

They however attained certification in the 2010/2011 Financial Year with 95, 1%.

Challenges pertaining to provision of water:

- Ageing Infrastructure.
- Lack of staff.
- Lack of funding for capital projects.

- Informal settlements use pit latrine that poses health risk.
- Lack of tools, equipment, machinery and vehicles for operation and maintenance.

15.3.2 Sanitation

Access to sanitation:

Approximately 66,1% of the of MLM Households have access to Flush toilets, whilst 16,6% of households use pit toilet without ventilations. According to COGTA, Basic Service Publication, (2009 Municipal Source), MLM Sanitation backlog stands at 11,5% which translate to 2 279 households.

Existing sanitation service infrastructure:

MLM waste water treatment plant is currently running at its full capacity of 3ML/day treating an average of ±4.5ml/d. Phase 1 has been completed. Vaalwater area is currently using oxidation ponds, but the ponds are over flowing which poses an environmental challenge, especially in rainy seasons, due to the close proximity to the Mokolo River (±60m). Package plant has been installed to remedy the situation. Alma presently has no waste water treatment plant. A total number of 480 hh in Alma and 400hh in Vaalwater have a backlog respectively. The 0, 5 ml/d package plants have been installed to avoid the situation of contaminating the ground water.

Both bulk system and internal sewer system are the property of MLM as well as the sewer treatment works that are connected to them for purification.

Green drop certification:

The DWA initiated the sanitation water quality regulation. The objective of the programme is to ensure that improvement of sanitation quality by means of compliance monitoring of all WSA. In an attempt to implement public confidence due to many negative reporting on water quality triggered the initiation of the incentive based regulation programme termed the Green Drop Certification. MLM received the following scoring in terms of Green Drop Certification, which is a concern.

Challenges pertaining to provision of water:

- Ageing Infrastructure.
- Lack of staff.
- Lack of funding for capital projects.
- Informal settlements use pit latrine that poses health risk.
- Lack of tools, equipment, machinery and vehicles for operation and maintenance.

15.3.3 Energy and electricity

The Department of Energy and Eskom plays a very important role in the provision, distribution and planning of electricity supply in the municipality. The MLM, in terms of the allocated powers and functions, has authority over electricity function.

MLM area is serviced by both the Municipality and Eskom. MLM, services the town and townships whereas Eskom services mainly farming community. MLM provides most of the internal reticulation. The municipality has intensions to upgrade the internal capacity however it is challenged with lack of funds. DBSA has been approach with application of a loan of ±R25m, whereas other option is to apply for a grant of ±R15m from Department of Energy which the municipality had already explored through submission of a Business Plan.

Access to energy and electricity:

The majority of households in MLM use electricity for cooking, heating and lighting. A significant number of households, mainly rural including informal settlements still use woods and paraffin has a source of lighting, cooking and heating. According to COGTA, Basic Service Publication, 2011, MLM Energy backlog stands at 12,1% which translate to 2,381 households.

Existing electricity infrastructure:

MLM has a total of 40MVA capacity to supply the community. Out of the 40MVA, Modimolle Town has 20MVA of which its optimum utilisation is ±18MVA. The Vaalwater area has a transformer of 3MVA and currently using 2.8 MVA. There is a need for additional capacity in Vaalwater to enable further development .

Challenges pertaining provision of electricity:

- Illegal Connection.
- Upgrading electricity supply to meet the demand and development of business operations.
- Limited number of vending stations.

15.3.4 Waste management

MLM currently renders the following waste removal services:

- Domestic waste removal
- Business/Industrial waste removal
- Street cleansing and litter picking service
- Waste Transfer
- Waste Treatment
- Landfill operation services

Waste collection: refuse removal:

Waste collection service is provided to 16,625 households with access including informal settlements. Farms and game lodges dump in their Private Properties. Farmers are required to acquire legal environment certificate that permits them to do dumping at a minimal scale in designated private areas.

Waste disposal:

There are two landfill sites which are licensed in the Municipal area. One in Vaalwater and the other in Modimolle/Phagameng, with a total capacity of 320,000m³ and the total general waste collected is 840,000m³. Currently there is a need to relocate the Modimolle Town Land Fill Site as it is at close proximity to the newly developed extension 10 townships. The legal status of both the land fill sites in Vaalwater and the Modimolle Town is being compromised.

The Vaalwater landfill site is compromised by the encroachment of Leseding Extension 2 and new Extension 3 development and MLM is compromised by the new Extension 10 development. The landfill site in Vaalwater is being rehabilitated with the assistance of WDM. The District is currently considering the establishment of a district wide landfill site. The municipality has identified a new Landfill site in MLM and the process of establishment of the site is underway.

Compaction and covering is done regularly to prevent nuisance, pollution and to keep the environment clean. Land rehabilitation is also being done.

Cleansing services:

The Municipality renders cleaning services as well. The cleansing function entails the cleaning of streets, open spaces and illegal dumping, the conditions of the streets is deteriorating.

Waste storage:

Households do have access to litter bins, provided by the municipality including skip bins at strategic locations

Waste transportation:

Waste transportation is the major challenge within the collection and transportation of waste, to improve the availability of vehicles the following needs to be undertaken:

- Improved maintenance
- Acquire mechanics for waste vehicles
- Replacement heavy waste management vehicles every five years
- Appropriately choose and utilize vehicles

- Train drivers
- Manage and control Fleet.

Waste transfer:

There are no waste transfers within the Municipality, however the Municipality is devising plans to provide such in strategic areas, as transfer of waste helps improve the turnaround time for the disposal of waste, waste minimization and the separation of waste into reusable components.

Challenges with regards to refuse disposal and waste management:

- Limited financial resources to establish new dumping sites.
- Refuse removal service is not up to the required standards due to lack of resources.
- Illegal dumping areas both in urban and rural settlements.
- Increased residential development in urban areas often without concurrent increase in resources.

15.3.5 Roads and transportation infrastructure

Municipal roads and storm water infrastructure:

The municipality has powers and functions on internal roads in Phagameng, Mabatlane, MLM and Alma. MLM is accessible to the N1, that links Gauteng Province and Limpopo Province and the R33 is a freight corridor that connects the east and the west. It is used mostly by trucks passing through Modimolle to Lephalale Local Municipality. The road is very narrow and many accidents have occurred due to the amount of trucks.

There is a plan to commission a feasibility study on the bypass road to Mookgopong/ Lephalale. The R101 road is a link that connects the south to the east and trucks are restricted to use this road. A fine of R10,000 is being stipulated for non-compliance. Trucks driving from Bela-Bela to MLM use the Eersbewoon road that intersects with R33; it passes through Modimolle Town and then proceeds to Mookgophong or Polokwane using the R101. The two roads that link Modimolle Town and Mabaleng are gravel roads, which pose a challenge on our public transport system.

The road network within the municipal area consists of gravel, concrete blocks and surfaced roads. The existing municipality road network comprises of a total of 186,4km. It is of particular importance that the bulk of the surfaced road network is still in a relatively good to fair condition (±85%) and subsequently, with appropriate and timeouts intervention, the integrity of the majority of the existing surface road network can be preserved. In terms of storm water drainage there are four parts of Modimolle Town which were developed without sufficient infrastructure for storm water drainage and this prone these areas to the excessive water surface run-off or even flooding during the heavy rains. The areas at Phagameng Township

are Extension 7 and Extension 8 & 9. The municipality should also ensure that the future settlements are well provided with sufficient storm water infrastructure at the early stages to avoid future backlogs occurrence.

Road and rail links:

The whole area is well covered by roads. The road network includes links to both the N1 in the south and the R33/R517 running from Marble Hall via Modimolle Town and Mabatlane to Lephalale. The rest of the MLM area is serviced by gravel roads that link farms to the major routes. MLM has a total road distance of 2 753km of which only 15% or 403km are surfaced. However, most of the roads in the Modimolle Town are surfaced but are not necessarily in good conditions. The condition of unpaved roads in the district ranges from good to very bad. The railway line connecting the south to the north is currently active and is being utilized for both passengers and freight goods. The railway link from Modimolle to Vaalwater (Mabatlane) is currently closed and was previously used to transport agricultural products. The municipality is not a transport authority. Currently MLM do not have a bus transport network. The existing transport network is adequate at this time, although it should be noted that the network must be re-evaluated regarding proposed development.

Backlog on roads and stormwater:

- Storm water in Phomolong section to Ext 7 is running in an uncontrolled manner
- Lack of funds to develop Road Infrastructure Strategy
- Damming of water flooding
- Aging infrastructure of roads, the roads are over their life span. These roads are mainly in town (Needs rehabilitation).
- Too many potholes because of aged roads.
- New storm water pipes must be installed in town and Phagameng to reduce flooding.
- Municipality must fund internal roads in town since the MIG does not fund internal street in town.

15.3.6 Public transport

The spatial pattern in terms of the modes of transport used by people mirrors the patterns described for most of the other variables assessed. Private transport is limited to the higher income areas of the urban core. Overall bus services are not significant but taxi to play a role in Modimolle, Phagameng and Phomolong area. The MLM has four taxi ranks, one in Vaalwater (Mabatlane), two in Modimolle Town and one in Phagameng. The distance from Phagameng to Modimolle CBD is about 3.5km by which some people prefer to walk to town. There is currently no taxi rank in Alma (Mabaleng) and most people are transported by private car owners. Public transport to Alma from Modimolle Town is currently being challenged by the District road condition. The two access roads to Alma are district roads and currently

gravel roads. The municipality has different mode of transport and it is as follows: Taxi, Private Cars, Donkey Carts, and Bicycles & Walking.

Transport challenges and public transport:

- Lack of formalization of the taxi industry.
- Lack of public transport facilities.
- Poor access road.
- Recapitalization of un-roadworthy taxis.
- Cost of public transport services

15.3.7 Housing profile

Distribution of settlement type:

The municipality is characterized by townships, farms and informal settlements. Settlements in MLM are dispersed and distributed across the municipal area. Approximately 85% of the households are residing in the urban area, while 12,7% live in Farms areas. Although the areas are strongly agricultural based this high percentage of urbanization is a reflection of the ability of the agricultural sector to create job opportunities.

Distribution of dwelling types:

- Dwelling Types: The extent of informal houses is compounded by the extent of backyard dwellers in certain areas. The existence of backyard dwelling in areas without migrant labour is usually an indication of a strong demand for housing in the lower income groups.
- Period of Residence: The population in the municipal areas is generally very stable. Growth (shorter period of residence) occurred in very specific places. There is clear pressure in Phomolong and in Mabatlane. The extent to which RDP houses were built might be in itself a stimulus for urbanization and hence the demand for housing.
- Tenure and Ownership: Tenure and ownership is very difficult to assess. The MLM urban core shows high levels of ownership with free occupation associated with the Phomolong area and the farming communities. Indications are that there is a demand for rental housing albeit not in the lower income areas.

Challenges pertaining to housing provision:

- Lack of well located, developable land for housing (most of the land which is well located and well suited is privately owned and insufficient for housing subsidies).
- Under staffed town planning unit.

- Lengthy procedure in dissemination between Limpopo Provincial Government and Local authorities regarding housing matters.
- Lack of housing integrated planning and development (housing will be constructed without road infrastructure and connection plans to the main bulk sewer line).
- The municipal sewer treatment plant is operating above its capacity and threatening new developments.
- Renting and selling out of RDP Houses at early years by beneficiaries.
- Illegal occupation of RDP houses.
- Lack of proper policy in controlling influx of informal dwellers/settlements.
- Limited budget on implementation of housing programme.
- Lengthy procedure in information discrimination between Coghsta and municipality.

15.3.8 Health and social development

Health facilities:

Modimollle has one hospital and 4 Clinics. There is also a system of mobile clinics (about 4) to all the villages of the Municipality. More than 63% of the population is within 60 minutes from health facilities. The Municipality does not have home based carers and drop in centres, which are critical to health and Welfare service of the Communities.

State of HIV/AIDS preference:

Growth has been accompanied by greater visibility of the epidemic, especially owing to increasing number of HIV and AIDS related deaths. According to the Department of Health (2015, MLM HIV prevalent is standing at 25%. Despite the scale of the epidemic, there is relatively limited data on the impact at personal, community, business or provincial level. One of the reasons is the enormous stigma that is still attached to HIV infection.

15.3.9 Safety and security

Safety and security facilities:

It has been noted that the crime rate in MLM is high although the municipality has only four (4) police stations (Modimolle, Rankinspass, Dorset and Vaalwater). This is conducive for economic growth, especially in the tourism and retail industry. However, the Alma (Mabaleng settlement is situated at ±15km away from the Rankin pass and ±30km from Vaalwater Police Stations). This further challenges social and security cluster communities for proper planning. The Phagameng area has been provided with a satellite Police station; otherwise Phagameng was at a radius of ±3.5 KM. More than 79% of the population is within a 30-minute drive from a police station. The most inaccessible areas coincide with the areas with high conservation potential and this also the most sparsely populated areas.

15.3.10 Education

MLM is well endowed with Educational facilities. The Municipality is served by 2 Education Circuits. Currently within the municipality there are Primary Schools, Secondary Schools, Special Schools, ABET Centres, Pre-School and Independent Schools. There are no tertiary institutions except private initiatives that offer computer skills, security training etc.

15.3.11 Sports, art and culture

Most of the community facilities including sports grounds are located in urban areas to the exclusion of the majority of rural areas. The community facilities existing informer townships and rural areas are of poor standard compared to those in Town. There is therefore a need not only to ensure accessibility to existing facilities but also to ensure that facilities exist in appreciation of the social circumstance/conditions of the communities they are targeted at. MLM has 5 Community Halls, 25 Sports Facilities and 20 Municipal Parks.

15.3.12 Telecommunication services

A large section of the municipal area has access to formal telecommunications facilities, 88,4% use Cell phones, 10,3% use fixed lines. Telecommunications is well provided in big institutions such as hospitals, schools and government departments.

Provision of post offices services:

The MLM has two post offices and four retail postal agencies. The current postal services are strategically well located and sufficient for the existing demand within the municipality. These facilities must receive regular maintenance to ensure that the facility stays in usable condition.

15.3.13 Cemeteries

There are 6 Cemeteries, only two are operational, and two were closed due to high water table (Phagameng and Leseding). There is a need to identify new sites.

v) Impacts and risks identified including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts

This section includes the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts can be reversed; may cause irreplaceable loss of resources; and can be avoided, an assessment of each identified potentially significant impact and risk, including cumulative impacts, as well as how these impacts can be managed or mitigated and level of residual risk.

This risk assessment only focusses on the four activities being applied for. The updated EMP will include all additional activities and its associated impacts and management measures.

Please note, significance rating should be done by the various specialists as part of the specialist studies. The wetland specialist conducted a significance rating and the stormwater management plans included a significance rating. Significance rating for all other environmental aspects are based on assumptions made by the EAP. The Mitigation hierarchy of the Mining and Biodiversity Guideline: Mainstreaming biodiversity into the mining sector (Department of Environmental Affairs et al, 2013) will be used to further assess the environmental impacts. This will be done by the environmental assessment practitioner, considering the already compiled specialist reports.

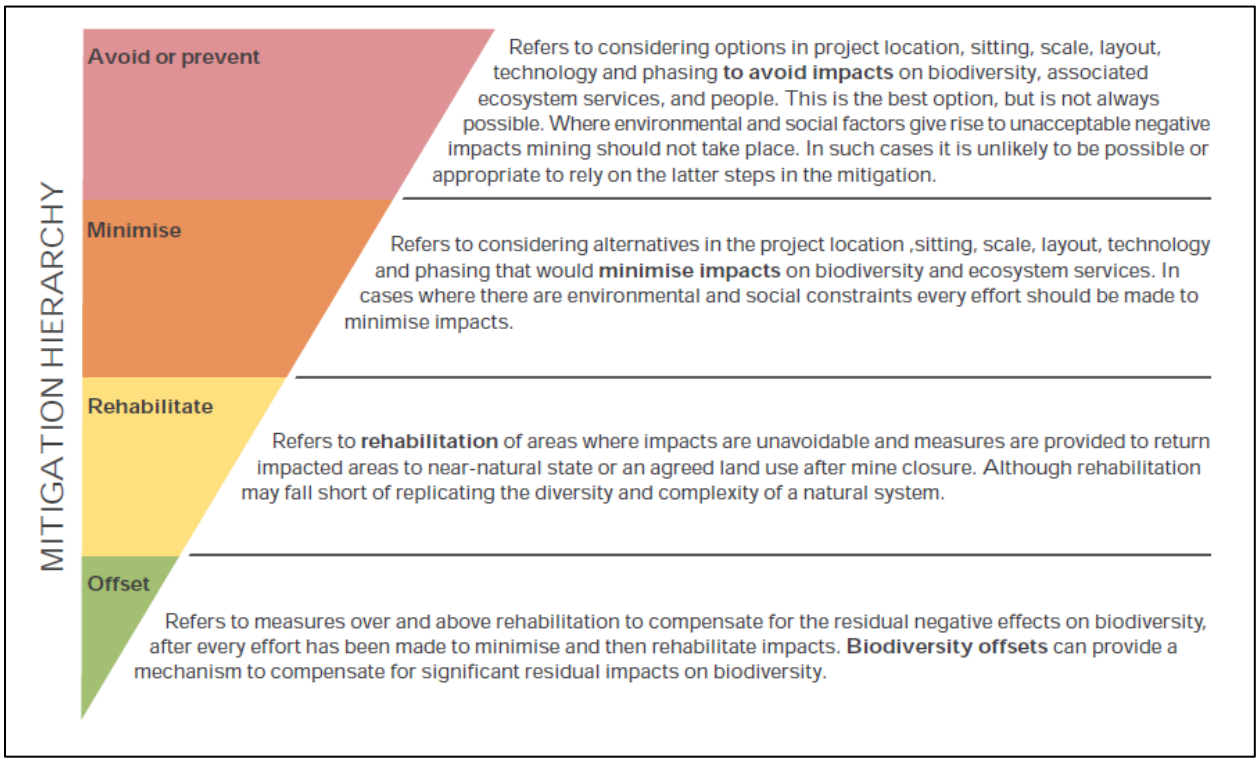


Figure 34: The mitigation hierarchy for dealing with negative impacts on biodiversity

1 Preferred option

1.1 Geology

The significance rating is based on previous EMPs and therefore based on assumptions by the EAP.

Activity: Abstraction of the ore.

Nature and consequence: Total abstraction of the ore.

Description		Rating before management	Rating with management
Quantity or size of disturbance			
Large	The area will be more than 20ha.	3	3
Severity or destruction effect			
Moderate	The geology will be completely removed; however, this will not have an impact on other environmental components.	2	2
Extent			
Site specific	If management measures are implemented, geology will only be removed in the quarries.	2	1
Duration (impact phase and estimated timeframes)			
Permanent	The removal of geology will only take place during the operational phase; however, the impact will be permanent.	3	3
Probability			
Definite	Removal of geology is taking place and will definitely take place until the mining activities cease, however, the geology will be permanently removed.	3	3
Reversibility			
Irreversible	Roll-over mining will take place as part of rehabilitation, however, the geology at point of mining will be irreversible impacted.	3	3
Irreplaceability of resources			
Resource replaceable, receptor not sensitive	The removal of geology will not directly influence other environmental components. This is also not a sensitive receptor.	1	1
Degree to which can be avoided, managed or mitigated			
Somewhat avoidable with management measures or mitigation	The extent of geology removed could be avoided if incorporating the management measures as set out below.	2	2
Significance			
Medium	Medium significance prior to and after management.	19	16
Environmental objective:			

Description	Rating before management	Rating with management
• To minimise the disturbance of the local geology through effective prevention measures during mining activities and to mine responsibly by ensuring safety and stability of the quarry so that geology of the adjacent environment is not affected.		
Monitoring requirements: • Continual monitoring of mining plan.		
Management or mitigation: The mine will ensure that the following is implemented: • Effective mining practices and planning; • Work within mine plan.		
Roles and responsibility: • Mine manager		
Management timeframe: • Throughout the mining of the quarry.		
Mitigation hierarchy: • None – ore will be removed.		
Environmental budget: • No environmental budget will be allocated for the removal of geology; however, financial provision will be allocated for rehabilitation.		
Residual risk: • The removal of geology will be permanent and therefore the impact will be permanent and therefore a residual risk. No post-closure management of this risk is proposed.		

1.2 Soil, pre-mining land capability and land use

Information for this section was extracted from the Soil, land capability and land use assessment (Rehab Green, 2017):

1.2.1 Section of open pit that will be rehabilitated.

Environmental component: Soil, land capability and land use at the section of open pit that will be rolled-over and rehabilitated.

Activity: Stripping of all topsoil at the open pit footprint. According to the Client the topsoil of the initial cuts of 9.9ha will immediately be replaced on the existing north and south pits. This implies that at that stage, at least a reasonable area of the existing pits should have been rolled-ver with overburden material to the correct elevation and to a free draining topography in order to do proper rehabilitation. If such an area at the existing pits is not prepared at that stage, the topsoil of the initial cuts of the proposed pit will have to be stockpiled that implies an additional impact.

The client intent to commence with roll-over of the initial cuts and do progressive roll-over and rehabilitation as mining takes place from east to west. At this stage topsoil will be stripped at the high wall side and directly be and levelled areas behind the mining face. It however implies that there will constantly be an open pit area where all topsoil is removed and subsequently no land capability will exist, and no pre-mining land uses will be possible.

Nature and consequence 1: Deterioration in soil quality and physical properties due to mixing of soil's A and B horizons. During the stripping process the A and B-horizons will be mixed and therefore not be replaced in the same sequence. This will cause constant varying texture in the post-mining soil profile, which will adversely affect infiltration rates, soil stability and water holding capacity. It will further cause deterioration of soil fertility due to the mixing of the thinner, but more fertile A horizons with the thicker less fertile B horizons, which usually result in significant lower organic carbon in the post-mining upper soil horizon. This will adversely affect soil structure and stability as well as fertility.

Impact phase: Operational phase until rehabilitation was done

Description		**Rating before management**	**Rating with management**
Quantity or size of disturbance			
Large	Will take place in the total open pit area of 26ha	3	1
Severity or destruction effect			
Moderate	It has a mentionable effect on post-mining soil properties and land capability	2	1
Extent			
Site specific	It will take place only in the open pit area where topsoil is stripped and replaced	1	1
Duration (impact phase and estimated timeframes)			
Permanent	The original physical and chemical properties will re-establish naturally over many years.	3	1
Probability			
Definite: If the A and B horizons are not stripped separately and replaced in the same sequence the impact will definitely take place		3	1

Description		Rating before management	Rating with management
Reversibility			
Reversible	The impact will be reversible with management measures	1	1
Irreplaceability of resources			
Resource somewhat replaceable, receptor moderately sensitive	Disturbance of the soil horizons to such an extent has a moderate impact	2	1
Degree to which can be avoided, managed or mitigated			
Avoidable with management measures		1	1
Significance			
Medium to low		16	8
Environmental objective: • To replace topsoil as pure and with as little disturbance as possible.			
Monitoring requirements: • The topsoil stripping and replacement depths should be monitored throughout the mining and rehabilitation process			
Management or mitigation: • Separate stripping of the A and B horizons and replacement in the same sequence has a high cost and management implication and causes high compaction in the post-mining soil profile as well as problems with mechanical equipment that get stuck. • Separate stripping of the A and B horizons and replacement in the same sequence is not recommended due to mentioned obstacles. The impact should rather try to be lessened by stripping only high-quality topsoil, at correct depths (1.2m) as indicated in Figure 6 (of specialist study) where after reestablishment of the A and B horizon properties should take place naturally over many years.			
Mitigation hierarchy: • Minimise			
Roles and responsibility: • Environmental Manager			
Management timeframe: • Throughout LoM until end of rehabilitation.			
Environmental budget: • A budget for rehabilitation is required by law and should be in place as prescribed by law. The financial provision in this report includes the replacement of soil as part of roll-over mining of the quarry.			
Residual risk: • None			

1.2.2 Stripping of soils

Nature and consequence 2: Deterioration in post-mining soil quality and land capability if soils are stripped too deep and are subsequently mixed with underlying, lower quality overburden materials, which adversely affect infiltration rates, permeability and soil stability. Reduction of post-mining land capability and potential land use if topsoil is stripped too shallow and replaced at shallower depth as prior to mining, which reduces soil volume and subsequent water holding capacity and nutrient availability.

Description		**Rating before management**	**Rating with management**
Quantity or size of disturbance			
Large to very large	Sections that are stripped too deep or too shallow can vary from small up to the total pit area.	3	1
Severity or destruction effect			
Large to very large	It has a mentionable effect on post-mining soil properties and land capability	3	1
Extent			
Site specific	It will take place only in the open pit area where topsoil is stripped and replaced	1	1
Duration (impact phase and estimated timeframes)			
Permanent	Once topsoil is stripped and replaced at incorrect depths the impact is permanent.	3	1
Probability			
Definitely: If the stripping and replacing depths are not constantly monitored throughout the mining process, there is a very small chance that stripping and replacement will take place at correct depths.		3	1
Reversibility			
Irreversible	The impact is irreversible once it took place but it can be avoided with	3	1

Description		Rating before management	Rating with management
	management measures prior		
Irreplaceability of resources			
Resource irreplaceable, receptor highly sensitive	Topsoil that is lost due to incorrect stripping depth cannot be replaced, it is gone forever. It can however be avoided by management	3	`
Degree to which can be avoided, managed or mitigated			
Avoidable with management measures: The impact can be avoided by constantly monitor the stripping and replacing depths throughout the mining process		1	1
Significance			
High to low		20	8

Environmental objective:

- To strip the topsoil of the pit area at correct depths (1.2m) as indicated in the stripping guideline Figure 6 of specialist study, and replace it at a depth of at least 1.0m in order to prevent a deterioration in post-mining soil potential and land capability as far as possible.

Monitoring requirements:

- The topsoil stripping depth (1.2m) and replacement depths (at least 1.0m) should be monitored throughout the mining and rehabilitation process.
- It is recommended that the operators of stripping equipment are well informed of the correct stripping depth and that it is inspected by the rehab officer on a weekly basis.
- It is recommended that depth markers are placed (by a surveyor) on surfaces that are prepared for topsoil replacement in order to guide operators and ensure correct post-mining soil depths.
- A post-mining soil and land capability assessment should be done by a soil specialist who is registered by the South African Council for Scientific Professions at the end of the mining operation in order to determine the post-mining land capability and land use potential. A postmining soil and land capability map should be compiled that should be submitted with the closure application.

Management or mitigation:

- Ensure that topsoil is stripped to a depth of 1.2m with as little deviation as possible.
- Ensure that the areas where topsoil will be replaced are sloped to the correct elevation and are free draining.
- Ensure that depth markers (stakes) are put out by the surveyor to ensure replacement at correct depths (at least 1m)
- Care should be taken to tip enough soil per square unit to reinstate the total required post mining soil depth at once. Spreading of soil over far distances and repeated traversing of heavy mechanical equipment should be

Description	Rating before management	Rating with management
minimised in order to prevent compaction in the lower profile which is difficult to alleviate afterwards. The dumped soil heaps should thus only be levelled on top to reach the required soil thickness. Caterpillar-type tracked equipment is preferred for levelling of topsoil because these tracks cause less compaction. Bowl scrapers cause enormous compaction and should not be used.		
Mitigation hierarchy: • Rehabilitate		
Roles and responsibility: • Environmental officer for monitoring correct soil stripping and replacement depths. The mine surveyor for placing post-mining soil depth markers on areas that are prepared for topsoil replacement.		
Management timeframe: • Throughout LoM until end of rehabilitation.		
Environmental budget: • A budget for rehabilitation is required by law and should be in place as prescribed by law. The financial provision in this report includes the replacement of soil as part of roll-over mining of the quarry.		
Residual risk: • Erosion of rehabilitated areas		

1.2.3 Rehabilitated areas

Nature and consequence 3: Soil erosion at rehabilitated areas where exposed soil surfaces are highly vulnerable to erosion initiation without a vegetation cover that serves as a buffer against erosion.

Description		Rating before management	Rating with management
Quantity or size of disturbance			
Large.	All sections where topsoil is replaced are vulnerable to soil erosion until the vegetation cover has established to such a point where it provides a buffer against soil erosion	3	1
Severity or destruction effect			
Moderate	Moderate to severe soil erosion can take place at exposed soil surfaces, especially during the rainy season.	2	1
Extent			

Description		Rating before management	Rating with management
Site specific	Soil erosion will take place only in the open pit area where topsoil is stripped and replaced.	1	1
Duration (impact phase and estimated timeframes)			
Throughout life of activity	Soil erosion is a potential impact that can occur at any time from the topsoil replacement phase until the area is stabilized by a well-established vegetation cover.	2	1
Probability			
Probably: If the replaced topsoil is not re-vegetated, there is a very high probability that soil erosion will occur.		2	1
Reversibility			
Irreversible	Soil erosion is mostly irreversible once it took place, but it can be avoided with prior management measures or it can be stabilized after it took place.	3	3
Irreplaceability of resources			
Resource irreplaceable, receptor highly sensitive	Topsoil that is lost due to soil erosion can usually not be replaced.	3	3
Degree to which can be avoided, managed or mitigated			
Avoidable with management measures: Soil erosion can mostly be avoided by management measures		1	1
Significance			
Medium to low		17	12
Environmental objective: • To replace topsoil during winter and prepare for seeding just before the rainy season. To establish a good grass cover on rehabilitated areas in order to stabilize the soil and prevent soil erosion.			
Monitoring requirements: • Erosion occurrences should be monitored after every rain			

Description	Rating before management	Rating with management
Management or mitigation: • The timing of topsoil stripping and replacement should be synchronized with the rainy season. • Topsoil should be replaced during winter and soil preparation and seeding should be done just before the • rainy season. • A grass cover should be established to serve as buffer against soil erosion. The grass cover should consist of a mixture of available local species as well as a strong growing and stabilizing pioneer specie such as C*ynodon dactylon*		
Mitigation hierarchy: • Avoid / prevent		
Roles and responsibility: • Environmental officer for synchronizing the overburden roll-over, the replacement and preparation of topsoil and seeding just before the rainy season. Also monitoring soil erosion and stabilization of any occurrences		
Management timeframe: • Throughout LoM until end of rehabilitation.		
Environmental budget: • A budget for rehabilitation is required by law and should be in place as prescribed by law. The financial provision in this report includes the replacement of soil as part of roll-over mining of the quarry.		
Residual risk: • Erosion of rehabilitated areas could potentially be a residual risk, however, if rehabilitation is correctly implemented, this will not be a residual risk.		

1.2.4 Pollution by hydrocarbons caused by leaking vehicles and machinery that are used for stripping and replacement of topsoil

Nature and consequence 4: Potential soil pollution by hydrocarbons caused by leaking vehicles and machinery that are used for stripping and replacement of topsoil

Description		Rating before management	Rating with management
Quantity or size of disturbance			
Very small to small	The area that might be polluted with hydrocarbons are usually small	1	1
Severity or destruction effect			
Moderate	The impact on soil physical and chemical properties by hydrocarbon spillages by vehicles and machinery	2	1

Description		Rating before management	Rating with management
	are usually slight to moderate		
Extent			
Site specific	Spillages of hydrocarbons usually contaminates soils only at small spots at areas where topsoil are stripped or replaced by mechanical equipment	1	1
Duration (impact phase and estimated timeframes)			
Throughout life of activity	Hydrocarbon spillages can occur at any time from the topsoil stripping and replacement phase until seeding action.	2	1
Probability			
Probably: Some mechanical equipment will probably spill hydrocarbons on soils somewhere during the mining process.		2	1
Reversibility			
Irreversible	Hydrocarbon contamination is mostly irreversible once it took place. Contaminated soils cannot be cleaned, it can only be removed.	3	3
Irreplaceability of resources			
Resource irreplaceable, receptor highly sensitive	Topsoil which is contaminated with hydrocarbons is usually removed and disposed at a suitable disposal facility and cannot be replaced.	3	3
Degree to which can be avoided, managed or mitigated			
Avoidable with management measures: Hydro carbon spillages can be avoided and minimizes to a large extent by management measures		1	1

Description	Rating before management	Rating with management
Significance		
Medium to low	15	12
Environmental objective: • To manage and control all possible hydrocarbon spillages in such a way that it prevents soil pollution or to minimize it as far as possible.		
Monitoring requirements: • All vehicle and machinery should be inspected daily by the operators and leakages should be reported immediately. All machinery should be serviced and maintained in in proper equipped facility.		
Management or mitigation: • Construction on a properly designed hydrocarbon storage facility • Prevent spills from occurring by training personal in handling of hydrocarbons; • If a spill occurs it is to be cleaned up immediately and reported to the appropriate authorities; • Contaminated soil will be disposed at a suitable disposal facility; • All vehicles are to be serviced in a well-equipped workshop area or at an off-site location; • Leaking vehicles will have drip trays place under them where the leak is occurring.		
Mitigation hierarchy: • Avoid / prevent		
Roles and responsibility: • Mine management and environmental officer to ensure all facilities and measures are in place to minimize hydrocarbon pollution and to have systems in place to clean up spillages effectively once it occurred.		
Management timeframe: • Throughout the life of mine		
Environmental budget: • The budget to clean up spills is covered in the operational budget. No additional environmental budget is necessary.		
Residual risk: • No residual risks if spillages are cleaned up.		

1.2.5 Final void

Environmental component: Soil, land capability and land use at section of open pit that will not have overburden from roll-over mining, and rehabilitated (10.8ha - final void).

Activity: A final void will occur at the end of the mining process due to a shortage of overburden material.

Impact phase: Final stage of the operational phase and permanent thereafter

Nature and consequence 5: The open pit will end up in a final void where no topsoil will be replaced and the current arable land capability and grazing land use will change to a farm dam, which will probably be partly filled with water during certain periods of the year. The final void will have no soil potential which will

render the pre-mining arable land capability and grazing land use to cease permanently. The land capability will reduce from the arable class to the wilderness class.

Description		**Rating before management**	**Rating with management**
Quantity or size of disturbance			
Moderate	The size of the final void will be 10.8ha.	2	2
Severity or destruction effect			
Large to very large	No topsoil will be replaced, the original topography will change dramatically and the current land capability and land use will cease permanently	3	3
Extent			
Site specific	It will take place only at the final section of the open pit	1	1
Duration (impact phase and estimated timeframes)			
Permanent	Without topsoil replacement the current soil potential, land capability and land use will cease permanently.	3	3
Probability			
Definitely: If the mining process ends up in a final void the impact will definitely occur.		3	3
Reversibility			
Irreversible	The impact is irreversible once it took place and cannot not be avoided with management measures because a shortage of material is unavoidable	3	3
Irreplaceability of resources			
Resource irreplaceable, receptor highly sensitive	The geological strata that should be used to fill the final void is irreplaceable	3	3
Degree to which can be avoided, managed or mitigated			

Description	Rating before management	Rating with management
Not avoidable with management measures: The size of the final void can probably be contained to some extent but is unavoidable by management measures due to an unavoidable shortage of material	3	3
Significance		
High	21	21
Environmental objective: • To keep the size of the final void as small as possible in order to minimize the loss of soil, land capability and land use as far as possible.		
Monitoring requirements: • No monitoring can be done.		
Management or mitigation: • Keep the size of the final void as small as possible; fence off the final void for safety reasons; shape edges of final void to gradients that can withstand erosion to some extent.		
Mitigation hierarchy: • Offset		
Roles and responsibility: • Environmental officer and mine management to see that all possible safety measures with regard to the final void is in place		
Management timeframe: • From creation of the final void until mine closure		
Environmental budget: • A budget to fence off the final void and final shaping of the edges might be required. This will be discussed with the landowner and will only be put in place once necessary.		
Residual risk: • Erosion of final void edges; safety risks caused by water in the final void. This will however, not be a residual risk if rehabilitation of the final void is done correctly.		

1.2.6 Proposed haul road

Environmental component: Soil, land capability and land use at the footprint of the proposed haul road

Activity: Construction of a haul road that stretches from the existing pit to the new proposed pit. The proposed haul road covers a length of 811m and a width of approximately 10m, which translates to a total area of 0.8ha.

Nature and consequence 6: The construction of the haul road will involve placement of a thick layer of overburden on the soil surface which will cause all productive soil functions to cease and the current land

capability and land use will also cease completely until the overburden material are removed, the soil surface loosened and revegetated.

Impact phase: Construction, through operational phase until rehabilitation was done

Description		Rating before management	Rating with management
Quantity or size of disturbance			
Small	The total area comprised by the haul road comprises less than 1ha.	1	1
Severity or destruction effect			
Large to very large	All soil functionality and pre-mining land capability and land use will cease completely	3	3
Extent			
Site specific	It will take place only at the haul road footprint	1	1
Duration (impact phase and estimated timeframes)			
Throughout the life of the activity	The impact will remain until the haul road is removed.	2	2
Probability			
Definitely: If the haul road is built the impact will definitely occur.		3	3
Reversibility			
Only reversible with management	The impact can only be reversed by complete removal of the structure at the end of the mining process.	2	2
Irreplaceability of resources			
Resource replaceable, receptor not sensitive	The topsoil will not be removed and all soil functionality, land capability and land use can be regained after removal of the structure	1	1
Degree to which can be avoided, managed or mitigated			
Not avoidable with management measures. The impact cannot be avoided		3	3

Description	Rating before management	Rating with management
Significance		
Medium	16	16
Environmental objective: • To remove the structure at the end of the mining operation properly and rehabilitate the footprint in such a way that the original soil potential and land capability are restored far as possible.		
Monitoring requirements: • No monitoring can be done.		
Management or mitigation: • There is no management or mitigation for this impact during the construction and operational phases. • The only mitigation is to remove all roads building material during the decommissioning phase. • The soil surface should be cross ripped to loosen the soil and alleviate compaction. • The footprint should then be revegetated with a grass mixture that consists mainly of available local species.		
Mitigation hierarchy: • Rehabilitate		
Roles and responsibility: • Environmental officer to oversee rehabilitation of the footprint.		
Management timeframe: • Decommissioning phase		
Environmental budget: • A budget for rehabilitation of the footprint should be available. The financial provision in this report includes the replacement of soil as part of removal of haul road.		
Residual risk: • No residual risk if the structure footprint is rehabilitated properly		

1.3 Vegetation and animal life

Information for this section was extracted from the Biodiversity Habitat Assessment (Galago Environmental Biodiversity and Aquatic Specialists, 2017).

1.3.1 Destruction of indigenous vegetation

Environmental component: Vegetation

Activity: Mining activities, storage of hazardous substances, waste management; haul road operation

Nature and consequence: Total destruction of indigenous vegetation in footprint areas.

Impact phase: Impact can take place throughout construction to decommissioning phase and will be throughout life of activity.

Description		Rating before management	Rating with management
Quantity or size of disturbance			
Small	The mining area in relation to natural vegetation in the area is relatively small.	1	1
Severity or destruction effect			
Large	Total destruction of indigenous vegetation.	3	3
Extent			
Site specific	Mining activities will be within the footprint on site	1	1
Duration (impact phase and estimated timeframes)			
Throughout life of activity	Destruction of indigenous vegetation. Rehabilitation will not take very long	2	2
Probability			
Probably		2	2
Reversibility			
Only Reversible with management	The impact will be reversible to an extent with management measures.	2	1
Irreplaceability of resources			
Resource somewhat replaceable, receptor moderately sensitive	Some species will be able to re-establish over time after rehabilitation	2	2
Degree to which can be avoided, managed or mitigated			
Not avoidable with management measures	Impact not avoidable as the activities will destroy the vegetation	3	3
Significance			
Medium	Medium pre-management and post-management	16	15
Environmental objective: • To prevent vehicles and machinery to encroach on areas outside the mining footprint areas • To prevent dust from mining activities spreading into neighbouring natural areas as far as possible. • To prevent illegal destruction of vegetation in neighbouring areas including old wood for burning in winter months.			
Monitoring requirements:			

Description		Rating before management	Rating with management
• Monitor the mining footprint areas and ensure that mining activities do not encroach onto neighbouring natural areas.			
Management or mitigation: • It is recommended that the mining areas are fenced to reduce the chance for mining personnel, vehicles and machinery to encroach on neighbouring areas.			
Mitigation hierarchy: • Avoid / prevent			
Roles and responsibility: • Environmental Manager			
Management timeframe: • Throughout LoM until end of rehabilitation.			
Environmental budget: • The mine is in the process to work with SANBI on this matter. A budget will be agreed upon once the memorandum of agreement is in place.			
Residual risk: • None			

1.3.2 Destruction of protected trees

Environmental component: Vegetation

Activity: Mining activities, storage of hazardous substances, waste management; haul road operation

Nature and consequence: Destruction and removal of protected tree species in mining footprint areas.

Impact phase: Impact can take place throughout construction to decommissioning phase and will be throughout life of activity.

Description		Rating before management	Rating with management
Quantity or size of disturbance			
Small	The mining area in relation to natural vegetation in the area is relatively small.	1	1
Severity or destruction effect			
Large	Total destruction of Protected trees.	3	1
Extent			
Site specific	Mining activities will be within the footprint on site	1	1
Duration (impact phase and estimated timeframes)			

Description		**Rating before management**	**Rating with management**
Throughout life of activity	Destruction of Protected trees.	2	1
Probability			
Probably		2	2
Reversibility			
Only Reversible with management	The impact will be reversible to an extent with management measures.	2	1
Irreplaceability of resources			
Resource somewhat replaceable, receptor moderately sensitive	With management and propagation, the Protected Trees can be re-located or planted in rehabilitated areas	2	1
Degree to which can be avoided, managed or mitigated			
Avoidable with management measures	Impact avoidable should Protected Trees be replaced	2	1
Significance			
Medium	Medium pre-management and low post-management	15	9

Environmental objective:

- To prevent vehicles and machinery to encroach on areas outside the mining footprint areas
- To prevent dust from mining activities spreading into neighbouring natural areas as far as possible.
- To prevent illegal destruction of Protected trees in neighbouring areas including old wood for burning in winter months.

Monitoring requirements:

- Monitor the mining footprint areas and ensure that mining activities do not encroach onto neighbouring natural areas.

Management or mitigation:

- It is recommended that the mining areas are fenced to reduce the chance for mining
- personnel, vehicles and machinery to encroach on neighbouring areas.
- A Protected Trees permit must be obtained from the Department of Forestry with management measures to propagate, move or replant trees in rehabilitated areas.

Mitigation hierarchy:

- Offset

Roles and responsibility:

Description	Rating before management	Rating with management
• Environmental Manager		
Management timeframe: • Throughout LoM until end of rehabilitation.		
Environmental budget: • The mine is in the process to work with SANBI on this matter. A budget will be agreed upon once the memorandum of agreement is in place.		
Residual risk: • None		

1.3.3 Destruction of protected trees but with conservation concern (Red data trees)

Environmental component: Red Data trees

Activity: Mining activities, storage of hazardous substances, waste management; haul road operation

Nature and consequence: Destruction and removal of Red data tree species in mining footprint areas.

Impact phase: Impact can take place throughout construction to decommissioning phase and will be throughout life of activity.

Description		Rating before management	Rating with management
Quantity or size of disturbance			
Small	The mining area in relation to natural vegetation in the area is relatively small and only 2 trees will be affected.	1	1
Severity or destruction effect			
Large	Total destruction of Red data trees.	3	1
Extent			
Site specific	Mining activities will be within the footprint on site	1	1
Duration (impact phase and estimated timeframes)			
Throughout life of activity	Destruction of Red data trees.	2	1
Probability			
Probably		2	2
Reversibility			

Description		Rating before management	Rating with management
Only Reversible with management	The impact will be reversible to an extent with management measures.	2	1
Irreplaceability of resources			
Resource somewhat replaceable, receptor moderately sensitive	With management and propagation, the Red Data Trees can be re-located or planted in rehabilitated areas	2	1
Degree to which can be avoided, managed or mitigated			
Avoidable with management measures	Impact avoidable should Red Data Trees be conserved *in situ* or replaced if possible	2	1
Significance			
Medium	Medium pre-management and low post-management	15	9

Environmental objective:

- To prevent vehicles and machinery to encroach on areas outside the mining footprint areas
- To prevent dust from mining activities spreading into neighbouring natural areas as far as possible.
- To prevent illegal destruction of Red data trees in neighbouring areas including old wood for burning in winter months.

Monitoring requirements:

- Monitor the mining footprint areas and ensure that mining activities do not encroach onto neighbouring natural areas.

Management or mitigation:

- It is recommended that the mining areas are fenced to reduce the chance for mining personnel, vehicles and machinery to encroach on neighbouring areas.
- A Protected Trees permit and a permit for the removal of sensitive indigenous tree species must be obtained from the Department of Forestry and Conservation department with management measures to propagate, move or replant trees in rehabilitated areas. This should only be done if these trees cannot be conserved *in situ*. This is Alternative 1
- The Red Data trees must be conserved in situ if possible with a 50m buffer in the case of Alternative 2.

Mitigation hierarchy:

- Offset

Roles and responsibility:

- Environmental Manager

Description	Rating before management	Rating with management
Management timeframe: • Throughout LoM until end of rehabilitation.		
Environmental budget: • The mine is in the process to work with SANBI on this matter. A budget will be agreed upon once the memorandum of agreement is in place.		
Residual risk: • None		

1.3.4 Destruction of alien and/or invasive plant species

Environmental component: Alien and/or Invasive vegetation

Activity: Mining activities, storage of hazardous substances, waste management; haul road operation

Nature and consequence: **Positive** effect of eradication of these species in mining footprint areas.

Impact phase: Impact can take place throughout construction to decommissioning phase and will be throughout life of activity.

Description		Rating before management	Rating with management
Quantity or size of disturbance			
Small	The mining area in relation to natural vegetation invaded by alien/invader species in the area is relatively small.	1	1
Severity or destruction effect			
Low	Total destruction of alien/invader vegetation species in mining area.	1	1
Extent			
Site specific	Mining activities will be within the footprint on site	1	1
Duration (impact phase and estimated timeframes)			
Throughout life of activity	Destruction of indigenous vegetation. Rehabilitation will not take very long	2	1
Probability			
Probably		2	2
Reversibility			

Description		Rating before management	Rating with management
Reversible	The impact will be reversible	1	1
Irreplaceability of resources			
Resource replaceable, receptor not sensitive	Eradication will have a positive impact	1	1
Degree to which can be avoided, managed or mitigated			
Avoidable with management measures	Impact avoidable	1	1
Significance			
Low	Low pre-management and post-management	10	10
Environmental objective: • To prevent the spread of alien and/or invasive vegetation species into the surrounding area. • To reduce the spread of alien and/or invasive vegetation species into the surrounding area.			
Monitoring requirements: • Monitor the spread of alien and/or invasive vegetation species into the surrounding area.			
Management or mitigation: • It is recommended that an alien and/or invasive species eradication plan be developed and implemented on the mining area as well as the surrounding farm portions			
Mitigation hierarchy: • Positive impact			
Roles and responsibility: • Environmental Manager			
Management timeframe: • Throughout LoM until end of rehabilitation.			
Environmental budget: • This budget will form part of the larger mining right area budget.			
Residual risk: • None			

1.3.5 Destruction of faunal/avifaunal woodland habitat

Environmental component: Fauna (Mammals, Avifauna and Herpetofauna)

Activity: Mining activities, storage of hazardous substances, waste management; haul road operation

Nature and consequence: Total destruction of faunal habitat in mining footprint areas.

Impact phase: Impact can take place throughout construction to decommissioning phase and will be throughout life of activity.

Description		Rating before management	Rating with management
Quantity or size of disturbance			
Small	The mining area in relation to natural vegetation in the area is relatively small.	1	1
Severity or destruction effect			
Large	Total destruction of faunal habitat in mining area.	3	3
Extent			
Site specific	Mining activities will be within the footprint on site	1	1
Duration (impact phase and estimated timeframes)			
Throughout life of activity	Destruction of faunal habitat. Immigration of species after rehabilitation will take very long	2	2
Probability			
Probably		2	2
Reversibility			
Only Reversible with management	The impact will be reversible to an extent with management measures.	2	1
Irreplaceability of resources			
Resource somewhat replaceable, receptor moderately sensitive	Some species will be able to re-establish over time after rehabilitation	2	2
Degree to which can be avoided, managed or mitigated			
Not avoidable with management measures	Impact not avoidable as the activities will destroy the faunal habitat	3	3
Significance			
Medium	Medium pre-management and post-management	16	15
Environmental objective: • To prevent vehicles and machinery to encroach on areas outside the mining footprint areas • To prevent dust from mining activities spreading into neighbouring natural areas as far as possible. • To prevent illegal destruction of vegetation in neighbouring areas including old wood for burning in winter months.			

Description	Rating before management	Rating with management
• To prevent reduction of water quality in the surrounding floodplain area as it is an important faunal corridor		
Monitoring requirements: • Monitor the mining footprint areas and ensure that mining activities do not encroach onto neighbouring natural areas or the floodplain area.		
Management or mitigation: • It is recommended that the mining areas are fenced to reduce the chance for mining personnel, vehicles and machinery to encroach on neighbouring areas. • No hunting of faunal species may be allowed by mining personnel in and around the mining areas. • Noise and dust must be kept to a minimum.		
Mitigation hierarchy: • Minimise		
Roles and responsibility: • Environmental Manager		
Management timeframe: • Throughout LoM until end of rehabilitation.		
Environmental budget: • This budget will form part of the larger mining right area budget.		
Residual risk: • None		

1.3.6 Summary of management measures

The following mitigation measures are proposed by the specialists:

- Protected trees should be conserved in situ, otherwise a permit must be obtained from the Department of Forestry for the removal of these plants.
- It is proposed that the removal and replanting of these trees be done if possible as alternative 1 (preferred alternative).
- A protective buffer of 50m, should be allowed around the species of conservation concern, *Elaeodendron transvaalensis* (which is also a protected tree), as alternative 2.
- If approval for mining of the pit area is granted, a permit to remove the protected trees should be obtained from the relevant authority. A proper management plan must then be developed and implemented on site before mining commences in the new pit area, whereby a nursery is established by the mine or a nursery nearby to propagate these protected trees from seeds or other means. These trees should then be planted where rehabilitation of the existing mine is taking place.
- Encroachment by Northern Spike thorn and Sickle bush should be inhibited by removal of the densest patches combined with a controlled burning programme.

- Removal of the dense mat of dried material between the trees is recommended using a controlled burning programme.
- If chemical control of Queen of the Night trees is not viable on the larger site, the plants should be treated with a biological control agent. The use of *Hypogeococcus pungens*, obtainable from the Plant Protection Research Institute, is recommended.
- Every effort should be made to retain the linear integrity, flow dynamics and water quality of the drainage line, floodplain and dams.
- If the South African python, giant bullfrog or any herpetological species are encountered or exposed during the mining, they should be removed and relocated to natural areas in the vicinity.
- The contractor must ensure that no herpetofauna species are disturbed, trapped, hunted or killed during the construction phase. Conservation-orientated clauses should be built into contracts for construction personnel, complete with penalty clauses for non-compliance.
- The attenuation ponds must be designed with walls that will allow small fauna easy escape from these dams, so that they do not get trapped by too steep walls and die.
- Proper veld management practises should be implemented with respect to grazing, burning and control of woody invasions.
- Where possible, work should be restricted to one area at a time, as this will give the smaller birds, mammals and reptiles a chance to weather the disturbance in an undisturbed zone close to their natural territories.
- No vehicles should be allowed to move in or across the wet areas or drainage lines and possibly get stuck. This leaves visible scars and destroys habitat, and it is important to conserve areas where there are tall reeds or grass, or areas where there is short grass and mud.
- It is suggested that where work is to be done close to the drainage lines, these areas be fenced off during construction, to prevent heavy machines and trucks from trampling the plants, compacting the soil and dumping in the system.
- During the construction phase, noise must be kept to a minimum to reduce the impact of the development on the fauna residing on the site.
- Alien and invasive plants must be removed.

The following mitigation measures were developed by GDARD, 2014 (Department of Agriculture and Rural Development, Biodiversity Management Directorate) and are applicable to the study site, even though it is located in Mpumalanga Province.

- An appropriate management authority, that must be contractually bound to implement the EMP and RoD during the operational phase of the mine, should be identified and informed of their responsibilities in terms of the EMP and RoD.

- All areas designated as sensitive in a sensitivity mapping exercise should be incorporated into an open space system that also includes the rest of the farm portions.
- The open space system should be managed in accordance with an Ecological Management Plan that complies with the Minimum Requirements for Ecological Management Plans and forms part of the EMP.
- The crossing of natural drainage systems should be minimized and only constructed at the shortest possible route, perpendicular to the natural drainage system. Where possible, bridge crossings should span the entire stretch of the buffer zone.

1.4 Surface water

Information for this section was extracted from the Storm Water Management Plan (Rational Environmental, 2017).

1.4.1 Flooding risk

Environmental component: Surface water

Activity: Development of quarry with the potential of flooding.

Nature and consequence: Damage to infrastructure and/or excessive inflow into open quarry. Financial/production loss and/or surface water contamination

Impact phase: Impact can take place throughout construction to decommissioning phase

Description		**Rating before management**	**Rating with management**
Quantity or size of disturbance			
Small	Quarry located on watershed with minimal catchment runoff	1	1
Severity or destruction effect			
Very small	No damage is expected due to surface runoff	1	1
Extent			
Site specific	Flooding of quarry and damage to roads are limited to the direct site	1	1
Duration (impact phase and estimated timeframes)			
Temporary. From construction to decommissioning phase	Temporary impact	1	1
Probability			

Description		Rating before management	Rating with management
Not probably	The probability of a flood is very low around the proposed quarry	1	1
Reversibility			
Only reversible with management	Berms to be put in place around the quarry to prevent any inflow.	2	1
Irreplaceability of resources			
Resource replicable, receptor not sensitive	Planned infrastructure very limited and easy to maintain. Flooding of quarry is easy to dewater and use in the process.	1	1
Degree to which can be avoided, managed or mitigated			
Avoidable with management measures	Berms along the outer perimeter will be sufficient to prevent flooding or damage	1	1
Significance			
Low	Low significance prior to management, and low significance with management	9	8
Environmental Objective: • Separate clean and affected surface water. • Divert clean runoff away from mining operations. • All infrastructure should be able to withstand a 1:50 year flood event.			
Monitoring requirements: • Regularly inspect storm water berms and drains that it is not damaged, eroded or blocked.			
Management or mitigation: • Management measures to avoid the potential impacts as a result of flooding are listed within Part A(g)(v)(4.4)			
Mitigation hierarchy: • Avoid / prevent			
Roles and responsibility: • Storm water measures must be implemented by the construction site supervisor. • Monitoring and maintenance may be delegated to a trained site supervisor.			
Management timeframe:			

Description	Rating before management	Rating with management
• From construction phase, through to decommissioning and rehabilitation.		
Environmental Budget: • Construction should form part of site establishment and construction. No additional budget is therefore required.		
Residual risk: • No residual risk expected.		

1.4.2 Depression after roll-over mining

Environmental component: Surface water

Activity: Rehabilitation of quarry.

Nature and consequence: Nett loss in material will create depression. Surface runoff affected permanently by preventing natural drainage.

Impact phase: Impact will take place through life of activity and remain as a residual impact

Description		Rating before management	Rating with management
Quantity or size of disturbance			
Small	Only the direct quarry footprint affected	1	1
Severity or destruction effect			
Small	The nett loss in runoff is minimal, considering the flat slope and small catchment area	1	1
Extent			
Area adjacent to site	The area directly downstream of the quarry will also be depleted of potential runoff.	2	2
Duration (impact phase and estimated timeframes)			
Permanent	The natural drainage will be permanently affected for the site. Roll-over mining can be optimised to return part of the disturbed footprint to its original topography.	3	2
Probability			

Description		**Rating before management**	**Rating with management**
Definite	The topography will definitely change, resulting in change in runoff pattern.	3	2
Reversibility			
Only reversible with management	Proper roll-over mining can limit the extent of the change in drainage.	2	2
Irreplaceability of resources			
Resource replicable, receptor not sensitive	The reduced runoff impact is minimal.	1	1
Degree to which can be avoided, managed or mitigated			
Somewhat avoidable with management measures	Good rehabilitation planning is required to re-establish surface runoff drainage patterns	2	1
Significance			
Low	Medium significance prior to management, and low significance with management	15	12
Environmental Objective: • Plan natural drainage of surface water as part of rehabilitation.			
Monitoring requirements: • No specific monitoring is required			
Management or mitigation: • Rehabilitation planning of the disturbed site should consider the impact of natural runoff that will be diverted away from the downstream receiving environment and into the residual depression that will be formed post rehabilitation.			
Mitigation hierarchy: • Rehabilitate			
Roles and responsibility: • Natural drainage must for form part of the roll-over mining planning to be implemented by the site manager.			
Management timeframe: • Mainly from roll-over mining commencement through to final rehabilitation.			
Environmental Budget: • Integrated part of roll-over mining and rehabilitation. Does not require separate budget.			
Residual risk:			

Description	Rating before management	Rating with management
• A natural depression will remain post-closure where surface water will likely accumulate.		

1.4.3 Erosion and siltation risk

Environmental component: Surface water

Activity: Concentration of accelerated runoff.

Nature and consequence: Erosion of steep slopes accompanied by siltation of downstream receiving environment. Loss of soil with reduced capacity downstream.

Impact phase: Impact can take place throughout construction to decommissioning phase

Description		Rating before management	Rating with management
Quantity or size of disturbance			
Low	Erosion will likely be limited to side slopes of overburden stockpiles until it is filled. Topsoil stockpiles should be vegetated to prevent erosion.	2	1
Severity or destruction effect			
Low	Siltation may take place as well as leaching of minerals out of topsoil	1	1
Extent			
Site Specific	It will be limited to the quarry only	1	1
Duration (impact phase and estimated timeframes)			
Throughout life of activity	It is most likely that exposed material will continue to erode for the duration of the quarry	2	1
Probability			
Probably	If not managed there is a probability that erosion and subsequent siltation will take place.	2	1
Reversibility			

Description		Rating before management	Rating with management
Only reversible with management	Impacts from erosion and siltation can be reversible with adequate rehabilitation.	2	1
Irreplaceability of resources			
Resource replicable, receptor not sensitive	Eroded soil can be replaced and capacity loss from siltation can be re-opened.	1	1
Degree to which can be avoided, managed or mitigated			
Avoidable with management measures	Careful design of slopes, and other storm water measures, together with regular maintenance can avoid erosion and siltation.	2	1
Significance			
Low	Low significance prior to management, and low significance with management	13	8
Environmental Objective: • Minimise areas that is high risk for erosion.			
Monitoring requirements: • Regularly inspect steep slopes on stockpiles, steep roads and high walls for signs of erosion.			
Management or mitigation: • Management measures to avoid erosion and siltation are listed within Part A(g)(v)(4.4)			
Mitigation hierarchy: • Avoid / prevent			
Roles and responsibility: • It is the responsibility of all personnel to report erosion. • The site manager should always try to find solutions that will prevent erosion, and not only repair after it occurred.			
Management timeframe: • Throughout the life of the mine until all high erosion risk areas are rehabilitated and vegetated.			
Environmental Budget: • No budget specifically allocated.			
Residual risk:			

Description	Rating before management	Rating with management
• No residual risk expected if managed.		

1.4.4 Storm water management plan

For the new proposed quarry, it is only required that a berm be constructed around the perimeter of the quarry to prevent any inflow of clean runoff once the excavations commence. Development of the quarry should take runoff into consideration to allow drainage to a single low point.

Figure 35: Stormwater management around quarry

General storm water management measures

- Storm water control infrastructure within this document is designed to withstand a 1:50 year flood event. In the event of runoff breaching infrastructure it is important to first ensure the safety of the people on site.
- Regular inspections should be conducted on all channels, trenches, and berms to ensure function and capacity of infrastructure is maintained as well as maintenance where signs of erosion become evident. High risk erosion areas include all roads and berms where surface water is concentrated into sheet flow. Evidence of erosion was observed on the side slopes of stockpiles, this should be minimised by shaping the top edge of the stockpiles to not allow runoff over the sides.
- No affected water from the mine is allowed to spill into the clean water environment. This should be ensured through design as well as operational control measures.
- Erosion prevention measures (e.g. grass, cement or rock) should be in place at all concentration points on the mine. These areas specifically include steep slopes at loose fine material stockpiles.

1.5 Groundwater

Information for this section was extracted from the Groundwater Impact Assessment (Groundwater Complete, 2017).

1.5.1 Removal of all topsoil and vegetation at the quarry footprint in order to mine the underlying geological strata

Nature and consequence: Removal of topsoil and vegetation can lead to an increase in groundwater recharge to the aquifer. It also leads to an increase of surface runoff.

The **stripping and stockpiling** of topsoil, rock and overburden from the infrastructure surface areas is considered negligible since no chemical interaction is envisaged that could have an adverse impact on groundwater quality.

Description		**Rating before management**	**Rating with management**
Quantity or size of disturbance			
Small	The area affected is expected to be small.	1	1
Severity or destruction effect			
Very Low	The increase in recharge will not be severe, since an increase in surface runoff is also expected.	1	1
Extent			
Site specific	No adverse impacts in terms of groundwater levels are expected on	1	1

Description		Rating before management	Rating with management
	adjacent sites and no impacts on groundwater quality are expected.		
Duration (impact phase and estimated timeframes)			
Temporary	Removal of topsoil and land clearance is only planned in the construction phase after which the area will be mined.	1	1
Probability			
Probably	Management measures to avoid the increase in recharge are minimal.	2	2
Reversibility			
Reversible	With rehabilitation, the impact will be partially reversible since recharge will still be higher due to the higher permeability of the underlying mine void.	1	1
Irreplaceability of resources			
Resource replaceable, receptor not sensitive	The groundwater source will not be adversely affected and therefore not sensitive in terms of topsoil and vegetation removal.	1	1
Degree to which can be avoided, managed or mitigated			
Partially avoidable with management measures	Whatever measures taken, a small impact in terms of increased recharge to the aquifer will occur.	2	2
Significance			
Low	Low pre-management and low post-management	10	10
Environmental objective: • No significant impacts are expected. No management objectives proposed.			
Monitoring requirements: • None			
Management or mitigation: • None			
Mitigation hierarchy: • Rehabilitate			
Environmental budget: • Part of final financial provision.			
Residual Impacts:			

Description	Rating before management	Rating with management
• None		

1.5.2 Placement of overburden and topsoil back into the quarry.

The quarry will form a depression as a result of ore that is removed, and therefore a decrease in volume of material placed back in the quarry.

During the rehabilitation period, the quarry will start filling with groundwater seepage to reinstate the equilibrium with surrounding aquifers.

The rehabilitation should however aim at minimizing infiltration to the rehabilitated quarry, since this will cause higher decant rates, that, if contaminated, will need to be managed. The final surface needs to be free-draining to minimize recharge.

The overburden itself is not expected to impact on the groundwater quality.

Description		Rating before management	Rating with management
Quantity or size of disturbance			
Moderate	The groundwater quality is not expected to be impacted by the overburden back-fill. The maximum depth of the proposed pit is 33m. With the relatively flat surface topography, it is highly likely that the groundwater level at the pit area is less than 33m, and in this case drawdown due to dewatering is expected. The groundwater level will start to recover once the quarry has been filled and rehabilitated. This is only the case if the groundwater level pre-mining were above the quarry floor elevations. The depression on the surface may cause an increase in recharge, since surface water will in all likelihood accumulate here.	2	1
Severity or destruction effect			
Very small	The overburden is not expected to have an impact on the groundwater quality. The	1	1

Description		Rating before management	Rating with management
	groundwater level will start to recover once the quarry has been filled and rehabilitated. Therefore, the surrounding aquifer will recover, which is a positive effect.		
Extent			
Site specific	No adverse impacts on groundwater quality are expected with the replacement of the overburden and topsoil.	1	1
Duration (impact phase and estimated timeframes)			
Temporary	Should the water level be affected by mining, it will recover post-closure after some time.	2	1
Probability			
Probably	Only probable if the groundwater level is above the quarry floor elevation. The depression on surface may even cause an elevated water level, since recharge may increase as surface water is likely to accumulate in this area.	2	1
Reversibility			
Reversible	The impact will be reversible with management measures.	1	1
Irreplaceability of resources			
Resource replaceable, receptor not sensitive	Should the groundwater level be affected by the mining operation, it will recover post-closure and therefore the resource also is replaceable, since no impacts in terms of groundwater quality are expected.	1	1
Degree to which can be avoided, managed or mitigated			
Avoidable with management measures	Impact avoidable with management measures	1	1
Significance			
Low	Low pre-management and low post-management	11	8
Environmental objective:			

Description	Rating before management	Rating with management
• Reduce surface water accumulation in the surface depression.		
Monitoring requirements: • Surface drainage away from the quarry.		
Management or mitigation: • The rehabilitation should aim at minimizing infiltration to the rehabilitated quarry.		
Mitigation hierarchy: • Rehabilitate		
Environmental budget: • Part of final financial provision.		
Residual Impacts: • Once the water levels have recovered, no residual impacts are expected.		

1.5.3 Mining of mineral ore

It is anticipated that, if the groundwater quality is affected (not expected) by the mining operation, the quality will improve away from the quarry, as the dilution effect of the entire aquifer increases further away from the quarry.

With the available qualities in the existing pit water, only fluoride indicates elevated concentrations. The one borehole situated close to the existing quarry does not indicate any signs of impacts from the mining activities. However, no downgradient boreholes exist, but the good quality of the water in the pit is a good indication that the groundwater quality may not be affected in terms of quality.

The major impact of mining in terms of groundwater will be groundwater level drawdown, should the water levels be higher than the quarry floor elevations. At the time of this assessment, the quarry floor elevations were not available and therefore the impacts cannot yet be quantified.

The following rating criteria considers worst case scenario, with the mining operation having an impact on the groundwater quality and quantity.

Description		Rating before management	Rating with management
Quantity or size of disturbance			
Moderate	The groundwater quality may be impacted on by the mining operation. The groundwater level, if above the quarry	2	1

Description		Rating before management	Rating with management
	floor elevation, will decrease due to dewatering.		
Severity or destruction effect			
Moderate	Little can be done to manage the water level drawdown, should the mining have an impact. If the quality is affected, a containment strategy should be incorporated to limit pollution plume movement.	2	1
Extent			
Area adjacent to site	A groundwater pollution plume may cause a decrease in qualities further downstream, if not contained. Water level drawdown will impact on the cone of depression area which may exceed the site boundaries.	2	1
Duration (impact phase and estimated timeframes)			
Temporary	Should the water level be affected by mining, it will recover post-closure after some time. Groundwater qualities will improve with time, due to dilution and the source not being a continuous contaminant.	2	1
Probability			
Probably	Only probable if the groundwater level is above the quarry floor elevation and the mining operation impacting on the groundwater quality.	2	1
Reversibility			
Reversible	The impact will be reversible with management measures.	1	1
Irreplaceability of resources			
Resource replaceable, receptor not sensitive	Should the groundwater quality and level be affected by the mining operation, it will recover/improve post-closure and therefore the resource is replaceable.	1	1
Degree to which can be avoided, managed or mitigated			

Description		**Rating before management**	**Rating with management**
Avoidable with management measures	Impact avoidable with management measures	1	1
Significance			
Low	Low pre-management and low post-management	13	8
Environmental objective: • To minimize the extent of disturbance of the aquifer. • To prevent degeneration of groundwater quality. • To manage the anticipated impacts associated with the inflow of groundwater to the mine workings.			
Monitoring requirements: • Regular monitoring of groundwater levels and quality in monitoring boreholes to be developed.			
Management or mitigation: • No management action is available to prevent dewatering. • Drains and cut-off trenches (storm water management system) around the proposed quarry should be implemented before commencing with pit development to prevent clean run-off water from entering the pit. • The localised dewatering of the surrounding aquifer cannot be prevented, since the mining will occur below the local groundwater level. The cone of depression resulting from the void, however, is not expected to affect nearby groundwater users/receptors, due to the limited gradient that will be created and the low hydraulic properties of the flint aquifer. • During active mining, poor quality water accumulating in the workings should be pumped to the pollution control dam for recycling to limit the quality related impacts. • These statements need to be confirmed through regular monitoring of groundwater levels and quality in monitoring boreholes to be developed.			
Mitigation hierarchy: • Minimise			
Environmental budget: • Part of final financial provision.			
Residual Impacts: • The groundwater quality is not expected be affected in terms of quality and the water level will recover post closure. Therefore no/little residual impacts are expected.			

1.5.4 Construction of haul road from already existing mining area to new quarries and transportation of ore to already existing plant on existing mining area

The construction of **haul roads** will cause a very small reduction in recharge due to the compaction of the surface of the roads. This impact is countered by the fact that the runoff water will contribute to the catchment yield. No adverse impact is foreseen on groundwater quality, since no carbonaceous or otherwise reactive material will be used for construction.

No significant groundwater impacts are expected during construction and transportation of ore. Groundwater quality impacts may only occur from spillage of contaminated material during transportation. Run-off from haul-roads should be diverted and contained in the dirty water system.

Description		**Rating before management**	**Rating with management**
Quantity or size of disturbance			
Small	The area affected is expected to be small.	1	1
Severity or destruction effect			
Very Low	The increase in recharge will not be severe, since an increase in surface runoff is also expected.	1	1
Extent			
Site specific	No adverse impacts in terms of groundwater levels are expected on adjacent sites, and no impacts on groundwater quality are expected. Quality impacts will only occur if contaminated material is spilled during transportation.	1	1
Duration (impact phase and estimated timeframes)			
Temporary	The haul road will only be used during the operational phase and transportation will also cease at the end of the operational phase.	1	1
Probability			
Probably	Management measures to avoid the increase in recharge are minimal. Run-off from haul-roads should be diverted and contained in the dirty water system.	2	1
Reversibility			
Reversible	With rehabilitation, the impact will be reversible.	1	1
Irreplaceability of resources			
Resource replaceable, receptor not sensitive	The groundwater source will not be adversely affected and therefore not sensitive in terms of haul road construction and transportation of ore.	1	1
Degree to which can be avoided, managed or mitigated			

Description		Rating before management	Rating with management
Partially avoidable with management measures	Whatever measures taken, a small impact in terms of increased recharge to the aquifer will occur.	2	2
Significance			
Low	Low pre-management and low post-management	9	8
Environmental objective: • Reduce and contain impacts from potential contaminated material spillages.			
Monitoring requirements: • Very little impact on groundwater quantity and quality is expected overall during the operational phase activities, mostly because of the small surface area involved during this project's life phase.			
Management or mitigation: • Run-off from haul-roads should be diverted and contained in the dirty water system. • Compacted surfaces will be kept free of contaminated material by cleaning spillages, thereby reducing infiltration of contaminated water. • The size of compacted areas must be minimized to as small as practically possible.			
Mitigation hierarchy: • Minimise			
Environmental budget: • Part of final financial provision.			
Residual Impacts: • After rehabilitation, no/little residual impacts are expected.			

1.6 Air quality

Information for this section was extracted from the Air Quality Impact Assessment (Airshed Planning Professionals, 2017. Refer to the Air Quality Impact Assessment, section 5 for the detailed dispersion modelling results.

Description	Particulate Concentrations	Dust Fallout	Gaseous Pollutant Concentrations
Quantity or size of disturbance			
Exceedance of the SA NAAQS/NDCRs	2	1	1
Severity or destruction effect			
Particulates and gaseous concentrations have a human health impact. Dust fallout is only assessed as a nuisance impact	2	1	2

Description	Particulate Concentrations	Dust Fallout	Gaseous Pollutant Concentrations
Extent			
Area adjacent to site	2	2	2
Duration (impact phase and estimated timeframes)			
While activities are conducted	2	2	2
Probability			
Probable	2	2	2
Reversibility			
Reversible	1	1	1
Irreplaceability of resources			
Resource replaceable, no exceedances of SA NAAQS at sensitive receptor locations.	1	1	1
Degree to which can be avoided, managed or mitigated			
Avoidable with current mitigation measures also applied to future operations.	1	1	1
Significance			
Low impact of the proposed expansion on ambient particulate and gaseous concentrations and dust fallout rates.	13	11	12

1.6.1 Air quality management plan:

The Air Quality Management Plan (AQMP) for the Cyferfontein Mine should follow an iterative process, including: implementation, monitoring, reporting, reviewing and adjustment to the necessary steps. Included below are the definition of objectives and targets to achieve through dust suppression strategies. Monitoring, reporting and review allow for the assessment of operations and adjustment of implemented strategies to meet objectives.

Objectives and Targets

The establishment of objectives and targets with regards to fugitive emissions are important to minimise the impacts of these emissions on the surrounding environment, which will affect potential health impacts and relations with nearby communities.

The objective of the AQMP is to reduce emissions within specific target ranges by employing appropriate technologies and dust suppression strategies. In general, an AQMP, with regards to particulate or dust control has the following goals:

- Prevent or reduce dust emissions
- Minimize the duration of exposure to dust

- Reduce wind speed at ground level
- Bind dust particles together
- Capture and remove dust at its source
- Monitor management practices to ensure that measures are effective

Four types of measures may be taken to reduce emissions from unpaved roads: (a) initial design and construction to minimise wear and silt generation; such measures include proper selection and compaction of road material and careful attention to the design of the drainage system, (b) measures aimed at reducing the extent of unpaved roads, e.g. paving, (c) traffic control measures aimed at reducing the entrainment of material by restricting traffic volumes and reducing vehicle speeds, and (d) measures aimed at binding the surface material or enhancing moisture retention, such as wet suppression and chemical stabilization (Cowherd, Muleski, & Kinsey, 1988) (APCD , 1995).

It is recommended that the current dust suppression strategies employed (i.e. wet suppression) to reduce fugitive emissions from the haul roads be employed to future operations. The high clay content in the soil allows for the haul road to harden rapidly when compacted by the wheels of haul trucks if water sprays are frequently employed.

Monitoring, Reporting and Review

Current Monitoring Network and Monitoring Recommendations

The current ambient air quality monitoring network at the Cyferfontein Mine consists of four dust fallout monitoring stations around the mining operation, (Figure 36). The current dust fallout monitoring locations are located on-site, and are centred around the current operations. It is recommended that the dust fallout network be expanded to include sampling locations around the future quarry and haul road.

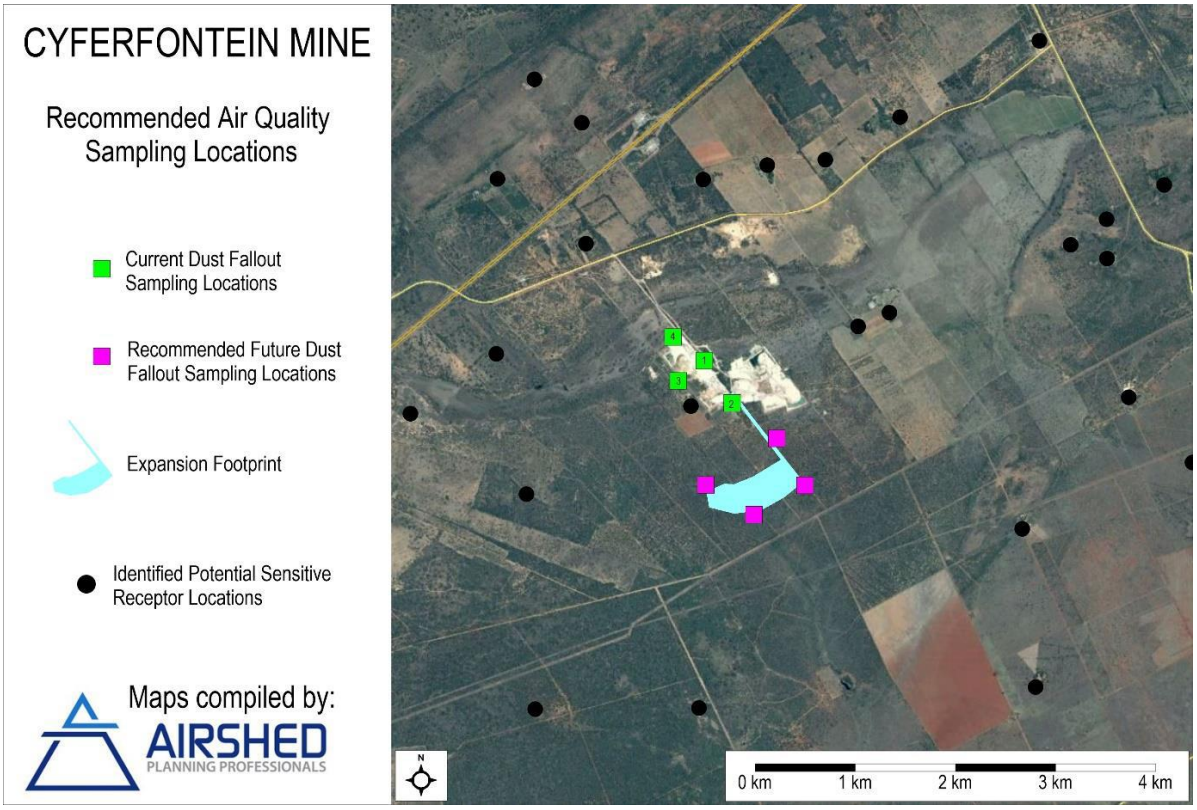


Figure 36: Recommended air quality monitoring locations

Emission Perception

According to the Ministry of Environment, New Zealand (MFE, 2001) visibility is a key indicator of air quality. Visibility is a subjective perception of the status of air quality and affected by a number of factors, such as: obscuration of objects, colour of the sky and moisture of the air. Contaminants resulting in poor visibility include both particulates and gases. Particulates, due to the various size fractions, can influence visibility in two ways:

- Finer fractions (between PM2.5 and PM10) cause visible light scattering affecting long-range visibility under high concentration loads.
- Coarser particles (associated with nuisance) are usually the visible dust from fugitive dust sources.

A visual plume of emissions can be perceived by local communities to be significant. Mining operations, crushers, materials transfer points and vehicles on haul roads all result in visible dust plumes. Poor visibility associated with dust emissions can be perceived as a health risk, especially under poor dispersion conditions. It is recommended that staff as well as members of the surrounding communities be encouraged to report significant visual emissions, as described below.

Monitoring Reporting

Measured ambient dust fallout rates should be recorded monthly. Ideally this should be in the form of a graph, clearly indicating exceedances of 1 200 mg.m-2.d-1 for on-site locations. Annual reporting should include the number of months for which dust fallout rates exceed these levels. Two non-sequential exceedances of the limit are permitted per calendar year.

The abovementioned graphs should be accompanied by additional information regarding measured exceedances, this should include:

- The location at which the exceedance was measured.
- Possible reasons for the exceedance (e.g. new mining activities in the area, construction work in the area, high wind speeds etc.) or localised sources.
- Remedial measures implemented to rectify exceedances.
- Frequency of exceedances at location (are high dust fallout rates regularly recorded at this location or is this a once-off occurrence?).

Inspection and Community Liaison

Table 11 and Table 12 (refer to the Air Quality Impact Assessment) provide examples of an inspection logbook and a water spray logbook that can be used as part of the day-to-day dust management at Cyferfontein Mine. An example of a complaints register is provided in Table 13 (refer to the Air Quality Impact Assessment). These tools, together with monthly monitoring results can be invaluable in tracking performance of implemented mitigation measures. It is recommended that a complaints register be kept at the site office, and that both members of the surrounding community as well as staff be encouraged to note all air quality related problems (health problems, odours, nuisance dust, visible dust etc.) on the complaints register.

The date and time noted on the complaints register should not be the date and time that the complaint is logged but the date and time that the reported problem is observed. If used correctly, the complaints register can be compared to monitoring data, the dust inspection logbook as well as recorded meteorological data to identify problem areas and to iteratively adjust the AQMP to ensure efficient and effective mitigation of fugitive dust sources.

1.7 Environmental noise

Information for this section was extracted from the Environmental Noise Impact Assessment Report (Varicon, 2017.

Environmental Component: Noise Disturbance

Activities: Removal of topsoil, Placement of topsoil, Placement of overburden, Construction of Haul Roads, Mining of mineral ore, Transport ore to plant, Roll-over mining of Quarry, Revegetation

Nature and Consequence: Noise generation through mining activities causing noise nuisance on environment and community

Impact phase: Impact can take place throughout construction to decommissioning phase

Description		**Rating before management**	**Rating with management**
Quantity or size of disturbance			
Very small to small	Noise generation is small and will be limited to vehicle noise and mining activities. The mineral ore is very soft and is removed through pick and shovel method. Noise levels could be accumulative between the existing quarry and the new quarry when in operation, but the levels should remain below the statutory requirements.	1	1
Severity or destruction effect			
Moderate	From an environmental perspective, there are no residents or settlements in close proximity of the operations that could be affected. Therefore, the severity or destruction effect will not be physical, but could be more on a disturbance level which could result into an emotional or psychological level. The owners of the farms and any other farming communities resides fairly remote from the mining activities. From an occupational perspective, the mine and plant workers could be effected more seriously and this issue should be dealt with under the Mine Health and Safety Act.	2	1
Extent of disturbance			
Site specific	The noise generation will mainly be limited to the mining site, but will extent past the boundaries of the quarry area through the vehicles that travel in and out of the quarry.	1	1
Duration of disturbance			
Throughout life of the activity	Noise generation will continue for the duration of the mining activities.	2	2
Probability of disturbance			
Definite	All vehicles and mining processes are noise generation activities.	3	3
Reversibility of disturbance			
During mining only reversible	Noise is an unwanted reality and will always exist with any mining activity. The severity and extent of damage as a	2	1

Description		Rating before management	Rating with management
with management Reversible once mining stops	result can be controlled and minimised very effectively through proper management and mitigation measures during the life of a mine. The impact, however, will cease once mining stops.		
Irreplaceability of resources			
Resource replicable, receptor not sensitive	From an environmental perspective, there are no human receptors that could be harmed through exposure to high noise levels. Therefore, no resources are in danger of being damaged or lost.	1	1
Degree to which disturbance can be avoided			
Somewhat avoidable with management measures	There will always be noise, but the intensity can very effectively be controlled through management and mitigation measures, therefore limiting the disturbance.	2	2
Significance of Disturbance			
Medium to Low	Medium prior to management and mitigation Low with management and mitigation	14	12
Environmental objective: • To reduce Environmental Noise Disturbance as effectively as possible			
Monitoring requirements: • Regular Environmental Noise Surveys			
Management or mitigation: • All maintenance and operating of equipment should be done as per specifications of the OEM's. • Effective maintenance of the vehicle engines and exhaust systems. • Hearing conservation programme as per DMR guidelines on Noise Control, including zoning of high noise areas, such as vehicles for people working in close proximity of the vehicle engines while operating • The use of approved hearing protection devices for the personnel involved with the mining process. • Limit the use of noise generation activities or vehicles or appliances after 22:00. • From an occupational perspective, the mining workers should be protected through standards and procedures and monitored as requires through Section 12 of the MHSA.			
Mitigation hierarchy: • Minimise			
Roles and responsibility: Management			
Management timeframe: • Throughout LoM until end of rehabilitation.			
Environmental budget:			

Description	Rating before management	Rating with management
• No budget allocated.		
Residual risk: • No residual risks.		

1.8 Visual aspects

No visual aspect assessment was conducted because this is an already existing mine.

Activity: All mining and associated activities.

Nature: Change in topography leading to visible intrusions in the rural area.

Description		Rating before management	Rating with management
Quantity or size of disturbance			
Moderate	The change in topography is large, however, not the entire mining area is visible from outside areas.	2	2
Severity or destruction effect			
Low	The sense of place is disturbed; however, the visual intrusion is mostly only visible from the road.	1	1
Extent			
Area adjacent to site	Intrusion is on area adjacent to mining site	2	2
Duration (impact phase and estimated timeframes)			
Permanent	Depending on rehabilitation, this could be permanent.	3	2
Probability			
Definite	This is an ongoing activity.	3	3
Reversibility			
Only reversible with management	The change in topography is irreversible but with adequate rehabilitation, the visual impact can be reversed.	3	2
Irreplaceability of resources			
Resource replaceable	The resource is not sensitive.	1	1
Degree to which can be avoided, managed or mitigated			
Somewhat avoidable.	The visual impact can be somewhat avoided with adequate rehabilitation practices.	3	3
Significance			

Description		**Rating before management**	**Rating with management**
Medium	Medium significance prior to and after management.	18	16
Environmental objective: • To minimise the visual impact of the mine and its related activities.			
Monitoring requirements: • Monitoring as per the rehabilitation plan.			
Management or mitigation: • Rehabilitate as per rehabilitation plan			
Mitigation hierarchy: • Rehabilitate			
Roles and responsibility: • Mine manager			
Management timeframe: • As part of rehabilitation.			
Environmental budget: • No environmental budget will be allocated for the rehabilitation of the topography; however, financial provision will be allocated for rehabilitation.			
Residual risk: • Permanent changes in topography leading to permanent changes in visual aspect.			

1.9 Cultural and heritage resources

Information for this section was extracted from the Phase I Cultural Heritage Resources Impact Assessment (African Heritage Consultants, 2017).

Environmental component: Heritage or cultural resources

Activity: All activities associated with the mining extension.

Nature and consequence: Unearthing of any heritage materials which may lead to damage or destruction of these resources.

Impact phase: Impact can take place throughout construction to decommissioning phase and will be throughout life of activity.

Additional comments: In term of the South African Heritage Resources Act, 1999 (Act 25 of 1999) the following applies:

> *Structures*
>
> *34. (1) No person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the relevant provincial heritage resources authority.*

Archaeology, palaeontology and meteorites

35.(4) No person may, without a permit issued by the responsible heritage resources authority—

(a) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;

(b) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;

(c) trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or

(d) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites.

Burial grounds and graves

36.(3) No person may, without a permit issued by SAHRA or a provincial heritage resources authority—

(a) destroy, damage, alter, exhume or remove from its original position or otherwise disturb the grave of a victim of conflict, or any burial ground or part thereof which contains such graves;

(b) destroy, damage, alter, exhume, remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority; or

(c) bring onto or use at a burial ground or grave referred to in paragraph (a) or (b) any excavation equipment, or any equipment which assists in the detection or recovery of metals.

Description		**Rating before management**	**Rating with management**
Quantity or size of disturbance			
Moderate	The size of the disturbance will be directly related to the area which will be cleared for mining but will be reduced if managed.	2	1
Severity or destruction effect			
High	Heritage Resources are protected as indicated above	3	3
Extent			
Site specific	The impact will only apply to the direct site of disturbance.	1	1
Duration (impact phase and estimated timeframes)			

Description		Rating before management	Rating with management
Throughout life of activity	This impact could take place as long as mining takes place.	2	2
Probability			
Not probably	No heritage resources were found in the area. Archaeological deposits can, however, occur below ground level.	1	1
Reversibility			
Irreversible	Once the resources are negatively impacted it is irreversible, however, with correct management measures, the destruction or damage of sources could be prevented.	3	1
Irreplaceability of resources			
Resource is irreplaceable	Heritage resources cannot be replaced.	3	3
Degree to which can be avoided, managed or mitigated			
Avoidable with management measures	Impact avoidable with management measures	1	1
Significance			
Medium to low	Medium significance prior to management, and low significance with management	16	13

Environmental objective:

- To prevent the destruction or damage of any heritage or cultural resources on site.

Monitoring requirements:

- Inspection of areas for any heritage resources, during stripping of the topsoil, prior to commencement of mining.

Management or mitigation:

- Heritage awareness must be included in normal site induction for all employees, contractors and visitors to the subject properties. This will ensure that the general level of heritage awareness is raised and that there is compliance with the act. The sections of the NHRA as stated above in 'Additional comments' must be highlighted to each visitor, contactor and employee or any other person acting on the sites or immediate surrounds.
- All actions on the property will be subject to the provisions of the NHRA and any transgressions of the act will make the transgressor liable in terms of the act.
- The works / mining area must be demarcated to limit the footprint of the mining activities and limit creep of activities outside the impact area.
- Should any archaeological artefacts or skeletal material be revealed in the area during construction activities, such activities should be halted to allow for an investigation by a suitably qualified professional, and a university

Description	Rating before management	Rating with management
or museum must be notified for an investigation and evaluation of the find(s) to take place (cf. Section 36(6) of NHRA). • Prior to the commencement of any work or action that will impact or effect a heritage resource, the relevant authorisation must be obtained from the SAHRA. • Where there is uncertainty with regard to the status of a heritage resource, object, place or artefact, or any legislative or other policy issue the SAHRA can be contacted for clarity.		
Roles and responsibility: • Environmental manager		
Management timeframe: • Throughout LoM		
Environmental budget: • No budget allocated.		
Residual risk: • No residual risks.		

1.10 Regional socio-economic aspects

1.10.1 Safety of community

Activity: Roll-over mining into quarries.

Nature and consequence: Safety of quarries

Description		Rating before management	Rating with management
Quantity or size of disturbance			
Moderate	The facility is large, but forms part of the larger mine area.	2	2
Severity or destruction effect			
High	The safety risk is high	3	3
Extent			
Area adjacent to site	Risk is on area adjacent to mining site	2	2
Duration (impact phase and estimated timeframes)			
Permanent	Depending on rehabilitation, this could be permanent.	3	2
Probability			
Probable		2	2
Reversibility			
Only reversible with management	In the case of an event occurring, this will be irreversible.	3	3

Description		Rating before management	Rating with management
Irreplaceability of resources			
Resource irreplaceable		3	3
Degree to which can be avoided, managed or mitigated			
Somewhat avoidable.	The impact can be somewhat avoided with adequate rehabilitation practices.	3	3
Significance			
High	High significance prior to and after management.	21	20
Environmental objective: • To minimise the risk of the quarries.			
Monitoring requirements: • Monitoring as per the CoP			
Management or mitigation: • Management as per the CoP.			
Mitigation hierarchy: • Minimise			
Roles and responsibility: • Mine manager			
Management timeframe: • Ongoing.			
Environmental budget: • None			
Residual risk: • Ongoing			

1.10.2 Landowner compensation

Comment: Landowner enquired regarding compensation.

Action plan: Compensation will be discussed during the landowners meeting.

1.10.3 Number of quarries

Comment: Landowner of portions 61 and 62 enquired regarding the number of quarries.

Action plan: A landowner's meeting will be held. The number of quarries will be discussed during this meeting.

1.10.4 Fencing around quarry

Comment: Landowner of portions 61 and 62 requested that fencing be put around the quarries. He will supply electricity.

Action plan: These fences will be put in place if and when mining continues on portions 61 and 62. The landowner will then provide the electricity.

1.10.5 Borehole logs

Comment: Landowner of portion 3 of Cyferfontein requested borehole logs.

Action plan: Send completed borehole logs to landowner.

1.10.6 Final void on portion 62 of Cyferfontein

Comment: The landowner stated that he would prefer a final void on one side that can be used as a farm dam, instead of a depression over the entire area. It was further requested that the edges of the final void (farm dam) be shallow enough for the establishment of birds. It will also be appreciated if a hide could be put in place.

Action plan: The final void will be such a way to create a farm dam. The sides of this dam will be sloped to ensure it is shallow enough for the establishment of birds. The construction of a bird hide will be discussed with the landowner.

1.10.7 Final void on portion 7 of Cyferfontein

Comments: The landowner stated that he would prefer a shallow depression over the entire area instead of a dam.

Action plan: The final void will be such a way to create a shallow depression over the area.

1.10.8 Access between farm portions

Comment: How will Imerys ensure fences are not removed but still have access?

Action plan: Gates will be put in between farm portions.

1.10.9 Dust on the Eersbewoond road

Comment: Dust is also a problem on the Eersbewoond road.

Action plan: The mine has requested the air quality specialist to respond. The following response was received from the specialist (summarised):

During their impact assessment and emissions quantification this also came up as the most significant dust source (by a LARGE margin), from both the current and the future operations. Not only is the road the most significant source, but it is also the source closest to sensitive receptor locations.

A quick note: It might perhaps be wise to emphasize to the public that dust emissions from the road won't be worse after the expansion than they are at present.

A strict speed limit, possibly enforced with speed humps will definitely decrease the emissions (according to the US EPA emission estimation techniques the dust emissions from unpaved public roads are proportional to the square root of the vehicle speed divided by 30). Please see the table below for an estimation of emissions relative to 60km/hr emissions. A decrease in speed will therefore decrease the emissions, but not by as much as mitigation measures such as water sprays or chemical suppressants.

Speed km/hr	Emissions relative to 60km/h emissions
10	41%
20	58%
30	71%
40	82%
50	91%
60	100%
70	108%
80	115%
90	122%
100	129%

Another option is to apply chemical surfactants to bind the surface material. A drawback of this is that the road (especially considering the high clay content of the soil in the area) can become slippery when wet.

The mine will have further discussions regarding the dust problem on the Eersbewoond Road.

1.10.10 Replanting of Sheppard's Tree
Comment: How will Sheppard's Tree be replanted?
Action plan: The mine held a meeting with a horticulturalist from SANBI. SANBI will help the mine to relocate and reseed Sheppard's Trees. This is a project that will start end of November when the seeds will be harvested.

1.10.11 Clay on roads
Comment: Empty trucks throws clay onto the dirt road (Eersbewoond Road.
Action plan: Discussions must take place with the transport companies.

1.10.12 Sirens used on mine vehicles

Comment: Can the mine not apply for an exemption from the sirens used on the mine vehicles? This is especially disturbing during night time and early morning.

Action plan: There is no management for this. The mine must use sirens.

1.10.13 Road over wetland area

Comment: The road leading in to the mine is higher than the surrounding wetland area. This has led to damming of water in the past. The adjacent property has culverts to ensure water is free-flowing. Imerys does not have such culverts in place.

Action plan: Imerys has put pipes/culverts in place to prevent such damming of water.

1.10.14 Tarring of road

Comment: Could road be tarred?

Action plan: Imerys will join discussions if the landowners decide to speak to the department.

1.10.15 Process water

Comment: WUL will be subject to the treatment / processing of mine effluent by incorporating a facility / infrastructure for said treatment. How does use of surface water within the licenced catchment impact the wetland which is 500m away from the envisaged mine site? How is the water from process dam treated before effecting dust management? What other deleterious chemical composition, total suspended solids and / or salt loads are present in the dirty water?

Action plan: Fluoride level are above the Domestic Use Standards. No fluoride is used or generated in the mining process and it is concluded that the elevated fluoride originates from the soil and aquifer host rock in natural ion exchange reactions. Similar elevated fluoride concentrations in groundwater are observed in the Waterberg Group rocks, as well as in the Rooiberg felsite formations. Watering of the roads in the mine area will therefore not be significantly affected by the water from the quarry.

1.10.6 Review pack

Comment: Will landowners and stakeholders get insight in review packs?

Action plan: This will be implemented as per applicable regulation.

2 Alternative options

Please note, all impacts will be similar for the preferred option of retaining the Red Data Trees and the removal of the red data Trees, with the exception of this one activity. The additional impact of removing of Red Data Trees are included in this section. See Part A(g)(v)(1.3.3.) for the additional impact in the proposed alternative.

See Part A(g)(vii) for a table indicating the positive and negative impacts of the proposed alternative, the second alternative and the no-go alternative.

3 Cumulative impacts

There is no strategic environmental assessment for the area, which will include the impacts of all the activities in the area. The cumulative impacts are only assumptions from the EAP.

The quarries are surrounded by the rest of the mine and its mining activities as well as other land uses.

3.1 Geology

There are already existing mining sites in the area, therefore the geology of large part of the area is being removed.

3.2 Soil, pre-mining land capability and land use

Additional mining areas, as well as residential areas and farming will impact on the soil, pre-mining land capability and land use.

3.3 Vegetation and animal life

The mine is surrounded by other land uses in the area, which could lead to cumulative impacts on the vegetation and animal life of the area.

3.4 Surface water

Various roads and other land uses could also impact the surface water such as the Nylsvley area. Please note, the proposed new mining area will not impact the Nylsvley area.

3.5 Groundwater

There are already existing mining sites in the area. There is also a sewage plant near the Engen Garage. All these land uses could cumulatively impact on the groundwater quality.

3.6 Air quality

All land uses in the area could possibly lead to accumulative impacts on the air quality.

3.7 Environmental noise

All land uses in the area could possibly lead to accumulative impacts on the environmental noise.

3.8 Visual aspects

The visual aspects of the area are dominantly rural dwellings with some already existing quarries. These existing quarries, with the new quarry could have a cumulative effect on the area.

3.9 Cultural and heritage resources

None

3.10 Regional socio-economic aspects

None proposed.

vi) Methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks

According to the Information Series 5: Impact Significance of the Integrated Environmental Management Information Series (Department of Environmental Affairs and Tourism, 2002):

'The concept of significance is at the core of impact identification, prediction, evaluation and decision-making. Deciding whether a project is likely to cause significant environmental effects is central to the practice of EIA.'

Impact assessment is therefore based on the description of an impact, the significance of this impact, and how the impact can be managed. Impact assessment and management measures must be based on the requirements as set out in the relevant Regulations and guidelines of the NEMA, the MPRDA, and the NWA.

Impacts on each **environmental component**, as well as an **indication of the phases** (construction, operational, decommissioning) and **estimated timeframes** in relation to the potential impacts rated, are assessed in Part A(g)(v)(1) above in the form of a table. The **management measures and mitigation** is also included in the tabel in Part A(g)(v)(1) above, and where applicable, will be **conducted daily, weekly, monthly, quarterly, annually or periodically** as the case may be in order to control any action, activity or process which causes pollution or environmental degradation. The **roles and responsibilities** for the execution of the monitoring and management programmes are also included in this table. All impacts identified as part of this process are rated using the criteria as set out below.

1. Nature: Description of the aspect of the activity;
2. Consequence: Result of aspect on the environment;
3. Extent;

4. Duration: Including during which phase (construction, operational, decommissioning) and whether temporary, throughout the life of the activity or permanent;
5. Probability;
6. Reversibility;
7. Irreplaceability of resources: Sensitivity of resources or environmental receptor; and
8. Degree to which can be avoided managed or mitigated: This will include significance rating after management incorporated.
9. Significance: This is worst case scenario without any management measures. See below how significance is determined:

Description	Rating
Quantity or size of disturbance	
Very small to small	1
Moderate	2
Large to very large	3
Severity or destruction effect	
Very low to low	1
Moderate	2
Large to very large	3
Extent	
Site specific	1
Area adjacent to site	2
Beyond the boundaries of adjacent area	3
Duration	
Temporary	1
Throughout life of activity	2
Permanent	3
Probability	
Not probably	1
Probably	2
Definite	3
Reversibility	
Reversible	1
Only reversible with management	2
Irreversible	3
Irreplaceability of resources	
Resource replaceable, receptor not sensitive	1
Resource somewhat replaceable, receptor moderately sensitive	2
Resource irreplaceable, receptor highly sensitive	3

Description	Rating
Degree to which can be avoided, managed or mitigated	
Avoidable with management measures or mitigation	1
Somewhat avoidable with management measures or mitigation	2
Not avoidable with management measures or mitigation	3
Significance	
Low	8-13
Medium	14-19
High	20-24

vii) The positive and negative impacts that the proposed activity (in terms of the initial site layout) and alternatives will have on the environment and the community that may be affected

Refer to Part A(g)(v) for all positive and negative impacts. There is one additional negative impact if the preferred alternative option is implemented.

viii) The possible mitigation measures that could be applied and the level of risk

Refer to Part A(g)(v) above for possible mitigation measures that could be applied and the level of risk.

ix) Motivation where no alternative sites were considered

Not applicable.

x) Statement motivating the alternative development location within the overall site

The removal of the Red Data Trees will lead to the destruction of these trees.

h) Full description of the process undertaken to identify, assess and rank the impacts and risks the activity will impose on the preferred site (In respect of the final site layout plan) through the life of the activity

Refer to Part A(g)(v) above for a full description of the process undertaken to identify, assess and rank the impacts and risks the activity will impose on the preferred site (In respect of the final site layout plan) through the life of the activity.

i) Assessment of each identified potentially significant impact and risk

This section includes all the known typical impacts of each of the activities (including those that could or should have been identified by knowledgeable persons) and not only those that were raised by registered interested and affected parties).

Refer to Part A(g)(v) for a complete impact assessment.

j) Summary of specialist reports

Table 28: Summary of specialist reports

List of studies undertaken	Recommendations of specialist reports	Reference to applicable section of report where specialist recommendations have been included.
Air Quality Impact Assessment for the Proposed Extension of the Cyferfontein Mine Near Modimolle, Limpopo	The AQMP for the Cyferfontein Mine should follow an iterative process, including: implementation, monitoring, reporting, reviewing and adjustment to the necessary steps. Included below are the definition of objectives and targets to achieve through dust suppression strategies. Monitoring, reporting and review allow for the assessment of operations and adjustment of implemented strategies to meet objectives. *Monitoring Reporting* Measured ambient dust fallout rates should be recorded monthly. Ideally this should be in the form of a graph, clearly indicating exceedances of 1 200 mg.m-2.d-1 for on-site locations. Annual reporting should include the number of months for which dust fallout rates exceed these levels. Two non-sequential exceedances of the limit are permitted per calendar year.	Part A(g)(v)

List of studies undertaken	Recommendations of specialist reports	Reference to applicable section of report where specialist recommendations have been included.
	The abovementioned graphs should be accompanied by additional information regarding measured exceedances, this should include: • The location at which the exceedance was measured. • Possible reasons for the exceedance (e.g. new mining activities in the area, construction work in the area, high wind speeds etc.) or localised sources. • Remedial measures implemented to rectify exceedances. • Frequency of exceedances at location (are high dust fallout rates regularly recorded at this location or is this a once-off occurrence?). *Inspection and Community Liaison* Table 11 and Table 12 (refer to the Air Quality Impact Assessment) provide examples of an inspection logbook and a water spray logbook that can be used as part of the day-to-day dust management at Cyferfontein Mine. An example of a complaints register is provided in Table 13 (refer to the Air Quality Impact Assessment). These tools, together with monthly monitoring results can be invaluable in tracking performance of implemented mitigation measures. It is recommended that a complaints register be kept at the site office, and that both members of the surrounding community as well as staff be encouraged to note all air quality related problems (health problems, odours, nuisance dust, visible dust etc.) on the complaints register. The date and time noted on the complaints register should not be the date and time that the complaint is logged but the date and time that the reported problem is observed. If used correctly, the complaints register can be	

List of studies undertaken	Recommendations of specialist reports	Reference to applicable section of report where specialist recommendations have been included.
	compared to monitoring data, the dust inspection logbook as well as recorded meteorological data to identify problem areas and to iteratively adjust the AQMP to ensure efficient and effective mitigation of fugitive dust sources.	
Biodiversity Habitat Assessment of Portions 7, 61 and 62 of the farm Cyferfontein 457-KR	• Protected trees should be conserved in situ, otherwise a permit must be obtained from the Department of Forestry for the removal of these plants. • It is proposed that the removal and replanting of these trees be done if possible as alternative 1 (preferred alternative). • A protective buffer of 50m, should be allowed around the species of conservation concern, *Elaeodendron transvaalensis* (which is also a protected tree), as alternative 2. • If approval for mining of the pit area is granted, a permit to remove the protected trees should be obtained from the relevant authority. A proper management plan must then be developed and implemented on site before mining commences in the new pit area, whereby a nursery is established by the mine or a nursery nearby to propagate these protected trees from seeds or other means. These trees should then be planted where rehabilitation of the existing mine is taking place. • Encroachment by Northern Spike thorn and Sickle bush should be inhibited by removal of the densest patches combined with a controlled burning programme. • Removal of the dense mat of dried material between the trees is recommended using a controlled burning programme. • If chemical control of Queen of the Night trees is not viable on the larger site, the plants should be treated with a biological control agent. The use	Part A(g)(v)

List of studies undertaken	Recommendations of specialist reports	Reference to applicable section of report where specialist recommendations have been included.
	of *Hypogeococcus pungens*, obtainable from the Plant Protection Research Institute, is recommended. • Every effort should be made to retain the linear integrity, flow dynamics and water quality of the drainage line, floodplain and dams. • If the South African python, giant bullfrog or any herpetological species are encountered or exposed during the mining, they should be removed and relocated to natural areas in the vicinity. • The contractor must ensure that no herpetofauna species are disturbed, trapped, hunted or killed during the construction phase. Conservation-orientated clauses should be built into contracts for construction personnel, complete with penalty clauses for non-compliance. • The attenuation ponds must be designed with walls that will allow small fauna easy escape from these dams, so that they do not get trapped by too steep walls and die. • Proper veld management practises should be implemented with respect to grazing, burning and control of woody invasions. • Where possible, work should be restricted to one area at a time, as this will give the smaller birds, mammals and reptiles a chance to weather the disturbance in an undisturbed zone close to their natural territories. • No vehicles should be allowed to move in or across the wet areas or drainage lines and possibly get stuck. This leaves visible scars and destroys habitat, and it is important to conserve areas where there are tall reeds or grass, or areas where there is short grass and mud. • It is suggested that where work is to be done close to the drainage lines, these areas be fenced off during construction, to prevent heavy machines	

List of studies undertaken	Recommendations of specialist reports	Reference to applicable section of report where specialist recommendations have been included.
	and trucks from trampling the plants, compacting the soil and dumping in the system. • During the construction phase, noise must be kept to a minimum to reduce the impact of the development on the fauna residing on the site. • Alien and invasive plants must be removed.	
Environmental Noise Impact Assessment Report	• All maintenance and operating of equipment should be done as per specifications of the OEM's. • Effective maintenance of the vehicle engines and exhaust systems. • Hearing conservation programme as per DMR guidelines on Noise Control, including zoning of high noise areas, such as vehicles for people working in close proximity of the vehicle engines while operating • The use of approved hearing protection devices for the personnel involved with the mining process. • Limit the use of noise generation activities or vehicles or appliances after 22:00. • From an occupational perspective, the mining workers should be protected through standards and procedures and monitored as requires through Section 12 of the MHSA.	Part A(g)(v)
Groundwater Impact Assessment at the Cyferfontein Flint Mine	• The rehabilitation should aim at minimizing infiltration to the rehabilitated quarry. • No management action is available to prevent dewatering. • Drains and cut-off trenches (storm water management system) around the proposed quarry should be implemented before commencing with pit development to prevent clean run-off water from entering the pit.	Part A(g)(v)

List of studies undertaken	Recommendations of specialist reports	Reference to applicable section of report where specialist recommendations have been included.
	• The localised dewatering of the surrounding aquifer cannot be prevented, since the mining will occur below the local groundwater level. The cone of depression resulting from the void, however, is not expected to affect nearby groundwater users/receptors, due to the limited gradient that will be created and the low hydraulic properties of the flint aquifer. • During active mining, poor quality water accumulating in the workings should be pumped to the pollution control dam for recycling to limit the quality related impacts. • These statements need to be confirmed through regular monitoring of groundwater levels and quality in monitoring boreholes to be developed. • Run-off from haul-roads should be diverted and contained in the dirty water system. • Compacted surfaces will be kept free of contaminated material by cleaning spillages, thereby reducing infiltration of contaminated water. • The size of compacted areas must be minimized to as small as practically possible.	
Phase I Cultural Heritage Resources Impact Assessment	• Heritage awareness must be included in normal site induction for all employees, contractors and visitors to the subject properties. This will ensure that the general level of heritage awareness is raised and that there is compliance with the act. The sections of the NHRA as stated above in 'Additional comments' must be highlighted to each visitor, contactor and employee or any other person acting on the sites or immediate surrounds.	Part A(g)(v)

List of studies undertaken	Recommendations of specialist reports	Reference to applicable section of report where specialist recommendations have been included.
	• All actions on the property will be subject to the provisions of the NHRA and any transgressions of the act will make the transgressor liable in terms of the act. • The works / mining area must be demarcated to limit the footprint of the mining activities and limit creep of activities outside the impact area. • Should any archaeological artefacts or skeletal material be revealed in the area during construction activities, such activities should be halted to allow for an investigation by a suitably qualified professional, and a university or museum must be notified for an investigation and evaluation of the find(s) to take place (cf. Section 36(6) of NHRA). • Prior to the commencement of any work or action that will impact or effect a heritage resource, the relevant authorisation must be obtained from the SAHRA. • Where there is uncertainty with regard to the status of a heritage resource, object, place or artefact, or any legislative or other policy issue the SAHRA can be contacted for clarity.	
Soil, Land Capability and Land Use Assessment of the proposed Cyferfontein Mine Open Pit Extension, Situated on Portions 7, 61 and 62 of the farm Cyferfontein 457 KR, Limpopo Province	• Separate stripping of the A and B horizons and replacement in the same sequence is not recommended due to mentioned obstacles. The impact should rather try to be lessened by stripping only high quality topsoil, at correct depths (1.2m) where after reestablishment of the A and B horizon properties should take place naturally over many years. • Ensure that topsoil is stripped to a depth of 1.2m with as little deviation as possible. • Ensure that the areas where topsoil will be replaced are filled to the correct elevation and are free draining.	Part A(g)(v)

List of studies undertaken	Recommendations of specialist reports	Reference to applicable section of report where specialist recommendations have been included.
	• Ensure that depth markers (stakes) are put out by the surveyor to ensure replacement at correct depths (at least 1m) • Care should be taken to tip enough soil per square unit to reinstate the total required post mining soil depth at once. Spreading of soil over far distances and repeated traversing of heavy mechanical equipment should be minimised in order to prevent compaction in the lower profile which is difficult to alleviate afterwards. The dumped soil heaps should thus only be levelled on top to reach the required soil thickness. Caterpillar-type tracked equipment is preferred for levelling of topsoil because these tracks cause less compaction. Bowl scrapers cause enormous compaction and should not be used. • The timing of topsoil stripping and replacement should be synchronized with the rainy season. • Topsoil should be replaced during winter and soil preparation and seeding should be done just before the rainy season. • A grass cover should be established to serve as buffer against soil erosion. The grass cover should consist of a mixture of available local species as well as a strong growing and stabilizing pioneer specie such as C*ynodon dactylon.* • Construction on a properly designed hydrocarbon storage facility • Prevent spills from occurring by training personal in handling of hydrocarbons; • If a spill occurs it is to be cleaned up immediately and reported to the appropriate authorities; • Contaminated soil will be disposed at a suitable disposal facility;	

List of studies undertaken	Recommendations of specialist reports	Reference to applicable section of report where specialist recommendations have been included.
	• All vehicles are to be serviced in a well-equipped workshop area or at an off-site location; • Leaking vehicles will have drip trays place under them where the leak is occurring. • Keep the size of the final void as small as possible; fence off the final void for safety reasons; shape edges of final void to gradients that can withstand erosion to some extent.	
Cyferfontein Mine Storm Water Management Plan	• Rehabilitation planning of the disturbed site should consider the impact of natural runoff that will be diverted away from the downstream receiving environment and into the residual depression that will be formed post rehabilitation. • For the new proposed quarry, it is only required that a berm be constructed around the perimeter of the quarry to prevent any inflow of clean runoff once the excavations commence. Development of the quarry should take runoff into consideration to allow drainage to a single low point. • Storm water control infrastructure within this document is designed to withstand a 1:50 year flood event. In the event of runoff breaching infrastructure it is important to first ensure the safety of the people on site. • Regular inspections should be conducted on all channels, trenches, and berms to ensure function and capacity of infrastructure is maintained as well as maintenance where signs of erosion become evident. High risk erosion areas include all roads and berms where surface water is concentrated into sheet flow. Evidence of erosion was observed on the side slopes of stockpiles, this should be minimised by shaping the top edge of the stockpiles to not allow runoff over the sides.	Part A(g)(v)

List of studies undertaken	Recommendations of specialist reports	Reference to applicable section of report where specialist recommendations have been included.
	• No affected water from the mine is allowed to spill into the clean water environment. This should be ensured through design as well as operational control measures. • Erosion prevention measures (e.g. grass, cement or rock) should be in place at all concentration points on the mine. These areas specifically include steep slopes at loose fine material stockpiles.	
Synopsis: Specialist Investigation to Determine the Presence/ Absence of Wetland Habitat at the Northern Border of the Cyferfontein Clay Quarry Present on Portion 7 of the Farm Cyferfontein, Modimolle, Limpopo Province	Not applicable, the mining extension falls outside the wetland area.	Not applicable.

Refer to Addendum 3 attached for of the specialist reports.

All specialist recommendations have been included in the EIA report

k) Environmental impact statement

(i) Summary of the key findings of the environmental impact assessment

1 Geology

1. The geology will be completely removed; however, this will not have an impact on other environmental components.

2 Soil, pre-mining land capability and land use

1. Deterioration in soil quality and physical properties due to mixing of soil's A and B horizons. During the stripping process the A and B-horizons will be mixed and therefore not be replaced in the same sequence. This will cause constant varying texture in the post-mining soil profile, which will adversely affect infiltration rates, soil stability and water holding capacity. It will further cause deterioration of soil fertility due to the mixing of the thinner, but more fertile A horizons with the thicker less fertile B horizons, which usually result in significant lower organic carbon in the post-mining upper soil horizon. This will adversely affect soil structure and stability as well as fertility.
2. Deterioration in post-mining soil quality and land capability if soils are stripped too deep and are subsequently mixed with underlying, lower quality overburden materials, which adversely affect infiltration rates, permeability and soil stability. Reduction of post-mining land capability and potential land use if topsoil is stripped too shallow and replaced at shallower depth as prior to mining, which reduces soil volume and subsequent water holding capacity and nutrient availability.
3. Soil erosion at rehabilitated areas where exposed soil surfaces are highly vulnerable to erosion initiation without a vegetation cover that serves as a buffer against erosion.
4. Potential soil pollution by hydrocarbons caused by leaking vehicles and machinery that are used for stripping and replacement of topsoil.
5. The open pit will end up in a final void where no topsoil will be replaced and the current arable land capability and grazing land use will change to a farm dam, which will probably be partly filled with water during certain periods of the year. The final void will have no soil potential which will render the pre-mining arable land capability and grazing land use to cease permanently. The land capability will reduce from the arable class to the wilderness class.
6. The construction of the haul road will involve placement of a thick layer of overburden on the soil surface which will cause all productive soil functions to cease and the current land capability and land use will also cease completely until the overburden material are removed, the soil surface loosened and revegetated.

3 Vegetation and animal life

1. Total destruction of indigenous vegetation in footprint areas.
2. Destruction and removal of protected tree species in mining footprint areas.

3. Destruction and removal of Red data tree species in mining footprint areas.
4. **Positive** effect of eradication of these species in mining footprint areas.
5. Total destruction of faunal habitat in mining footprint areas.

4 Surface water

Damage to infrastructure and/or excessive inflow into open quarry. Financial/production loss and/or surface water contamination.

Nett loss in material will create depression. Surface runoff affected permanently by preventing natural drainage.

Erosion of steep slopes accompanied by siltation of downstream receiving environment. Loss of soil with reduced capacity downstream.

5 Groundwater

1. Removal of topsoil and vegetation can lead to an increase in groundwater recharge to the aquifer. It also leads to an increase of surface runoff.
2. The quarry will form a depression as a result of ore that is removed, and therefore a decrease in volume of material placed back in the quarry.
3. During the rehabilitation period, the quarry will start filling with groundwater seepage to reinstate the equilibrium with surrounding aquifers.
4. It is anticipated that, if the groundwater quality is affected (not expected) by the mining operation, the quality will improve away from the quarry, as the dilution effect of the entire aquifer increases further away from the quarry.
5. With the available qualities in the existing pit water, only fluoride indicates elevated concentrations. The one borehole situated close to the existing quarry does not indicate any signs of impacts from the mining activities. However, no downgradient boreholes exist, but the good quality of the water in the pit is a good indication that the groundwater quality may not be affected in terms of quality.
6. The major impact of mining in terms of groundwater will be groundwater level drawdown, should the water levels be higher than the quarry floor elevations. At the time of this assessment, the quarry floor elevations were not available and therefore the impacts cannot yet be quantified.
7. The construction of **haul roads** will cause a very small reduction in recharge due to the compaction of the surface of the roads. This impact is countered by the fact that the runoff water will contribute to the catchment yield. No adverse impact is foreseen on groundwater quality, since no carbonaceous or otherwise reactive material will be used for construction.
8. No significant groundwater impacts are expected during construction and transportation of ore. Groundwater quality impacts may only occur from spillage of contaminated material during transportation. Run-off from haul-roads should be diverted and contained in the dirty water system.

6 Air quality

Particulates and gaseous concentrations have a human health impact. Dust fallout is only assessed as a nuisance impact.

7 Environmental noise

Noise generation through mining activities causing noise nuisance on environment and community.

8 Visual aspects

Change in topography leading to visible intrusions in the rural area.

9 Cultural and heritage resources

Unearthing of any heritage materials which may lead to damage or destruction of these resources.

10 Regional socio-economic aspects

1. Safety of filled quarries
2. Public comments
    - Landowner compensation
    - Number of quarries
    - Fencing around quarry
    - Borehole logs
    - Final void on portion 62 of Cyferfontein
    - Final void on portion 7 of Cyferfontein
    - Access between farm portions
    - Dust on the Eersbewoond road
    - Replanting of Sheppard's Tree
    - Clay on roads
    - Sirens used on mine vehicles
    - Road over wetland area
    - Tarring of road
    - Process water

(ii) Final Site Map

Refer to Addendum 1 for all the maps.

(iii) Summary of the positive and negative implications and risks of the proposed activity and identified alternatives

See below Table 28 indicating the comparative assessment of the positive and negative implications of proposed activity and identified alternatives.

Table 29: Advantages and disadvantages of the proposed alternative versus the second alternative and the no-go alternative

Preferred alternative	Second alternative	No-go alternative
Removal of geology	Removal of geology	Loss of mining reserve.
Potential deterioration of soil	Potential deterioration of soil	No soil deterioration from mining.
Potential soil erosion	Potential soil erosion	No soil erosion from mining
Potential soil pollution	Potential soil pollution	No soil pollution from mining
Change in land use at final void	Change in land use at final void	No change in land use.
Productive soil functions to cease under haul road.	Productive soil functions to cease under haul road.	No loss of productive soil functions.
Total destruction of indigenous vegetation in footprint areas.	Total destruction of indigenous vegetation in footprint areas.	No destruction of indigenous vegetation in footprint areas.
Destruction and removal of protected tree species in mining footprint areas.	Destruction and removal of protected tree species in mining footprint areas.	No destruction and removal of protected tree species in mining footprint areas.
Destruction and removal of Red data tree species in mining footprint areas.	No destruction and removal of Red data tree species in mining footprint areas.	No destruction and removal of Red data tree species in mining footprint areas.
Positive effect of eradication of these species in mining footprint areas.	Positive effect of eradication of these species in mining footprint areas.	No removal of alien vegetation.
Total destruction of faunal habitat in mining footprint areas.	Total destruction of faunal habitat in mining footprint areas.	No destruction of faunal habitat in mining footprint areas.
Damage to infrastructure and/or excessive inflow into open quarry.	Damage to infrastructure and/or excessive inflow into open quarry.	No infrastructure.
Surface runoff affected permanently by preventing natural drainage.	Surface runoff affected permanently by preventing natural drainage.	No change in surface runoff.
Erosion of steep slopes accompanied by siltation of downstream receiving environment	Erosion of steep slopes accompanied by siltation of downstream receiving environment	No erosion.
Increase in groundwater recharge to the aquifer.	Increase in groundwater recharge to the aquifer.	No increase in groundwater recharge to the aquifer.
Increase of surface runoff.	Increase of surface runoff.	No increase of surface runoff.
Groundwater level drawdown.	Groundwater level drawdown.	No groundwater level drawdown.

Preferred alternative	Second alternative	No-go alternative
Particulates and gaseous concentrations have a human health impact. Dust fallout is only assessed as a nuisance impact.	Particulates and gaseous concentrations have a human health impact. Dust fallout is only assessed as a nuisance impact.	No increase in nuisance.
Noise generation through mining activities causing noise nuisance on environment and community.	Noise generation through mining activities causing noise nuisance on environment and community.	No increase in environmental noise.
Change in topography leading to visible intrusions in the rural area.	Change in topography leading to visible intrusions in the rural area.	No change in topography leading to visible intrusions in the rural area.
Unearthing of any heritage materials which may lead to damage or destruction of these resources.	Unearthing of any heritage materials which may lead to damage or destruction of these resources.	No unearthing of any heritage materials.
Safety of quarries.	Safety of quarries.	No safety issues.
Game safety at quarries.	Game safety at quarries.	No safety issues.
Dust on the Eersbewoond road.	Dust on the Eersbewoond road.	Dust on the Eersbewoond road.
Clay on roads.	Clay on roads.	Clay on roads.
Sirens used on mine vehicles.	Sirens used on mine vehicles.	Sirens used on mine vehicles.
Road over wetland area.	Road over wetland area.	Road over wetland area.

l) Proposed impact management objectives and the impact management outcomes for inclusion in the environmental management programme

Refer to Part A(g)(v) for all Proposed impact management objectives and the impact management outcomes for inclusion in the EIA/EMP Part B.

m) Final proposed alternatives

Refer to Part A(g)(i) for the alternatives. There were no objections from the public on the proposed alternative.

n) Aspects for inclusion as conditions of Authorisation

All management measures set out in this EIA/EMP must be complied to. The mine must further comply with any conditions set out under other authorisations.

o) Description of any assumptions, uncertainties and gaps in knowledge

Visual

The visual aspects and impacts thereon are based on assumptions made during site visits.

Biodiversity

According to the farmer, the larger site, and also the pit area, has not been burned for several years with the result that severe encroachment of Northern Spike thorn and Sickle Bush occurred. Thick layers of dried vegetation impeded observation and identification of herbaceous species. It is assumed that the species composition of the *Acacia – Euclea* undulata woodland study unit of the larger site is the same as that of the *Acacia – Euclea* undulata woodland study in the pit area.

The Galago Environmental team has sufficient experience and ample access to information sources to confidently compile lists of biota such as presented herein to support conclusions and suggested mitigation measures based on a site visit. In instances where doubt exists, a species is assumed to be a possible occupant (viz. Suncus species); -this approach renders the conclusions to be robust. In instances where the possible occurrence has significant ecological implications, an intensive survey is recommended. In view of the latter, it is highly unlikely whether an intensive survey to augment this site visit will add significantly to the data base, and the additional costs are unlikely to warrant the effort.

Even though every care is taken to ensure the accuracy of this report, environmental assessment studies are limited in scope, time and budget. Discussions and proposed mitigations are to some extent made on reasonable and informed assumptions built on bone fide information sources, as well as deductive reasoning. Deriving a 100% factual report based on field collecting and observations can only be done over several years and seasons to account for fluctuating environmental conditions and migrations. Since environmental impact studies deal with dynamic natural systems, additional information may come to light at a later stage. Galago Environmental can thus not accept responsibility for conclusions and mitigation measures made in good faith based on own databases or on the information provided at the time of the directive. This report should therefore be viewed and acted upon with these limitations in mind.

The on-site bird survey was done outside the main breeding season of most species and during the time when all Palaearctic and intra-African migrants had already migrating to the north. This, however, will not have an effect on recording Red Data species, since most Red Data species are resident to South Africa and the few Red Data species that are Palaearctic migrants are mainly threatened in their northern hemisphere distribution ranges.

The site surveys was done during several hours in one day and not on a regular basis during several season over a period of time, thus the avifaunal biodiversity could change slightly as more species are confirmed from the various habitat system within the study area. The time of the day and weather condition also as has an effect on the number of species recorded in the study area during the site visit. The general assessment of species rests mainly on the 1987 atlas for birds of the then-Transvaal (Tarboton et al. 1987),

the 1997 SABAP1 atlas data (Harrison et al. 1997) and the current data for the SABAP2 period for comparison, so any limitations in either of those studies will by implication also affect this survey and conclusions.

The general assessment of species rests mainly on the 1997 SABAP1 atlas data (Harrison et al. 1997) for comparison with the current SABAP2 atlas, so any limitations in either of those studies will by implication also affect this survey and conclusions.

Furthermore, the number of atlas cards received and the diversity of habitat systems surveyed for avifaunal species within a q.d.g.c. or pentad or lack thereof could also have an effect on the avifaunal diversity that could potentially occur on the study site. A total of 220 atlas cards were received for the 2428CD q.d.g.c. over the SABAP1 project period and to date, 233 cards for the entire 2428CD q.d.g.c. over the current SABAP2 project period and 12 and 20 cards for the 2445_2825 and 2450_2825 pentads respectively (in which the study site is situated) since 1 July 2007.

Galago Biodiversity and Aquatic Specialists are committed to the conservation of biodiversity, but concomitantly recognise the need for economic development. Even though we appreciate the opportunity to learn through the processes of constructive criticism and debate, we reserve the right to form and hold our own opinions and therefore will not willingly submit to the interest of other parties or change statements to appease them.

Even though every care is taken to ensure the accuracy of this report, environmental assessment studies are limited in scope, time and budget. To some extent, conclusions are drawn and proposed mitigation measures suggested based on reasonable and informed assumptions built on bone fide information sources, as well as deductive reasoning. Deriving a 100% factual report based on field collecting and observations can only be done over several years and seasons to account for fluctuating environmental conditions and migrations. Since environmental impact studies deal with dynamic natural systems, additional information may come to light at a later stage. Galago Biodiversity and Aquatic Specialists can therefore not accept responsibility for conclusions drawn and mitigation measures suggested in good faith based on own databases or on the information provided at the time of the directive. This report should therefore be viewed and acted upon with these limitations in mind.

Groundwater

The mine borehole is situated approximately 1 600 m from the proposed pit. This is the closest available water level from the proposed pit. The depth of the water level in the proposed pit area will determine whether groundwater abstraction, and therefore a drawdown cone, will occur. With the relatively flat surface

topography, it is highly likely that the groundwater level at the pit area is less than 33 meters and, in this case, drawdown due to dewatering is expected.

Groundwater monitoring boreholes are needed to confirm water levels and flow gradients in the area.
The waste and water leaching tests area underway. Additional management measures may be required from these tests.

There is limited information in terms of groundwater users downgradient of the proposed facility that should be addressed to improve the level of confidence in the impact assessment.

Heritage

The vegetation is dense Bushveld and grassland. The site was visited and inspected on foot and by vehicle. Visibility was bad because of the dense vegetation.

Environmental noise

Daytime and nighttime levels were taken at the best possible positions, and a total of 8 sampling positions were identified around the dedicated area. Assistance was provided by mine management to gain access to these positions and perform the noise survey.

Soil land use and land capability

The locations of the proposed infrastructure were obtained from BECS via email in electronic dxf file format named “cyfer_62_pit_incl7.dxf” and “haul_road_1.dxf” which were accepted as the finial positions of the infrastructure.

Stormwater

Calculations assume uniform rainfall intensities throughout the duration of the storm over the entire catchment areas assessed.

Storm water control recommendations are based on industry experience and best practice. Designs are based on capacity sizing and should be used as a guide in the preparation of the site.

Contour elevation data used during the assessment is received from the Surveyor-general and the data is assumed to be accurate.

This storm water management plan does not distinguish between existing or proposed measures and should be viewed as an operation document for the complete management of all storm water requirements.

p) Reasoned opinion as to whether the proposed activity should or should not be authorised

i) Reasons why the activity should be authorised or not

The mining extension will impact the environment, however with correct management measures and rehabilitation, these impacts will be minimised.

ii) Conditions that must be included in the authorisation

Additional conditions that may be considered are:

1. The mine must update the water monitoring requirements as soon as DWS has issued an IWUL.

q) Period for which the Environmental Authorisation is required

The LoM is 6 years, where after final rehabilitation must still be done. The period for EA is therefore approximately 11 years.

r) Undertaking

The undertaking required to meet the requirements of this section is provided at the end of the EMP and is applicable to both the EIA report and the EMP.

s) Financial Provision

The financial provisioning must include:

1. Annual forecasted financial provision calculation;
2. Confirmation of the amount that will be provided should the right be granted (in this case, the mine already has a right, therefore the amount updated annually);
3. Method of providing financial provision contemplated in Regulation 53; and
4. Capacity to manage and rehabilitate the environment.

1 Annual forecasted financial provision calculation

According to the Regulations pertaining to the Financial Provision for Prospecting, Exploration, Mining or Production Operations, GN 1147 of 2015, under the National Environmental Management Act 107 of 1998 (as amended):

6. An applicant must determine the financial provision through a detailed itemisation of all activities and costs, calculated based on the actual costs of implementation of the measures required for—

(a) annual rehabilitation, as reflected in an annual rehabilitation plan;

(b) final rehabilitation, decommissioning and closure of the prospecting, exploration, mining or production operations at the end of the life of operations, as reflected in a final rehabilitation, decommissioning and mine closure plan; and
(c) remediation of latent or residual environmental impacts which may become known in the future, including the pumping and treatment of polluted or extraneous water, as reflected in an environmental risk assessment report.

11. (1) The holder of a right or permit must ensure that a review is undertaken of the requirements for —
(a) annual rehabilitation, as reflected in an annual rehabilitation plan;
(b) final rehabilitation, decommissioning and closure of the prospecting, exploration, mining or production operations at the end of the life of operations as reflected in a final rehabilitation, decommissioning and mine closure plan; and
(c) remediation of latent or residual environmental impacts which may become known in the future, including the pumping and treatment of polluted or extraneous water, as reflected in an environmental risk assessment report.

Shangoni Management Services compiled a list indicating rates for actual costs to rehabilitate. The following is extracted from the Annesley Andalusite Mine Closure Liability Update (Shangoni Management Services, 2016):

The CES Group was contracted by Shangoni to acquire rates for demolition and rehabilitation of mining activities (Table 30). Procurement of budget pricing approached by identifying reputable demolition companies, various sites of varying sizes at various locations and identifying local companies in the study area with ability to work on similar scale project. A bill of quantities (BoQ) was distributed to the various companies. The table below indicates the number of contractors to which the BoQ was distributed and the number of tenders received afterwards.

Table 30: Results of rate acquisition process

Area	Number of contractors identified	Tenders received
National	6	1
North West	6	3
Free State	5	1
Northern Cape	7	2
Limpopo	5	3 (One joint venture with national based company)
Total	29	10

The prices received from contractors were reviewed by the CES Group, after which average and meridian rates were drawn rates to correctly establish a baseline rate. The following methods to establish the baseline rates were followed:

- Price A - Average if priced – across the board average of rates received per category;
- Price B - Median pricing – "middle" rate of all rates in series per category;
- Price C - Average between Price A & B;
- Price D - Average rate excluding top and bottom rates per category.
- Price D - rate category that was used in the closure cost calculation, unless otherwise indicated in the closure cost spreadsheet "Rate" sheet.

The closure budget consists of the following areas:
Physical - Demolition of infrastructure where infrastructure does not form part of end land use. Potential to transfer to third party was identified.
Biophysical - Actions to safeguard (making safe and stable) and re-establish the biophysical to ensure a sustainable landform and mitigate identified risks. This includes levelling of the dumps, seeding of the trees and grass.

Auditable calculations of costs per activity or infrastructure

Table 31: Tariffs used for quantum determination

Rehabilitation and Demolition	Unit	Rates
800mm thick /deep Reinforced in situ concrete structures: Demolition and removal to demolition site	m^3	R 502.27
400mm thick /deep reinforced concrete	m^3	R 447.27
250mm thick /deep reinforced concrete	m^3	R 350.00
340mm thick /deep concrete slabs	m^3	R 400.00
220mm thick brick wall buildings (single storey) Face brick building, 14.8 x 10m x 4.4m high, consisting of 600 x 230mm strip footings laying 655mm deep, 150mm surface bed finished off with ceramic floor tiles including 110mm internal walls, with 1000 x 100mm apron around building and Roller shutter doors at service hatch 3000 x 1200mm. Ceilings at 2805mm high. Roof trusses 1600mm high at centre with 500mm overhang, pitching 15 degrees and 0.6mm IBR profiled colomet roof sheeting, ridge capping, fascia boards, barge boards, gutters and downpipes.	m^2	R 447.27
Face brick building, 48 x 12.46m x 7.85m high, consisting of 750 x 300mm strip footings laying 755mm deep, 150mm surface bed finished off with ceramic floor tiles including 110mm internal walls, with 1000 x 100mm apron around building. Ceiling below hollow block slab at 2805mm high. 1st floor hollow block slab, 255mm thick finished off with ceramic floor tiles. Stairs to 1st floor 220mm threads x 150mm risers and slab to wall at 1400mm high in middle and to one side	m^3	R 435.00

Rehabilitation and Demolition	Unit	Rates
of building. Ceilings at 2890mm high. Prefabricated roof trusses 1900mm high at centre with 500mm overhang, pitching 15 degrees and 0.6mm colomet roof sheeting, ridge capping, fascia boards, barge boards, gutters and downpipes. Canopy at entrance to building 3m wide x 2.8m high		
Excavating foundations 600 x 230 x 655mm deep strip footings	m^3	R 320.00
Light steel construction cladded with corrugated iron (car ports etc.) Carports 7.5m x 11m, consisting of 6 x 75 SHS Columns in 500mm deep concrete bases with colomet 6mm IBR roof sheeting on 75 x 75 SHS Curved purlins (one carport size 5.5 x 2.5m x 2.3m high)	m^2	R 53.13
Medium steel construction buildings (corrugated iron cladded workshops and sheds with concrete floors)	m^2	R 290.00
Dismantle, break down and remove plant structure, not exceeding 15m height	m^3	R 171.85
Demolish and remove 48kg/m railway line on P2 concrete sleepers, including fasteners, pads & clips.	m	R 80.00
Up to 400mm Diameter piping	m	R 37.69
Greater than 400mm Diameter piping	m	R 67.90
Dismantle and remove Cattle Fencing not exceeding 1.2m high, including posts, gates, foundations, etcetera	m	R 12.00
Dismantle and remove Mesh Fencing not exceeding 1.8m high, including posts, gates, foundations, etcetera	m	R 12.00
Dismantle and remove Security Fencing exceeding 1.8m high, including posts, gates, foundations, etcetera	m	R 13.50
Dismantle and remove Steel Palisade Fencing exceeding 1.8m high, including posts, gates, foundations, etcetera	m	R 22.00
Dismantle and remove Palisade Concrete Fencing exceeding 1.8m high, including posts, gates, foundations, etcetera	m	R 22.00
Dismantle and remove Electric Fencing not exceeding 2.1m high, including posts, gates, foundations, etcetera	m	R 22.00
Dismantle and remove Diamond Mesh Fencing not exceeding 2.4m high, including posts, gates, foundations, etcetera	m	R 22.00
Dismantle and remove Precast walling not exceeding 1.8m high, including posts, gates, foundations, etcetera	m	R 22.00
Wildlife fence 1.8m	m	R 140.00
15m H Pole structure complete with double 11kV Wolf conductor (6 x ACSR) and all accessories	m	R 45.00
Demolition of reinforced concrete silo 20m high	m^3	R 89.77
Disconnect and remove 2 x MCC panels. Demolish and remove face brick building 6,5 x 9 x 5.05m high to roof truss, strip footings laying 750mm deep, 6 x 2m high columns with 300mm thick concrete slab on columns. Steel stairs and hand railing to 1st floor. Steel roof structure 1,6m high to pitch.	no	R 26,850.00

Rehabilitation and Demolition	Unit	Rates
Disconnect and remove transformers, demolish transformer room brick building, 3 x 3 x 4m high.	no	R 10,850.00
Remove fuel pumps & tank	m³	R 850.00
Remove overhead workshop cranes 15 Ton Single Girder crane - 20m wide	no	R 6,500.00
Drain and fill French drain	no	R 6,585.00
Filling of Soakaways	no	R 6,585.00
Remove water tank	m³	R 450.00
Permatank	m³	R 850.00
Overland conveyor	m	R 540.00
Earthworks, break-up and level	m³	R 40.01
6m Office	no	R 1,500.00
12m Office	no	R 1,500.00
9.6m Park home	no	R 1,500.00
Quarry maintenance	ha	R 10,000.00
No cost incurred	n/a	R -
Ripping of dirt road	m²	R 14.89
Ripping of previously tar surfaced surface areas (tar removal measured elsewhere)	m²	R 21.31
Remove tarred surface areas not exceeding 50mm thick	m²	R 25.87
Break-up and remove paving bricks	m²	R 34.94
Break-up and remove concrete paving	m²	R 30.51
Demolish reinforced concrete	m³	R 950.69
Remove pumps and piping and demolish pump room size 3,5 x 5,25 x 3m high.	no	R 1,805.75
Drain dam, leave to dry, remove liner	m²	R 18.63
Earthworks, break-up and level*	m³	R 40.01
Traditional seeding	m²	R 3.36
Grass	m²	R 43.08
Enviroberm	m	R 22.55
Hydro seeding	m²	R 26.50

* Rating has been changed to include the sloping of the WRD and plant area.

List of infrastructures

The infrastructure on the mine extension consist only of a haul road and the pits itself. The haul road will be 860m long and 10m wide. The pits will be a maximum surface area of 261,000m² and volume of 3,280,262,000m³.

Costs assumptions

- The haul roads will be ripped and removed at end of LoM.
- The pits will be concurrently filled as part of roll-over mining, therefore no WRD or overburden dumps.
- A void of 58,859,000m² will be left as a farm dam.
- Monitoring of rehabilitation, erosion and groundwater must be included.
- Seeding of rehabilitated areas and replanting of Sheppard's Trees must be included.
- The first year's financial provision is included.

Table 32: Financial provision first year

Item	Size (m / m² / m³)	Rate	Final cost
Infrastructure removal			
Haul road	R 8,600.00	R 14.89	R 128,054.00
Sloping of topsoil			
Quarry	R 52,200.00	R 8.09	R 422,298.00
Vegetation			
Seeding first year	R 44,933.33	R 3.36	R 150,976.00
Sheppard's Tree	Estimate	R 30,000.00	R 30,000.00
Removal of alien vegetation	Estimate	R 30,000.00	R 30,000.00
Monitoring			
Soil erosion, vegetation growth, and alien vegetation monitoring	First year	R 30,000.00	R 30,000.00
Groundwater monitoring	Quarterly for first year	R 30,000.00	R 120,000.00
Sub-total			R 911,328.00
P&G (13.5%)			R 123,029.28
Contingency (10%)			R 91,132.80
Total			**R 1,125,490.08**

2 Confirmation of the amount that will be provided should the right be granted

The amount of R 1,125,490.08 will be provided should the right be granted.

3 Method of providing financial provision contemplated in regulation 53

This amount will be provided using a bank guarantee.

4 Capacity to manage and rehabilitate the environment

Refer to the tables in Part A(g)(v) for a description of the environmental budget.

t) Deviations from the approved scoping report and plan of study

There is no deviation from the scoping report. All comments have been included in this EIA/EMP.

u) Other Information required by the competent Authority

i) Compliance with the provisions of sections 24(4)(a) and (b) read with section 24 (3) (a) and (7) of the National Environmental Management Act (Act 107 of 1998)

(1) Impact on the socio-economic conditions of any directly affected person

Refer to Part A(g)(v) above.

(2) Impact on any national estate referred to in section 3(2) of the National Heritage Resources Act

Refer to Part A(g)(v) above.

v) Other matters required in terms of sections 24(4)(a) and (b) of the Act

None

PART B

ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT

1) Draft environmental management programme.

a) Details of the Environmental Assessment Practitioner

Refer to Part A(a) for the requirement for the provision of the details and expertise of the EAP.

b) Description of the Aspects of the activity

The requirement to describe the aspects of the activity that are covered by the draft EMP is already included in Part A(1)(h), and (g)(v) herein as required.

c) Composite map

Refer to Addendum 1 for all the maps.

d) Description of impact management objectives including management statements

i) Determination of closure objectives

1 End land use

The end land-use has been identified as grazing and game farming. Water accumulating within the remaining void will be utilised and optimised to compliment the end land-use. Sloping should be at a safe angle for cattle and other animals to graze on site and provide easy access to the water. Sloping should allow for free drainage and prevent siltation of the water resources.

2 Residual impacts

2.1 Geology

The removal of geology will be permanent and therefore the impact will be permanent and therefore a residual risk.

2.2 Soil, pre-mining land capability and land use

Erosion of rehabilitated areas and erosion of final void edges; safety risks caused by water in the final void.

2.3 Vegetation and animal life

According to the specialist, if proper revegetation takes place there will be no residual risk. The removal of the red date trees may be a residual risk if these trees cannot be replanted.

2.4 Surface water

A natural depression will remain post-closure where surface water will likely accumulate.

2.5 Groundwater

The groundwater quality is not expected be affected in terms of quality and the water level will recover post closure. Therefore no/little residual impacts are expected.

3 Closure objectives

The closure objective is to restore the land to a self-sustaining, aesthetically pleasing landform and planted to pasture that could be used for grazing by the surrounding communities.

4 Rehabilitation process

Information for this section was extracted from the Soil, land capability and land use assessment (Rehab Green, 2017) with some inclusions from Imerys (material balance), Executive Summary (Galago Environmental Biodiversity and Aquatic Specialists, 2017), and Groundwater Impact Assessment (Groundwater Complete, 2017).

4.1 Principles for stripping and stockpiling of topsoil in general

It is important to have knowledge of the primary principles of soil stripping and stockpiling although stockpiling is not planned at the current operation. Stripping and stockpiling has an impact on soil, land capability and land use, but it is important to realize that the way this action is performed is also the first and one of the most important mitigation measures. The impact on soil, land capability and land use are mitigated by means of the rehabilitation process which commences with stripping and stockpiling of topsoil before mining takes place and is not a process that starts with replacing of topsoil after or during the mining operation. Rehabilitation and subsequent mitigation of soil, land capability and land use consists therefore of the following phases:

- Stripping and stockpiling of topsoil
- Filling of open pits and levelling of spoil material to a free draining surface
- Replacing and levelling of topsoil and preparation of the surface
- Soil amelioration and re-vegetation

If the first phase of rehabilitation namely stripping and stockpiling of topsoil, is not done with the aim of reinstating post-mining land capability similar to pre-mining land capability, then successful rehabilitation will not be achieved and it will probably result in a serious deterioration from pre-mining to post-mining land capability.

In practice, even with optimal rehabilitation procedures applied, some deterioration from pre-mining to post-mining land capability is unavoidable. It is therefore crucial to follow the proposed rehabilitation procedures as far as possible in order to minimise degradation of soil characteristics and to re-establish the highest possible post-mining land capability.

The term topsoil refers to the A and B-horizons of the soil profile as defined in the Taxonomic Soil Classification system for South Africa. The A-horizon comprises the upper part (0-300 mm) of the soil profile and the B-horizon from 300 mm up to the stripping depth specified per soil type indicated in Figure 41. The characteristics of soil horizons (A- and B-horizons) are further described in Appendix E in terms of soil stripping, stockpiling and replacing.

Stripping, stockpiling and replacing of topsoil has a very high impact on soil, land capability and land use and the procedures followed during execution of these actions directly influence the post-mining land capability and consequently determine the degree of deterioration from pre-mining to post-mining land capability. They also directly determine the possible post-mining land uses.

During stripping and stockpiling the following principles should be aimed for:

- **Prevent mixing of high quality topsoil (A and B-horizons) with low quality underlying material to ensure sufficient volumes of high quality soil for rehabilitation.** The quality of soil earmarked for rehabilitation purposes significantly deteriorates when the high-quality topsoil is mixed with the underlying poorer quality material (clay layers, calcrete, plinthite, weathered rock etc). This results in significant deterioration in the quality of the soil's physical and chemical properties and a decline in the soil fertility necessary for re-vegetation. The deterioration in soil quality also significantly increases the susceptibility of rehabilitated soils for erosion and seal and crust formation.

- **Separate stockpiling of different soil type groups to obtain the highest post-mining land capability.** Topsoil quality or potential is not just limited to the grade of soil generally referred to as topsoil but can vary from very high to low due to various properties. Soil properties of different soil types can vary substantially e.g. high quality red and yellow well-drained soils and low-quality grey poorly drained wetland soils can occur over very short distances in the same field. Mixing of different soil types results in rapid changes in soil properties and characteristics such as texture, infiltration rates and water holding capacity over short distances after replacement, which will definitely adversely affect the post-mining land capability. Contrary to the general perception, separate stockpiling of different soil types does not have significant cost implications for the mine and only requires planning and continuing management.

- **Separate stripping, stockpiling and replacing of soil horizons (A and B-horizon) in the original natural sequence to combat hard-setting and compaction, maintain soil fertility and conserve the natural seed source.** The higher soil fertility of the A-horizon, especially phosphorus and carbon contents, declines significantly when it is mixed with the B-horizon, resulting in poorer re-vegetation success. It also increases the susceptibility to compaction and hard setting. The A-horizon also serves as a seed source which will enhance the re-establishing of natural species. The A and B-horizons should be stripped and stockpiled separately and replaced with the A-horizon overlying the B-horizon. Contrary to the general perception, separate stockpiling of different soil types and horizons does not have significant cost implications for the mine and only requires planning and continuing management. Separate stripping, stockpiling and replacing of the A and B horizons in the same sequence is the ideal procedure but goes along with practical, mechanical and cost implications and is mostly not achievable without proper management.

The soil horizons and properties influencing stripping and stockpiling procedures are discussed in Appendix E of the the Soil, land capability and land use assessment (Rehab Green, 2017).

4.2 Handling of topsoil during construction to decommissioning phase

4.2.1 Roll-over mining of open pit and levelling of overburden material

Before topsoil can be replaced, the open pit should be filled to an elevation as similar as possible to the pre-mining topography in order to ensure a continuation of the pre-mining surface drainage pattern. The surface should be surveyed by a surveyor in order to ensure that it has the correct elevation and slopes to be free draining. A non-free draining surface results in local depressions of periodically saturated zones and increased percolation which usually leads to localised subsidence of underlying overburden material. Slopes of the overburden surface should therefore be as similar to the pre-mining surface as possible and should change gradually since abrupt changes in slope gradient increase the susceptibility for erosion initiation.

The mine has a material balance which indicates the amount of material to be moved. The current state of material is shown in Figure 37 below. Figure 38 shows how the material will be moved in phase 1. Material will be moved to the already existing pits. Figures 39 and 40 indicates the moving of material within the new pits. During the rehabilitation period, the quarry will start filling with groundwater seepage to reinstate the equilibrium with surrounding aquifers. The rehabilitation should however aim at minimizing infiltration to the rehabilitated quarry, since this will cause higher decant rates, that, if contaminated, will need to be managed. The final surface needs to be free-draining to minimize recharge.

A final void will remain on portion 62 of Cyferfontein. This void must be shaped in such a way that it is shallow enough for the establishment of birds and to ensure the safety of any animals on the farm. The establishment of a bird hide must be discussed with the farmer.

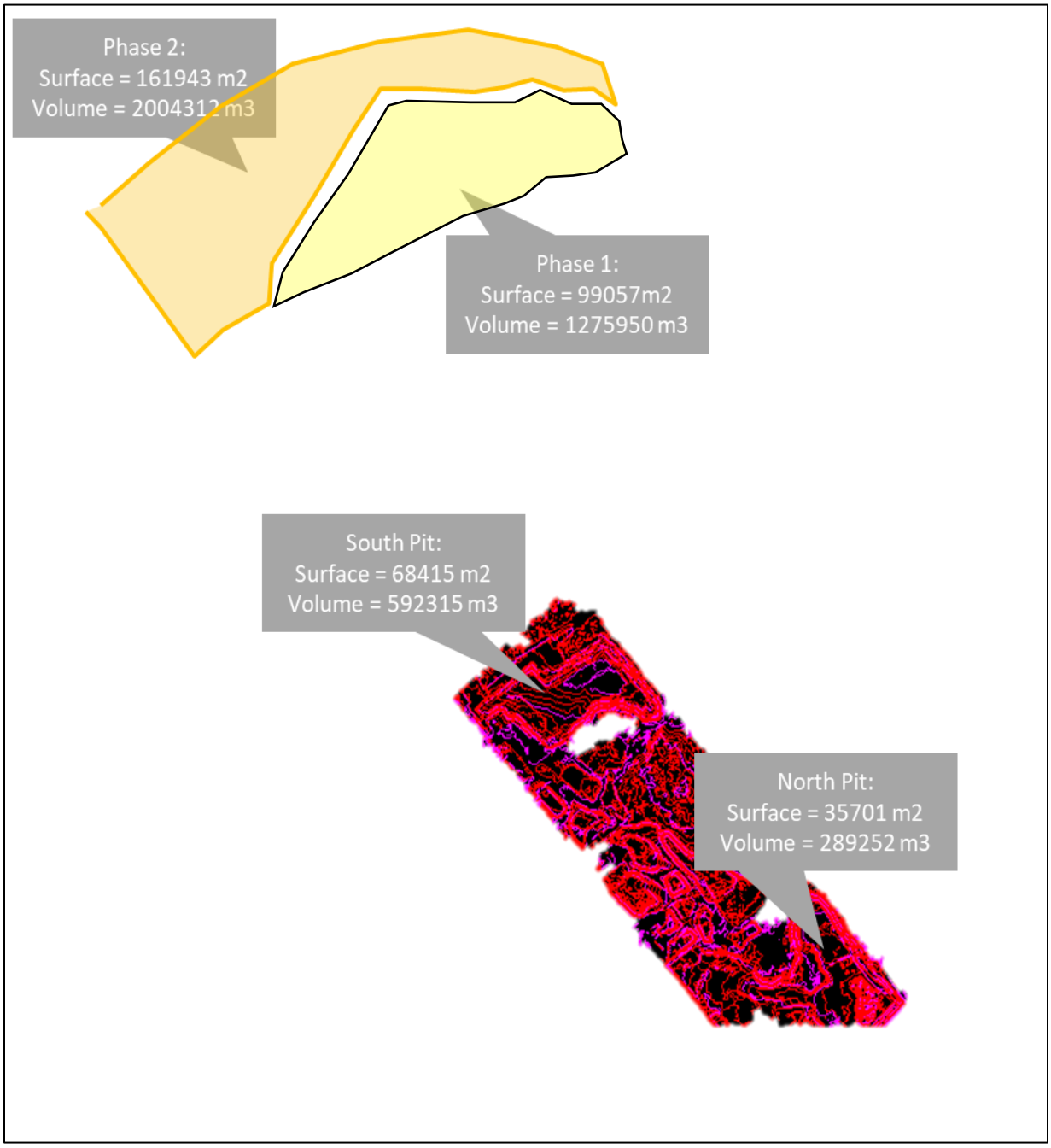


Figure 37: Material balance current state

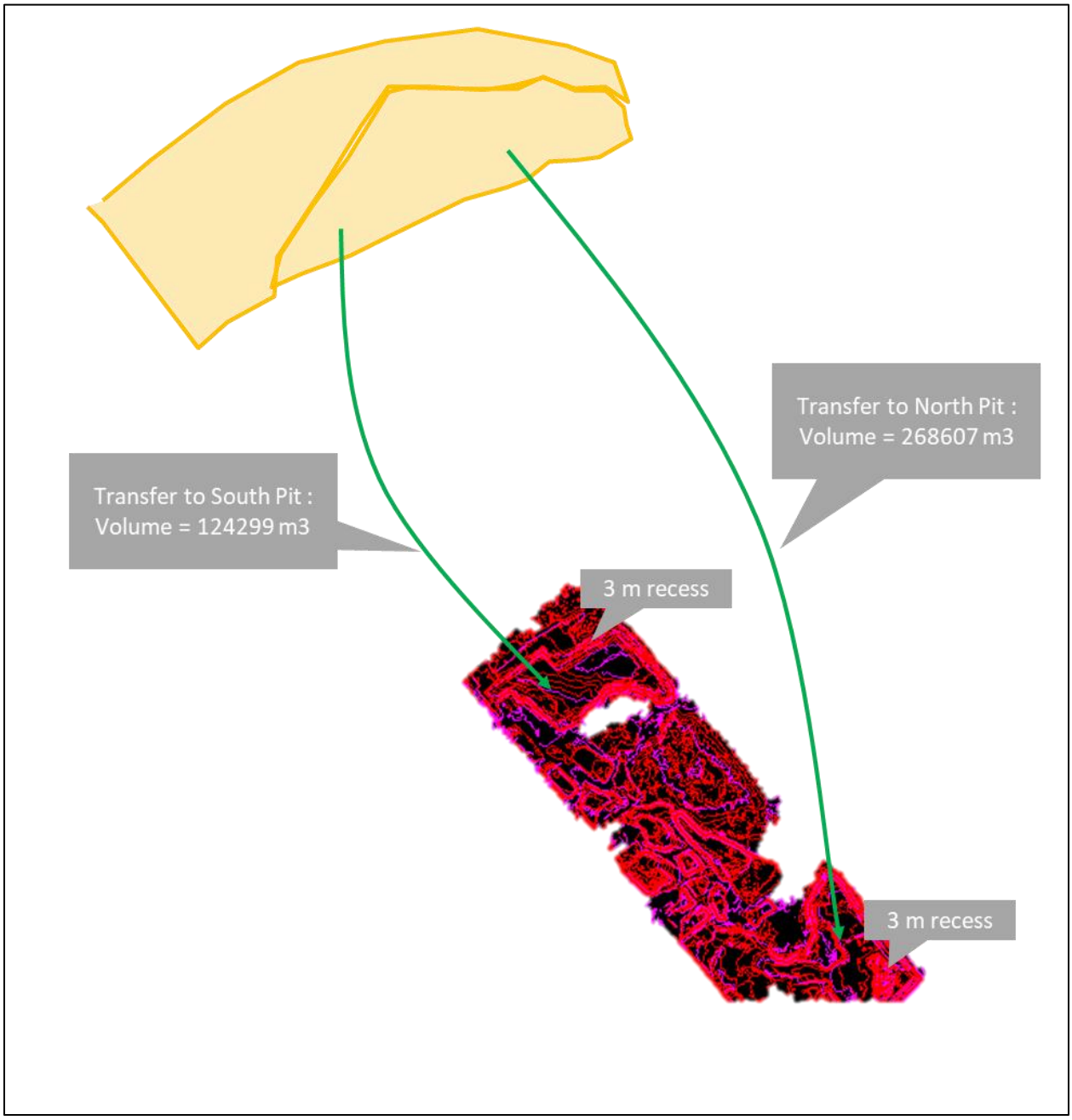


Figure 38: Removal of material in phase 1

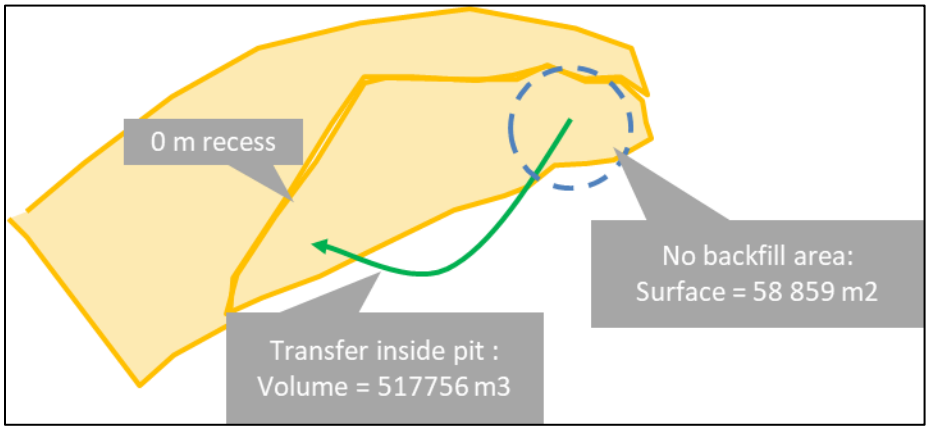


Figure 39: Removal of material in phase 2

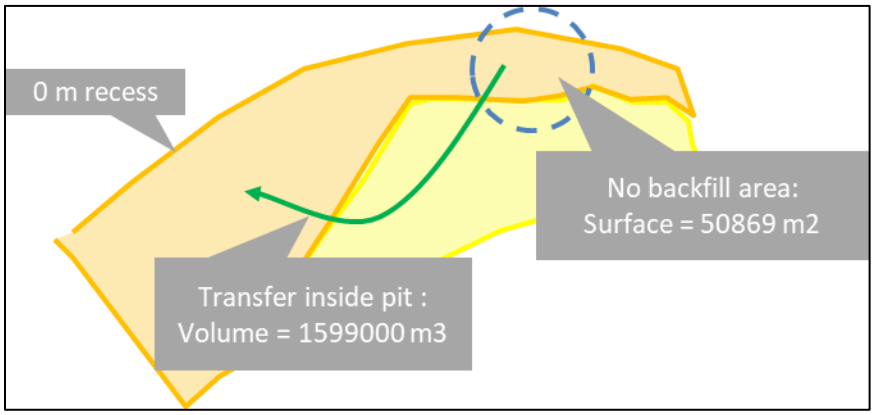
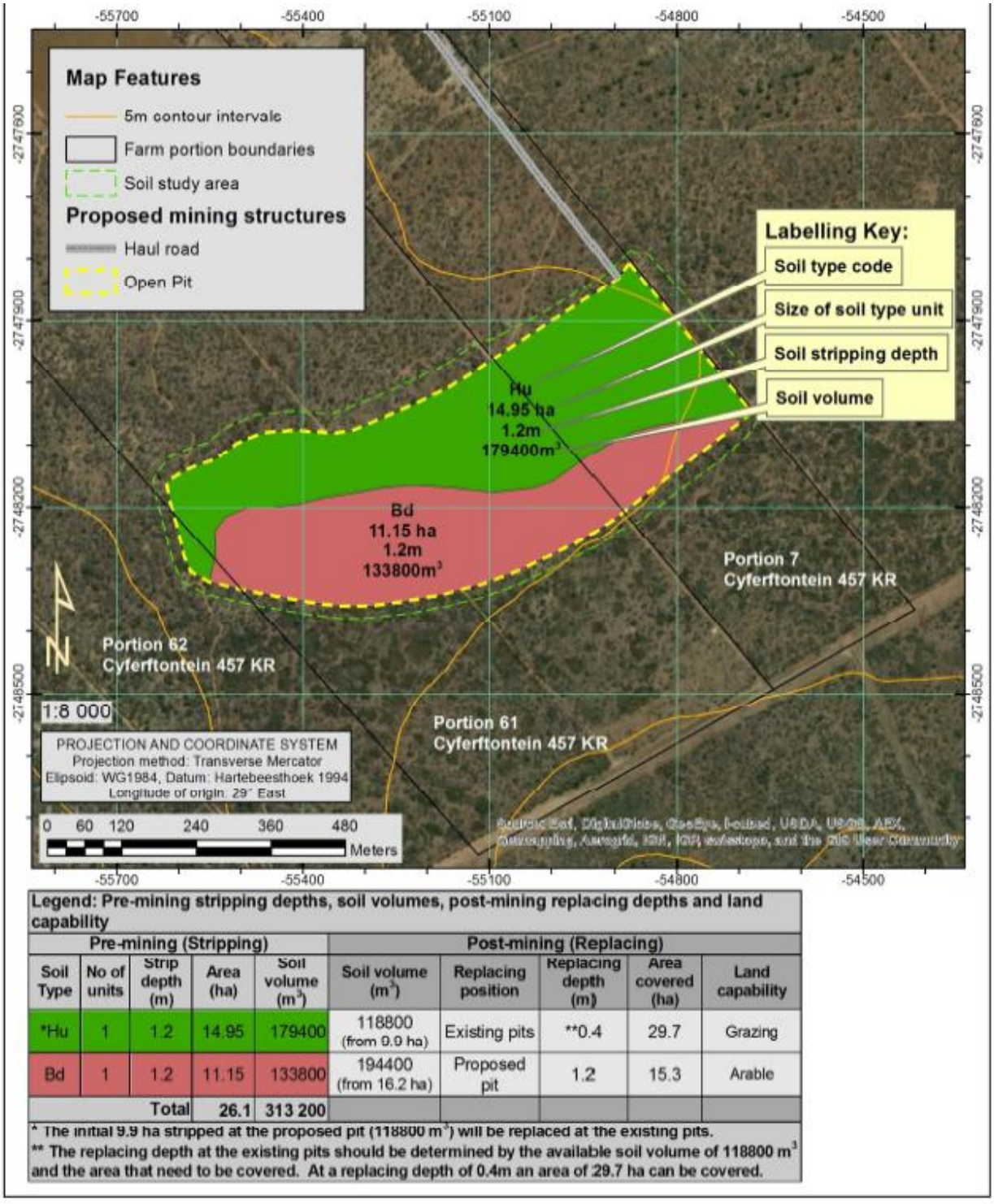


Figure 40: Removal of material in phase 3

4.2.2 Stripping and direct replacing of topsoil at open pit area

The following guidelines are applicable to the phase where topsoil is stripped and directly replaced at the filled areas. This can general not be done at the beginning of the operational phase and topsoil has to be stockpiled until sections of the open pit are filled and ready for direct topsoil replacement. The Client, however, indicated that the topsoil of the initial open pit section, comprising 9.9ha, will be replaced directly at the existing open pit area. Therefore, for all practical purposes, only direct topsoil replacing will take place at the proposed open pit and no topsoil will be stockpiled.



Legend: Pre-mining stripping depths, soil volumes, post-mining replacing depths and land capability

Pre-mining (Stripping)					Post-mining (Replacing)				
Soil Type	No of units	Strip depth (m)	Area (ha)	Soil volume (m^3)	Soil volume (m^3)	Replacing position	Replacing depth (m)	Area covered (ha)	Land capability
*Hu	1	1.2	14.95	179400	118800 (from 9.9 ha)	Existing pits	**0.4	29.7	Grazing
Bd	1	1.2	11.15	133800	194400 (from 16.2 ha)	Proposed pit	1.2	15.3	Arable
		Total	26.1	313 200					

* The initial 9.9 ha stripped at the proposed pit (118800 m^3) will be replaced at the existing pits.
** The replacing depth at the existing pits should be determined by the available soil volume of 118800 m^3 and the area that need to be covered. At a replacing depth of 0.4m an area of 29.7 ha can be covered.

Figure 41: Soil stripping depth and soil volumes guide

Figure 41 and Table 33 shows the pre-mining soil types, the size of the soil types units, the stripping depth and the available soil volumes of the proposed open pit area. Table 33 shows that soil types Hu and Bd

should be stripped to a depth of 1.2m and will yield a total soil volume of 313,200m³. The initial 118,800m³ of topsoil, stripped from 9.9ha, will be replaced at the existing south and north pits. The remaining 194,400m³ will be directly replaced at the proposed pit to a depth of 1.2m and will cover an area of 15.3ha. The remaining 10.8ha will become a final void that will not be covered with topsoil and will be classed as wilderness land capability. The Client indicated that the final void was requested by the current land owner, with the aim to be used as a farm dam. The section of 15.3ha, that will be covered with 1.2m topsoil will has arable land capability, should slopes be less than 7% and stability are sufficient.

Table 33: Soil stripping and soil volume guide

Legend: Pre-mining stripping depths, soil volumes, post-mining replacing depths and land capability									
Pre-mining (Stripping)					Post-mining (Replacing)				
Soil Type	No of units	Strip depth (m)	Area (ha)	Soil volume (m^3)	Soil volume (m^3)	Replacing position	Replacing depth (m)	Area covered (ha)	Land capability
*Hu	1	1.2	14.95	179400	118800 (from 9.9 ha)	Existing pit	**0.4	29.7	Grazing
Bd	1	1.2	11.15	133800	194400 (from 16.2 ha)	Proposed pit	1.2	15.3	Arable
		Total	26.1	313 200					
* The initial 9.9 ha stripped at the proposed pit (118800 m^3) will be replaced at the existing pits. ** The replacing depth at the existing pits should be determined by the available soil volume of 118800 m^3 and the area that need to be covered. At a replacing depth of 0.4m an area of 29.7 ha can be covered.									

Care should be taken to tip enough soil per square unit to reinstate the total required post-mining soil depth at once. Spreading of soil over far distances and repeated traversing of heavy mechanical equipment should be minimised in order to prevent compaction in the lower profile which is difficult to alleviate afterwards. The dumped soil heaps should thus only be levelled on top to reach the required soil thickness. Caterpillar-type tracked equipment is preferred for levelling of topsoil because these tracks cause less compaction. Bowl scrapers cause enormous compaction and should not be used. The replaced topsoil thickness should be progressively monitored during replacement to prevent encountering shortages of topsoil.

4.2.3 Soil amelioration and re-vegetation

- The soil fertility status should be determined by soil chemical analysis after levelling (before seeding/re-vegetation).
- Soil amelioration should be done according soil analyses as recommended by a soil specialist, in order to correct the pH and nutrition status before revegetation.

- The footprint should preferably be re-vegetated with a grass seed mixture and the soil stability and erosion should be monitored afterwards.
- Crop farming is not recommended but can be introduced on those areas declared suitable for crop farming by a soil specialist after a post-mining soil and land capability assessment was done.
- The mine will also investigate the replanting of indigenous trees.
- Re-vegetation should be done as soon as possible and preferably in spring and early summer to stabilize the soil and prevent soil loss during the rainy season.
- A short-term fertilizer program should be based on the soil chemical status in order to maintain the fertility status for 2 to 3 years after rehabilitation until the area can be declared as self-sustaining.
- A Protected Trees permit must be obtained from the Department of Forestry with management measures to propagate, move or replant trees in rehabilitated areas.
- The removal of exotic succulent plants such as queen-of the night and prickly pear is imperative.

4.3 Post-mining land capability requirements

The post-mining land capability class will be determined mainly by the soil type and the thickness of the soil layer placed back on the overburden surface. Other factors and characteristics that might influence the post-mining land capability are slope, erodibility, compaction and reduction of soil quality due to contamination of soils by subsoil, soft overburden or spoil material. A post-mining land capability assessment needs to be done by a soil specialist by means of auger observations at a grid spacing of 100m x 100m. This is required to evaluate the rehabilitation procedures and to verify that the topsoil thickness is at least 1.0m thick. A final post-mining land capability map needs to be compiled and should be submitted for closure purposes.

ii) The process for managing any environmental damage, pollution, pumping and treatment of extraneous water or ecological degradation as a result of undertaking a listed activity

Refer to Part A(d)(i).

iii) Potential risk of acid mine drainage

The following was extracted from the Cyferfontein Mine Quarry Water Quality Report (Aquatico, 2017):

The typical impacts on groundwater quality caused by mining of certain minerals with specific sulphide or gangue minerals (e.g. pyrite) in the soil/rock, include different chemical reactions such as ion exchanges, mobilization and precipitation of ions and / or groups of ions. Sulphate (SO4) related chemical reaction is one of the most important reactions in this regard. SO4 related reactions take place when it enters the groundwater system through oxidation of pyrite through chemical weathering, mining, washing or percolation through stockpiles of the host material.

Iron sulphate forms, as well as sulphuric acid (H2SO4), causing decreases in the pH and mobilization of metal ions (that are usually more soluble at a low pH), the reactions collectively referred to as “acid mine drainage”.

AMD reactions are prevalent in precious and base metal mining environments where sufficient metal sulphide minerals (mainly pyrite) are present. It also occurs widespread in the coal mining environment due to the presence of pyrite. Sulfur is a necessary element for the sustenance of all living systems. It is therefore not at all surprising that sulfur is found in abundance in coal, a rock composed primarily of organic detritus. The forms of sulfur in coal as reported by chemical analyses are organic sulfur, pyritic or sulfide sulfur, and sulfate sulfur (USGS, 1978).

The potential for a mining operation to produced AMD (e.g. to cause mine and groundwater to become acidic) is tested by conducting static acid-base-accounting (ABA) tests on the mined rock/mineral as well as on all the different waste rock materials - overburden, interburden and under-burden. This is done by pulverizing the rock samples, analyzing for the inorganic content and calculating various ratios that indicate whether the rock will eventually cause the water environment to become acidic. This usually occurs if the sulphur content is such that there the acid generating potential is higher than the base (buffer) potential in the rock composition. Static ABA tests provide a snap-shot indication of the potential of the rock to produce acidic water under oxidizing conditions.

Recently, industry best practice is to conduct kinetic tests where representative rock samples are put in containers and kept under specific moisture conditions (referred to as humidity cells) and a leachate sample of distilled water through the rock column is obtained and analysed weekly. The results over time after more than 20 weeks are interpreted and reactions are modeled to indicate potential for acidification. The kinetic tests are a step better than static ABA and provide a reaction series over time and provide a better idea of the oxidation and acid-generating reactions over time.

Both the test types described above are laboratory scale based on assumptions of moisture content, particle size distribution and numerous others and are also based on a very short time (geologically speaking).

The actual situation where mining has been ongoing and water has been in contact with the mined reserve and waste material remains the only proof of the mine becoming acid or not. At Cyferfontein the quarry operation has been ongoing for some decades and rain water has been in contact with the mined flint clay as well as the overburden and other waste rock material. There are no indications of acidity in the water. In fact, the water in the pits is of better quality than the upgradient (natural, unaffected) groundwater.

- To summarize the AMD situation at the Cyferfontein Quarry:
- The mined material is flint clay;
- The overburden and waste rock material consist of clay, silt and sand;
- No pyrite or other metal sulphide mineral is known to occur.
- Rain water run-off that has been in contact with the mine reserve and waste material shows no signs of becoming acidic.

As such, acid mine drainage does not apply to the Cyferfontein operation.

iv) Steps taken to investigate, assess, and evaluate the impact of acid mine drainage

Refer above, not necessary.

v) Engineering or mine design solutions to be implemented to avoid or remedy acid mine drainage

Refer above, not necessary.

vi) Measures that will be put in place to remedy any residual or cumulative impact that may result from acid mine drainage

Refer above, not necessary.

vii) Volumes and rate of water use required for the mining, trenching or bulk sampling operation

Water from the quarries will be removed and used for dust suppression. No water is used for the mining of the pit itself. Approximately 6,351m^3 water will be removed from the quarry per day.

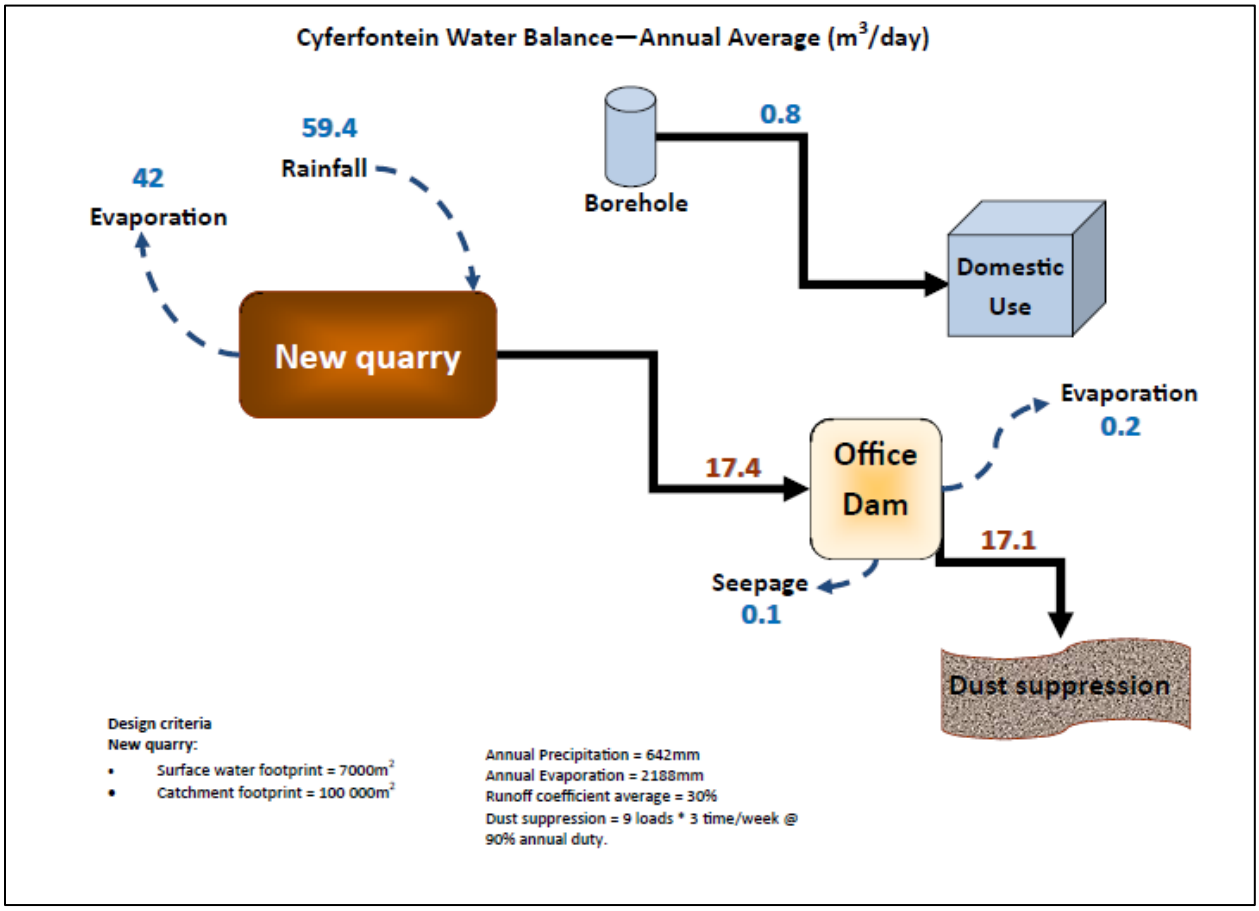


Figure 42: Cyferfontein water balance

viii) Has a water use licence has been applied for?

The mine is in the process to apply for a WUL.

ix) Impacts to be mitigated in their respective phases

Refer to Part A(g)(v) as well as Part A(i) of this report.

e) Impact management outcomes

Refer to Part A(g)(v) as well as Part A(i) of this report.

f) Impact management actions

Refer to Part A(g)(v) as well as Part A(i) of this report.

g) Financial provision

(a) Describe the closure objectives and the extent to which they have been aligned to the baseline environment described under Regulation 22 (2) (d) as described in 2.4 herein

Refer to Part B(1)(d) for closure objectives.

(b) Confirm specifically that the environmental objectives in relation to closure have been consulted with landowner and interested and affected parties

This EIA/EMP will first be send to all registered I&APs and stakeholders. Any comments from them will be included in the final EIA/EMP.

(c) Provide a rehabilitation plan that describes and shows the scale and aerial extent of the main mining activities, including the anticipated mining area at the time of closure

Refer to Part B(1)(d)(4) for a rehabilitation plan.

(d) Explain why it can be confirmed that the rehabilitation plan is compatible with the closure objectives

The closure objective is to restore the land to a self-sustaining, aesthetically pleasing landform and planted to pasture that could be used for grazing by the surrounding communities. The rehabilitation step in the EIA/EMP aims to achieve this objective.

(e) Calculate and state the quantum of the financial provision required to manage and rehabilitate the environment in accordance with the applicable guideline

Refer to Part A(s).

(f) Confirm that the financial provision will be provided as determined

Refer to Part A(s).

h) Mechanisms for monitoring compliance with and performance assessment against the environmental management programme and reporting thereon

Baseline monitoring is required to establish existing conditions that will help to define the requirements for site restoration and provide a basis for comparison of effects during the operation. Compliance monitoring should be carried out during the operation to ensure that the specified target limits are being met. The following environmental monitoring will be conducted at Cyferfontein Mine.

i) Monitoring of impact management actions

Source activity	Impacts requiring monitoring programmes	Functional requirements for monitoring*	Roles and responsibilities	Monitoring and reporting frequency and time periods for implementing impact management actions	Reference in EIA/EMP
Stripping of all topsoil and ore abstraction.	Total abstraction of the ore body takes place.	Monitor mining plan.	Mining manager	Continuous monitoring	Part A(g)(v)(1)
	Deterioration in soil quality.	Monitor topsoil stripping and replacement depths.	Environmental Manager	Continuous monitoring - throughout the mining and rehabilitation process	Part B(h)(i)(1)
	Destruction of indigenous vegetation, protected trees, red data trees, and faunal/avifaunal woodland habitat	Monitor the mining footprint areas and ensure that mining activities do not encroach onto neighbouring natural areas.	Environmental Manager	Continuous monitoring - throughout the mining and rehabilitation process	Part A(g)(v)(1)
	Destruction of alien and/or invasive plant species	Monitor the spread of alien and/or invasive vegetation species into the surrounding area.	Environmental Manager	Continuous monitoring - throughout the mining and rehabilitation process	Part A(g)(v)(1)
	Flooding risk	Inspect storm water berms and drains that it is not damaged, eroded or blocked.	Mining manager	Continuous monitoring	Part B(h)(i)(2)
	The groundwater quality may be impacted on by the mining operation.	Groundwater levels monitoring.	Environmental Manager	Quarterly (or as per IWUL)	Part A(g)(v)(1)
		Groundwater quality monitoring.	Environmental Manager	Quarterly (or as per IWUL)	Part A(g)(v)(1)

Source activity	Impacts requiring monitoring programmes	Functional requirements for monitoring*	Roles and responsibilities	Monitoring and reporting frequency and time periods for implementing impact management actions	Reference in EIA/EMP
	Cultural and heritage resources	Inspection of areas for any heritage resources, during stripping of the topsoil.	Environmental Manager	Prior to commencement of mining	Part A(g)(v)(1)
	Safety of community.	Monitoring as per the CoP	Mining manager	Continuous monitoring	Part A(g)(v)(1)
	Clay on roads	Inspection of roads.	Mining manager	Continuous monitoring	Part A(g)(v)(1)
Stripping of all topsoil and ore abstraction and rehabilitation	Soil erosion.	Erosion occurrences	Environmental Manager	After every rain	Part B(h)(i)(2)
	Air quality impact	Air quality monitoring (refer to Part A(g)(v)(1.6.1)	Environmental Manager	Monthly	Part A(g)(v)(1)
	Environmental noise	Environmental Noise Surveys	Environmental Manager	Regular intervals	Part A(g)(v)(1)
	Visual aspects	Monitor rehabilitation	Environmental Manager	Continuous monitoring	Part A(g)(v)(1)
Placement of overburden and topsoil back into the quarry.	Minor to no impact on groundwater quality	Ensure surface drainage away from the quarry.	Mining manager	Continuous monitoring	Part A(g)(v)(1)
Vehicles and machinery	Pollution from hydrocarbons.	Inspection of all vehicle and machinery should be inspected.	Operators	Daily	Part A(g)(v)(1)
		Report leakages.	Operators	Immediately	Part A(g)(v)(1)
		Service and maintain all machinery in proper equipped facility.	Mining manager	As per maintenance register	Part A(g)(v)(1)
Generation of waste	Waste generation	Waste monitoring	Mine Manager	Volumes – monthly Contractors and disposal agents - inspected biennially	Part B(h)(i)(3)

Source activity	Impacts requiring monitoring programmes	Functional requirements for monitoring*	Roles and responsibilities	Monitoring and reporting frequency and time periods for implementing impact management actions	Reference in EIA/EMP
Additional audits	Impacts of mine water on surface and groundwater	GN 704	Environmental Manager	Biennially	Part B(h)(i)(4)
	All components of environment	Housekeeping	Mine Manager	Monthly	Part B(h)(i)(4)
		Environmental legal compliance audits	Mine Manager	Biennially	Part B(h)(i)(4)

*Refer below for a complete description

1. Soil

- The topsoil stripping depth (1.2m) and replacement depths (at least 1.0m) should be monitored throughout the mining and rehabilitation process.
- It is recommended that the operators of stripping equipment are well informed of the correct stripping depth and that it is inspected by the rehab officer on a weekly basis.
- It is recommended that depth markers are placed (by a surveyor) on surfaces that are prepared for topsoil replacement in order to guide operators and ensure correct post-mining soil depths.
- A post-mining soil and land capability assessment should be done by a soil specialist who is registered by the South African Council for Scientific Professions at the end of the mining operation in order to determine the post-mining land capability and land use potential. A postmining soil and land capability map should be compiled that should be submitted with the closure application.

2. Erosion

- Checks must be carried out at regular intervals to identify areas where erosion is occurring.
- Regular inspections should be conducted on all channels, trenches, berms and pollution control dams to ensure function and capacity of infrastructure is maintained as well as maintenance where signs of erosion become evident. High risk erosion areas include all road and berms where surface water is concentrated into sheet flow.

3 Waste monitoring

As part of the monitoring programme the following will be conducted:

- Volumes of all waste generated and disposed of will be monitored and measured on a monthly basis and records kept, and
- All contractors and disposal agents, premises and disposal sites will be inspected biannually to ensure that all environmental and legal requirements are adhered to.

4 Additional audits

4.1 GN 704 Audits

Cyferfontein will need to comply with the Regulations GN 704, dated 4 June 1999, under the NWA, 1998, on the use of water for mining and related activities aimed at the protection of water resources.

The GN 704 Audits will be conducted every two years to identify the status of compliance against the requirements of GN 704. In addition to this, monitoring programmes will be reviewed and strengthened to assess the level of impact for areas of non-compliance with the requirements of GN 704.

4.2 General Housekeeping Audits

These audits will cover the overall housekeeping on the site. Audits will be conducted on a monthly basis by the Mine Management, with shortcomings recorded.

Legislation.

4.3 Legal compliance audit

Environmental Legal Compliance Audits will be performed every two years to determine the status of compliance against all applicable legislation and policies.

The mine will conduct a legal compliance audit in the near future to ascertain whether any application under any legislation is necessary.

ii) Monitoring and reporting frequency

Refer to Part B, section (j) above.

iii) Responsible persons

Refer to Part B, section (j) above.

iv) Time period for implementing impact management actions

Refer to Part B, section (j) above.

v) Mechanism for monitoring compliance

Refer to Part B, section (j) above.

i) Indicate the frequency of the submission of the performance assessment report

The performance of the EIA/EMP will be assessed every two years. A financial provision will accompany the EIA/EMP which will be updated on an annual basis. This financial provision update will be accompanied by a report on rehabilitation that has taken place.

j) Environmental awareness plan

This section includes:

1. Manner in which the applicant intends to inform his or her employees of any environmental risk which may result from their work; and
2. Manner in which risks will be dealt with in order to avoid pollution or the degradation of the environment.

The following was extracted from the Environmental training procedure (BECS Environmental, 2016).

i) Induction training

1. Induction training is relevant to all new employees and contractors (including any employee and/or contractor that has not yet been trained on the environmental induction material) as well as all visitors to Cyferfontein Mine.
2. Training will be repeated every 18 months.

3. Induction training will include the following:
   a. Relevant impacts and management as per the approved and operational EMP of Cyferfontein Mine (these will be site- and job specific);
   b. Environmental procedures; and
   c. Environmental emergency procedure.
4. The trainee will after completion of induction:
   a. Sign the necessary induction form/book; and
   b. Have all relevant PPE necessary for the specific job.

ii) General environmental awareness training

1. Management will identify environmental awareness needs and related environmental topics.
2. The environmental awareness will include:
   a. The significant environmental impacts, actual or potential, of their work activities and the benefits of improved personal performance; and
   b. The potential consequences of departure from specified operating procedures.

3. Environmental awareness training will form part of the safety talks prior to each shift.
4. Visual aids will be used, where applicable to help with awareness training. These could be in the form of posters displayed at specific work areas after training was done.

iii) Competency training

1. Management will identify job-related training needs for all employees who have or can have a significant impact on the environment.
2. A training needs matrix will be completed for Cyferfontein Mine.
3. Job specific training will convey the importance of conformance with the environmental procedures. Simplified summaries of these procedures may be used to ensure better understanding at lower levels of the organisation.

4. Management will identify specialised training needs. for personnel performing tasks, which can cause significant environmental impacts, or personnel who needs specialised environmental knowledge for areas of responsibility. These courses will be sourced externally.
5. Management will undergo legal training from time to time. A summary of this training wil also be given to employees of Cyferfontein Mine.

iv) Development of training material

1. The Health and Safety Officer will develop and maintain training material for induction training, general environmental awareness and competency training. This excludes specialised competency training which wil be externally sourced.
2. This training material will be based on the approved and operational EMP as well as environmental procedures. Additional topics will also be included for general environmental awareness.
3. Training material will be reviewed using results from audits, changes to plant/operation, competency assessments and new significant aspects.

v) Scheduling of training

1. Once training topics and material have been compiled, the Health and Safety Officer will ensure employees are scheduled according to the needs identified.

vi) Training records

1. Upon completion of training, a training record will be completed. This may be in the following formats:
   a. Attendance registers;
   b. Sign off on procedure to demonstrate understanding of procedure; and/or
   c. Certificates of attendance / completion.

2. All training records will be kept for the period of employment plus an additional 5 years.

vii) Reconciliation to determine gaps in attendance

1. All employees and contractors must undergo all training as identified (as per training needs analysis). Reconciliation will be done on all training attendance registers, against the training schedules, to identify any shortcomings in training performed and reschedule if necessary.

viii) Competency assessment

1. An evaluation will be conducted on all employees and contractors. The aim is to identify both the effectiveness of training as well as the competence in performing the job.

2. Competency evaluation records will be completed by the approved training assessor and will be included with the attendance records.

k) Specific information required by the Competent Authority

1 Financial provision

The financial provision will be reviewed on an annual basis.

2 Procedures for environmentally related emergencies and remediation

The following was extracted from the Environmental emergencies procedure (BECS Environmental, 2016).

2.1 List of environmental incidents

Description or activity	Aspect	Impact	Associated procedure and other records
Diesel tank	Burst of pipe, leakage from tank	Major spillage causing soil pollution	Spill handling procedure, Environmental Emergency Response Plan, diesel MSDS,
		Any spillage into a water resource	
Diesel tanker	Off-loading and loading spillages	Major spillage causing soil pollution	Spill handling procedure, Environmental Emergency Response Plan, diesel MSDS
		Any spillage into a water resource	
		Any spillage into a water resource	
Abnormal rainfall/floods	Overflow of dirty water infrastructure or mine residue	Major spillage causing soil pollution	Environmental Emergency Response Plan
		Any spillage into a water resource	
Veld fires	Veld fire through mining area	Destruction of fauna and flora, hazard to community	Environmental Emergency Response Plan, smoke detectors and fire-hose inspection checklists

2.2 Major spillages onto soil or spillages into water resources

1. Cyferfontein Mine will as soon as reasonably practicable after obtaining knowledge of the incident, report through the most effective means reasonably available:
   a. the nature of the incident;
   b. any risks posed by the incident to public health, safety and property;
   c. the toxicity of substances or by-products released by the incident; and

d. any steps that should be taken in order to avoid or minimise the effects of the incident on public health and the environment to:
    i. the DWS and/or the Limpopo Department of Economic Development, Environment, and Tourism;
    ii. the South African Police Services and the relevant fire prevention service;
    iii. the relevant head of municipality; and
    iv. all persons whose health may be affected by the incident.

2. Cyferfontein Mine will, as soon as reasonably practicable after knowledge of the incident:
    a. take all reasonable measures to contain and minimise the effects of the incident, including its effects on the environment and any risks posed by the incident to the health, safety and property of persons;
    b. undertake clean-up procedures;
    c. remedy the effects of the incident;
    d. assess the immediate and long-term effects of the incident on the environment and public health; and
    e. and take such measures as the catchment management agency may either verbally or in writing direct within the time specified by such institution.

3. Steps to be taken to contain, minimise and clean-up are as follow:
    a. Isolate and evacuate the affected area to prevent unauthorised access;
    b. If safe to do so, isolate source of leak or spillage to prevent further losses;
    c. Use appropriate PPE;
    d. Protect stormwater drains around the affected area by sealing them off:
    - Construct berm walls cross-stream using soil if pollution has escaped into drainage ditches; and
    - If possible construct temporary retention dams across stream using soil, and divert flow into them.
    e. Transfer any residual contents and contaminated absorbents to suitable temporary storage containers;
    f. Obtain specialist advice on decontamination of surfaces, drains and interceptors;
    g. Remove any retention berms/temporary retention dams only when authorised; and
    h. Dispose of contaminated material as hazardous waste (see Waste Management Procedure: AAM-EP-01).

4. Cyferfontein Mine will, within 14 days of the incident, report to the DWS, and/or the Limpopo Department of Economic Development, Environment, and Tourism, and relevant head of municipality such information as is available to enable an initial evaluation of the incident, including:

a. the nature of the incident;
b. the substances involved and an estimation of the quantity released and their possible acute effect on persons and the environment and data needed to assess these effects;
c. initial measures taken to minimise impacts;
d. causes of the incident, whether direct or indirect, including equipment, technology, system, or management failure; and
e. measures taken and to be taken to avoid a recurrence of such incident.

2.3 Drills

1. Emergency drills of above incidents will be held at least biannually.
2. The emergency drill should be a practical exercise where practicable or as a minimum, a desktop exercise.
3. A realistic scenario will be created, e.g. water can be spilled from an oil drum in order to test the reaction of personnel in line with the emergency procedure.
4. The emergency drill report should be completed.
5. It is advisable that photographs or videos should be taken for review after the drill has been conducted.
6. A debriefing session should be held after each drill to discuss any non-conformances or areas for improvement identified during the drill.

2) Undertaking

The EAP herewith confirms

a) the correctness of the information provided in the reports ☒

b) the inclusion of comments and inputs from stakeholders and I&APs ☒

c) the inclusion of inputs and recommendations from the specialist reports where relevant ☒

d) the acceptability of the project in relation to the finding of the assessment and level of mitigation proposed ☒

The EIA/EMP will, should it comply with the provisions of section 24N of NEMA as well as the applicable EIA Regulations i.t.o. NEMA, be approved, become an obligation in terms of the approved EIA/EMP and mining right issued.

Herewith I, the person whose name and identity number is stated below, confirm that I am the person authorised to act as representative of the, and confirm that the above EIA & EMP compiled in accordance with Appendices 3 & 4 of the EIA Regulations.

Full Names and Surname	
Identity Number	
Designation	
Signature	

-END-

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