mineral resources

Department:
Mineral Resources
REPUBLIC OF SOUTH AFRICA

BASIC ASSESSMENT REPORT

And

ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT

SUBMITTED FOR ENVIRONMENTAL AUTHORIZATIONS IN TERMS OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 AND THE NATIONAL ENVIRONMENTAL MANAGEMENT WASTE ACT, 2008 IN RESPECT OF LISTED ACTIVITIES THAT HAVE BEEN TRIGGERED BY APPLICATIONS IN TERMS OF THE MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT, 2002 (MPRDA) (AS AMENDED).

NAME OF APPLICANT: IMERYS REFRACTORY MINERALS SOUTH AFRICA (PTY) LTD - ANNESLEY ANDALUSITE MINE (HAVERCROFT OPERATION)
TEL NO: 081 010 9005
POSTAL ADDRESS: PO Box 217, Burgersfort
PHYSICAL ADDRESS: Farm Streatham 100 KT, and Havercroft 99 KT, Greater Tubatse Local Municipality, Limpopo Province

FILE REFERENCE NUMBER SAMRAD: 73 MRC

February 2018

BECS environmental

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1 IMPORTANT NOTICE

In terms of the Mineral and Petroleum Resources Development Act (Act 28 of 2002 as amended), 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 and an Environmental Management Programme report 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 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 un-interpreted information and that it unambiguously represents the interpretation of the applicant.

2 OBJECTIVES OF THE BASIC ASSESSMENT PROCESS

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

a) determine the policy and legislative context within which the proposed activity is located and how the activity complies with and responds to the policy and legislative context;
b) identify the alternatives considered, including the activity, location, and technology alternatives;
c) describe the need and desirability of the proposed alternatives,
d) through the undertaking of an impact and risk assessment process inclusive of cumulative impacts which focused on determining the geographical, physical, biological, social, economic, heritage, and cultural sensitivity of the sites and locations within sites and the risk of impact of the proposed activity and technology alternatives on these aspects to determine:
    i) the nature, significance, consequence, extent, duration, and the probability of the impacts occurring to; and
    ii) the degree to which these impacts—
        (aa) can be reversed;
        (bb) may cause irreplaceable loss of resources; and
        (cc) can be managed, avoided or mitigated;
e) through a ranking of the site sensitivities and possible impacts, the activity and technology alternatives will impose on the sites and location identified through the life of the activity to—
    i) identify and motivate a preferred site, activity, and technology alternative;
    ii) identify suitable measures to manage, avoid or mitigate identified impacts; and
    iii) identify residual risks that need to be managed and monitored.

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Addendum 4C: Copy and proof of the site notices, and map indicating the location of these site notices

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Executive summary

Applicant

BECS Environmental has been appointed by Imerys Refractory Minerals South Africa (Pty) Ltd: Annesley Andalusite Mine (Havercroft Operation) to apply for a basic assessment as part of decommissioning of the Havercroft Operation. Havercroft Operation forms part of the mining right of Annesley Mine. These two mining operations were previously known as Rhino Minerals (Pty) Ltd (refer to the mining right attached as Addendum 5A). The name has changed to Imerys Refractory Minerals South Africa (Pty) Ltd (a member of the Imerys Group), however, it is still the same company with same company registration number. Havercroft Operation was originally the Havercroft Andalusite Mine. This operation is now non-operational. Annesley Operation is still operational. The commodity type that was mined at Havercroft is an aluminium nesosilicate mineral called Andalusite (Al_2SiO_5).

Refer to Table 1 below for a description of the applicant, Figure 1 for an organogram of the applicant, and Table 2 for a description of the landowner of the mining site.

Table 1: Description of the applicant

Project applicant	Imerys Refractory Minerals South Africa (Pty) Ltd
Trading name	Annesley Andalusite Mine
Contact person	Fuzi Maseko
Designation	Mine Manager - Annesley Operation and Havercroft Operation
Telephone number	+27 81 010 9005
E-mail address	Fuzi.Maseko@imerys.com

Table 2: Description of the landowner

Landowner	Tribal Authority (Babinatlou Community) through the Government of South Africa
Contact person	Isaac Mampuru
Cell phone number	060 622 0054
E-mail address	morokeic@gmail.com

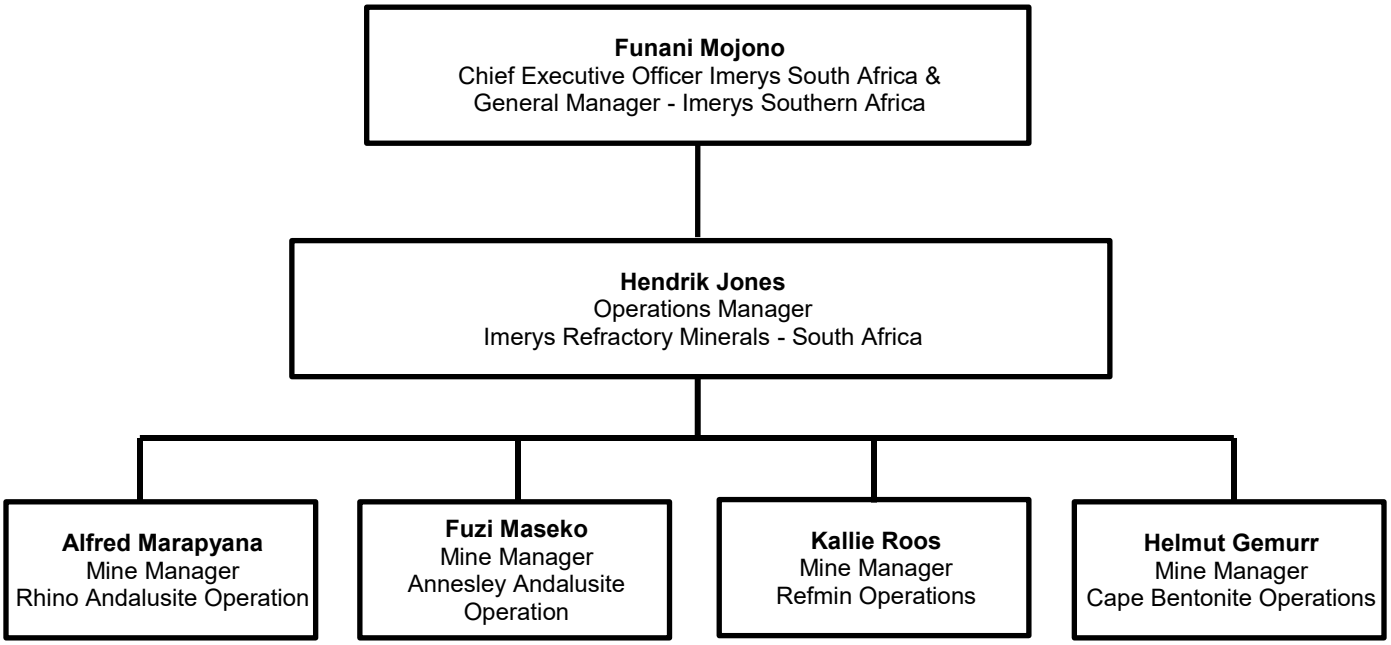

Figure 1: Annesley Andalusite Mine organogram

Project description

Havercroft Mine Operation:

Havercroft Operation is currently non-operational. This basic assessment application is for decommissioning of the operation and rehabilitation of the area.

Legal requirements

According to Section 24(2) and 24(5) of the National Environmental Management Act No 107 of 1998 (as amended) (NEMA):

'The Minister, or an MEC with the concurrence of the Minister, may identify (a) activities which may not commence without environmental authorisation(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.'

PART A

SCOPE OF ASSESSMENT AND BASIC ASSESSMENT REPORT

a) Details of the Environmental Assessment Practitioner

This section includes the following:

i. Details of the EAP;
ii. Expertise of the EAP, which includes the qualifications of the EAP (with evidence) and a summary of the EAP's past experience - in carrying out the EIA Procedure; and
iii. 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 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 past experience.

Table 3: Description of the environmental assessment practitioner

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)
Name of second responsible EAP	Deshree Pillay
Expertise of EAP	B. Sc Environmental Science (UP), B. Sc Honours Geography & Environmental Science (UP)

I, Salome Beeslaar (8310190032081), hereby declare that I have no conflict of interest related to the work of this report. 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)
20 February 2018

b) Location of the overall activity

Havercroft Operation is located 5km from the old Penge mining town, 5km from Ga Malepe, and approximately 31km north of Burgersfort town, on the R37 road towards Penge. Havercroft Operation is located approximately 5km north of Annesley Operation. The mining right is situated within the Sekhukhune District Municipality and Greater Tubatse Local Municipality, Limpopo Province.

The mine lies in the Primary Catchment of the Olifants River and the Quaternary Catchment referred to as the B71F draining region as defined by the Department of Water and Sanitation (DWS). The applicable water management area is the Olifants and the responsibility of the Mpumalanga Regional DWS, situated in Mashishing (Lydenburg).

A 132kVa Eskom power-line servitude runs through the mine property, through Segorong Village to Penge. No servitude runs through the quarry areas. A Telkom telephone line passes through the mine, towards Segorong Village. Main tarmac access roads from Burgersfort to Penge bypasses the mine. Gravel access road from Annesley Operation to Havercroft Operation passes through the mine area, and a gravel road from Annesley to Polokwane also passes through the mine. The Apiesdoring siding on the Steelpoort-Burgersfort-Lydenburg Railway line is approximately 35km from the mine and is equipped with ore handling facilities.

Table 4: Farm names, 21-Digit Surveyor General codes, and coordinates

Farm Name	The farm Streatham 100 KT, and the farm Havercroft 99 KT
Application area (Ha)	8,183.3068ha
Magisterial district	Sekhukhune District Municipality and Greater Tubatse Local Municipality
Distance and direction from nearest town	5km of the old Penge mining town, 5km from Ga Malepe, and approximately 31km north of Burgersfort town, on the R37 road towards Penge

21-digit Surveyor General Code for each farm portion	Streatham 100 KT: T00KT00000000010000000 3893.7945ha	Havercroft 99 KT: T00KT00000000009900000 4289.5123ha
Coordinates	Streatham 100 KT: S24.3139, E30.1623 S24.3487, E30.2155 S24.3050, E30.2557 S24.2830, E30.2387	Havercroft 99 KT: S24.3487, E30.2155 S24.3782, E30.2633 S24.3674, E30.3047 S24.3050, E30.2557

c) Locality map

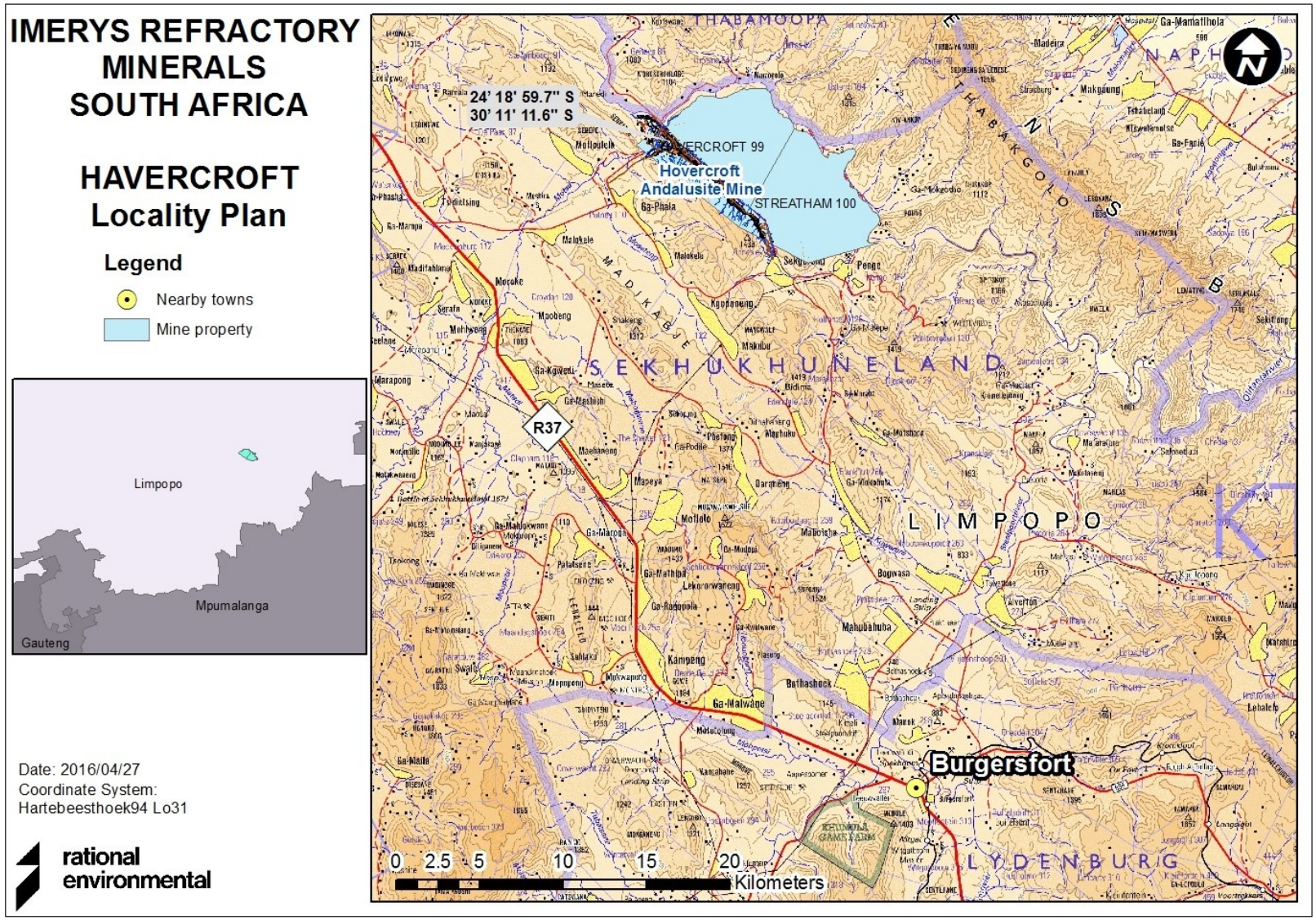

Figure 2: Locality map of Havercroft Operation (taken from Havercroft Mine Closure Plan (BECS Environmental, 2016, draft)

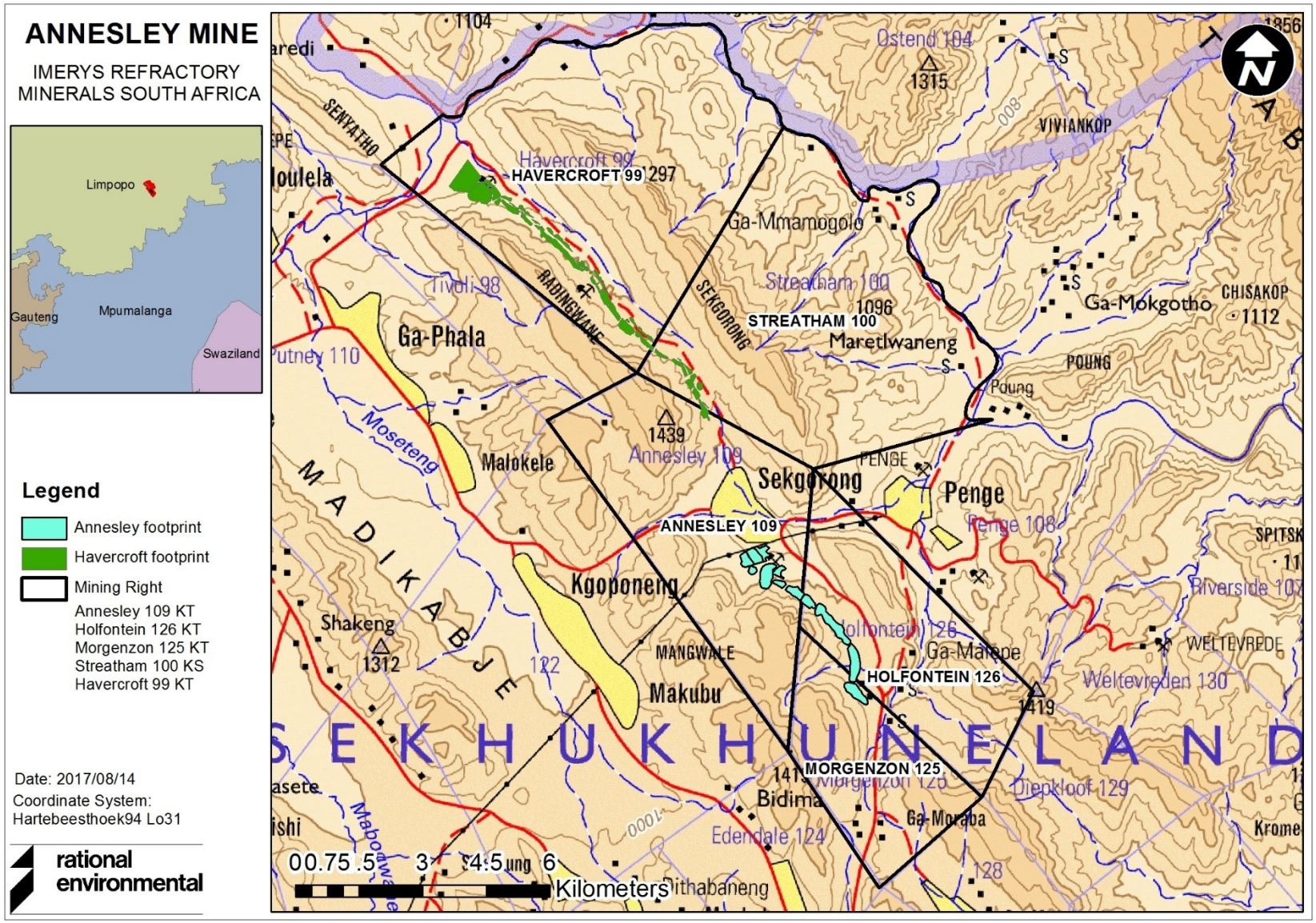

Figure 3: Annesley Operation in relation to Havercroft Operation

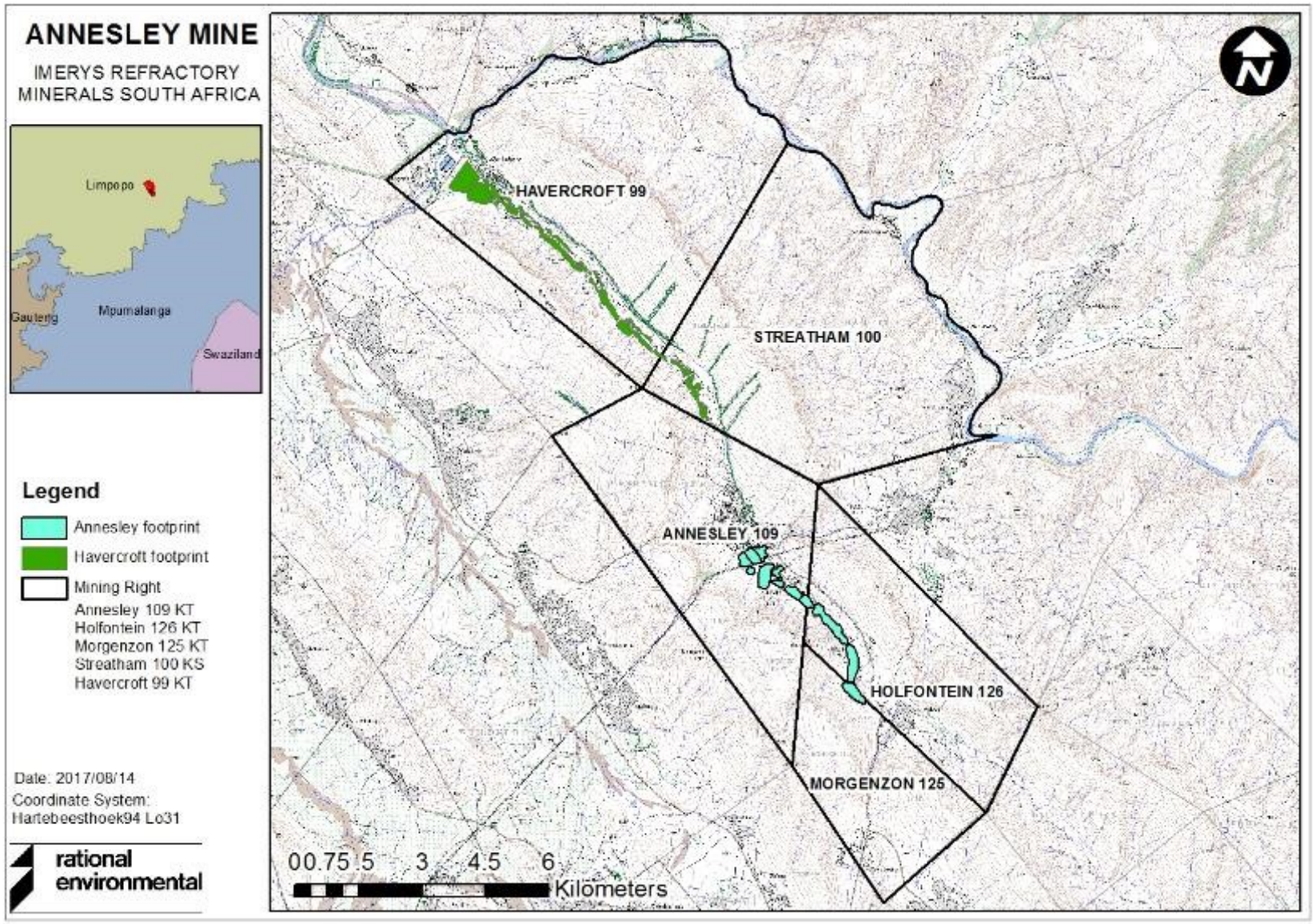

Figure 4: Annesley Operation in relation to Havercroft Operation

d) Description of the scope of the proposed overall activity

(i) Listed and specified activities

Refer to Table 5 below for a list of the specified activity applied for.

Table 5: Specified activity applied for

Name of activity	Aerial extent of the activity	Listed activity	Applicable listing notice
Basic assessment: The Havercroft Operation will be decommissioned. The decommissioning of any activity requiring (ii) a prospecting right, mining right, mining permit, production right or exploration right, where the throughput of the activity has reduced by 90% or more over a period of 5 years excluding where the competent authority has in writing agreed that such reduction in throughput does not constitute closure.	**Sloping:** 1,466,633.50m³ **Roads and plant:** 42,762.14m²	22(ii)	GNR 983
No waste license – sloping of mine residue, and no backfilling.	N/A	N/A	N/A

(ii) Description of the activities to be undertaken

Havercroft Operation is currently non-operational. The mining method used was opencast bench mining, advancing along the strike of the ore body. Mining was not continuous due to geological intrusions, such as dolerite dykes, and non-perennial watercourses that cut through the ore deposit. This results in a series of separate quarries along the strike of the ore body. The ore was crushed and screened, removing fines and barren ore. The ore was then concentrated by Heavy Medium Separation, whereafter it was dried and magnetically separated to produce a pure final product. Havercroft Operation consists of the following infrastructures (refer to Figure 5 for the site layout plan).

- Plant,
- Workshops,
- Offices,
- Slimes Dam,
- Quarries (1 - 15),
- Return water dam, and
- A Waste rock dump

Refer to Part B(1)((i)(c) for a complete description of the rehabilitation of the operation.

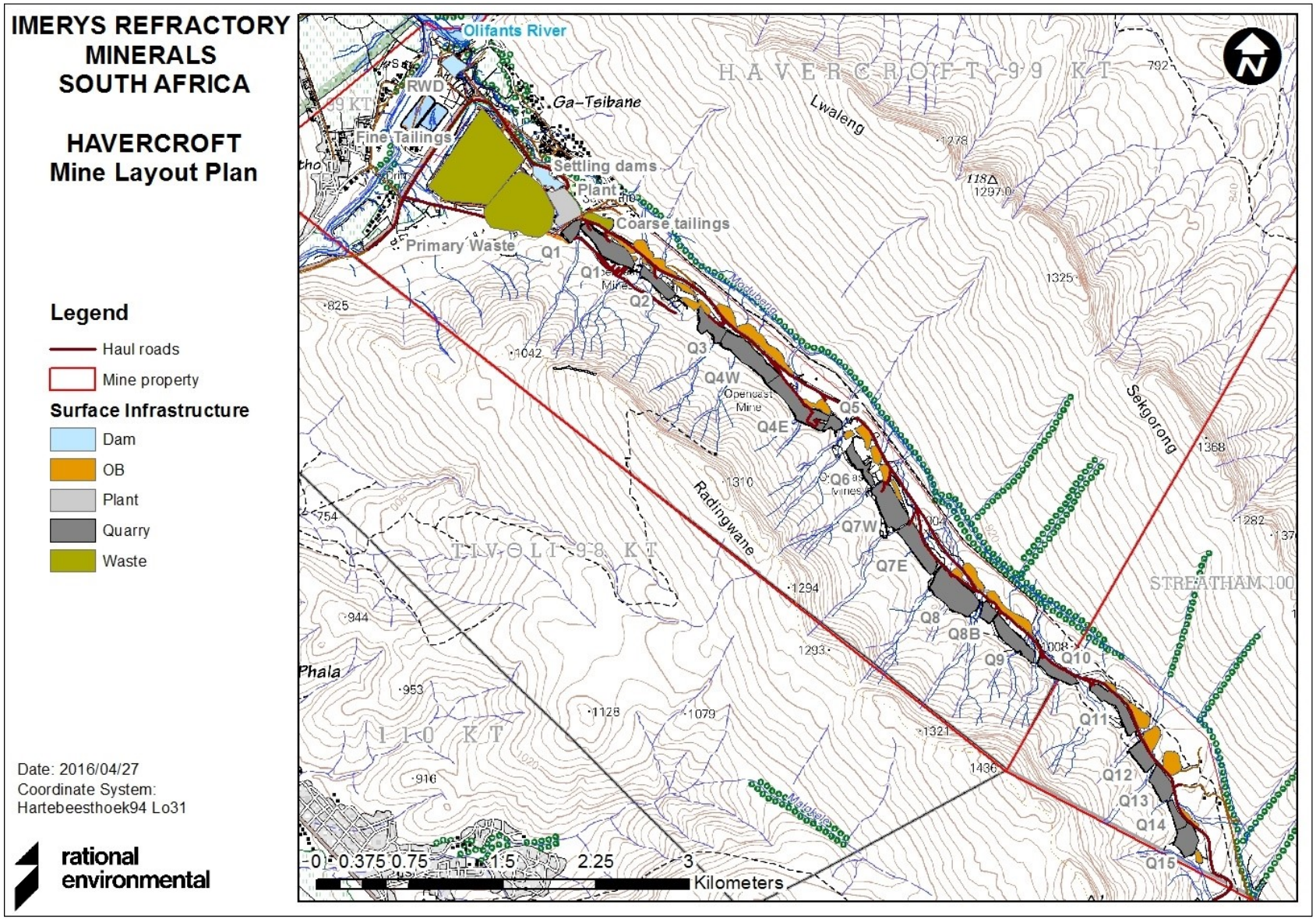

Figure 5: Havercroft Operation surface layout plan

e) Policy and legislative context

Applicable legislation and guidelines used to compile the report	Description of legislation and guidelines used to compile the report (reference and description)	Reference where applied	How does this development comply with and respond to the policy and legislative context (significance)
Authorisation applications			
MPRDA	According to the MPRDA, Annesley Andalusite 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 DMR.	Addendum 5A	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.
	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.	Addendum 5A	The mine applied for a section 102 amendment (i.t.o. MPRDA) in 2006, to include the Segorong Project (extension) into the mining right. The amendment was approved in 2011.
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 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	Addendum 5A	The mine is in the process to apply for an EIA for the river diversion, settling point and the backfilling of the quarries at Annesley Operation. No backfilling to take place at Havercroft Operation.

Applicable legislation and guidelines used to compile the report	Description of legislation and guidelines used to compile the report (reference and description)	Reference where applied	How does this development comply with and respond to the policy and legislative context (significance)
	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, and a prospecting right as well as an EA for any new prospecting activities.		This basic assessment application includes a listed activity under NEMA. No EA for the application of a mining right is necessary because the mine is older than 8 December 2014.
NWA	Section 21 of the NWA sets out the water uses for which an IWUL is required. These water uses commenced on 1 October 1998, and include permissible water uses (water uses for which no licensing or registration is necessary), general authorisations (GA) (water uses for which registration only is required), and water use licenses (water used for which both registration and licensing 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 water uses are deemed lawful. In 1999, the GN 704 Regulations i.t.o. NWA was published. These Regulations pertained to all mining rights, and exemptions of water uses if necessary.	Not applicable	The mine had and IWUL; however, it has elapsed. DWS will advise whether an IWULA is necessary for the decommissioning and rehabilitation of Havercroft Operation.

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NEMAQA	A list of activities which need an AEL was published in 2010 (GN 248 of 2010 i.t.o. the NEMAQA. This list was updated in 2013 (GN 893 of 2013 i.t.o. NEMAQA). These lists further included compliance timeframes for plant emission standards, whereby new plant had to comply to new plants emission standards on 1 March 2010; existing plants had to comply with existing plant standards on 1 March 2015, and existing plants have to comply with new plants standards on 1 March 2020.	Not applicable	This is not applicable to Havercroft Operation. There is a dryer at the Annesley Operation for which the mine has an AEL.
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).	Not applicable	This is not applicable to Havercroft Operation. Mine residue will be sloped. No backfilling will take place.
National Heritage Resources Act no 25 of 1999 (NHRA)	All required permits as per the Act.	Not applicable	This is currently not applicable to Havercroft Operation. In the event of any heritage resource discovered, a qualified specialist will be appointed.

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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.	Not applicable	This is not applicable to Havercroft Operation. No additional vegetation will be removed.
Mining			
Mining plans and surveying: GN 447 of 2011 i.t.o. the Mine Health and Safety Act No 29 of 1996 (as amended) (MHSA)	A competent person must survey the mine. No mining operations may be carried out within a horizontal distance of 100m from reserve land, buildings, roads, railways, dams, waste dumps, or any other structure whatsoever including such structures beyond the mining boundaries, or any surface, which it may be necessary to protect in order to prevent any significant risk, unless a lesser distance has been determined safe by risk assessment and all restrictions and conditions determined in terms of the risk assessment are complied with.	N/A N/A	A competent surveyor conducts the mine surveying. The mine must compile risk assessment to assess whether any mining operations are carried out within a horizontal distance of 100m from the mentioned infrastructure.
Mine residue			
Mine residue management: Regulation 73 of the MPRDR (GN 349 of 2011 i.t.o. MPRDA), 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.	N/A	The impacts of the mine residue are contained within the mine's EIA/EMP. All impacts related to the sloping of the mine residue on Havercroft Operation are included in this BAR.

Applicable legislation and guidelines used to compile the report	Description of legislation and guidelines used to compile the report (reference and description)	Reference where applied	How does this development comply with and respond to the policy and legislative context (significance)
Mine residue management - Assessment of impacts and analyses of risks Regulations 3 & 9(1)(a&g) & 12 of GN 632 of 2015 (Regulations Regarding the Planning and Management of Mine Residue) under NEMWA, regulation 8 of GN 634 of 2013 (Waste Classification and Management Regulations) under NEMWA, GN 632 of 2015 has replaced regulation 73 of GN 527 of 2004 under MPRDA. Refer to transitional period	A risk analysis based on the characteristics and the classification must be used to determine the appropriate mitigation and management measures.	N/A	Although a Waste Assessment Report was conducted for the mine residue in Annesley Operation, this does not include a risk assessment with appropriate mitigation and management measures.
	The decommissioning, closure and post-closure management of mine residue must be done in accordance with the relevant provisions in the environmental authorisation, an EMP; and any other relevant legislation.	N/A	The decommissioning, closure and post-closure management of mine residue forms part of the EIA/EMP. This BAR is compiled for the decommissioning of Havercroft Operation.
	The pollution control barrier system shall be defined by the: GN 635 of 2013 under NEMWA (National Norms and Standards for the Assessment of Waste for Landfill Disposal); and GN 636 of 2013 (National Norms and Standards for Disposal of Waste to Landfill).	N/A	This BAR is for sloping of already existing mine residue and not for new mine residue.
Mine residue management: Regulation 4 of GN 632 of 2015 under NEMWA (Regulations Regarding the Planning and Management of Mine Residue) under NEMWA	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.	N/A	A registered engineer is appointed as the competent person on dams and residue.
	Mine residue must be characterised in terms of its: • physical characteristics; • chemical characteristics; and	N/A	The waste assessment has been done by Aquatico and includes these requirements.

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	mineral content that may include the specific gravity of the residue particles and its impact on particle segregation and consolidation.		
	Mine residue must be classified in accordance with SANS 10234 within 180 days of generation.	N/A	Although a Waste Assessment Report was compiled, it does not include the GHS classification.
Mine residue management - Characterisation Regulation 5 of GN 632 of 2015 (Regulations Regarding the Planning and Management of Mine Residue) under NEMWA	A risk analysis must be conducted and documented on all mine residue.	N/A	The waste assessment has been done by Aquatico and includes these requirements.
	The classification of residue stockpile and residue deposit must be undertaken on the basis of the: • characteristics of the residue; • location and dimensions of the deposit (height, surface area); • importance and vulnerability of the environmental components that are at risk; • spatial extent, duration and intensity of potential impacts; and pollution control barrier system compliant with the commensurate norms and standards for disposal of waste to landfill.	N/A	
Mine residue management - Investigation and site selection Regulation 6 of GN 632 of 2015 (Regulations Regarding the Planning and Management of Mine Residue) under NEMWA	The process of investigation and selection of a site mine residue must entail: • the identification of a sufficient number of possible candidate sites. • qualitative evaluation and ranking of all alternative sites;	N/A	This was not done for any of the sites, however, no new mine residue will be established.

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	Qualitative investigation of the top-ranking sites to review the ranking done in terms of paragraph(b);
	• a feasibility study on the highest-ranking site or sites, involving:
	  ○ a preliminary health and safety classification;
	  ○ an environmental classification;
	  ○ geotechnical investigations; and
	  ○ hydrological investigations.
	Further investigation on the preferred site, must be conducted by competent person		

Mine residue management: Regulations 7 & 9(1)(b) of GN 632 of 2015 (Regulations Regarding the Planning and Management of Mine Residue) under NEMWA	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 is 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	N/A	No designs according to this legislation were undertaken. This cannot be done anymore but must form part of any new mine residue planning.

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	trained to recognize any potential or actual problem in the performance of the work.		
Mine residue management - Impact Management Regulation 8 of GN 632 of 2015 (Regulations Regarding the Planning and Management of Mine Residue) under NEMWA	Conduct statistical defensible and representative characterisation programme of relevant materials	N/A	Although a Waste Assessment Report was compiled, it does not include a statistical defensible and representative characterisation programme of relevant materials.
	Conduct an impact prediction study to assess the potential impacts of such actions or activities on the water resource over the full life cycle of the mining operations and until the impact from the operation is acceptable, which includes a monitoring programme and an evaluation of the effect of the mitigatory measures to demonstrate acceptable levels of impact.	N/A	Although a Waste Assessment Report was compiled, it does not include an impact prediction study to assess the potential impacts of such actions or activities on the water resource over the full life cycle of the mining operations and until the impact from the operation is acceptable, which includes a monitoring programme and an evaluation of the effect of the mitigatory measures to demonstrate acceptable levels of impact.
Mine residue management - Impact Management Regulations 9(1)(d-f)&(2) & 11 of GN 632 of 2015 (Regulations Regarding the Planning and Management of Mine Residue) under NEMWA	Preventative or remedial action must be taken in respect of any sign of pollution.	N/A	The mine has an environmental emergency procedure.
	Adequate measures must be implemented to control dust pollution and erosion of the slopes at all residues.	Part A(h)(v)	This will form part of the mine's management measures.
	Dust and mine residue must be managed in accordance with the requirements on dust control as regulated by Mine Health and Safety Act and in terms of the NEMAQA.		This will form part of the mine's management measures.

Applicable legislation and guidelines used to compile the report	Description of legislation and guidelines used to compile the report (reference and description)	Reference where applied	How does this development comply with and respond to the policy and legislative context (significance)
	A system of routine maintenance and repair in respect of all residues must be implemented to ensure the control of pollution and the integrity of rehabilitation.		This will form part of the mine's management measures.
Mine residue management - Monitoring and reporting system Regulation 9(1)(c) & 10 of GN 632 of 2015 (Regulations Regarding the Planning and Management of Mine Residue) under NEMWA	A monitoring system for a mining residue with respect to potentially significant impacts as identified in the EIA must be included	N/A	This forms part of the EMP of the mine.
Rehabilitation and closure			
Section 24R of NEMA, Appendix 5 of the EIA Regulations, sections 43, 56, 61 of MPRDA	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 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.	This entire BAR	The LoM for Annesley is more than 5 years. This BAR is compiled as part of decommissioning of Havercroft Operation.
Financial provision			
Section 24P of the NEMA, Regulations pertaining to financial	The EMP must address the requirements as determined in the regulations, pertaining to the	Part A(s)	The financial provision is updated annually.

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provisioning for prospecting, exploration, mining, or production operations (GN 1147 of 2015 i.t.o. NEMA	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.		
Non-mining waste management			
Waste classification and disposal Regulation 5 of GN 634 of 2013 (Waste Classification and Management Regulations) under NEMWA	Safety data sheets • Generators of hazardous waste must ensure that an MSDS for the hazardous waste is prepared in accordance with SANS 10234. • If possible, use MSDS of product or products it originates from. • No MSDS necessary for Health Care Risk Waste.	N/A	This will form part of the mine's management measures.
Waste classification and disposal Regulation 15(d) of GN 1179 of 1995 (Hazardous Chemical Substances Regulations) under OHSA	A waste generator shall, as far as is reasonably practicable ensure that all HCS waste which can cause exposure, is disposed of only on sites specifically designated for this purpose in terms of the ECA (or NEMA), in such a manner that it does not cause a hazard inside or outside the site concerned.		
	No person may collect waste for removal from premises unless such person is authorised by law to collect that waste, where authorisation is required.		

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Waste classification and disposal Regulation 10 of GN 634 of 2013 (Waste Classification and Management Regulations) under NEMWA	Waste generators must keep accurate and up to date records of the management of the waste they generate, which records must reflect: • the classification of the wastes; • the quantity of each waste generated, expressed in tons or m³ per month; • the quantities of each waste that has either been re-used, recycled, recovered, treated or disposed of; and • by whom the waste was managed. The records must be retained for a period of at least five (5) years, and made available to the Department upon request.		
Waste classification and disposal Regulation 11 of GN 634 of 2013 (Waste Classification and Management Regulations) under NEMWA	Every holder of waste that has been classified as hazardous must be in possession of a waste manifest document containing the relevant information Generators of waste classified as hazardous must complete a waste manifest document for each consignment of waste transported to a waste manager or waste transporter. All waste generators of hazardous waste must: retain copies, or be able to access copies/records, of the waste manifest documentation for a period of at least five (5) years; and		

Applicable legislation and guidelines used to compile the report	Description of legislation and guidelines used to compile the report (reference and description)	Reference where applied	How does this development comply with and respond to the policy and legislative context (significance)
	make the waste manifest documentation available to the Department upon request.		
Waste handling, and storage: GN 527 of 2004 i.t.o. MPRDA, GN 1179 i.t.o. OHSA, sections 7 & 24 of NEMWA, and GN 634 of 2013 i.t.o. NEMWA	Employees collecting, transporting, and disposal of hazardous waste must wear suitable Personal Protective Equipment (PPE). A waste disposal contractor must wear suitable PPE. All collectable hazardous waste must be placed into containers that will prevent the likelihood of exposure during handling. Waste containers must be intact and not corroded or in any other way rendered unfit for the safe storage of waste. Adequate measures must be taken to prevent accidental spillage or leaking. Waste must be contained in such a way that it cannot be blown away. Avoid nuisances such as odor, visual impacts, and breeding of vectors. Prevent pollution of the environment and harm to health. Any container or storage impoundment holding waste must be labeled, or where labeling is not possible, records must be kept. A new waste storage facility must be registered with the competent authority within 90 days prior to the construction taking place. The assessment of impacts relating to the disposal of waste material must form part of the EMP.	N/A	This will form part of the mine's management measures.
Waste handling, and storage:	A waste generator shall, as far as is reasonably practicable ensure that if the services of a waste	N/A	This is not in the contracts.

Applicable legislation and guidelines used to compile the report	Description of legislation and guidelines used to compile the report (reference and description)	Reference where applied	How does this development comply with and respond to the policy and legislative context (significance)
Regulation 15(f) of GN 1179 (Hazardous Chemical Substances Regulations) under OHSA, Regulation 13 of GN 926 of 2013 (National norms and standards for the storage of waste) under NEMWA	disposal contractor are used, a provision is incorporated into the contract stating that the contractor shall also comply with the provisions of these regulations.		
Waste handling, and storage Regulation 6 of GN 634 of 2013 (Waste Classification and Management Regulations) under NEMWA & Regulation 10 of GN 926 of 2013 (National norms and standards for the storage of waste) under NEMWA	Any container or storage impoundment holding waste must be labeled, or where labeling is not possible, records must be kept. Hazardous waste must be stored in covered containers and only open when waste is added or emptied.	N/A	This will form part of the mine's management measures.
Waste re-use, recycle, recover: GN 527 of 2004 i.t.o. MPRDA, sections 7 & 24 of NEMWA, and GN 634 of 2013 i.t.o. NEMWA	Waste must be re-used, recycled, recovered, treated and/or disposed of within 18 months of generation. Recycle hazardous waste as far as is reasonably practicable. Any person who undertakes an activity involving the reduction, re-use, recycling or recovery of waste must, before undertaking that activity, ensure that the reduction, re-use, recycling or recovery of the waste use less natural resources than disposal of such waste and to the extent that it is possible, is less harmful to the environment than the disposal of such waste.	N/A	Waste is removed from the site via a waste contractor. No recycling takes place on the mine.

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Unlawful disposal and littering: Sections 26 & 27 of NEMWA	No disposal of waste in or on any land, waterbody or at any facility. No disposal of waste in a manner that is likely to cause pollution of the environment or harm to health and well-being. No littering of any public place, land, vacant erf, stream, watercourse, street or road, or on any place to which the general public has access. Unless the disposal of that waste is authorised by law	N/A	This will form part of the mine's management measures.
Waste tyres: Regulations in terms of storage of tyres (GN 149 of 2009 i.t.o NEMWA)	All requirements	N/A	The mine does not store tyres.
Asbestos management and disposal: GN 341 of 2008 i.t.o. ECA, and regulation 20 of GN 155 of 2001 i.t.o OHSAS	Ensure that all asbestos waste is placed in containers that will prevent the likelihood of exposure during handling. All vehicles, re-usable containers or any other similar articles which have been in contact with asbestos waste must be cleaned and decontaminated after use. All asbestos waste which can cause exposure must be disposed of only on sites specifically designated for this purpose. All persons occupied in the collection, transport, and disposing of waste in a manner which may detrimentally impact on a water resource, disposal of asbestos waste, must wear PPE, including contractors.	N/A	The mine does not have asbestos waste.
Water management			

Applicable legislation and guidelines used to compile the report	Description of legislation and guidelines used to compile the report (reference and description)	Reference where applied	How does this development comply with and respond to the policy and legislative context (significance)
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.	N/A	The impacts of water pollution are contained within the mine's EIA/EMP.
Water management and pollution control: GN 704 Regulations of 1999 i.t.o. NWA	No TDF 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 Regulations of 1999 i.t.o. NWA place: restrictions on locality; restrictions on the use of material; capacity requirements of clean and dirty water systems; protection of water resources; and security and additional measures.		
Water management and pollution control Regulation 9 of GN 632 of 2015 (Regulations regarding the planning and management of residue stockpiles and residue deposits) under NEMWA, Regulation 68 of GN 527 of 2004 (Mineral and Petroleum Resources Development Regulations) under MPRDA	A mine must ensure that preventative or remedial action is taken in respect of any sign of pollution.	N/A	The mine has an environmental emergency procedure.
Dams with safety risks Sections 117-123 of NWA	All residue stockpiles and deposits must be classified into one or a combination of the following	N/A	The mine does not have an environmental classification for the mine residue.

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	categories: (1) the safety classification to differentiate between residue stockpiles and deposits of high, medium and low hazard based on their potential to cause harm to life or property; and (2) the environmental classification to differentiate between residue stockpiles and deposits. A mine must within the period specified, provide the Minister with any information, drawings, specifications, design assumptions, calculations, documents and test results requested by the Minister, pertaining to dams with a safety risk.		
Hazardous chemical substances management			
Use, storage, and handling: Regulation 14 of GN1179 of 1995 under OHSAS, GN 1381 of 1994, GN 247 of 1993, and GN 690 of 1989 under the Hazardous Substances Act No 15 of 1973 (as amended) (HSA)	A Hazardous chemical substance (HCS) in storage or distributed must be properly identified, classified and handled in accordance with SABS 072 and SABS 0228. A container or a vehicle in which an HCS is transported must be clearly identified, classified and packed in accordance with SABS 0228 and SABS 0229. Any container into which an HCS is decanted must be clearly labeled with regard to the contents thereof. Hazardous substances must also be classified according to the Hazardous Substances Regulations (GN 453 of 1977) i.t.o the Hazardous Substances Act No 15 of 1973.	N/A	This will form part of the mine's management measures.

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Transportation: Section 54 of National Road Traffic Act No 93 0f 1996 (NRTA), regulation 277 of GN 255 of 2000 under NRTA	No person shall except as prescribed, accept after transportation, any prescribed dangerous goods. The NRTA and regulations place strict obligations on the "consignee", "consignor, "driver" and "operator" during transportation. Imerys is in the position of the "consignee" due to the off-loading.	N/A	Due to the number of requirements as set out in these regulations, it is unclear whether this is in place.
Polychlorinated biphenyl (PCB): GN 549 of 2014 I.t.o. NEMA	PCBs must be phased out.	N/A	There is no phasing-out plan yet in place.
Radioactive sources: Section 3A of the HAS, GN 246 & 247 of 1993 i.t.o HSA	The possession and use of Group IV hazardous substances require a written authority in terms of the HSA.	N/A	There are no such sources on the mine.
Air quality management			
Ambient air quality management Regulation 64 of GN 527 of 2004 (Mineral and Petroleum Resources Development Regulations) under MPRDA, GN 1210 of 2009 (National Ambient Air Quality Standards) & GN 486 of 2012 (National Ambient Air Quality Standard for PM Less than 2.5 Micron Metres) under NEMAQA	Limits and compliance for SO2, NO2, PM10, O3, C6H6, Pb, CO, PM2.5	N/A	This will form part of the mine's management measures.
Ambient air quality management GN 351 of 2014 (Regulations Regarding the Phasing-out and Management of Ozone- Depleting Substances) under NEMAQA	Hydrochlorofluorocarbons are phased-out.	N/A	Annesley is not yet phasing out old air conditioners

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Dust control Regulations 9(f) & 11 of GN 632 of 2015 (Regulations Regarding the Planning and Management of Residue Stockpiles and Residue Deposits) under NEMWA	A mine must ensure that adequate measures are implemented to control dust pollution and erosion of the slopes at all residues.	N/A	This will form part of the mine's management measures.
Atmospheric impact report and air dispersion modeling GN 747 of 2013 (Regulations Prescribing the Format of the Atmospheric Impact Report) & GN 533 of 2014 (Regulations Regarding Air Dispersion Modelling) under NEMAQA	Atmospheric impact report and air dispersion modeling only if required from officer or if applying for AEL	N/A	The mine has an atmospheric impact report and air dispersion modeling in place.
Environmental noise control and management: Regulation 66 of GN 572 of 2004 i.t.o. MPRDA, section 34 of NEMAQA, Sections 25 & 26 of ECA, and GN 154 of 1992 i.t.o. ECA	The mine must comply with the provisions of the MHSA. The assessment of impacts relating to noise pollution management and control, where appropriate, must form part of the EMP No person shall make, produce or cause a disturbing noise, or allow it to be made, produced or caused by any person, animal, machine, device or apparatus or any combination thereof. No person shall drive a vehicle on a public road in such a manner that it may cause a noise nuisance.	N/A	This will form part of the mine's management measures.

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Noxious or offensive gases: Section 35 of NEMAQA, GN 1651 of 1974 i.t.o. APPA	No vehicle may be driven on a public road if the noxious gases emitted have a density or content as to produce a mean reading of 70 or more.	N/A	This is very old legislation, there is no new such legislation – technology also old?
Blasting, vibration and shock management, and control: Regulation 67 of GN 572 of 2004 i.t.o. MPRDA	The mine must comply with the provisions of the MHSA. An assessment of impacts relating to blasting, vibration and shock management and control, where applicable, must form part of the EMP.	N/A	No blasting takes place.
Biodiversity management			
Alien and invasive species GN598 of 2014 (Alien and Invasive Species Regulations) & GN864 of 2016 (Alien and Invasive Species Lists) under 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.	N/A	The mine needs an alien eradication plan.
Fire breaks and firefighting: Sections 12, 13, 17, 18 & 34 of National Veld and Forest Fire Act No 101 of 1998 (NVFFA)	Every owner on whose land a veldfire may start or burn or from whose land it may spread, must prepare and maintain a firebreak on his/her side of the boundary between his/her land and any adjoining land. Every owner must have the appropriate equipment and measures in place to be ready to be able to combat veld fires and must be in a position to report the occurrence of fires and to take such measures as may be necessary to combat such fires.	N/A	All vehicles and equipment at the mine are regularly inspected and maintained. The emergency plan includes the prevention and control of veld fires.

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Acquisition, disposal, sale or use of fertilizers, farm feeds, agricultural remedies and stock remedies: Section 7*bis* of Fertilizers, Farm Feeds, Agricultural Remedies and Stock Remedies Act No 36 of 1947 (FFFARSRA)	Prohibition of certain fertilizers.	N/A	This will form part of the mine's management measures.
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 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	N/A	This will form part of the mine's management measures.

Applicable legislation and guidelines used to compile the report	Description of legislation and guidelines used to compile the report (reference and description)	Reference where applied	How does this development comply with and respond to the policy and legislative context (significance)
	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 National Heritage Resources Act No 25 of 1999 (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 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.	N/A	This will form part of the mine's management measures.
Emergency incidents			
Section 30 of NEMA, section 20 of NWA S20, and Section 18 of 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	N/A	The mine has a new environmental emergency procedure. This procedure will be implemented, and this will be audited as part of the legal compliance audit.

Applicable legislation and guidelines used to compile the report	Description of legislation and guidelines used to compile the report (reference and description)	Reference where applied	How does this development comply with and respond to the policy and legislative context (significance)
	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.		
Sustainable development			
Sustainable development principles: Section 2(3 & 4), of NEMA, section 2, 2(a)(ii), 22(2)(d) of NWA, GN 527 of 2004 i.t.o. MPRDA, section 37 of MPRDA, section 2(a)(ii) of Section 2(3 & 4) of NEMA, section 2 of NWA, section of, and section of NWA	Any mining operation must be conducted in accordance with generally accepted principles of sustainable development by integrating social, economic and environmental factors into the planning and implementation of mining in order to ensure that exploitation of mineral resources serves present and future generations. The mine shall investigate new and emerging technologies and put into practice water efficient devices or applied technique for the re-use of water containing waste. The Closure Plan must include agreed standard or land use which conforms with the concept of sustainable development.	N/A	The mine has recently updated their environmental procedures. The mine also has a Social and Labour Plan (SLP) in place. The LoM is more than 5 years, however, the mine is in the process of compiling a closure plan as part of the new NEMA requirements. This plan will include end land use.

Applicable legislation and guidelines used to compile the report	Description of legislation and guidelines used to compile the report (reference and description)	Reference where applied	How does this development comply with and respond to the policy and legislative context (significance)
International conventions/treaties	Convention on Biological Diversity, ratified by RSA on 2 November 1995: Conservation of biological diversity, the sustainable use of its components. UN Framework on Climate Change and Kyoto Protocol, ratified by RSA on 29 August 1997: The NDEA has published a report on 'A national climate change response strategy" in response to the Kyoto Protocol'. Greenhouse gas emissions and inventories will be specifically dealt with in the NEMAQA. Climate change is referred to explicitly in the White Paper on Integrated Pollution and Waste Management in 2000 and referenced in the White Paper on a National Water Policy for South Africa, 1997. It is also specifically addressed in the Government's imminent National Water Resource Strategy.' Greenhouse gases are only included under AEL requirements in the NEMAQA. Stockholm Convention on Persistent Organic Pollutants, ratified by RSA on 4 September 2002: Persistent organic pollutants (POPs) include various insecticides as well as PCBs. South Africa published a report 'National Implementation Plan for the Stockholm Convention on Persistent Organic Pollutants' in 2012. According to this report, the duty of care covers the responsibility of Imerys to avoid	N/A	The mine must make a list of these chemicals if there are any on the mine. If there are no such chemicals on the mine, keep proof of this.

Applicable legislation and guidelines used to compile the report	Description of legislation and guidelines used to compile the report (reference and description)	Reference where applied	How does this development comply with and respond to the policy and legislative context (significance)
	the use, storage, generation, or uncontrolled disposal thereof. Vienna Convention on the Protection of the Ozone Layer, and the Montreal Protocol, ratified by RSA on 15 January 1990: The Montreal Protocol includes ozone depleting substances as well as a list of products containing these substances. On 18 September 2015, the NDEA published a notice (GN 703 of 2015), requesting all companies to submit information regarding the listed chemicals as per Annex A within 60 days from the publication. 17 November 2015.		

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 6: 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?	Threatened Ecosystems: Havercroft Operation falls within the Sekhukhune Norite Bushveld which is an endangered threatened ecosystem. Sensitive, vulnerable, highly dynamic or stressed ecosystems: There is a High risk of desertification in this area because of the extensive removal of natural vegetation. The excessive harvesting of firewood further increases this risk. A large constraint is the potential future impact on mining and industrial activities on the natural vegetation and scenic environment. Pollution of water and air in this zone is a noticeable risk also. Critical Biodiversity Areas ("CBAs") and Ecological Support Areas ("ESAs"): The area surrounding the quarries are classified as Critical Biodiversity Area 1 Conservation targets: The high-lying areas should be conserved to retain the natural vegetation and characteristics with the aim of accommodating possible future tourism. The extensive natural environment provides an opportunity for tourism activities including caravan parks, hiking trails, mountain biking, sky diving, game parks, overnight accommodation, country estate, etc. There is a couple of cases where the environment has been kept in its natural states through a number of private game and nature reserves. Ecological drivers of the ecosystem: The ecosystem forms part of the Sekhukhuneland Centre of Endemism; it includes important sub-
1.1 How were the following ecological integrity considerations taken into account?	
1.1.1 Threatened Ecosystems,	
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 Critical Biodiversity Areas ("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?	
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	

Guideline requirement	Comments on requirement
remedy (including offsetting) the impacts? What measures were explored to enhance positive impacts?	catchments, pans and wetlands and is important for grassland processes (NEMBA, GN 1002 of 2011). Environmental Management Framework for the Olifants and Letaba Rivers: The mountains to the east of the quarries has a sensitivity index of 3 whereas the low-lying areas of the quarries itself has a sensitivity index of -1. The area further falls within Management Zone E (Rural Sekhukhune/platinum mining focus area). Future mining operations within this area along the platinum belt are already being planned. Over-allocation of the water resources in this area is a definite constraint. The area is also drought prone. A large potential conflict occurs in the areas that have been identified as future potential mining areas overlap with Centres of Endemism, which contain endangered vegetation. Thus, a conflict of opportunity occurs between the mining sector and the conservation/ecotourism sector. The other major anticipated conflict is that of the mining sector and agricultural sector competing in respect to water allocation. Spatial Development Framework: According to the SDF for the Greater Tubatse Local Municipality, Havercroft Operation falls within a mining belt (Environomics, 2009). This basic assessment application is for the decommissioning of infrastructure on Havercroft Operation as well as the rehabilitation of the area. From above, it can the following can be summarised: • Havercroft Operation falls within a mining belt; • Targets of the rehabilitation must include using indigenous and if possible, endemic vegetation, especially in the high-lying areas.

Guideline requirement	Comments on requirement
	• Water scarcity is an issue and must be considered. • Wetlands and pans are important in the area and can be incorporated into the rehabilitation. • Water pollution is also an issue for the entire area. The rehabilitation of Havercroft Operation must ensure that water in the area is not contaminated.
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?	Building rubble will be generated as part of decommissioning. The community will dismantle the plant and reuse most of the building rubble. Any other waste will be taken to Annesley from where it will be disposed of as part of their waste stream.
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?	All proposed activities are in the already existing mining area. It is not envisaged that any cultural heritage resources will be disturbed.
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?	This basic assessment application is for the decommissioning of infrastructure on Havercroft Operation as well as the rehabilitation of the area. No depletion of renewable or non-renewable resources are envisaged.
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	

Guideline requirement	Comments on requirement
taken to ensure responsible and equitable use of the resources? 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 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?	All ecological impacts have already taken place. This application will aid in improving the ecosystem.
1.8.1 What are the limits of current knowledge (note: the gaps, uncertainties and assumptions must be clearly stated)?	An Earthworks report was done to indicate the sloping of the area. No other studies were done for rehabilitation. All information is based on previous studies done on the mine.
1.8.2 What is the level of risk associated with the limits of current knowledge?	It is unclear what the level of risk will be on the groundwater quality.
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?	No additional risk-averse cautious approach will be followed.
1.9 How will the ecological impacts resulting from this development impact on people's environmental right in terms following	This area must be adequately rehabilitated to ensure the community can use the area once decommissioning and rehabilitation are finished.
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	The end land-use has been identified as grazing and game farming. Water accumulating within the remaining quarries will be utilised and optimised to

Guideline requirement	Comments on requirement
negative impacts, but if avoidance is not possible, to minimise, manage and remedy negative impacts?	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.
1.9.2 Positive impacts: e.g. improved access to resources, improved amenity, improved air or water quality, etc. What measures were taken to enhance positive impacts?	
1.10 Describe the linkages and dependencies between human well-being, 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 the 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?	There is no alternative to this project.
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?	Refer to the cumulative impact assessment; Part A(H)(v)(3)
A. Promoting justifiable economic and social development	
2.1 What is the socio-economic context of the area, based on, amongst other considerations, the following considerations?	<u>The IDP and any other strategic plans, frameworks of policies applicable to the area:</u> The strategic objectives are as follow: • Create environment that promotes the development of the Local economy and facilitate job creation; • Create environment that promotes the development of the Local economy and facilitate job creation;
2.1.1 The 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.),	

Guideline requirement	Comments on requirement
2.1.3 Spatial characteristics (e.g. existing land uses, planned land uses, cultural landscapes, etc.), and 2.1.4 Municipal Economic Development Strategy ("LED Strategy").	• Create a conducive environment for human settlement and business; • Eradicate backlogs in order to improve access to services and ensure proper maintenance; • Improve organizational cohesion and effectiveness; • Promote a culture of participatory and good Governance; • To improve revenue collection and the overall management of finances in the municipality. (Greater Tubatse LM, 2016) <u>Spatial priorities and desired spatial patterns:</u> Because of the impact of mining development in terms of employment, local wealth creation and provision of engineering, economic and social infrastructure beyond the mines a mining belt is proposed on the western part of the GTM area. The mining activities have a multiplier effect as they lead to economic and spatial development in other sectors like retail, tourism, service and manufacturing industries. It is therefore very important that on the platinum-rich eastern limb of Bushveld Complex as passes through the GTM area should primarily be reserved for mine development. Currently, it is envisaged there will be more than thirty mines within this belt. (SJN Development Planning Consultants, 2007) <u>Spatial characteristics:</u> According to the SDF for the Greater Tubatse Local Municipality, Havercroft Operation falls within a mining belt. (SJN Development Planning Consultants, 2007)

Guideline requirement	Comments on requirement
	Municipal Economic Development Strategy: The area is not suitable for agriculture, and has been marked as mining area in the IDP. The IDP further states: Although there are several mines in the area, the existing resources remain unexploited. Investment in this sector is important as it brings with it an investment in infrastructure, results in the creation of job opportunities and generates many other economic spin-offs. The lack of economic growth in the region warrants special attention and support to optimize the available opportunities. However, cognizance should be taken of the outflow of money from the mines in Greater Tubatse to other regions. (Greater Tubatse LM, 2016) This basic assessment application is for the decommissioning of infrastructure on Havercroft Operation as well as the rehabilitation of the area. From above, it can the following can be summarised: • Economic growth is an objective for the area. • Because the area has a low agricultural potential, mining is a desirable economic growth factor. • The use of local people to decommission and rehabilitate will promote the economy. • Further, it should be noted that any further prospecting and mining projects could have a desirable effect on the economy of the area.
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?	Socio-economic development initiatives are for Greater Tubatse: • Education and skills development • Housing • Health
2.2.1 Will the development complement the local socio-economic initiatives (such as local economic development (LED) initiatives), or skills development programs?	

Guideline requirement	Comments on requirement
2.3 How will this development address the specific physical, psychological, developmental, cultural and social needs and interests of the relevant communities?	The mining at Annesley aid in the skills development of the area. The rehabilitation and decommissioning itself will not aid in additional socio-economic objectives. For this reason, it is imperative that any additional mining projects in the area, should be considered. Such project will address skills development in the long-term.
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. In terms of location, describe how the placement of the proposed development will: 2.5.1. result in the creation of residential and employment opportunities in close proximity to or integrated with each other, 2.5.2. reduce the need for transport of people and goods, 2.5.3. result in access to public transport or enable non-motorised and pedestrian transport (e.g. will the development result in densification and the achievement of thresholds in terms public transport), 2.5.4. compliment other uses in the area, 2.5.5. be in line with the planning for the area, 2.5.6. for urban related development, make use of underutilised land available with the urban edge, 2.5.7. optimise the use of existing resources and infrastructure, 2.5.8. opportunity costs in terms of bulk infrastructure expansions in non-priority areas (e.g. not aligned with the bulk infrastructure planning for the settlement that reflects the spatial reconstruction priorities of the settlement), 2.5.9. discourage "urban sprawl" and contribute to compaction/densification, 2.5.10. contribute to the correction of the historically distorted spatial patterns of settlements and to the optimum use of existing infrastructure in excess of current needs, 2.5.11. encourage environmentally sustainable land development practices and processes,	Not applicable to this project.

Guideline requirement	Comments on requirement
2.5.12. take into account special locational factors that might favour the specific location (e.g. the location of a strategic mineral resource, access to the port, access to rail, etc.), 2.5.13. the investment in the settlement or area in question will generate the highest socio-economic returns (i.e. an area with high economic potential), 2.5.14. impact on the sense of history, sense of place and heritage of the area and the socio-cultural and cultural-historic characteristics and sensitivities of the area, and 2.5.15. in terms of the nature, scale and location of the development promote or act as a catalyst to create a more integrated settlement?	
2.6 How were a risk-averse and cautious approach applied in terms of socio-economic impacts? Level of risk associated with limits of current knowledge related to the following: Inequality, Social fabric, Livelihoods, Vulnerable communities, Critical resources, Economic vulnerability and Sustainability	Refer to the impact assessment; Part A(H)(v)(1)
2.6.1 What are the limits of current knowledge (note: the gaps, uncertainties, and assumptions must be clearly stated)?	IDPs, SDFs, and other published documents are used to determine the socio-economic aspects of the area.
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:	This project will not affect these aspects.
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?	
2.7.2 Positive impacts. What measures were taken to enhance positive impacts?	

Guideline requirement	Comments on requirement
2.8 Considering the linkages and dependencies between human well-being, livelihoods, and ecosystem services, describe the linkages and dependencies applicable to the area in question and how the development's socioeconomic impacts will result in ecological impacts (e.g. over utilisation of natural resources, etc.)?	This basic assessment application is for the decommissioning of infrastructure on Havercroft Operation as well as the rehabilitation of the area. No depletion of renewable or non-renewable resources is envisaged.
2.9 What measures were taken to pursue the selection of the "best practicable environmental option" in terms of socio-economic considerations?	The community will be involved in the rehabilitation and decommissioning activities. Environmental Health and Safety (EHS) risks and project hazards are identified as early as possible. Health and safety training is done, and PPE is provided.
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 well-being, 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:	Refer to Part A(H)(ii) for public participation.
2.13.1 ensure the participation of all interested and affected parties,	
2.13.2 provide all people with an opportunity to develop the understanding, skills, and capacity necessary for achieving equitable and effective participation,	
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 interested and affected parties were taken into account and that adequate recognition was given to all forms of knowledge, including traditional and ordinary knowledge, and	
2.13.7 ensure that the vital role of women and youth in environmental management and development were recognised and their full participation therein was be promoted	
2.14 Considering the interests, needs, and values of all the interested and affected parties, describe how the development will allow for opportunities for all the segments of the community (e.g. a mixture of low-, middle-, and high-income housing opportunities) that is consistent with the priority needs of the local area (or that is proportional to the needs of an area)?	
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:	This information will only be available once this application has been approved and the mine has liaised with the community.
2.16.1 the number of temporary versus permanent jobs that 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 the impact on 1000 agricultural jobs, etc.).	
2.17 What measures were taken to ensure:	A summary of all legislation is included in Part A(e) of this report. All organs of state will receive this BAR. Any comments from them will be incorporated into the final decision. The community will be involved in the rehabilitation and decommissioning activities.
2.17.1 that there were intergovernmental coordination and harmonisation of policies, legislation, and actions relating to the environment	
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?	
2.19 Are the mitigation measures proposed realistic and what long-term environmental legacy and the managed burden will be left?	Residual impacts are discussed in Part B(d)(i)(2) of this BAR.
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 the 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?	There is no alternative to this project.
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?	Refer to the cumulative impact assessment as part of the impact assessment: Part A(h)(v).

The answers to the above-mentioned questions will ensure all the considerations are taken into account. During the assessment part of the report all the questions must again be considered. The incorporation of the above-mentioned questions into the basic assessment, scoping and reports will ensure that all the relevant considerations are taken into account in order to adequately consider need and desirability. The requirement to consider need and desirability

According to the 2014 IEM Guideline Series 9, Needs and Desirability (GN 891) when, considering ecological, social and economic impacts it is important to remember that while there might be some trade-offs between the considerations, in South Africa all development must in terms of Section 24 of the Constitution be ecologically sustainable, while economic and social development must be justifiable. There are therefore specific "trade-off rules that apply. Environmental integrity may never be compromised, and the social and economic development must take a certain form and meet certain specific objectives in order for it to be considered justifiable.

g) Motivation for the overall preferred site, activities and technology alternative

The final decommissioning and rehabilitation has been discussed with the community. Furthermore, the earthworks and sloping of the mine residue and the area has been planned with the aid of a specialist. The activities in this BAR is the most effective way to rehabilitate the area.

h) Full description of the process followed to reach the proposed preferred alternatives within the site

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 includes

(f) the option of not implementing the activity.

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

As above, no alternatives are applied for.

(b) The type of activity to be undertaken

As above, no alternatives are applied for.

(c) The design or layout of the activity

As above, no alternatives are applied for.

(d) The technology to be used in the activity

As above, no alternatives are applied for.

(e) The operational aspects of the activity

As above, no alternatives are applied for.

(f) The option of not implementing the activity

As above, no alternatives are applied for.

ii) Details of the Public Participation Process Followed

According to the Publication of Participation Guideline (NEMA), and 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):
"Interested and affected' parties 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."

The process followed adheres to the National Environmental Management Act 107-1998 - National guideline on minimum information (20180209-GGN-41432-00086) and the 2012, IEM Guideline Series 7, Public participation, GN 807.

(a) Formal announcement of the project

An advertisement was published in the local newspaper "Platinum Gazette" on 26 January 2018. Refer to Addendum 4B for a copy and proof of this advertisement. Three site notices were placed at and around the site on 26 January 2018. One site notice was placed at the King's place, one at MMakanaga Shop and one at Monopi Tavern. Refer to Addendum 4C for a copy and proof of the site notices placed. Letters were sent to all stakeholders as well as the Babinatlou Community on 24 January 2018. An sms was sent to all persons which could not be reach via email. Refer to Addendum 4A for this letter as well as proof of the letters sent, and sms's sent.

Details of the application were included in the notices placed in the designated areas mentioned above. The nature and the location of the activity, where further information can be obtained was added to the site notice. The applicant's intention to submit an application is clearly stated on the notice and comments in response to the site notices and advertisements are acknowledged. The competent authority will receive a copy of the newspaper advertisement which indicates the name of the newspaper and the date of publication. A picture of the site notice along with the coordinates of the site notice will also be sent to the competent authority and lastly copies of the written notices that were submitted by email or hand delivered will also be sent to the competent authority.

(b) Basic Assessment

A public and stakeholders meeting is held on 28 February 2018, 10h00, at Havercroft Mine. Refer to Addendum 4D for the meeting presentation.

The BAR is sent to all stakeholders and Babinatlou Community. Refer to Addendum 4E for proof of the BAR sent to all.

All I&APs are given the opportunity to comment on the final report if they are registered. This includes any issues that they have with the proposed activity and that they believe may be of significance in the consideration of the application. These comments need to be submitted within the specified timeframe.

The submission of the comments is received by the EAP. The organs of state have 40 days to comment (failing to do so will be taken as no comment) The DWS has 60 days in which to comment. If there are no comments within this time, then it will be regarded as no comments given to the CA.

Comments and responses are included in a separate report what is submitted with the BAR. Within 12 days of the date of decision taken by the department, all I&APs should be notified. They should also be notified that an appeal may be lodged.

All comments are included in Part A(h)(iii) below. Refer to Addendum 4F for all comments.

(c) Decision making announcement to stakeholders and I&APs

To be provided once received.

iii) Summary of issues raised by interested and affected parties

Refer below to a summary of all issues raised by the stakeholders and I&APs.

Table 7: Interested and affected parties identified

Interested and Affected Parties	Date comments received	Issues raised	EAPs response to issues as mandated by the applicant	Section reference in this report where issues and or response were incorporated
Affected parties				
Landowner/s				
According to the title deeds, the National	See below under 'Communities'	None	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 report where issues and or response were incorporated
Government of South Africa is the landowner, however, Babinatlou Community is the traditional landowner.				
Lawful occupier/s of the land				
The land is currently occupied by the mine.	None	None	N/A	N/A
Landowners or lawful occupiers on adjacent properties				
Babinatlou Community	See below under 'Communities'	None	N/A	N/A
Ward councillor - Ward 14				
Cllr. N Makofane	None	None	N/A	N/A
Ward councillor - Ward 15				
Cllr. A Kgaphola	None	None	N/A	N/A
Ward councillor - Ward 16				
Cllr. R Khoza	None	None	N/A	N/A
GTLM - Municipal manager				
Cllr R.S Mamekoa	None	None	N/A	N/A
SDM - Municipal manager				
Mr. Seporo Masemola	None	None	N/A	N/A
Organs of state				
DWS Mpumalanga – Lydenburg/Mashishing Office	None	None	N/A	N/A
Communities				
Babinatlou Community - Kgaogelo Mphofelo	31 January 2018	Requested meeting be moved to Havercroft Mine. High rate of unemployment in community.	2 February 2018 Venue moved to Havercroft Mine.	Part A(h)(v)(3.14)

Interested and Affected Parties	Date comments received	Issues raised	EAPs response to issues as mandated by the applicant	Section reference in this report where issues and or response were incorporated
Babinatlou Community – Isaac Mampuru	24 January 2018	Requested meeting invite and register as I&AP	1 February 2018 Final meeting invitation was sent	
Babinatlou Community – Thabo Mahlakwana	31 January 2018	Requested meeting invite and register as I&AP	1 February 2018 Final meeting invitation was sent	
DRDLR				
Ms Makhanana Senwana	None	None	N/A	N/A
Traditional Leaders				
Babinatlou Community	See below under 'Communities'	None	N/A	N/A
Limpopo Department of Economic Development, Environment and Tourism				
Juliet Mukhari	None	None	N/A	N/A
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, Forestry, and Fisheries (DAFF)	None	None	N/A	N/A
Other affected parties				
Historically disadvantaged communities				
None identified	None	None	N/A	N/A
Land claimants				
	None	None	N/A	N/A
Interested parties				
Lebalelo Water User Association	26 January 2018	Will attend the public meeting. Also, to add 3 additional persons	29 January 2018: Meeting invite sent through. Additional	N/A – no additional responses yet.

Interested and Affected Parties	Date comments received	Issues raised	EAPs response to issues as mandated by the applicant	Section reference in this report where issues and or response were incorporated
		from the Lebalelo Water User Association	persons were added to list of I&APs.	

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, socioeconomic, 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.

Please note, that this is an already existing mine.

1 Geology

Information for this section was extracted from the Havercroft Andalusite Mine EMP (Avmin Ltd, 1997):

1.1 Regional and local geology

Havercroft Mine Operation is situated along the north-northeastern rim of the Transvaal basin in the Timeball Hill Formation, which is near the base of the Pretoria Group. This location lies within the metamorphic aureole of the Bushveld Complex, the base of which lies some 3km stratigraphically above the orebody. The Bushveld Complex provided the heat source for the formation of the andalusite crystals.

The orebody outcrops/sub-outcrops against the north-eastern slopes of the Radingwane Mountain which is capped by the Daspoort Quartzites. The very uneven terrain is covered by a layer of rubble measuring from 0.5m to 6m thick. This talus consists mostly of quartzite boulders, an occasional lava boulder (sometimes very large) and very little soil.

The orebody is between 40m and 50m thick, strikes NW-SE and dips on average 15° to the SW. it displays three distinct zones and has gradational hanging wall and footwall contacts.

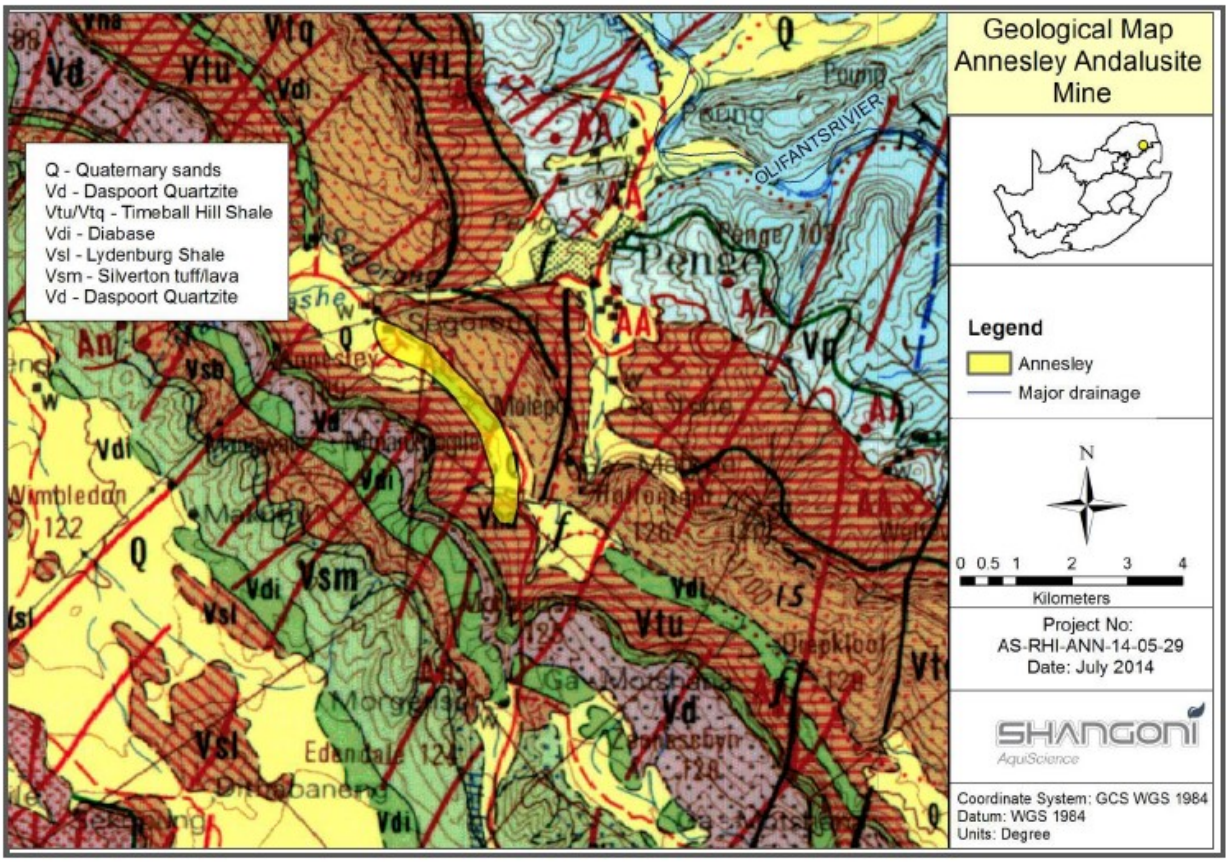


Figure 6: Pilgrims Rest Geological Map 2430 at a scale of 1:250 000 showing the general underlying geology of the study area Local Geology (Shangoni Management Services, 2017)

1.2 Mineralogy of the ore zone

The orebody is a metamorphically altered alumina-rich shale horizon. It is essentially a quartz-biotite-andalusite hornfels with minor amounts of garnet and staurolite. The andalusite crystals vary in cross-section from 1mm to 15mm and in length from 50mm to 20mm. weathering decreasing with depth, resulted in the formation of a sericitic layer around the andalusite crystals.

1.3 Intrusions and faulting

Up to three distinct diabase sills, irregularly weathered and probably of Bushveld Complex origin, are intrusive along bedding planes in the vicinity of and in the orebody. They vary in thickness from 0.5m to 5m and appears to be upwardly transgressive through the orebody from the east to the west. The ore above and below these sills displays alteration through contact metamorphism.

Six often very irregular, sub-vertical dolerite dykes of Karoo age transect the orebody from SW to NE. They are usually deeply weathered and deep gullies mark their position on the surface. Their effect on the ore appears to be minimal.

Only minor faulting and other structural deformation have been observed. Any water compartments that may exist lie below the mining operations at depths in excess of 50m.

2 Climate

Information for this section was extracted from the IWWMP (Shangoni Management Services, 2012), and Atmospheric Impact Report for Dryer (Shangoni Management Services, 2014):

2.1 Regional climate

The climate is moderate to hot, with occasional, very hot conditions in the low-lying valleys. The average daily temperature variation is 15°C. The area is part of a major mountain range and the winds blow consistently from the northeast. The rainy season lasts from late October until April with a maximum in November, mainly in the form of thunderstorms from the south-west, but also light to moderate precipitation blown in from the east. The rainfall is fairly low and in 12% of all years, there are severe drought conditions. There is no frost.

2.2 Rainfall and evaporation

Rainfall represents an effective removal mechanism of atmospheric pollutants. The annual rainfall at Annesley Andalusite Mine, during 2012, was approximately 510.68mm. Rainfall occurs mainly in the summer from December to February, with the peak being in December.

Table 8: Rainfall statistics

Month	Average (mm)	Days with more than 1 mm rain
January	95	9,8
February	84	6,8
March	70	6,8
April	20	2,6
May	8	2,2
June	4	1,3
July	4	1,3
August	8	1,7
September	19	1,8
October	59	6,3
November	102	10,1
December	86	8,4
Annual	559	59

Table 9: Evaporation

Month	Evaporation (mm)
January	212
February	174
March	174
April	139
May	121
June	102
July	119
August	167
September	228
October	259
November	228
December	217
Average	2140

2.3 Temperature

The mean summer temperature for the year 2012 was 23.3°C, with temperatures rising to 37.4°C in February. The mean winter temperature was 14.5°C with a minimum temperature of 3.6°C in August 2012. Figure 7 illustrates how temperatures range on a daily basis throughout the year.

Table 10: Temperature for Annesley

Month	Temperature	
	Max	Min
January	30,1	17,3
February	29,7	17,4
March	28,2	16,2
April	27,4	12,1
May	24,5	8,1
June	21,7	3,9
July	21,6	4,0
August	24,0	6,9
September	27,5	11,3
October	30,4	14,6
November	30,2	16,4
December	30,1	17,4
Annual	27,1	12,2

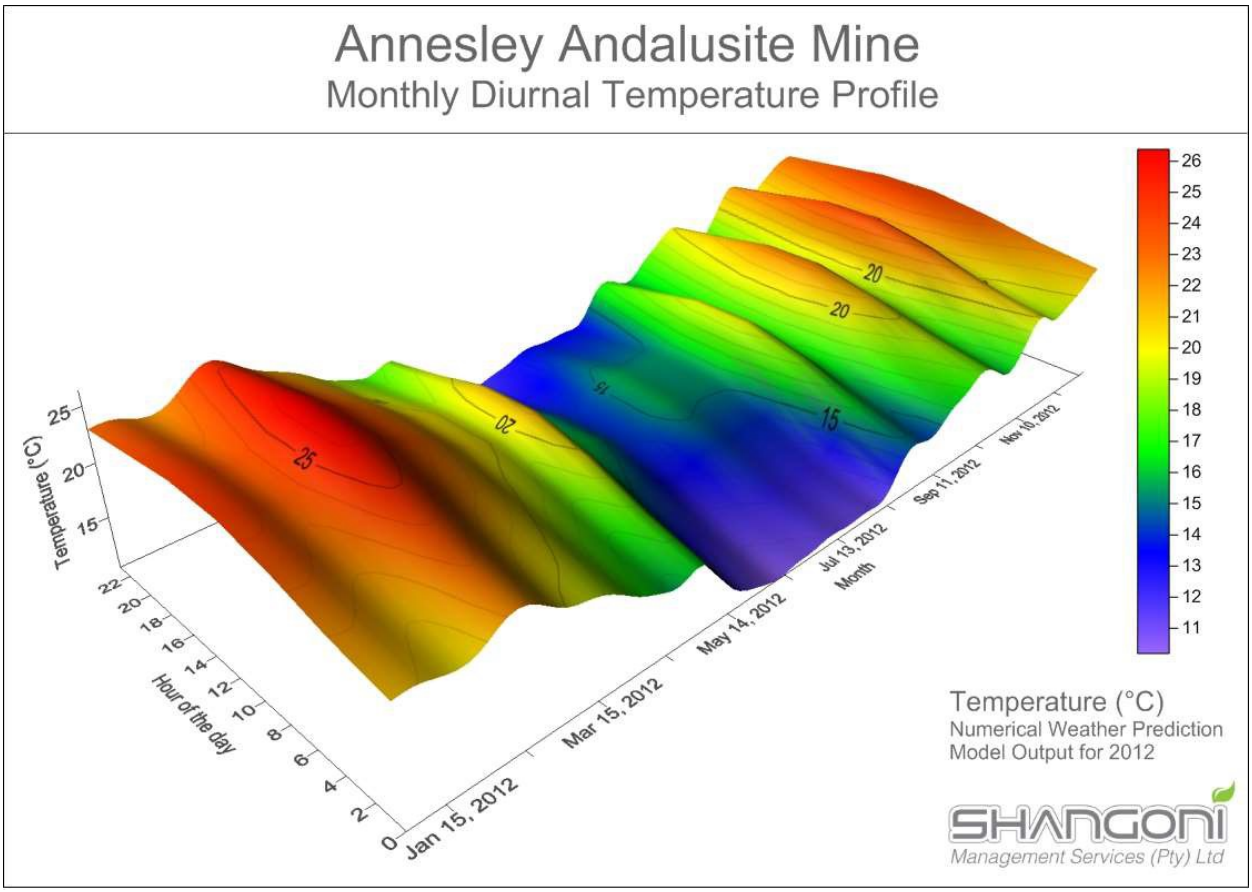


Figure 7: Monthly diurnal temperature profile Shangoni Management Services, 2014)

2.4 Wind

The predominant wind field throughout the year (2012), except during winter, was from an east northeasterly direction experiencing mostly moderate wind speeds between 1.5m/s and 3.1m/s. During winter wind was experienced primarily from a west southwesterly direction with some winds also coming from an east northeasterly direction.

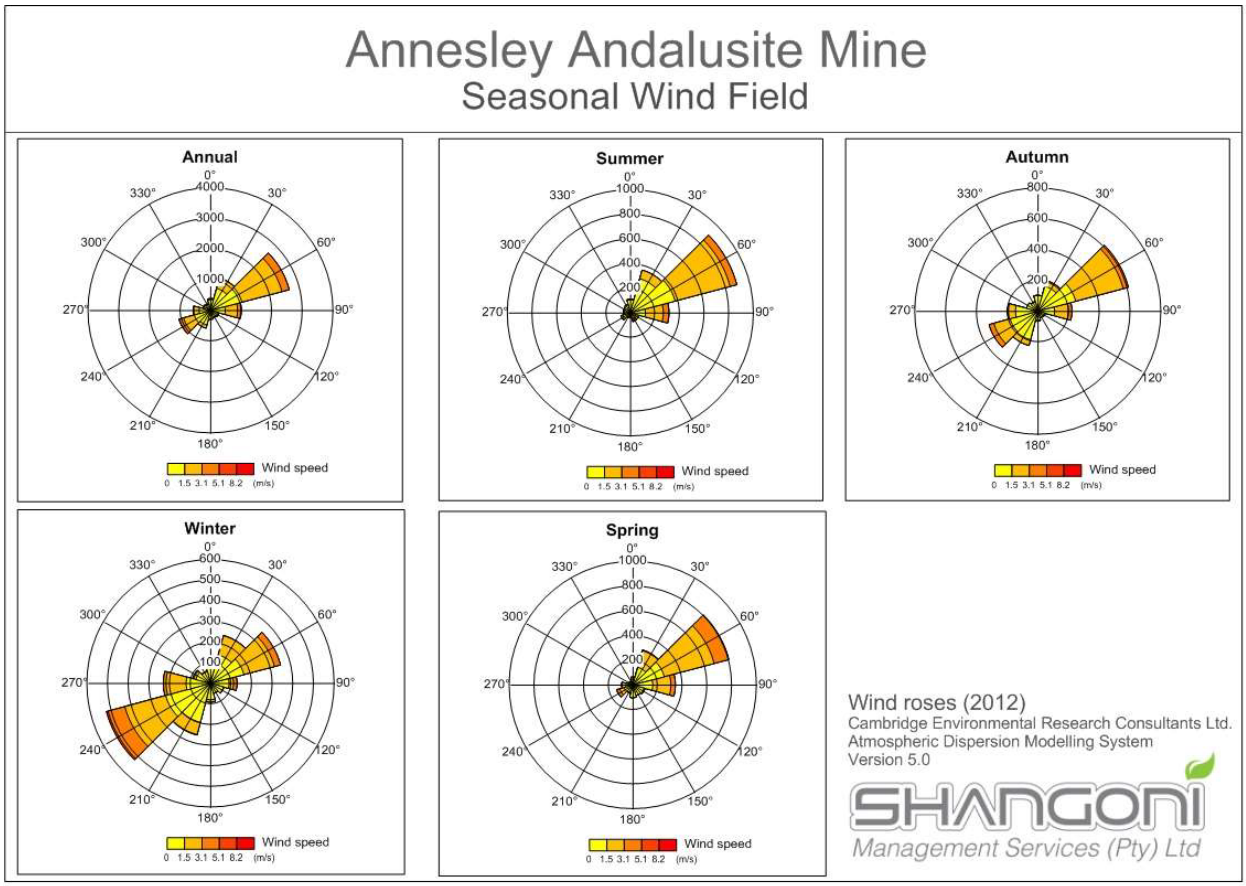


Figure 8: Seasonal wind roses (Shangoni Management Services, 2014)

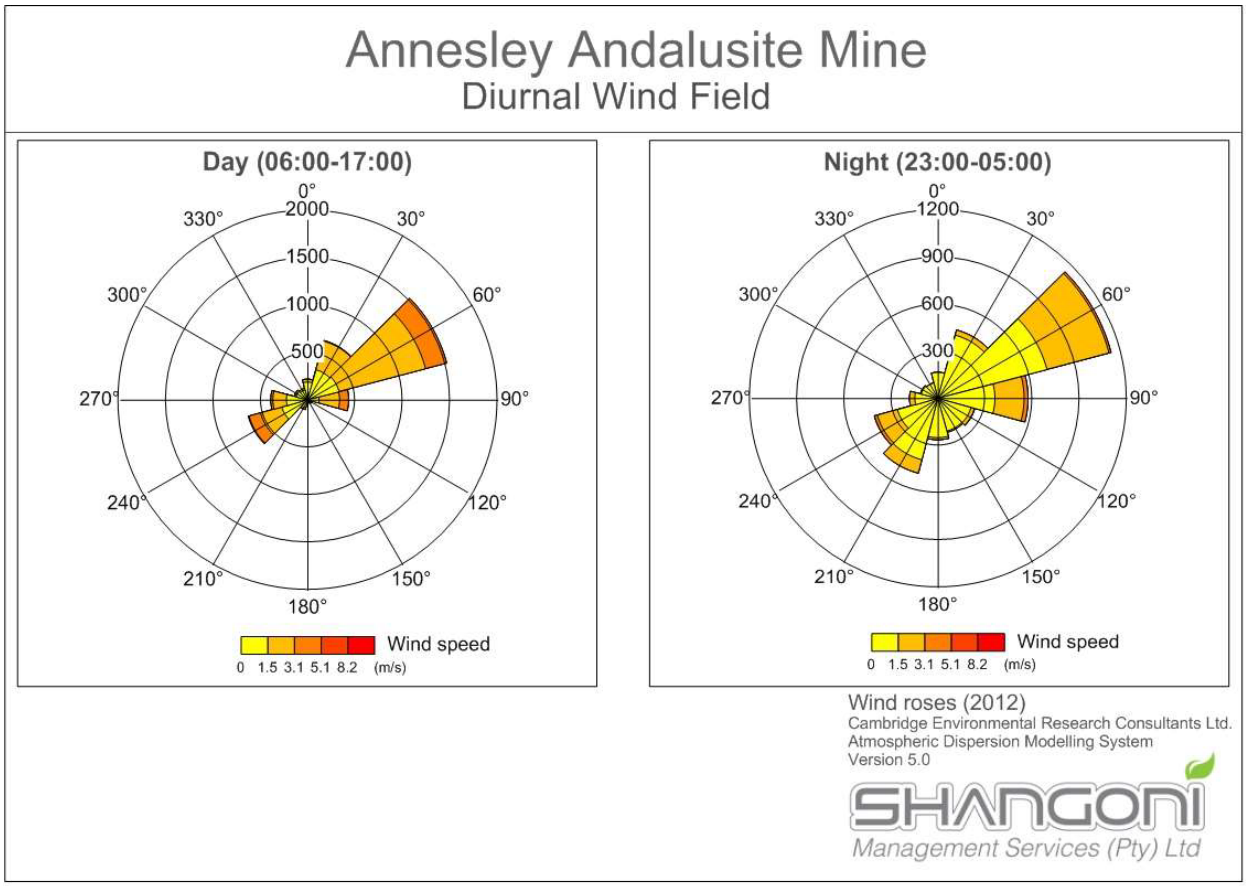


Figure 9: Diurnal wind roses (Shangoni Management Services, 2014)

2.5 Extreme events

The area experiences several extreme events on a regular basis, including frost, hail, drought, and high winds.

3 Topography

Information for this section was extracted from the Havercroft Andalusite Mine EMP (Avmin Ltd, 1997):

The mining area is 16km from the edge of the escarpment. The surrounding area is extremely rugged, with the high ridges above the mining area rising from the floor of the valley of the Olifants River at an elevation of 670m, to over 1,400m. The Radingwane Mountain is one of a series of parallel ranges which form the Drakensberg Range.

The mining area starts in the west in the flat valley of the Motse River and continues to the south-east, rising up and along the north slope of the ridge of the Radingwane Mountain, which is steeply sloping

(average slope 18°) and rugged. The slope is intersected by a large number of well-defined gullies, but there are no major ravines.

The mining area starts at 670m on the banks of the Motse River with the highest point of the ore body at 1,070m.

4 Soil

Information for this section was extracted from the Havercroft Andalusite Mine EMP (Avmin Ltd, 1997):

The soils of the mountain slopes, which overlie the orebody, are skeletal and only developed in localised potholes and as a component of the scree, which is made up of metamorphic (hornfels) schist, diabase sill material and quartzitic rocks.

The major components of the topsoils are weathered silica and clay material, chiefly loamy biotite, rich in porphyroblasts of staurolite and/or garnets and cordierite. The topsoil is generally friable, pelitic, with an abundance of gravel and pebbles of all sizes.

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

Information for this section was extracted from the Havercroft Andalusite Mine EMP (Avmin Ltd, 1997):

The land disturbed by the existing mining excavations is all wilderness land. The land is steep, the soil less than 0.25m deep and the volume of rocks larger than 100mm is more than 50%. The land covered by the TDF and WRD is arable land merging into grazing land.

The pre-mining land use, by the local subsistence farmers, was cultivated lands in the flat valley at the confluence of the Motse and Olifants Rivers, producing crops for local consumption. The steep valley of the Modubeng Spruit was used for grazing cattle and goats. The grass cover is sparse and the carrying capacity even in the flatter areas is no better than 15ha per head of large livestock.

There are a few scattered dwellings across the Modubeng Spruit to the northeast of the plant complex.

6 Vegetation

Information for this section was extracted from the Havercroft Andalusite Mine EMP (Avmin Ltd, 1997):

The area as described by Acocks, is Sourish Mixed Bushveld on the upper slopes, descending into Mixed Bushveld, which may be characterised as '*Acacia nigrescens-Combretum apiculatum-Kirkii wilmsii* Veld'.

The mining area is well wooded with a great variety of medium-sized species of trees as well as a great variety of shrubs and aloes.

The dominant grass species found in undisturbed areas are:

- *Aristida scrabbrivalus*
- *Aristida congesta barbicollis*
- *Enneapogon centroides*
- *Digitaria eriantha*
- *Eragrostis racemosa*

Stipagrostis uniplumis, Enneapogon centroides, and *Cynodon dactylon* grow abundantly on the top and slopes of the TDS and WRD.

The following species of trees are abundant on the north-east slope of the mountain.

Table 11: Tree species

Scientific name	**Common name**
Kirkii wilmsii	Mountain seringa
Acacia nigrescens	Knob thorn
Acacia senegalis	Three hook thorn
Acacia nilotica	Scented thorn
Acacia tortilis	Umbrella thorn
Acacia permixta	Slender thorn
Combretum apiculatum	Red bush willow
Combretum hereroense	Russet bush willow
Sclerocarya caffra	Marula
Dichrostachys cinerea	Sickle bush
Bolusanthus speciosus	Tree wisteria
Scotia brachypetala	Tree fuschia
Ziziphus mucronata	Buffalo thron
Bosnia albutrunca	Sheperds tree
Ozoroa paniculose	Common resin tree
Sterculia rogersii	Common star chestnut
Peltiphorum africanum	Weeping wattle
Balanites maughamii	Green thorn
Commiphora pyracanthoides	Common corkwood
Commiphora mollis	Velvet corkwood
Commiphora schimperi	Glossy-leaved commiphora

Scientific name	Common name
Euphorbia ingens	Tree euphorbia
Euphorbia terucalli	Rubber euphorbia
Euphorbia cooperi	Transvaal candelabra tree

The following shrubs are found:

- *Maytenus heterophylla*
- *Grevia flava*
- *Triaspis glacophila*
- *Clerodendrum* spp.
- *Becium obovatum*
- *Tinnea zambesica*
- *Euclia crispa*
- *Grevia bicolor*
- *Petalidium* spp.
- *Ormocarpum tricocarpum*
- *Ochna inerniis*
- *Psiadia puntulata*
- *Euclea undulata*

The following aloes are common:

- Marlothii
- Castanea
- Wickensii
- Globuligemma
- Cryptopoda

Species of Adansonia digitata (Baobabs) are found in the low-lying area between the Motse River and Modubeng Spruit.

Invader species present:

- *Nicotiana glauca*
- *Xanthium spinosum*
- *Xanthium strumarium*

7 Animal life

Information for this section was extracted from the Havercroft Andalusite Mine EMP (Avmin Ltd, 1997):

The area around the site is open to very few people in the actual mountainous areas, especially to the north. Hunting with dogs and snare setting have impacted on the number of animals, but the following species occur in this region:
Kudu, klipspringer, grey duiker, grey rhebuck, grysbuck, bushbuck, black-backed jackal, leopard, Chacma baboon, vervet monkey, and Bushpig.

The grey rhebuck and leopard are endangered species in the area.

8 Surface water

Information for this section was extracted from the Havercroft Andalusite Mine EMP (Avmin Ltd, 1997) and the Quarterly Water Quality Monitoring Report (BECS Environmental, 2016):

8.1 Surface water hydrology

The mining area is drained by a large number of well-defined watercourses which feed into the Modubeng Spruit. The extreme south-eastern section of the mining area drains into the south-flowing Segorong Spruit. The Modubeng Spruit and Segorong Spruit, which are both tributaries of the perennial Olifants River, only have a steady flow after periods of sustained good rains. The Olifants River adjoins the northern limit of the mining area and flows past the north-west of the mine. The Motse River flows to the west of the mine. The Moodubeng Spruit flows along the northern boundary of the mine.

The catchment area is 2,230ha and the sub-catchment area is 1,165ha. The mean annual run-off from the catchment cannot be measured or calculated due to the complexities of different slopes, soil types, and vegetation cover. An annual run-off volume of 10% is assumed. The calculated volumes at 10% run-off are catchment of 1,246,570m³ and sub-catchment of 651,235m³. There is no dry weather flow in any of the water courses or the Modubeng Spruit.

The peak flows for the catchments are presented in the table below.

Table 12: Estimated flood frequencies

Site	Catchment area (km²)	Flood peaks (m³/s)							
		Return periods							
		2	5	10	20	50	100	200	RMF
Olifants	34,237	410	920	1,400	2,000	3,550	4,950	6,250	8,400
Motse	820	175	275	378	530	760	1,000	1,200	1,800

Site	Catchment area (km²)	Flood peaks (m³/s)							
		Return periods							
		2	5	10	20	50	100	200	RMF
Modubeng	22.3	26	47	68	94	162	200	258	464

The drainage density of the site is 2.83km of drainage path per km² of land.

8.2 Surface water quality

Water quality monitoring was done in August 2016 (BECS Environmental, 2016). Refer below for the results.

Table 13: Domestic use: Target Water Quality Guidelines

Variable	Unit	Limit	Sample number		
			HAV 1	HAV 2	HAV 3
pH		6.0-9.0	7.76	7.68	7.81
Conductivity*	mS/m	≤70	96.8	59.3	61.9
Total dissolved solids	mg/l	≤450	781	449	510
Fluoride	mg/l	≤1.0	<0.05	<0.05	<0.05
Chloride	mg/l	≤100	186.2	84.9	138.2
Nitrate: N	mg/l	≤6	<0.02	<0.02	<0.02
Sulphate	mg/l	≤200	184.0	86.6	104.0
p-Alkalinity			0.0	0.0	0.0
m-Alkalinity			204.7	87.8	60.8
Carbonate			0.0	0.0	0.0
Bicarbonate			249.6	107.1	74.1
Total hardness		≤50	680.6	284.0	337.8
Calcium hardness			98.0	111.1	164.4
Magnesium hardness			582.5	172.9	173.5
Calcium	mg/l	≤32	39.3	44.5	65.8
Magnesium	mg/l	≤30	141.5	42.0	42.1
Sodium dissolved	mg/l	≤100	77.7	42.8	45.8
Potassium dissolved	mg/l	≤50	3.30	3.49	3.56
Iron dissolved	mg/l	≤0.1	<0.002	<0.002	<0.002
Manganese dissolved	mg/l	≤0.05	<0.005	<0.005	<0.005
Sum Cation	me/l		17.06	7.63	8.83
Sum Anion	me/l		17.08	7.66	8.86

Variable	Unit	Limit	Sample number		
			HAV 1	HAV 2	HAV 3
Total viable organisms*	per 100ml	≤75	389	127	104
Total coliform Org	per ml	≤5	119	<1	<1
Faecal coliform Org	per ml	0	59	<1	<1

* General limits for general authorisations

** Too numerous to count

8.3 Surface water users

The community, living along the banks of the Modubeng Spruit, use this water, when available, for domestic purposes and for watering livestock. When the river is dry, water is collected from the Motse River.

9 Groundwater

Information for this section was extracted from the Geohydrological evaluation for the water use licence application report (Aurecon, 2010)) (from the IWWMP, 2012 (Shangoni Management Services)), and the Geohydrological impact assessment as input to the Section24G Rectification (Shangoni AquaScience, 2017)::

According to the published 1:250 000 geological map (2430 Pelgrims Rest), the area under investigation is underlain by the Timeball Hill Formation that forms part of the Pretoria Group and mainly comprises of andesitic lava, shale, and quartzite. Diabase dykes and sills of the Upper Vaalium age have intruded the Pretoria Group.

The ore zone principally comprises of quartz, feldspar, biotite, and Andalusite bearing hornfels. The ore body outcrops/sub-outcrops against the north-eastern slopes of the Radingwane Mountain, which is capped by Daspoort Quartzite of the Daspoort Formation. The surface of the ore body is covered by a layer of rubble, between 0.5m to 6m thick, consisting primarily of quartzite boulders, occasional lava boulders, and very little soil.

The ore body is a metamorphically altered alumina-rich shale horizon. It is essentially a quartzbiotite-andalusite hornfels with minor amounts of garnet and staurolite. The ore body varies between 40m and 50m in thickness, strikes NW and dips on average 15° to the SW.

The geological map indicates the presence of several regional linear structures, comprising of NESW striking dolerite dykes and NW-SE striking diabase dykes. The drainage line through the mine area runs parallel to the regional orientation of the diabase dykes.

They are usually deeply weathered and deep gullies mark their position on the surface. Their effect on the ore appears to be minimal.

A minimum of four distinct diabase sills, irregularly weathered and probably of Bushveld Igneous Complex origin, are intrusive along bedding planes in the vicinity of and within the ore body. They vary in thickness from 0.5m to 5m and appear to upwardly transgress through the ore body from east to west. The ore above and below these sills, display alteration through contact metamorphism. Only minor faulting and other structural deformation have been observed.

Groundwater occurrence favours weathered shale, brecciated or jointed zones and especially the contact zone between intrusive diabase sheets and shale. These contact zones would usually act as targets for groundwater exploration. On the contrary, it must be stated that little groundwater seepage from the contact zones between shales and diabase/dolerite dykes intercepted in the mining area occur. During the site visit, a small volume of water accumulated at the base of the open quarries was observed. No active dewatering takes place in the open casts. The contact between the diabase and shale where fracturing usually takes place and act as preferential flow paths for groundwater may have been metamorphosed with no distinct contact and consequently, little fracturing. Future exploratory drilling on these contact zones will shed more light on this issue.

9.1 Groundwater use

There is only one existing borehole (ANBH Mine) within the Annesley mining area, which delivers a yield of approximately 10 000 l/d (0.12 l/s). Water from this borehole is used as domestic water (cleaning and personal hygiene purposes only). Some boreholes outside the mining area exist, most of which are being used by the local community.

Table 14: Summary of boreholes identified during the hydrocensus

BH number	Owner	Static water level (mbgl)	User application
ANBH Mine	Annesley Mine	BH Sealed	Domestic use
ANBH Penge	Annesley Mine	78.8	Process Water
ANBH Chief	Segorong chief	BH Sealed	Domestic use
H12-2270	DWS	BH Sealed	Domestic use
BH School	Ga Malepe school	BH Sealed	Domestic use
ANW 1 (well)	Ga Malepe community	0.5	Domestic use

From the hydrocensus data it can be concluded that groundwater is being used as source of potable water in the area. Based on the acquired data, the average yield of a successful borehole in the study area is in the region of 1ℓ/s (3,600ℓ/hour). Based on the investigation and data acquired from the mine, a volume of

~1350m³/day of groundwater are being abstracted from the mine and adjacent properties. The majority hereof is being abstracted from the "Old Penge Shaft" which amounts to an average daily abstraction of 1,333m³/day. The mine further abstracts less than 10,000ℓ/day from a borehole ("ANBH Mine") located close to the Annesley plant. The neighbouring communities utilise groundwater for domestic purposes from 4 identified boreholes and 1 hand dug well.

It must be stated that it was not always practically possible to measure the yields of the boreholes and as no records for the boreholes exist, a qualified guess was made. This was done in conjunction with information provided by mine personnel. The same applies to the volume of water being abstracted from boreholes.

9.2 Groundwater levels

The mining area is underlain by a diabase sill of approximately 100m thick and is concordant with the sedimentary rock in which it intrudes. This sill is approximately 40m below the footfall of the ore body. Several dolerite dykes intersect the ore body, but none of these will be mined, leaving the water compartments locally intact. Due to the highly undulating nature of the topography, varied geology and localised presence of dykes and sills, the depth to water table in the B71F quaternary catchment varies significantly. This could be less than 10mbgl in some places and more than 40mbgl at others.

It was not possible to obtain measured water levels from the hydrocensus boreholes due to the fact that all the boreholes identified were sealed to prevent equipment theft and contamination. The water level of the "Old Penge Shaft" was measured to be 78.8mbgl. This is however not representative of the static regional groundwater level as it is deeper than the surrounding boreholes and major pumping from this shaft takes place. The water level in the hand dug well was measured to be at 0.5mbgl. An NGA hydrocensus of registered boreholes in the B71F Quaternary Catchment was therefore undertaken to establish regional groundwater levels for the area.

A total of eight boreholes in the B71F catchment are registered with the Department of Water Affairs (DWA) with only five (5) boreholes located in relatively close proximity to Annesley or within similar geology. The water levels for these boreholes range between 12.93mbgl and 36mbgl.

9.3 Aquifer parameters

Falling head tests ("Slug Tests")

No boreholes were accessible to conduct falling head tests ("slug tests"). The test involves continuous measuring of the water level response in a borehole to the rapid displacement of water therein. This displacement or rise in water level is caused as a result of the introduction of a slug below the rest water level. Data acquired from the "slug tests" are used to calculate the hydraulic conductivity of the substrata in

the immediate vicinity of the borehole in order to get an idea of the groundwater flow velocity. Theoretical K-values are presented in Table 15 in order to compare groundwater flow velocities in different rock types.

Table 15: Comparison of the hydraulic conductivity in different rock types

Rock Type	**K (m/day)**
Shale	1×10^{-8} - 1×10^{-6}
Sandstone	10^{-3} - 1
Limestone	10-5 - 1
Basalt	3×10^{-4} - 3
Granite	1×10^{-4} - 3×10^{-2}
Slate	10^{-8} – 10^{-5}
Schist	10^{-7} – 10^{-4}
Groundwater movement	
Extremely slow	1×10^{-6}
Very slow	1×10^{-4}
Slow	1×10^{-2}
Moderate	1
Fast	10
Very fast	100

Keeping the (1) relatively low yielding boreholes, (2) little/no groundwater seepage into the open quarries and (3) occurring geological formations in mind, it can be concluded that groundwater movement at the mine will be very to extremely slow. The rock will have a typical hydraulic conductivity of 10^{-6} to 10^{-4}. The advantage of a low hydraulic conductivity is that any pollutants that might accidently leak to the aquifer will migrate at very slow pace.

9.4 Aquifer classification

The DWS has characterised South African aquifers based on the rock formations in which it occurs together with its capacity to transmit water to boreholes drilled into specific formations. The water-bearing properties of rock formations in South Africa can be classified into four classes defined as:

1. **Class A - Intergranular**
    - Aquifers associated either with loose and unconsolidated formations such as sands and gravels or with rock that has weathered to the only partially consolidated material.
2. **Class B - Fractured**
    - Aquifers associated with hard and compact rock formations in which fractures, fissures and/or joints occur that are capable of both storing and transmitting water in useful quantities.
3. **Class C - Karst**

- Aquifers associated with carbonate rocks such as limestone and dolomite in which groundwater is predominantly stored in and transmitted through cavities that can develop in these rocks.

4. **Intergranular and fractured**
    - Aquifers that represent a combination of Class A and B aquifer types. This is a common characteristic of South African aquifers. Substantial quantities of water are stored in the intergranular voids of weathered rock but can only be tapped via fractures penetrated by boreholes drilled into the fractured aquifer.

Each of these classes is further subdivided into groups relating to the capacity of an aquifer to transmit water to boreholes, typically measured in l/s. The groups, therefore, represent various ranges of borehole yields.

The water-bearing properties of the shale formations are generally more favourable than those of the quartzites due to their greater susceptibility to weathering. The quartzites do, however, constitute productive aquifers where these rocks are fractured and especially in the presence of ferruginization. Lesser and/ or more isolated groundwater occurrences are associated with fault and associated shear zones and with contact zones between diabase sills, dykes, shale, and quartzite. Water may also occur in occasional joints and fractures in fresh diabase.

Annesley Andalusite Mine is located in a **d3 aquifer class** region. The groundwater yield potential is classed as low to medium on the basis that most of the boreholes on record in the vicinity of the study area produce between 0.5 and 2.0l/s. Higher yields do sporadically occur where groundwater is tapped from good water-yielding fractures.

9.5 Regional aquifer classification

According to the regional aquifer classification map of South Africa, the Timeball Hill aquifer has been identified as a minor aquifer with relatively good groundwater quality (average = <300mg/l TDS). Based on the underlying hydrogeology of the project area the aquifer can be classified according to the Parsons classification system as follows:

i. Intergranular and fractured shale/quartzites/diamictite of the Timeball Hill Formation
    a. Minor-aquifer

9.6 Aquifer vulnerability

Tables 16 - 19 summarizes the aquifer classification vulnerability scores for the aquifer/s in the vicinity of Annesley Andalusite Mine. The final DRASTIC score of 101 indicates that the aquifer/s in the region has a medium susceptibility to pollution and a medium level of aquifer protection is therefore required.

Table 16: DRASTIC vulnerability scores

Factor	Range/Type	Weight	Rating	Total
D	15 - 30 m	5	3	15
R	10 - 50 mm	4	6	24
A	Fractured	3	6	18
S	Loamy sand	2	7	14
T	0-2%	1	10	10
I	Pretoria	5	4	20
C	-	3	-	-
DRASTIC SCORE = 101				

In order to achieve the Groundwater Quality Management (GQM) Index a point scoring system as presented in Table 18 and Table 19 was used.

Table 17: Ratings for the Aquifer System Management and Second Variable Classifications

Aquifer System Management Classification		
Class	Points	Study Area
Sole Source Aquifer System	6	
Major Aquifer System	4	
Minor Aquifer System	2	2
Non-Aquifer System	0	
Special Aquifer System	0-6	
Second Variable Classification (weathered/fractured)		
High	3	
Medium	2	2
Low	1	

Table 18: Ratings for the GQM Classification System

Aquifer System Management Classification		
Class	Points	Study Area
Sole Source Aquifer System	6	
Major Aquifer System	4	
Minor Aquifer System	2	2
Non-Aquifer System	0	
Special Aquifer System	0-6	
Second Variable Classification (weathered/fractured)		
High	3	
Medium	2	2
Low	1	

The occurring aquifer(s), in terms of the above definitions, is classified as a minor aquifer system. The vulnerability, or the tendency or likelihood for contamination to reach a specified position in the groundwater system after introduction at some location above the uppermost aquifer, in terms of the above, is classified as medium.

The level of groundwater protection based on the GQM Classification (Table 19):

GQM Index = Aquifer System Management x Aquifer Vulnerability

= 2 X 2 = 4

Table 19: GQM index for the study area

GQM Index	Level of Protection	Study Area
<1	Limited	
1-3	Low level	
3-6	Medium level	4
6-10	High level	
>10	Strictly non-degradation	

The ratings for the Aquifer System Management Classification and Aquifer Vulnerability Classification yield a GQM Index of 4 for the study area, indicating that a **medium level groundwater protection** may be required.

Due to the medium/high GQM index calculated for this area, a medium/high level of protection is needed to adhere to DWS's water quality objectives. Reasonable and sound groundwater protection measures are required to ensure that no further cumulative pollution affects the aquifer, even in the long term.

In terms of DWS's overarching water quality management objectives which is i) protection of human health and ii) the protection of the environment, the significance of this aquifer classification is that if any potential risk exists, measures must be triggered to limit the risk to the environment, which in this case is the i) protection of the secondary underlying aquifers and ii)) the non-perennial streams draining the project area.

9.7 Geochemical characterisation

Shangoni (2014) performed a geochemical study on four (4) mine residue deposit (MRD) samples to identify contaminants of concern and risks pertaining to day to day operation of the mine. Stormwater/leachate emanating from these MRDs are directed towards the pollution control and other water management infrastructure. A summary of the geochemical assessment is discussed below.

The waste locations sampled were:

- Overburden

- HMS Waste
- Primary Waste
- Slimes Slurry (tailings)

The following tests were included in their assessment:

- Aqueous extraction. This procedure indicates which chemical constituents may be solubilised by deionised water.
- Static acid-base accounting (ABA). Static tests are the analytical tests used as a screening criterion of the samples, used to determine the difference between the acid-generating capability and the acid-neutralizing potential of the samples. Originally developed for the coal mining industry, this procedure provides information on the potential of solids to generate or neutralise acid formation and is correlated to the concentration of sulphides and neutralising minerals.

9.7.1 Acid-Base Accounting

The results of the ABA analyses are displayed in Table 20 and rock classification guideline in Table 21. According to these results, all of the samples are classified as a Type III rock, which according to the guidelines imply that they are non-acid forming. This is largely due to the low almost absent sulphur content. Although the *HMS waste* calculated a Neutralising Potential Ratio (NPR), of 1:1.60, the very low sulphur content of the waste resulted in a Type III classification.

Table 20: Results of acid-base accounting

Acid-Base Accounting Modified Sobek (EPA-600)	**Sample Identification**			
	Primary Waste	**Overburden**	**Slimes**	**HMS Waste**
Paste pH	7.5	8.0	7.9	8.0
Total Sulphur (%) (LECO)	0.02	0.01	0.02	0.01
Acid Potential (AP) (kg/t)	0.625	0.313	0.625	0.313
Neutralization Potential (NP)	7.00	2.50	5.50	0.500
Nett Neutralization Potential (NNP)	6.38	2.19	4.88	0.187
NPR (NP: AP)	11.20	8.00	8.80	1.60
Rock Type	III	III	III	III

Table 21: Rock Classification

TYPE I	Potentially Acid Forming	Total S(%) > 0.25% and NP:AP ratio 1:1 or less
TYPE II	Intermediate (uncertain)	Total S(%) > 0.25% and NP:AP ratio 1:3 or less
TYPE III	Non-Acid Forming	Total S(%) < 0.25% and NP:AP ratio 1:3 or greater

9.7.2 Leachate analysis

The results of the aqueous extraction test are displayed in Table 22. The results were evaluated according to the SANS 241: 2011 water quality standards. Where no standard is proposed in the SANS guideline or where relevant, health-based water quality standards as proposed by the DWS (DWAF, 1996) were sourced.

***Note** that the solid-to-liquid ratio of 1:4 used in the aqueous laboratory extractions can be considered relatively similar to reality but it must be stressed that in-situ conditions can never be 100% simulated under laboratory conditions. Therefore, any exceedance of the water quality standards should be treated as an indication of potential contaminants only.*

The results in Table 22 indicate that the waste is chemically inactive/inert.

Table 22: Leach results evaluated according to the SANS 241: 2015 water quality guidelines

Parameter	SANS 241: 2015	Primary Waste	Overburden	Slimes	HMS Waste
pH	5.0 - 9.7	7.5	8.0	7.9	8.1
TDS	1200.0	156.0	94.0	176.0	140.0
Alkalinity ($CaCO_3$)	-	64.0	44.0	20.0	16.0
Chloride (Cl)	300.0	27.0	11.0	25.0	21.0
Sulphate (SO_4)	500.0	21.0	9.0	55.0	44.0
Nitrate (NO_3-N)	11.0	0.20	1.80	<0.2	<0.2
Fluoride (F)	1.5	1.30	1.00	0.40	0.40
Silver (Ag)	na	<0.025	<0.025	<0.025	<0.025
Aluminium (Al)	0.3	0.282	0.537	0.687	0.471
Arsenic (As)	0.05	0.013	<0.010	<0.010	<0.010
Boron (B)	na	<0.025	<0.025	<0.025	<0.025
Barium (Ba)	na	<0.025	<0.025	<0.025	<0.025
Beryllium (Be)	na	<0.025	<0.025	<0.025	<0.025
Bismuth (Bi)	na	<0.025	<0.025	<0.025	<0.025
Calcium (Ca)	-	<2	2	4	3
Cadmium (Cd)	0.003	<0.005	<0.005	<0.005	<0.005
Cobalt (Co)	0.5	<0.025	<0.025	<0.025	<0.025
Chromium (Cr)	0.05	<0.025	<0.025	<0.025	<0.025
Copper (Cu)	2	<0.025	<0.025	<0.025	<0.025
Iron (Fe)	2	0.137	0.290	0.633	0.511
Potassium (K)	-	<1.00	<1.00	1.0	1.0
Lithium (Li)	na	<0.025	<0.025	<0.025	<0.025

Parameter	SANS 241: 2015	Primary Waste	Overburden	Slimes	HMS Waste
Magnesium (Mg)	-	<2	<2	4	3
Manganese (Mn)	0.5	<0.025	<0.025	<0.025	<0.025
Molybdenum (Mo)	na	<0.025	<0.025	<0.025	<0.025
Sodium (Na)	200	46	28	33	27
Nickel (Ni)	0.07	<0.025	<0.025	<0.025	<0.025
Phosphorous (P)	-	0.028	0.032	<0.025	<0.025
Lead (Pb)	0.01	<0.020	<0.020	<0.020	<0.020
Antimony (Sb)	0.02	<0.010	<0.010	<0.010	<0.010
Selenium (Se)	0.01	<0.020	<0.020	<0.020	<0.020
Tin (Sn)	-	<0.025	<0.025	<0.025	<0.025
Strontium (Sr)	-	<0.025	<0.025	<0.025	<0.025
Titanium (Ti)	-	<0.025	<0.025	<0.025	<0.025
Vanadium (V)	0.2	<0.025	<0.025	<0.025	<0.025
Wolfram (W)	-	<0.025	<0.025	<0.025	<0.025
Zinc (Zn)	5	<0.025	<0.025	<0.025	<0.025
Zirconium (Zr)	-	<0.025	<0.025	<0.025	<0.025

Results are given in mg/l, except for pH

Solid to liquid ratio – 1: 4

The salinity (TDS) is low with results ranging between 94 mg/l and 176 mg/l, which is mostly contributed by chloride (Cl), sulphate (SO_4) and sodium (Na), while the pH is neutral to slightly alkaline ranging between 7.9 and 8.1. The primary waste recorded an arsenic (As) concentration of 0.013 mg/l which slightly exceeds the SANS guideline but is still within DWS health-based guideline of <0.05 mg/l. None of the remaining parameters exceed the SANS guideline and is overall of good quality and of fairly low/inert chemical reactivity.

9.8 Water quality

9.8.1 Sampling sites

Water quality data was sourced from the client and from the Shangoni (2014) report. Information pertaining to the available water quality datasets are shown in Table 23.

Table 23: Water sampling points for chemical constituents

Site ID	Coordinates	Site type
ANW1	S24.44250° E30.27653°	Hand dug well
BH School	S24.42535° E30.28083°	Domestic use borehole (No access)
ANBH Penge	S24.38356° E30.28016°	Production borehole (old Penge shaft)

Site ID	Coordinates	Site type
ANBH Chief	S24.38843° E30.24434°	Handpump for domestic use
H12 2770	S24.38797° E30.23859°	Open borehole (Dry)
ANBH Mine	S24.39388° E30.25409°	Borehole for domestic use downgradient from Pollution control dam (PCD) (hygiene only)
ANQ6	S24.41533° E30.27315°	Quarry 6 open pit (rainwater)
PCD	S24.394420 E30.254050	PCD (Emergency Dam)
Village	S24.6572 E30.33473	Village borehole (staff housing Burgersfort)

9.8.2 Water quality

9.8.2.1 Interpretation according to relevant standards

Standards & guidelines applicable to the geohydrological investigation were the South African water quality guidelines namely i) the domestic colour coded classification system and; ii) the South African National Standard for drinking water. The hydrochemical results for the water samples taken at Annesley Andalusite Mine interpreted according to the South African drinking water guidelines, are displayed in Table 24.

Table 24: Hydrochemical data

Site Name	SANS 241: 2011	ANBH Chief	ANQ6	PCD	Process water	ANBH Penge	ANBH Mine	ANW 1	Village borehole
pH	**≥5 to ≤9.7**	6.99	8.93	7.94	8.1	8.05	7.13	5.56	8.34
EC (mS/m)	**≤170**	**89.2**	**92.8**	**432**	**314**	**255**	**311**	4.8	145
TDS (mg/l)	**≤1200**	**503.2**	**523.5**	**2683**	**2041**	**1438.6**	**1754.5**	27.2	818
Ca (mg/l)	**-**	49.3	41.5	161	148	164.0	195.0	2.4	5.27
Mg (mg/l)	**-**	38.8	35.5	166	131	154.0	133.0	1.0	165
Na (mg/l)	**≤200**	58.6	80.9	**351**	**257**	180	**312**	2.7	78.1
K (mg/l)	**-**	2.1	2.9	3.97	11.0	43.3	8.3	1.1	7.91
MALK (mg/l)	**-**	268.0	113.0	195.7	311	288.0	311.0	7.7	505
Cl (mg/l)	**≤300**	68.2	**170.0**	**548.8**	**394**	**369.0**	**500.0**	3.9	165
SO_4 (mg/l)	**≤500** **≤250***	22.8	62.9	**582**	**517**	**632.0**	**746.0**	3.6	58
NO_3-N (mg/l)	**≤11**	0.287	0.628	<0.02	1.21	0.343	1.16	0.311	6.98
PO_4 (mg/l)	**-**	<0.008	<0.008	<0.02	0.008	<0.008	0.008	<0.008	0.078
N_Ammonia (mg/l)	**≤1.5***	0.009	0.022	-	0.030	0.086	0.012	0.062	0.017
F (mg/l)	**≤1.5**	0.70	0.54	<0.05	1.1	0.51	1.11	0.16	0.331
Al (mg/l)	**≤0.3#**	<0.003	<0.003	-	-	<0.003	<0.003	<0.003	<0.003
Fe (mg/l)	**≤2** **≤0.3***	**0.506**	<0.003	<0.02	0.010	<0.003	<0.003	<0.003	<0.003
Mn (mg/l)	**≤0.5** **≤0.1***	**0.17**	<0.001	<0.005	0.090	**1.37**	<0.001	0.015	<0.001

Site Name	SANS 241: 2011	ANBH Chief	ANQ6	PCD	Process water	ANBH Penge	ANBH Mine	ANW 1	Village borehole
Cr (mg/l)	**≤0.05**	<0.001	<0.001	-		<0.001	<0.001	<0.001	-
Cu (mg/l)	**≤2.0**	<0.001	<0.001	-		0.003	0.021	<0.001	-
Ni (mg/l)	**≤0.07**	<0.001	<0.001	-		<0.001	<0.001	<0.001	-
Zn (mg/l)	**≤5***	3.35	<0.002	-		<0.002	<0.002	<0.002	-
Co (mg/l)	**≤0.5**	0.001	<0.001	-		<0.001	<0.001	<0.001	-
Cd (mg/l)	**≤0.003**	<0.001	<0.001	-		<0.001	<0.001	<0.001	-
Pb (mg/l)	**≤0.01**	<0.004	<0.004	-		<0.004	<0.004	<0.004	-
As (mg/l)	**≤0.01**	<0.007	<0.007	-		<0.007	<0.007	<0.007	-
Se (mg/l)	**≤0.01**	<0.007	<0.007	-		<0.007	<0.007	<0.007	-
Si (mg/l)	**-**	19.3	3.31	-		14.1	23.8	6.42	-
Ag (mg/l)	**-**	<0.001	<0.001	-		<0.001	<0.001	<0.001	-
B (mg/l)	**-**	0.029	0.026	-		0.241	0.284	0.01	-
Be (mg/l)	**-**	<0.001	<0.001	-		<0.001	<0.001	<0.001	-
Bi (mg/l)	**-**	0.012	<0.004	-		<0.004	<0.004	<0.004	-
Li (mg/l)	**-**	0.021	0.026	-		0.033	0.04	0.002	--
Mo (mg/l)	**-**	0.018	0.013	-		0.017	0.042	0.006	-
Sr (mg/l)	**-**	0.224	0.302	-		0.665	1.34	0.013	-
Tl (mg/l)	**-**	<0.037	<0.037	-		<0.037	<0.037	<0.037	-
V (mg/l)	**≤0.2**	<0.001	0.004	-		<0.001	0.034	<0.001	-
Sb (mg/l)	**≤0.02**	0.002	0.002	-		0.003	0.021	0.001	-
Sn (mg/l)	**-**	<0.001	<0.001	-		0.083	0.075	<0.001	-
Tot Hardness (mg/l)	**-**	283	250	-		1044	1035	10.01	-
DWA Classification		***Good Class 1***	***Good Class 1***	***Poor class 3***	***Marginal Class 3***	***Poor class 3***	***Poor class 3***	***Ideal Class 0***	***Good Class 1***
Worst parameters		***EC/TDS, Fe, Mn***	***EC/TDS, Cl***	**EC/TDS**	**EC/TDS, Cl, Na**	**SO_4**	**SO_4**	**-**	***EC/TDS, Cl***

The following can be concluded:

- ANBH Chief, Quarry 6 (ANQ6), the hand dug well (ANW1) and the Village borehole recorded within the SANS 241: 2011 drinking water quality guidelines. The hand-dug well (ANW1) can be classified as *Ideal (Class 0)* while ANBH Chief, Quarry 6 and the Village borehole can be classified as *Good* (*Class 1*).
- *ANBH Chief* and *Quarry 6* recorded within *Good* (class 1)[1] drinking water standards (WRC, 1998) with EC/TDS, Fe and Mn, and EC/TDS and Cl exceeding *Ideal* (class 0) standards, respectively. The quality of these samples can be described as neutral (ANBH Chief) to slightly alkaline (ANQ6) with relatively fresh water. The borehole *ANBH Chief* recorded slightly raised Fe and Mn but this not an uncommon occurrence within groundwater where low levels of oxygen are present (solubility of Fe and Mn is, amongst others, correlated to an increasing reducing environment). *Quarry 6* water quality is reminiscent of an open and natural water body with an evaporation signature (Na-Cl).
- The hand-dug well (ANW1) recorded to within *Ideal* (class 0) drinking water standards.

The hydrochemistry for the borehole on-mine (*ANBH Mine*), as well as the *PCD*, the Penge Shaft water, and the mine *process water*, all exceed the SANS 241: 2015 drinking water quality guidelines. Exceedance was measured in terms of:

- Salinity (EC/TDS), Cl and SO_4 including Mn in *ANBH Penge* and Na in *ANBH Mine*.

They are classified as *Marginal* (*Class 2*) to *Poor* (*Class 3*) according to the colour coded classification system proposed by the DWS (WRC, 1998) mostly due to the high to elevated EC/TDS and SO_4, Cl and/ Na concentrations. The profiles can be described as neutral, relatively saline and extremely hard with high levels of Ca, Mg, Cl and Na and high to elevated levels of SO_4.

9.8.2.1 Groundwater Composition

Major ion composition of the water is used to classify it into various chemical types. Piper, Stiffs and a Schoeller diagram were used to present this classification graphically.

The Piper and Stiffs in Figure 10 and 11, respectively indicate that:

- Groundwater from *ANBH Chief* is typical of fresh recently recharged groundwater with a distinct Mg/Ca-HCO_3^- character.

[1] Note that classification in terms of drinking water is only according to hydrochemical parameters analysed and is not a suggestion of safe use.

- Quarry 6 (*ANQ6*) displays a water type characteristic of rainwater subjected to evaporation mixed with water of a Mg-SO_4 type character. This water type may also be an indication of ion exchange with the host rock.
- The hand-dug well displays a signature of a Na-HCO_3^- type water that is typical of shallow and 'open' groundwater systems in close contact with igneous types of rock or that has an evaporative signature.
- Groundwater from the Penge Shaft (*ANBH Penge*), the on-mine borehole (*ANBH Mine*), including the process water and *PCD* group together and display **similar signatures** based on their respective Stiff diagrams. All four hydrochemical sets display distinct Na/Mg-SO_4(Cl) characters.

A Schoeller diagram displaying the ion ratios for the sampling localities was constructed and shown in Figure 12. The diagram indicates similar ion compositions for the process water, ANBH Mine, and ANBH Penge, the process water sample, and water within the PCD. Background groundwater sources display unrelated signatures compared to groundwater from the on-mine borehole – ANBH Mine, located downgradient from the PCD.

Water abstracted from the Penge Shaft and used in the plant is polluted most probably due to historical mining activities at the old Asbestos Penge Mine and/ or due to the depth of the shaft. The fact that the groundwater from the Penge Shaft, the on-mine borehole, the process water and the PCD share very distinct similarities in ion composition, point towards a process related groundwater contamination effect as measured in the groundwater at ANBH Mine. The greatest contributing factor to the poor water quality of ANBH Mine is most probably related to the use of process water sourced from the Penge Shaft since the nature of the ore and mine residue deposits is chemically unreactive or inert. The pathway for pollution is either from leaching of the process water storage facilities such as the PCD or from process water spillages.

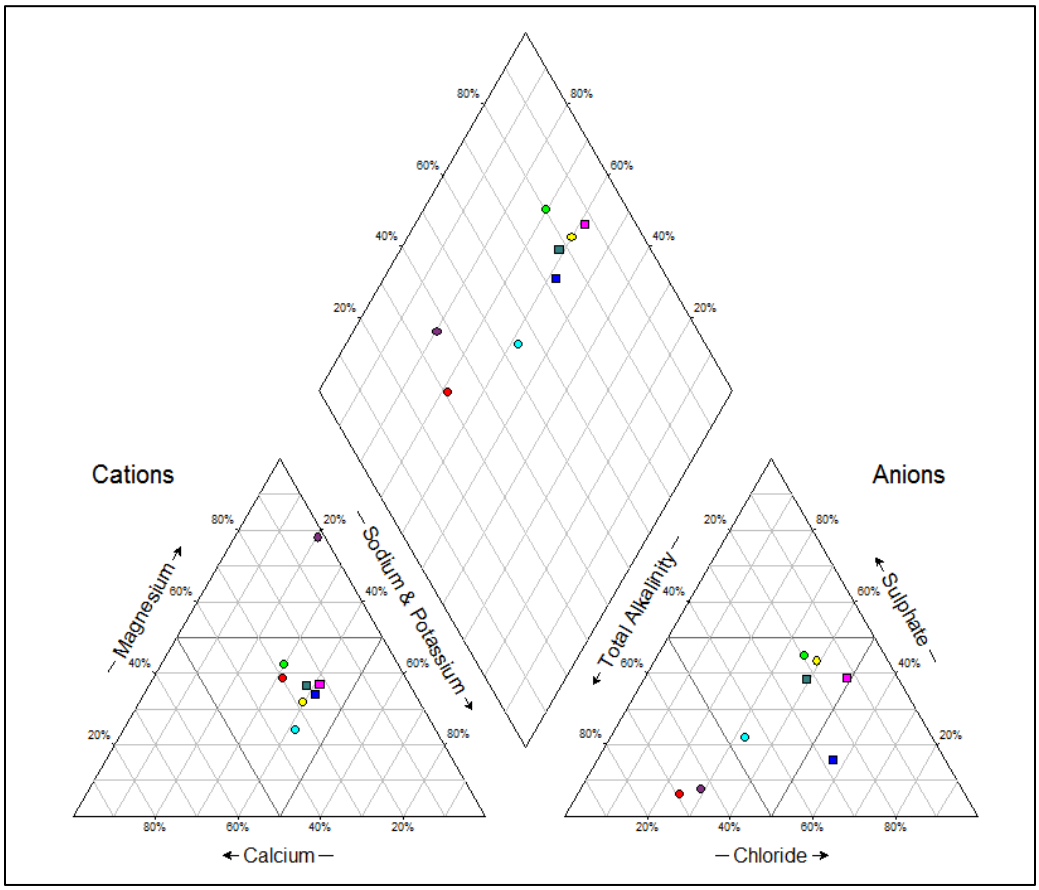


Figure 10: Piper diagram indicating the relative distribution of major cations and anions

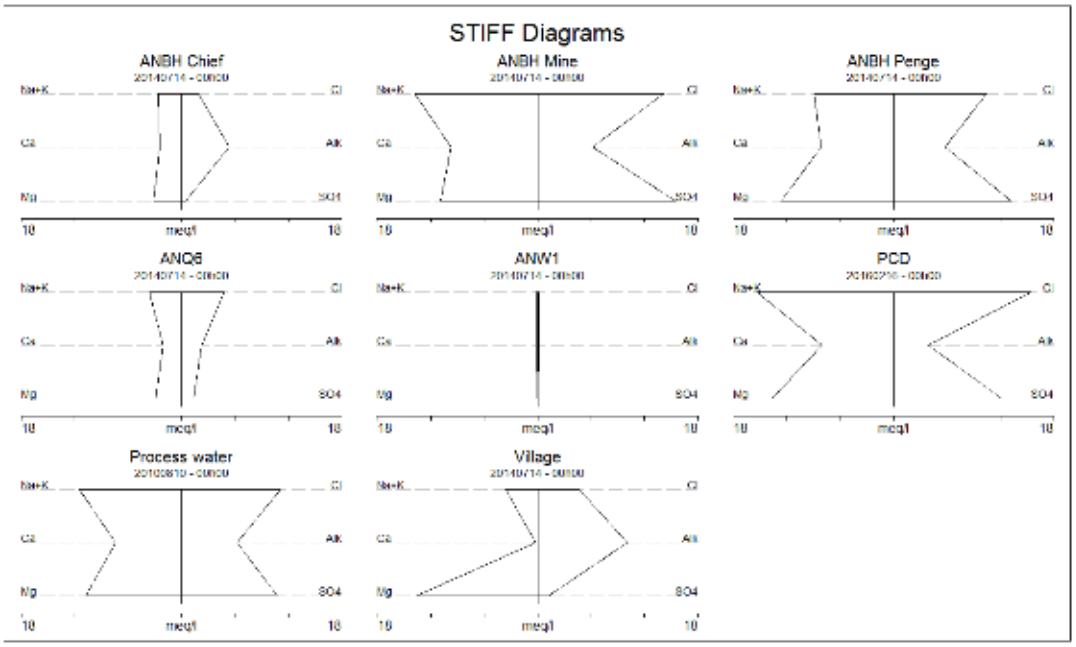


Figure 11: Stiff diagrams indicating the relative distribution of major cations and anions

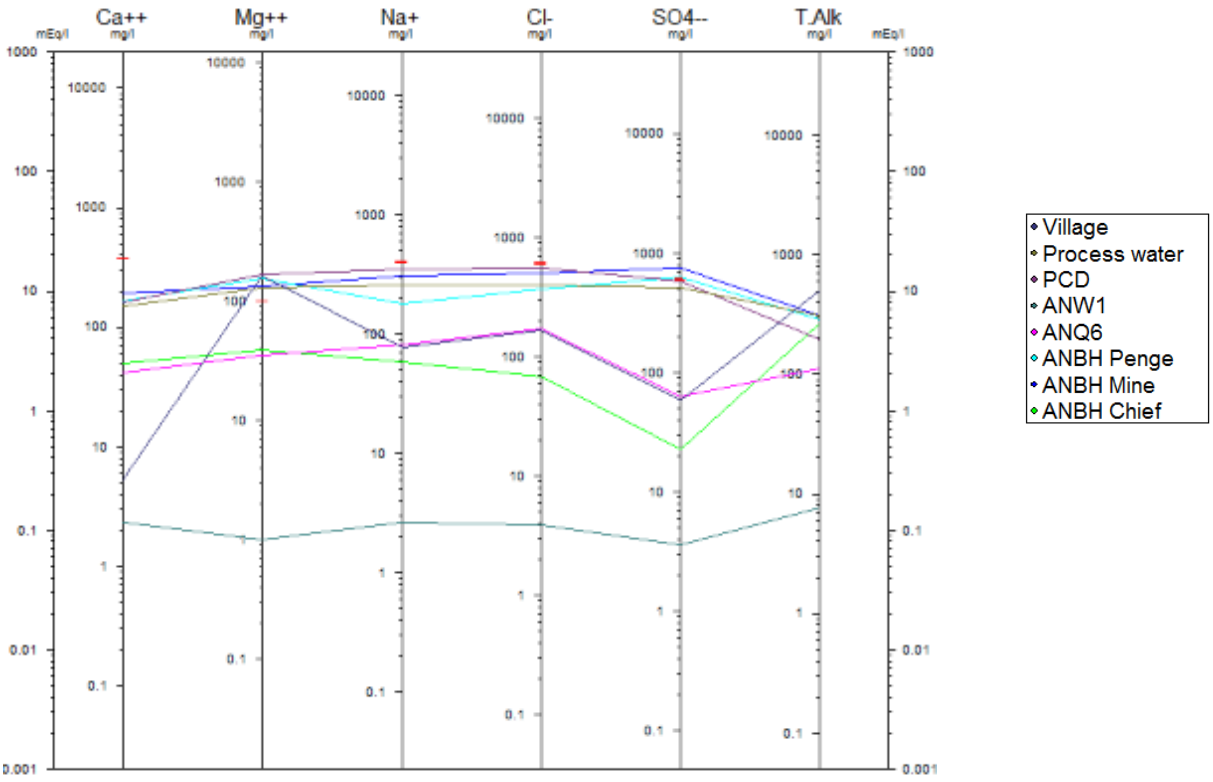


Figure 12: Schoeller diagram indicating the relative distribution of major cations and anions

9.9. Conceptual model

In a typical geohydrological setting, groundwater flow and aquifer development are closely linked to the geology of an area, which is no different for the aquifers underlying Annesley Andalusite Mine.

The area under investigation is underlain by the Timeball Hill Formation that forms part of the Pretoria Group and mainly comprises of andesitic lava, shale, and quartzite. Sills and dykes do occur widespread within the study area and groundwater occurrence generally favours these contact zones between intrusive diabase sheets/dykes and the host shale. These contact zones would usually act as targets for groundwater exploration as they may create preferential flow pathways for the movement of groundwater. However, a study by Aurecon (2010) revealed that that little/no favourable groundwater was intercepted on the contact zones between shales and diabase/dolerite dykes. It is expected that contact between the diabase and shale, where fracturing usually takes place and where preferential flow paths may exist, may have been metamorphosed with no distinct contact and consequently little fracturing. In addition, very small volumes of groundwater seepage into the mining pits occur. This emphasizes the impervious nature of the rock and an assumption can be made that groundwater flow in the occurring aquifers will be very slow. However, groundwater quality data suggest that the on-mine borehole is of poor quality displaying similar signatures to the upgradient PCD (emergency dam) and process water, and seepage is therefore expected to occur

from the dam/s. The ore and mine residue deposits are chemically inert, and therefore the abstraction and use of process water from the old Penge Shaft are believed to be the major contributor to the substandard water quality measured.

Based on hydrocensus information, it can be concluded that aquifer system in the study area is classified as a “Minor Aquifer System”. The local population are not solely dependent on groundwater and borehole yields are generally low.

A geochemical study on waste material and mine residue conducted by Shangoni Management Services in 2014 (Shangoni, 2014) revealed that the ore and the waste material generated on site are chemically inert. The leachate tests revealed that none of the parameters exceeded the SANS guideline, is overall of good quality and of fairly low chemical reactivity. A 1:4 (solid: leachate) ratio was used in the extraction tests and although this is unlikely to be replicated *in-situ*, it is sometimes regarded as a more representative ratio to use compared to the general 1:20.

10 Air quality

Information included in this section was sourced from ‘Greater Tubatse Local Municipality Integrated Development Plant’ (Greater Tubatse Local Municipality, 2015/16), ‘Annesley Andalusite Mine Annual Report (March 2016 – February 2017) (nd, 2017), ‘Annesley Andalusite Mine Ambient Air quality monitoring programme’ (Shangoni Management Services, 2016), and ‘South African Air Quality Information System – Air quality priority areas (http://www.saaqis.org.za/Priority%20Areas.aspx)

The Tubatse Local Municipality is found in the North eastern part of the District. The main towns in the area are Burgersfort and Steelpoort. The main activity in this area is the mining of chrome and platinum. There are also three chrome smelters in the area. This then means that the area is likely to have air pollutants like sulphur dioxide, nitrous oxides, chromium (VI) and particulate matter. There is also significant traffic in the area due to the transportation of minerals which introduces a substantial pollution from the vehicles. Other pollutants like pesticides can also emanate from the farms around Ohrigstad towards Burgersfort, of which the extent has not yet been determined.

Currently, the district has three passive air quality monitoring stations which are being monitored by an independent company. The pollutants being monitored include SO2, NOX and Fallout dust. (GTM IDP, 2015/16).

According to the South African Air Quality Information System (www.saaqis.org.za), Annesley Andalusite Mine is not situated in an air quality priority area (refer to Figure 13 below).

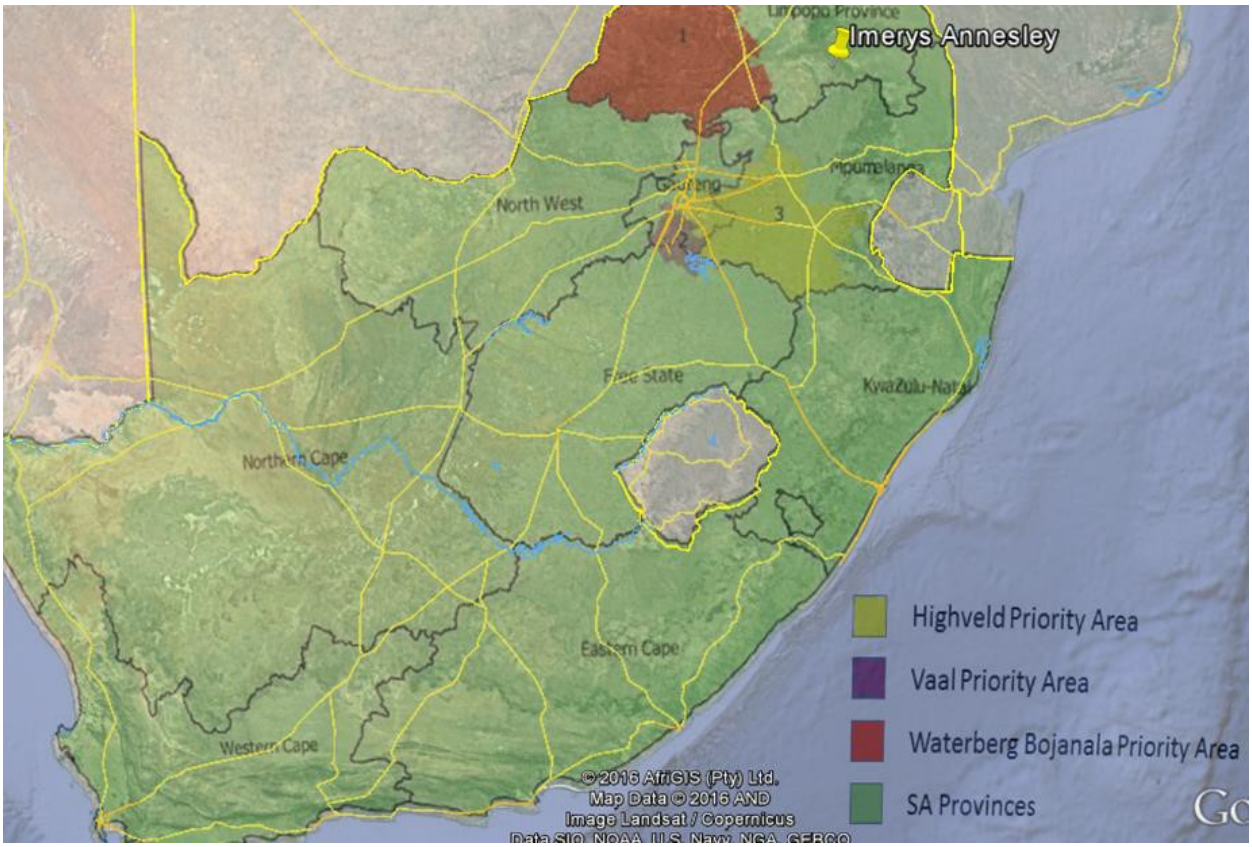


Figure 13: Air quality priority areas (*www.saagis.org.za)*

11 Environmental noise

Information for this section was extracted from the 'Approved EMP (nd, nd):

No baseline values were determined as the area is classified as rural and the statutory requirement for such areas is known to be 45dB. The only source of noise beyond the boundaries of the mine is expected to be low volume traffic noise from public roads.

12 Visual aspects

There is no specialist study done on visual aspects. The comment below is based on assumptions made during site visits.

Havercroft Mine Operation is visible from the scattered residential areas of the local inhabitants and from the access roads.

13 Cultural and heritage resources

Information for this section was extracted from the Approved EMP (Shangoni Management Services, 2006), and the EMP PAR (BECS Environmental, 2015):

Some tools dating to the Early and Middle Stone Age were found within the boundaries of Segorong village but are of low archaeological significance.

No archaeological site dating to the Iron Age was identified in the area of the mining area.

14 Sensitive features

According to the EMP (Shangoni Management Services, 2006), no red data vegetation species were noted but a protected tree species *Adonsonia digitata* (Baobabs) occurs in the low-lying area between the Motse River and Modubeng Spruit, outside of the mine area. *Euphorbia* species were found on the mine. It is unclear where these plant species are situated.

The grey rhebuck and leopard are endangered species in the area.

Havercroft Operation falls within the Sekhukhune Norite Bushveld which is an endangered threatened ecosystem. The area surrounding the quarries are classified as Critical Biodiversity Area 1.

15 Regional socio-economic aspects

Information for this section was extracted from the IWWMP (Shangoni Management Services, 2012):

The mining site is situated within the Sekhukhune District Municipality and Greater Tubatse Local Municipality. The statistics indicated in the table below was generated by the Demarcation Board and was valid as of March 2000.

Table 25: Socio-economic statistics for the area

Statistic	Number	Statistic	Number
No. of Households	1,410	**Age breakdown**	
Population		0-4	1,085
African	7,625	5-19	3,531
Coloured	12	20-29	1,155
Indian	0	30-49	1,143
White	12	50-64	426
Unspecified	33	Over 65	294
Gender		Age Unknown	55

Statistic	Number	Statistic	Number
Male	3,434		
Female	4,246		
Annual individual income		**Annual household income**	
None	6,740	None	472
R1 – 2,400	86	R1 – 2,400	163
R2,401 – 6,000	366	R2,401 – 6,000	313
R6,001 – 12,000	121	R6,001 – 12,000	182
R12,001 – 18,000	91	R12,001 – 18,000	96
R18,001 – 30,000	62	R18,001 – 30,000	54
R30,001 – 42,000	67	R30,001 – 42,000	39
R42,001 – 54,000	49	R42,001 – 54,000	28
R54,001 – 72,000	20	R54,001 – 72,000	22
R72,001 – 96,000	3	R72,001 – 96,000	16
R96,001 – 132,000	3	R96,001 – 132,000	5
R132,001 – 192,000	3	R132,001 – 192,000	4
R192,001 – 360,000	1	R192,001 – 360,000	3
Over R360,000	0	Over R360,000	0
Unspecified	70	Unspecified	13

1. *Major economic activities and sources of employment*
    - Annesley Andalusite Mine;
    - Local shops;
    - Schools and
    - Farmers in the Burgersfort/Steelpoort areas.

2. *Unemployment estimate for the region*

Statistics are misleading as rural communities don't always understand the difference between self-employed, employed, unemployed and pensioner. It is estimated that only about 11% of the residents are formally employed.

3. *Housing demand, and availability*

The mine is in the Malepe Tribal Area and land allocation is informal. The land is administrated as a communal land where small plots are allocated on a "Permission to Occupy" (PTO) basis. A number of formal townships have been established in the region, or is in the construction phase, and stands are readily available.

4. *Social infrastructure - schools, hospitals, sporting and recreating facilities, shops, police, civil administration*
    - Churches at Segorong: 4 churches namely; Baptist Church, Segorong RCC, Apostolic Church, St Engenas ZCC.
    - Schools in Segorong: Segorong Primary School: (260 pupils, 8 teachers) and Madikoloshe Secondary School (126 pupils, 9 teachers);
    - Businesses in Segorong: Magana Gokatwa (bottle store, not in use), Hygienic Butchery (not in use), Matikwene Eating house (active), Majestic Café, Super Saving Store (active);
    - Health Services: Hospital at Penge;
    - Recreation Facilities: None;
    - Police: Burgersfort;
    - Civil Administration: The authority in the area is the Malepe Tribal Authority and is in the jurisdiction of the Sekhukhune Local Municipality. The Administrative Centre is at Praktiseer, some 24 km to the south.
5. *Bulk services*
    - Process water to the mine is pumped from the old mine at Penge;
    - Bulk water supply to Segorong Village is from a tank fed by a fountain;
    - There is no internal water reticulation in Segorong. The community collects the water at the storage tank and carries it to their houses;
    - No waste removal services exist;
    - Existing sewerage varies from ordinary pit latrines with makeshift structure to no sewerage at all;
    - The high voltage power line to Penge passes through the property and a low voltage line from the Penge substation supplies electricity to the mine;
    - There is no electricity in Segorong Village.
    - Key Economic Activities

There are no Gross Geographic Product (GGP) estimates available for Sekhukhune Cross-Border District Municipality, in which the Annesley Andalusite Mine – Segorong Project resides since the demarcation was done in December 2000. The closest proxy is to consider sectoral employment. However, there is not a strict correlation between employment and GGP, because a sector such as agriculture has a considerably higher employment co-efficient than a sector such as mining, which is more capital intensive. Sectoral employment figures for Sekhukhune Cross-Border District Municipality are reflected below because these are the best available at present.

Table 26: Socio-Economic statistics for the area

Sector	Employment number
Agriculture, hunting; forestry and fishing	11357
Mining and quarrying	5618
Manufacturing	3315
Electricity; gas and water supply	707
Construction	3299
Wholesale and retail trade	9180
Transport; storage and communication	2668
Financial, insurance, real estate and business services	2736
Community, social and personal services	17250
Other and not adequately defined	6
Private Households	7642
Undetermined	6844
Total	70622

Community services, which are mostly government, is the largest employer by far, accounting for 25% of employment. It is probably also the largest contributor to GGP. It is evident that government is far more dominant in the Limpopo portion of Sekhukhune than in Mpumalanga.

The second biggest employer is agriculture and hunting, with 16% of total employment. In this case, Mpumalanga is the dominant contributor. Trading activities are in third place (13%) and this time the relative contributions from Limpopo and Mpumalanga are more balance, but with Limpopo ahead. This is a reflection of the larger number of people living in the Limpopo part of Sekhukhune district.

Private household activities are in fourth place at 11%. This time Mpumalanga is well ahead, reflecting the domestic work opportunities that are available at Groblersdal, Marble Hall, and Burgersfort. Mining is only the fifth largest employer, but probably the largest or second largest contributor to GGP. Limpopo, with its platinum mines in Tubatse and Fetakgomo, is the dominant area.

All the other sectors, including manufacturing and construction, are relatively small, accounting for less than five percent of total employment each. In-migration is likely to be less than 3000 of the total employment of almost 71,000, which is less than 5%. However, in addition to the total number of locally employed persons, there are probably at least 42,000 men who have families in Sekhukhune district, but who work elsewhere.

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

1 Impact assessment and management methodology

The significance methodology is based on the requirements as set out in the National Guideline on Minimum Information of 2018, GN 86 in terms of the NEMA. The impact methodology also includes all the requirements as set out in the EIA Regulations of 2014, GN 982 (as amended) in terms of the NEMA. Appendix B of the Operational Guideline to Integrated Water and Waste Management of 2010 in terms of the NWA, which contains the quantitative risk assessment is also included. This operational guideline is used because certain cases described in the impact assessment are water based. Appendix A of the General Authorisations of 2016, GN 509 in terms of the NWA were used to construct a risk matrix for any activity that impedes or diverts the flow of water in a watercourse and alters the bed, banks, course or characteristics of a watercourse. In rehabilitation and closure impact assessments the requirements as set out in regulation 60 of the Mineral and Petroleum Resources Development Regulations of 2004, GN 527 in terms of the MPRDA as well as the requirements set out in the Regulation Pertaining to the Financial Provision for Prospecting, Exploration, Mining or Production Operations of 2015, GN 1147 (as amended) in terms of NEMA are also included. Section 3(b) of the General Authorisations of 2016, GN 509 in terms of the NWA states that a suitably qualified SACNASP professional member must determine risks associated with this risk matrix.

Impact management is based on the requirements as set out in the National Guideline on Minimum Information of 2018, GN 86 in terms of the NEMA; as well as the requirements as set out in the EIA Regulations of 2014, GN 982 (as amended) in terms of the NEMA. The mitigation hierarchy, as part of the impact management, used is adopted from the Mining and Biodiversity Guideline (Mainstreaming Biodiversity into the Mining Sector) IDB of 2013 in terms of the MPRDA to provide a clear approach for avoiding impact on the surrounding environment.

Impact identification and prediction means forecasting the change of environmental parameters due to developmental patterns. These parameters may also be changing due to climate change and should be included. Impact identification and prediction is a stepwise procedure to identify the direct, indirect and cumulative impacts (relating to both positive and negative impacts) for which a proposed activity and its alternatives will have on the environment as well as the community. This should be undertaken by determining the geographical, physical, biological, social, economic, heritage and cultural sensitivity aspects of sites and locations as well as the risk of impact of the proposed activity. Refer to part A(h)(iv) for a complete description of these environmental attributes. Sources of data to be used for gathering data on the environmental attributes as well as the impacts include; monitoring / sampling data collected and stored, assumptions and actual measurements, published data available from the departments or other stakeholders in the area as well as specialist studies.

A matrix selection process is the most common methodology used in determining and ranking the site sensitivities:

- The consequence: includes the nature / intensity / severity of the impact, spatial extent of the impact, and duration of the impact.
    - The nature / intensity / severity of the impact: An evaluation of the effect of the impact related to the proposed development on the receiving environment. The impact can be either positive or negative. A description should be provided as to whether the intensity of the impact is high, medium or low or has no impact in terms of its potential for causing negative or positive effects. Cognisance should be given to climate change which may intensify impacts.
    - The spatial extent of the impact: Indication of the zone of influence of the impact: A description should be provided as to whether impacts are either limited in extent or affect a wide area or group of people. Cumulative impacts must also be considered as the extent of the impact as may increase over time.
    - The duration of the impact: It should be determined whether the duration of an impact will be short-term, medium term, long term or permanent. Cumulative impacts must also be considered as the duration of the impact as it may increase over time.
- The likelihood: includes the probability of the potential occurrence of the impact, and frequency of the potential occurrence of the impact
    - The probability of the impact: The probability is the quality or condition of being probable or likely. The probability must include the degree to which these impacts can be reversed; may cause irreplaceable loss of resources; and can be avoided, managed or mitigated
    - The frequency of the potential occurrence of the impact.
- The significance: This is worst case scenario without any management measures. See below how significance is determined: Impact that may have a notable effect on one or more aspects of the environment or may result in noncompliance with accepted environmental quality standards, thresholds or targets and is determined through rating the positive and negative effects of an impact on the environment based on criteria such as duration, magnitude, intensity and probability of occurrence. Mitigation measures should be provided with evidence or motivation of its effectiveness

Significance of impacts should be determined for each phase of the mining lifecycle this includes; preconstruction, construction, operational, closure (including decommissioning) and post closure phases.

Likely impacts should be described qualitatively and then studied separately in detail. This provides consistent and systematic basis for the comparison and application of judgements. Ratings should then be assigned to each criterion. The significance of impacts should further be assessed both with and without mitigation action. Impact magnitude and significance should as far as possible be determined

by reference to either legal requirements (accepted scientific standards) or social acceptability. If no legislation or scientific standards are available, the EAP can evaluate impact magnitude based on clearly described criteria.

The description of significance is largely judgemental, subjective and variable. However, generic criteria can be used systematically to identify, predict, evaluate and determine the significance of impacts resulting from project construction, operation and decommissioning. The collection of potential impacts (environmental and social) identified during the environmental assessment should as far as possible be quantified. The process of determining impact magnitude and significance should never become mechanistic. Impact magnitude is determined by empirical prediction, while impact significance should ideally involve a process of determining the acceptability of a predicted impact to society. Making the process of determining the significance of impacts more explicit, open to comment and public input would be an improvement of environmental assessment practice.

Acceptable without further mitigation: Risks classified as posing potential significant risks are assessed whether these risks are acceptable without further mitigation. Criteria and standards that exist for acceptability are either emissions-based or they relate to the receiving environment (e.g. air quality, water quality or noise). Establishing the acceptability of a potential impact is as important as determining its significance. An impact identified as being non-significant by a specialist may be unacceptable to a section of the community. On the other hand, a significant impact may be acceptable if, for example, adequate compensation is given. The level of acceptability often depends on the stakeholders, particularly those directly affected by the proposed project. Ratings that can be used for acceptability are given. Targets for acceptability are defined through the most sensitive receptors and through achievable outcomes.

Residual and latent risks: substantiation why each risk is latent, including why the risk was not or could not be mitigated during concurrent rehabilitation and remediation or during the implementation of the final rehabilitation, decommission and closure plan;

Also included is a description of the expected timeframe in which the risk is likely to manifest;
a detailed description of the triggers which can be used to identify that the risk is imminent or has manifested, how this will be measured and any cost implications thereof; and
results and findings of the risk assessment.

The following table is an example of the impact assessment methodology followed. The activities arising from each phase will be included in the impact assessment tables. This is to identify activities that require environmental management actions for mitigation measures. The assessment of impacts will be conducted according to the synthesis of criteria required by the integrated environmental management procedure.

- In the event of a rehabilitation or closure impact assessment an additional risk assessment will be undertaken:
- a detailed description of the drivers that could result in the manifestation of the risks, to be presented within the context of closure actions already having been implemented during the execution of concurrent rehabilitation or during the implementation of the final rehabilitation, decommission and closure plan;
- the undertaking of a screening level environmental risk assessment where (i) all possible environmental risks are identified, including those which appear to be insignificant; (ii) the process is based on the input from existing data; (iii) the risks that are considered are qualitatively ranked as (aa) a potential significant risk; (bb) a uncertain risk; (cc) an insignificant risk;
- the undertaking of a second level risk assessment on issues classified as potential significant risks where (i) appropriate sampling, data collection and monitoring be carried out; (ii) more realistic assumptions and actual measurements be made; and (iii) a more quantitative risk assessment is undertaken, again classifying risks as posing a potential significant risk or insignificant risk
- risks classified as uncertain risks must be re-evaluated and re-classified as either posing potential significant risks or insignificant risks;
- document the status of insignificant risks; and
- an explanation of changes to the risk assessment results as applicable in annual updates to the plan.

When dealing with management, impact management outcomes must: be set for the expected activity-based impacts as identified per project phase as in the impact identification and significance rating process; be informed by stakeholder expectations and ensure legal compliance; be clearly documented; be measurable to determine compliance; describe the desired outcome of the management measure/s prescribed or the standard to be achieved; and be aligned to the mines closure objectives.

Management statements detail the processes, procedures and practices required to achieve an impact management outcome. A hierarchy of management tools used can also be used as seen below.

Policy

Set of policies are principles, rules and guidelines formulated to reach an organisation long-term goals.

Standards

A document that provides requirements, specifications, guidelines or characteristics that can be used consistently to ensure that materials, products, processes and services are fit for their purpose.

Operating procedures

Established or prescribed methods to be followed routinely for the performance of designated operations or in designated situations.

Key Performance Indicators

Measurable value that demonstrates how effectively a company is achieving key business objectives

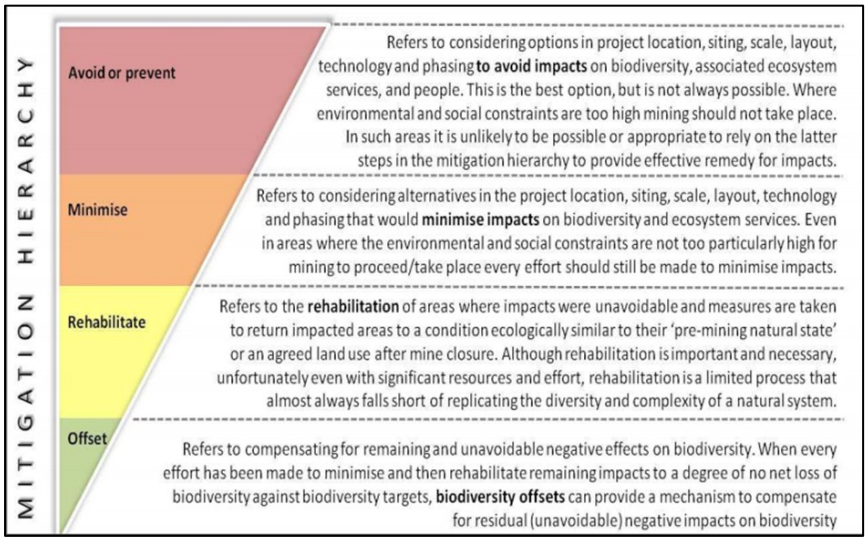
Managing measures contemplated can be grouped into:

- Modification measures – changes to process and or practices to reduce risk.
- Control – either through physical control or operational practices to ensure acceptable performance is maintained.
- Remedial action – rehabilitation and pollution clean-up processes and practices.
- Avoidances – where activities can be mitigated to an acceptable level, these are stopped or avoided.

As a further measure to management the mitigation hierarchy of the 2013 Mining and Biodiversity Guideline must also be incorporated. The aim is to prevent adverse impacts from happening or, where this is unavoidable, to limit their significance to an acceptable level.

In order to alleviate environmental harm, mitigation should include measures in the following order of priority as set out in the 2013 Mining and Biodiversity Guideline:

- Avoid or prevent loss to biodiversity and ecosystem services.
- Minimise impacts on biodiversity and ecosystem services.
- Rehabilitate concurrently or progressively with the proposed activity, and/or on cessation of the activity.
- Offset significant residual negative impacts on biodiversity or ecosystem services.



It is important to note that the mitigation hierarchy is applied to any stage of mining activity in the context of the biodiversity priority areas of information to determine the importance or sensitivity of the receiving

area. The following subsections will describe the four measures in the mitigation hierarchy listed above, introduce the notion of enhancement, and establish the boundaries of responsibility for mitigation and enhancement.

Avoiding or preventing impacts

If the biodiversity (an ecosystem, habitat for threatened species, ecological corridor or area that provides essential ecosystem services) is of conservation value or importance, it is best to plan to avoid or prevent impacts altogether by changing the location, siting, method or processes of the mining activities and related infrastructure.

Minimising impacts

Minimising impacts of mining is a mitigation measure that deals with the environment in general. In areas where the biodiversity is to be affected is of conservational value or importance, then every effort should be made to minimise those impacts that cannot be avoided or prevented. Mining companies should strive to minimise impacts on biodiversity to ensure environmental protection. Section 2 of NEMA contains environmental management principles that resonates with minimising the impact rather than stopping at mitigation, this is imperative in the mining sector.

Rehabilitating impacted areas

Rehabilitation is the measures that are undertaken to “as far as it is reasonably practicable, rehabilitate the environment affected by the prospecting or mining operations to its natural or predetermined state or to a land use which aligns to the generally accepted principle of sustainable development. A closure plan is an essential part of rehabilitation and must be developed based on the establishment of the closure objectives and criteria.

Biodiversity offsets

Biodiversity offsets are measurable conservation gains that help to balance any significant biodiversity losses that remain after actions to avoid, minimise and restore negative impacts have been taken. They are the last stage of mitigation and should be considered after appropriate avoidance, minimisation, and rehabilitation/restoration measures have been applied already.

Management measures to be implemented for the potential significant risks that must include:

- a description of the management measures to be applied; a predicted long-term result of the applied management measures;
- the residual and latent impact after successful implementation of the management measures;
- time frames and schedule for the implementation of the management measures;
- responsibilities for implementation and long-term maintenance of the management measures;
- financial provision for long-term maintenance; and
- monitoring programmes to be implemented.

Environmental component:

Activity:

Method for assessing risks:

			Before management	With management
CONSEQUENCE	**Nature / Intensity / Severity of Impact**			
	Low	Impacts affect the environmental in such a way that natural, cultural and/or social functions and processes are not affected.	1	
	Medium	Impacts affect the environment in such a way that natural, cultural and/or social functions and processes are altered	3	
	High	Impacts affect the environment in such a way that natural, cultural and/or social functions and processes will temporarily or permanently cease.	5	
	Spatial extent of Impact			
	On-site	Impact occurs on-site	1	
	Local	Impact occurs within 5km radius of the site	2	
	Regional	Regional Impact occurs within a 100km radius of the site	3	
	National	National Impact occurs within South Africa	4	
	International	Impact occurs internationally	5	
	Duration of Impact			
	Short-term	Through dilution and dispersion, the impact reduces to insignificant within 1 week.	1	
	Medium-term	Through dilution and dispersion, the impact reduces to insignificant within the life of the mine.	2	
	Long-term	The impact will cease after the operational life of the mine either because of natural process or by human intervention	3	
	Permanent	Where mitigation either by natural process or by human intervention will not occur in such a way or in such a time span that the impact can be considered transient.	4	
LIKELIHOOD	**Probability of potential occurrence of the Impact**			
	Improbable	The possibility of the impact materializing is very low either because of design or historic experience	**1**	
	Probable	There is a distinct possibility that the impact will occur	**2**	
	Highly probable	It is most likely that the impact will occur	**3**	
	Definite	The impact will occur regardless of any prevention measures	**4**	
	Frequency of potential occurrence of the Impact			

			Before management	With management
	Annually or less	Impact occurs at least once in a year or less frequently	1	
	6 months	Impact occurs at least once in 6 months	2	
	Monthly	Impact occurs at least once a month	3	
	Weekly	Impact occurs at least once a week.	4	
	Daily	Impact occurs daily	5	

CONSEQUENCE

LIKELIHOOD		3	4	5	6	7	8	9	10	11	12	13	14
	2	5	6	7	8	9	10	11	12	13	14	15	16
	3	6	7	8	9	10	11	12	13	14	15	16	17
	4	7	8	9	10	11	12	13	14	15	16	17	18
	5	8	9	10	11	12	13	14	15	16	17	18	19
	6	9	10	11	12	13	14	15	16	17	18	19	20
	7	10	11	12	13	14	15	16	17	18	19	20	21
	8	11	12	13	14	15	16	17	18	19	20	21	22
	9	12	13	14	15	16	17	18	19	20	21	22	23

Low	Where it will not have a significant influence on the environment. Management measures can be proposed to ensure that significance does not increase	5- 11
Medium	Where it could have a significant influence on the environment unless it is mitigated or managed	12- 17
High	Where it would have a significant influence on the environment regardless of any possible mitigation and hence must be either avoided or managed	18- 23
Medium positive	In the case of an impact having a positive outcome.	High positive

Acceptable without further mitigation:
Residual and latent risks
Cumulative impact
Screening-Level Risk Assessment
Environmental objective
Management measures to be applied (Alternative risk prevention or management strategies)
Management timeframe and schedule
Responsibilities for implementation and long-term maintenance
Monitoring programmes
Financial provision for long-term maintenance and/or environmental costs
Uncertainties associated with the preferred closure option, which list will be used to identify and define any additional work that is needed to reduce the level of uncertainty
Stakeholder expectations and / or comments

	Before management	With management
Legal compliance and standards		

2 Screening level environmental risk assessment

The **screening level risk assessment** includes all possible environmental risks identified in the approved EMP (1999) and includes the risk which appears to be insignificant. The risks are qualitatively ranked as:

- a potentially significant risk;
- an uncertain risk;
- an insignificant risk

According to the approved EMP (Shangoni, 2006), no latent impacts have been identified at this stage.

Residual impacts after closure are described in the approved EMP (Shangoni, 2006) below. Refer to the table below indicating whether these risks are potentially significant, uncertain, or insignificant.

Table 27: Screening level risks and significance

Environmental component	Description	Significance ranking
Geology and the mineral resource	Because the mining of Andalusite goes hand in hand with the extraction of the ore body the impact on the geology (mineral wise) will be permanent. As part of mine planning, the effects of mining on the geological features have been kept to a minimum to minimise the potential risk to the employees and the environment during mining. The extraction of ore takes place from the various pit areas as described in the mining method. No residual impact is foreseen with regards to geology because the mining activity ceases and no further destruction of the geology will take place.	Insignificant risk
Topography	The mining activity will have permanent impacts on the topography of the area. This is a result of the slimes dam, waste rock dumps and depression where the pit was constructed. The slimes dams have however been constructed in such a way that effective rehabilitation results in no effect on the topography. The only measures that can be taken to minimise the impact on the topography are to ensure that effective rehabilitation is done in accordance with the proposed rehabilitation measures. The management actions have been discussed in detail in the rehabilitation section. All the actions with regards to the rehabilitation	Potential significant risk

Environmental component	Description	Significance ranking
	of the structures have been designed to work towards prevention of pollution and to minimise the effect the structures may have on the topography of the area. The residual impact on the topography will be minimised as far as possible by applying the abovementioned approaches. The impact is however permanent and will continue after mining. Rehabilitation measure can minimise the visual effect and partially the topography effect due to sloping and terracing of areas.	
Soils	Various activities on the mine could have and can result in soil pollution. These activities include the workshop activities, use of pesticides, storage and handling of chemicals and the storage and disposal of waste. The potential does exist that polluted soil (due to spillages, storage etc.) may be present after closure. It is envisaged that these risks will be kept to a minimum through the implementation of the EMS per ISO 14001 standard requirements. The operational controls such as spill handling, disposal of waste, and the handling and storage of chemicals have been designed and implemented to keep this effect to a minimum. Prior to the application for closure, a survey will be conducted to identify all the polluted areas and appropriate actions will be taken to remediate the effect of the pollution on the surrounding soils.	Insignificant risk
Land capability, surrounding land use and landscape character	The areas that have been sterilised by the waste structures (waste rock dump, slimes dams) will not be rehabilitated back to the previous land capability. Objectives have been set for mine closure and the current mining area will be rehabilitated to such that it can be re-used for the pre-mining land use namely game and cattle farming. Considering the closure objectives, the impact on the land capability will be limited and the impact on land use will be negligible.	Insignificant risk
Vegetation	Although vegetation was destroyed as part of the mining activities, vegetation was and will be re-introduced to various rehabilitated areas on site as per the rehabilitation plan scheduling and rehabilitation procedure. The only residual impact that is foreseen is the ingression of invader plants. To combat this action plans will be developed to identify all the invader plants on site and develop plans to eradicate such	Potential significant risk

Environmental component	Description	Significance ranking
	invader plants. The re-vegetation of areas will only be done using indigenous plants. Clear objectives have been set in chapter 4 (of the EMP) with regards to mitigation of the impact on vegetation. Considering the effective implementation of the actions the residual impact of vegetation will be negligible.	
Air quality	Various sources of potential air pollution had been identified as part of the aspect and impact identification process. These potential dust sources include the slimes dams, plant operations, waste rock dumps and plant discard dumps, mining activities, haul roads and conveyor belts. Considering the management measures identified with regards to rehabilitation and closure it is foreseen that the potential impact of these sources on air quality will be negligible. It is foreseen that some level of post- closure maintenance would need to be done on the slimes dams and waste rock dumps to ensure the vegetation cover is acceptable. The financial provision has been calculated in such a way as to consider this post closure cost. The detail with regards to the post closure actions will be developed in due course. The plant will have no residual impact on the air quality because it will not be operational after closure. The plant and related infrastructure will most probably be demolished.	Insignificant risk
Radiation	No residual impact with regards to radiation is envisaged. Radiation sources will be removed and disposed at the appropriate sites.	Insignificant risk
Noise, vibration and shock	No residual impact cause by noise is envisaged after closure. This is due to closure of the plant operations and mining activities which were mainly responsible for the noise generated on the mine. Blasting will also stop thus no vibration and shock will take place. Some structures that have been damaged due to mining activities (blasting and shock) will be identified and appropriate action initiated prior to the mining operations closing.	Insignificant risk
Visual aspects	The potential impacts associated with the visual issues and change in topography will be addressed as part of the implementation of closure objectives and mitigation measures to minimise the impacts. Visual impacts will be present after closure. These impacts will be minimised as far as practical by means of effective rehabilitation practices.	Potential significant risk
Traffic	It is foreseen that no residual impact on traffic will take place after closure. Traffic will decrease in the area.	Insignificant risk

Environmental component	Description	Significance ranking
Archaeological, historical and cultural aspects	The impact that mining will have on these aspects identified in the heritage assessment will cease to exist after closure due to no mining activities taking place anymore. To ensure that these aspects are well managed and the impact of mining activities are minimized a management plan will be documented by the end of 2007. This plan will have identified appropriate management measures that would be required to minimize the potential impacts. These measures will extend after closure where required.	Insignificant risk
Socio-economic	The use of the community to decommission and rehabilitate will help with some temporary job creation. The community will also obtain reusable material from the infrastructure. The end land use is to return the area to the community for grazing which will also be a positive impact.	Potential significant positive risk

3 Second level risk assessment

3.1 Environmental component: Geology and the mineral resource

Activity: Partially sloping of mine residue over potentially economically viable minerals.

Method for assessing risks: Information for this risk was extracted from the Approved EMP (Shangoni Management Services, 2006).

			Before management	With management
CONSEQUENCE	**Nature / Intensity / Severity of Impact**			
	Low	The impact of the sloping mine residue will not alter the geology in the area, therefore, natural, social, cultural and environmental processes are not affected.	1	1
	Spatial extent of Impact			
	On-site	Impact occurs on-site at the point where the mine residue is sloping.	1	1
	Duration of Impact			
	Permanent	Once sloping is finished, this will n remain as a permanent land pattern.	4	4
LIKELIHOOD	**Probability of potential occurrence of the Impact**			
	Improbable	The mine has already remove all the economic viable material.	1	1
	Frequency of potential occurrence of the Impact			
	Annually or less	This is a once-off impact.	1	1
Significance before management			8	8
Acceptable without further mitigation: Rehabilitation to take place. Not acceptable without further monitoring after rehabilitation.				

	Before management	With management
Residual and latent risks: The residual impacts from the removal of geology will remain, as well as the residual impact from covering of geology. No additional latent impacts are envisaged.		
Cumulative impacts: Geology is also removed at the Annesley Mine which is 5km away.		
Screening-Level Risk Assessment: This risk is ranked as an insignificant risk.		
Environmental objective: To ensure correct sloping of mine residue.		
Management measures to be applied (Alternative risk prevention or management strategies): Sloping should be done in accordance with the rehabilitation plan included in Part B1(i)(c). In short: • Q1: Push remainder of OB opposite of high wall into the bottom of the quarry. Only light grading is required. • Q2: Push bottom OB stockpile into the quarry. Remove OB stockpile located within drainage line above the high wall to allow for free drainage into the quarry that will assist with vegetation growth. • Q3: General sloping for free drainage should be established. This area is also identified as a good location for a drinking hole. It is recommended to ensure that all slopes towards the water are safe and stable. • Q5: Break bench opposite of high wall. Potential traffic of locals and animals are expected to come from the east which would make this bench on the opposite side a potential safety risk. • Q6: Break lower benches that is easily reachable and push material to the bottom of the quarry. • Q11: Two OB stockpiles opposite of high wall should be pushed into the bottom of the quarry. • Q12: Push OB stockpile into quarry bottom. • Q13 & 14: Push OB stockpiles into quarry bottom. • Q15: OB stockpile should be brought back into the quarry. Note specifically not to push OB further down that may cause further disturbance and more difficult to move into the quarry.		
Mitigation hierarchy Rehabilitation		
Management timeframe and schedule: During rehabilitation.		
Responsibilities for implementation and long-term maintenance: Mine manager		
Monitoring programmes: Monitoring of rehabilitation. Refer to Part b(1)(j): • After reshaping the resultant topography must be surveyed to determine the degree to which the final topography meets planned objectives, particularly in terms of surface drainage and slope.		
Financial provision for long-term maintenance and/or environmental costs: • Refer to Part A(S) of this BAR for financial provision. The financial provision for sloping of the quarries amount to R1 235 023,45. • There will be no additional environmental costs for these management measures.		
Uncertainties associated with the preferred closure option, which list will be used to identify and define any additional work that is needed to reduce the level of uncertainty:		

	Before management	With management
None		
Stakeholder expectations and / or comments: None received.		
Legal compliance and standards: Refer to Part A(d) for legal compliance and standards. In short: Regulations 3 & 9(1)(a&g) & 12 of GN 632 of 2015 (Regulations Regarding the Planning and Management of Mine Residue) under NEMWA, regulation 8 of GN 634 of 2013 (Waste Classification and Management Regulations) under NEMWA, GN 632 of 2015 has replaced regulation 73 of GN 527 of 2004 under MPRDA. Refer to transitional period		

3.2 Environmental component: Topography including drainage patterns and visual aspects

Activity: Change in topography due to sloping of the slimes dam, waste rock dumps and the pits.

Method for assessing risks: Information for this risk was extracted from the Approved EMP (Shangoni Management Services, 2006).

			Before management	With management
CONSEQUENCE	**Nature / Intensity / Severity of Impact**			
	Positive medium	The impact on the topography will be positive and medium to high. Topography is not a resource, however, other resources such as drainage patterns and visual aspects are affected.	4	5
	Spatial extent of Impact			
	On-site	Impact occurs on-site at the point where the pits and mine residue will be sloped.	1	1
	Duration of Impact			
	Permanent	Once sloping is finished, this will n remain as a permanent land pattern.	4	4
LIKELIHOOD	**Probability of potential occurrence of the Impact**			
	Definite	The impact will occur regardless of any prevention measures	4	4
	Frequency of potential occurrence of the Impact			
	Annually or less	This is a once-off impact.	1	1
Significance before and after management: (**Positive**)			14	15
Acceptable without further mitigation: Rehabilitation to take place. Not acceptable without further monitoring after rehabilitation.				
Residual and latent risks: The impact from the mine residue and pit in the operational phase is permanent. The sloping will lessen this residual impact. No additional latent impacts are envisaged.				
Screening-Level Risk Assessment: This risk is ranked as a potential significant risk				

	Before management	With management
Environmental objective: To ensure correct sloping of mine residue.		
Cumulative impacts: Annesley mine which is 5km away also impacts the pits due to mining activities.		
Management measures to be applied (Alternative risk prevention or management strategies): Sloping should be done in accordance with the rehabilitation plan included in Part B1(i)(c). In short: • Sloping of most of the material to the north in the direction of the tailings facility and to the east towards the plant area.		
Management timeframe and schedule: During rehabilitation.		
Mitigation hierarchy Rehabilitate		
Responsibilities for implementation and long-term maintenance: Mine manager		
Monitoring programmes: Monitoring of rehabilitation. Refer to Part b(1)(j). • After reshaping the resultant topography must be surveyed to determine the degree to which the final topography meets planned objectives, particularly in terms of surface drainage and slope.		
Financial provision for long-term maintenance and/or environmental costs: • Refer to Part A(S) of this BAR for financial provision. The financial provision for sloping of the waste rock dump amounts to R10 630 041,57 • There will be no additional environmental costs for these management measures.		
Uncertainties associated with the preferred closure option, which list will be used to identify and define any additional work that is needed to reduce the level of uncertainty: None		
Stakeholder expectations and / or comments: None received.		
Legal compliance and standards: Refer to Part A(d) for legal compliance and standards • Regulation 4 of GN 632 of 2015 under NEMWA (Regulations Regarding the Planning and Management of Mine Residue) under NEMWA. • NEMA and the Environmental Conservation Act 73 of 1989 as amended (ECA)		

3.3 Environmental component: Soils

Activity: The EMP focusses on soil pollution. No mention is made of the residual impacts on the soil erosion. It is, however, assumed that the residual impacts of erosion on the soil will be significant and soil pollution from hydrocarbons and other chemicals will be insignificant. Very little topsoil was stockpiled during the mining activities. Topsoil is mixed with overburden and shows signs of erosion. Until such time that revegetation is completed, these areas will be prone to soil erosion.

Method for assessing risks: Per the final EMP Performance Assessment conducted in January 2016, erosion is visible on the site.

			Before management	With management
CONSEQUENCE	**Nature / Intensity / Severity of Impact**			
	Medium	The risks on soil erosion will be somewhat severe and reversible. The resources are moderately sensitive.	3	1
	Low	The risks on soil pollution will not be severe and reversible. The resources are not sensitive.	1	1
	Spatial extent of Impact			
	On-site	The risks will be site specific	1	1
	Duration of Impact			
	Permanent	Soil erosion will be permanent without management, but only temporary with management.	4	2
	Short-term	Soil pollution will be temporary.	1	1
LIKELIHOOD	**Probability of potential occurrence of the Impact**			
	Probable	Soil erosion impact will be probable without management measures.	2	1
	Probable	Soil pollution impact will be probable without management measures.	2	1
	Frequency of potential occurrence of the Impact			
	Monthly	Soil erosion impact can occur weekly without proper management.	4	1
	Monthly	Soil pollution impact can occur weekly without proper management.	4	1
Significance before and after management: Soil erosion			14	6
Significance before and after management: Soil pollution			9	5

Acceptable without further mitigation:

Rehabilitation to take place. Not acceptable without further monitoring after rehabilitation.

Residual and latent risks:

No residual risks from soil erosion or pollution; however, the loss of topsoil, which is a residual risk from mining activities, will remain.

Cumulative impacts:

Farming, residential and mining activities in the area can lead to soil erosion and pollution.

Screening-Level Risk Assessment:

Soil pollution is an insignificant risk. Risks form soil erosion are not included.

Environmental objective:

To prevent soil erosion and pollution.

Management measures to be applied (Alternative risk prevention or management strategies):

- Soil erosion prevention as per the rehabilitation plan.
- All vehicles and machinery must be maintained to prevent soil pollution.

	Before management	With management
• Any leakages must be removed as hazardous waste.		
Mitigation hierarchy Prevention		
Management timeframe and schedule: During rehabilitation.		
Responsibilities for implementation and long-term maintenance: Mine manager		
Monitoring programmes: Refer to Part B(1)(j) of this BAR for a monitoring and maintenance plan. • Erosion monitoring		
Financial provision for long-term maintenance and/or environmental costs: Financial provision is allocated for the monitoring of soil erosion, vegetation growth, and alien vegetation monitoring, R150 000,00		
Uncertainties associated with the preferred closure option, which list will be used to identify and define any additional work that is needed to reduce the level of uncertainty: None		
Stakeholder expectations and / or comments: None received.		
Legal compliance and standards: Refer to Part A(d) for legal compliance and standards: Contaminated land: GN 527 of 2004 i.t.o. MPRDA, and sections 35-41 of NEMWA		

3.4 Environmental component: Land capability, surrounding land use and landscape character

Activity: All mine residue will be sloped. According to the EMP (Shangoni, 2006), the areas that have been sterilised by the waste structures (waste rock dump, slimes dams) will not be rehabilitated back to the previous land capability.

Method for assessing risks: Information for this risk was extracted from the Approved EMP (Shangoni Management Services, 2006).

			Before management	With management
CONSEQUENCE	**Nature / Intensity / Severity of Impact**			
	Positive Medium	The impact on the Land capability, surrounding land use and landscape character will be medium to high. Topography is not a resource, however, other resources such as drainage patterns and visual aspects are affected.	4	5
	Spatial extent of Impact			
	On-site	The risk will be site specific.	1	1
	Duration of Impact			

			Before management	With management
	Permanent	Once sloping is finished, this will n remain as a permanent land pattern.	4	4
LIKELIHOOD	**Probability of potential occurrence of the Impact**			
	Definite	The impact will occur regardless of any prevention measures	4	4
	Frequency of potential occurrence of the Impact			
	Annually or less	This is a once-off impact.	1	1
Significance before and after management: (**Positive**)			14	15

Acceptable without further mitigation:

Rehabilitation to take place. Not acceptable without further monitoring after rehabilitation.

Residual and latent risks:

The impact from the mine residue and pit in the operational phase is permanent. The sloping will lessen this residual impact. No additional latent impacts are envisaged.

Cumulative impacts

None.

Screening-Level Risk Assessment:

These risks are ranked as insignificant risks

Environmental objective:

To ensure end land-use that has been identified as grazing and game farming.

Management measures to be applied (Alternative risk prevention or management strategies):

See Part B((1)(i)(c) of this BAR. In short:

- All pipelines must be removed;
- The plant area and associated infrastructure must be removed;
- Sloping as per rehabilitation plan must be done;
- All unused roads must be removed;
- Revegetation as per the rehabilitation plan must be implemented.

Management timeframe and schedule:

During rehabilitation.

Mitigation hierarchy

Rehabilitation

Responsibilities for implementation and long-term maintenance:

Mine manager

Monitoring programmes:

Refer to Part B(1)(j) of this BAR for a monitoring and maintenance plan.

- Topographical reshaping
- Erosion monitoring
- Vegetation monitoring

	Before management	With management
• Surface water drainage systems • Surface water quality • Groundwater quality • Mine residue characteristics with respect to plant growth (soil quality		
Financial provision for long-term maintenance and/or environmental costs: The complete financial provision for rehabilitation is R17,284,909.10		
Uncertainties associated with the preferred closure option, which list will be used to identify and define any additional work that is needed to reduce the level of uncertainty: It is assumed that with adequate management, the risk will subside.		
Stakeholder expectations and / or comments: None received.		
Legal compliance and standards: Refer to Part A(d) for legal compliance and standards: GN 527 of 2004 i.t.o. MPRDA, and sections 35-41 of NEMWA		

3.5 Environmental component: Vegetation

Activity: EMP (Shangoni, 2006), after closure, the rehabilitated soil could become infested with alien and invasive plant species.

Method for assessing risks: Information for this risk was extracted from the Approved EMP (Shangoni Management Services, 2006).

			Before management	With management
CONSEQUENCE	**Nature / Intensity / Severity of Impact**			
	Medium	The risks of alien vegetation infestation will be somewhat severe but reversible. The resources are also moderately sensitive.	3	1
	Medium	The severity of incorrect planting methods is medium.	3	1
	Spatial extent of Impact			
	On-site	The risk will be site specific.	1	1
	Duration of Impact			
	Permanent	Destruction of natural vegetation due to alien vegetation as well as the incorrect plating of indigenous vegetation will be permanent, but only be temporary if management measures are implemented.	4	1
LIKELIHOOD	**Probability of potential occurrence of the Impact**			
	Definite	Alien vegetation is already evident on the existing mine; however, the probability will decline if management measures are implemented.	4	1
	Probable	Incorrect planting methods is a possibility.	2	1
	Frequency of potential occurrence of the Impact			

			Before management	With management
	Monthly	Impact occurs based on the establishment and growing period of vegetation, periods of growth are shorter for certain vegetation.	3	3
Significance before and after management: Alien vegetation			15	7
Significance before and after management: Incorrect planting methods			13	7

Acceptable without further mitigation:

Rehabilitation to take place. Not acceptable without further monitoring after rehabilitation.

Residual and latent risks:

With adequate monitoring and maintenance, there will be no residual or latent risks.

Cumulative impacts

Residential, farming and mining activities can lead to the loss of indigenous vegetation and enhance the growth of alien vegetation.

Screening-Level Risk Assessment:

These risks are not included

Environmental objective:

To prevent the establishment of alien vegetation as they use a lot of environmental resources which restricts the growth of indigenous vegetation.

Management measures to be applied (Alternative risk prevention or management strategies):

See Part B((1)(i)(c) of this BAR. In short:

- All alien seedlings and saplings must be removed as they become evident for the duration of operation and after closure for at least five years.
- Manual / mechanical removal is preferred to chemical control.
- Implement an alien invasive plant monitoring and management plan whereby the spread of alien and invasive plant species into the rehabilitated areas are regularly removed and re-infestation monitored for at least five years.
- The areas should be planted within indigenous vegetation typical of the area.

Mitigation hierarchy

Minimise and avoid

Management timeframe and schedule:

During rehabilitation.

Responsibilities for implementation and long-term maintenance:

Mine manager

Monitoring programmes:

Refer to Part B(1)(j) of this BAR for a monitoring and maintenance plan.

- Rehabilitated areas will be monitored for a period of at least five years for the occurrence or alien invasive plant speciess

Financial provision for long-term maintenance and/or environmental costs:

Refer to Part A(S) of this BAR. The financial provision for vegetation includes seeding, euphorbias planting and the removal of alien plants, R743 748,64

	Before management	With management
Uncertainties associated with the preferred closure option, which list will be used to identify and define any additional work that is needed to reduce the level of uncertainty: It is assumed that with adequate management, the risk will subside.		
Stakeholder expectations and / or comments: None received.		
Legal compliance and standards: Refer to Part A(d) for legal compliance and standards. GN598 of 2014 (Alien and Invasive Species Regulations) & GN864 of 2016 (Alien and Invasive Species Lists) under NEMBA		

3.6 Environmental component: Groundwater

Activity: Seepage from already existing mine residue.

Method for assessing risks: Information for this risk was extracted from the Hydrogeological Report (Shangoni Management Services, 2013) conducted for Krugerspost Mine. These mines are not close to each other, however, the mineral mined are both Andalusite. A mining waste geochemical characterisation procedure was conducted on the waste generated by the andalusite mining activities to evaluate the potential risk it poses to the receiving surface and groundwater environments.

A sampling and analysis strategy to obtain representative samples of the geological materials and mine wastes was implemented. The analysis strategy included static geochemical testing of the waste material and included:

- An Acid Rain leach to determine the geochemical composition of materials (major and trace elements) based on a worst-case scenario; and
- The acid rock drainage, neutralisation and leaching potential of metals.

The samples were submitted to the Waterlab Pty Ltd, a SANAS accredited testing laboratory. Analyses included ABA analyses, major cation and anion distribution and an ICP-OES scan for dissolved metal phases.

			Before management	With management
CONSEQUENCE	**Nature / Intensity / Severity of Impact**			
	Medium	Groundwater pollution: The pH is likely to be neutral to slightly alkaline and heavy metal solubilisation will, therefore, be minimal. Further, it can be determined that the waste present a slight/ low risk to the environment posed by the sloping of mine residue.	3	3
	Negligible	AMD: The pH is likely to be neutral to slightly alkaline, therefore the severity of acid mine drainage will be negligible.	0	0

			Before management	With management
	Spatial extent of Impact			
	Local	Vertical seepage will dominate during the operational phase due to the high hydraulic conductivity of fines thereby reducing horizontal seepage risks towards the matrix and receiving environment. Seepage loads from the slimes and tailings wastes will, therefore, most probably remain isolated during the operational phases.	2	2
	Duration of Impact			
	Permanent	Pollution potential will be permanent, depending on new monitoring results.	4	4
LIKELIHOOD	**Probability of potential occurrence of the Impact**			
	Probable	Groundwater pollution: Although it is expected that vertical seepage will dominate over horizontal seepage, it may nevertheless remain a potential risk towards the receiving environment. This would be especially true if large-scale fracturing and/ weathering are present in the host matrix.	2	2
	Improbable	AMD: It is unlikely that significant acid (if any) will be generated from the mine residue.	1	1
	Frequency of potential occurrence of the Impact			
	Annually or less	Impact occurs at least once in a year or less frequently.	1	14
Significance before and after management: Groundwater pollution:			14	9
Significance before and after management: AMD:			0	0

Acceptable without further mitigation:

Rehabilitation to take place. Not acceptable without further monitoring after rehabilitation.

Residual and latent risks:

- Depending on the results of further monitoring, the risk of potential pollution (excluding acid mine drainage) will be a residual risk.
- The potential for acid mine drainage becoming a latent impact is not probable.

Cumulative impacts

Groundwater can be polluted from the mining of Andalusite or the pollution from the nearby township. There is a sewerage works in the area which can contribute largely to groundwater pollution.

Screening-Level Risk Assessment:

These risks are ranked as uncertain risks

Environmental objective:

- To monitor groundwater pollution.
- To reduce any groundwater pollution that may occur.

Management measures to be applied (Alternative risk prevention or management strategies):

	Before management	With management
All quarries will be sloped and vegetated. This will help to reduce any form of seepage from the mine residue. Boreholes must be drilled as per the IWUL to monitor the groundwater quality.		
Management timeframe and schedule: Until DWS and DMR states otherwise.		
Responsibilities for implementation and long-term maintenance: Mine manager		
Monitoring programmes: Refer to Part B(1)(j) of this BAR for a monitoring and maintenance plan. • Groundwater monitoring.		
Financial provision for long-term maintenance and/or environmental costs: Refer to Part A(S) of this BAR. Groundwater monitoring amounts to R600,000.00		
Uncertainties associated with the preferred closure option, which list will be used to identify and define any additional work that is needed to reduce the level of uncertainty: It is uncertain whether seepage will continue, therefore groundwater monitoring after rehabilitation and closure is necessary.		
Stakeholder expectations and / or comments: None.		
Legal compliance and standards: Refer to Part A(d) for legal compliance and standards Section 21 of the National Water Act sets out the water uses for which an IWUL is required. Regulation 4 of GN 632 of 2015 under NEMWA (Regulations Regarding the Planning and Management of Mine Residue) under NEMWA'		

3.7 Environmental component: Surface water

Activity: Run-off from already existing mine residue.

Method for assessing risks: Information for this risk was extracted from the Quarterly Water Quality Monitoring Report (BECS Environmental, 2016).

			Before management	With management
CONSEQUENCE	**Nature / Intensity / Severity of Impact**			
	Medium	Surface water pollution: It must be noted that there are many settlements in the area which also affect the water qualities. Refer below for GoogleEarth Image of the samples.	3	1

			Before management	With management
		 Of concern are the high microbiological results in the rivers. No sanitary facilities are used at Havercroft Mine. These results are therefore possibly from the settlements in the area. The natural hardness of water is influenced by the geology of the catchment and the presence of soluble calcium and magnesium minerals. Total hardness for all three samples were far above the acceptable limits. TDS, where the Olifants River and Mogomotsi River meet, was above the limit, however, this is negligible compared to the high concentration in the Mogomotsi River itself. Chloride, calcium magnesium and sodium were also above acceptable limits at some of the points.		
	Low	<u>Sedimentation:</u> Sloping of wastes do pose several advantages compared to surface storage and include the elimination of erosion and therefore sedimentation risks towards the receiving environment.	1	1
	Spatial extent of Impact			
	Local	Receptors which may be influenced by the mining activities include the users in the Mogomotsi River (aquatic species, livestock, wildlife).	2	2
	Duration of Impact			
	Long-term	Pollution potential will be permanent, depending on new monitoring results	3	3
LIKELIHOOD	**Probability of potential occurrence of the Impact**			
	Probable	<u>Surface water pollution:</u> This is already evident on the existing mine; however, the probability will decline if management measures are implemented.	2	1
	Improbable	<u>Sedimentation</u> from mine residue will not be probable.	1	1
	Frequency of potential occurrence of the Impact			
	Annually	Impact occurs at least once in a year or less frequently	1	1
Significance before and after management: <u>Surface water pollution:</u>			11	8

	Before management	With management
Significance before and after management: Sedimentation:	8	8
Acceptable without further mitigation: Rehabilitation to take place. Not acceptable without further monitoring after rehabilitation.		
Residual and latent risks: Depending on the results of further monitoring, the risk of potential pollution and sedimentation will not be a latent risk.		
Cumulative impact According to the Hydrogeological Report (Shangoni Management Services, 2013, the sewerage works, Annesley Mining Operations and domestic activities will influence the surface water quality.		
Screening-Level Risk Assessment: These risks are ranked as uncertain risks		
Environmental objective: To prevent the contamination and sedimentation of surface water resources by implementing management strategies		
Management measures to be applied (Alternative risk prevention or management strategies): All quarries will be sloped as per Part B(1)(i)(c) to reduce erosion and subsequent sedimentation. The slimes dam will be revegetated. This will help to reduce any form of sedimentation from the dam.		
Mitigation hierarchy Minimise		
Management timeframe and schedule: Until DWS and DMR states otherwise.		
Responsibilities for implementation and long-term maintenance: Mine manager		
Monitoring programmes: • Surface water drainage systems • Surface water quality		
Financial provision for long-term maintenance and/or environmental costs: Refer to Part A(S) of this BAR. • No additional costs, will form part of the groundwater quality monitoring costs.		
Uncertainties associated with the preferred closure option, which list will be used to identify and define any additional work that is needed to reduce the level of uncertainty: It is uncertain whether seepage leading to surface water pollution will continue, therefore monitoring of the rivers after rehabilitation and closure is necessary.		
Stakeholder expectations and / or comments: None		
Legal compliance and standards: Refer to Part A(d) for legal compliance and standards • Section 21 of the NWA sets out the water uses for which an IWUL is required.		

3.8 Environmental component: Community safety

Activity: Non-operational slimes dam and highwalls of the open pits.

Method for assessing risks: Advice from the Professional Engineer

			Before management	With management
CONSEQUENCE	**Nature / Intensity / Severity of Impact**			
	Low	According to the Professional Engineer, the Slimes Dam will have a low Zone of influence since no wet slimes are deposited on the dam anymore.	1	1
	High	People from the community who walk in the vicinity of the mine are at risk of falling into the open pits.	5	1
	Spatial extent of Impact			
	Site specific	Both hazards are site-specific.	1	1
	Duration of Impact			
	Permanent		4	4
LIKELIHOOD	**Probability of potential occurrence of the Impact**			
	Improbable	Not probable for slimes dam failure.	1	1
	Probable	Falling from pit is probable without management measures.	2	1
	Frequency of potential occurrence of the Impact			
	Annually	Once-off	1	1
Significance before and after management: Slimes dam			8	8
Significance before and after management: Falling into pits			13	8
Acceptable without further mitigation: Acceptable.				
Residual and latent risks: No residual or latent risks.				
Cumulative impact N/A, no cumulative impact				
Screening-Level Risk Assessment: These risks are not included				
Environmental objective: Provide an environment that is safe for the community				
Management measures to be applied (Alternative risk prevention or management strategies): Euphorbia will be planted along the open pit. Once it grows into s dense bush it will be difficult for people to fall inside the open pits.				
Mitigation hierarchy Avoid				
Management timeframe and schedule: As part of rehabilitation				
Responsibilities for implementation and long-term maintenance: Mine manager				

	Before management	With management
Monitoring programmes: Vegetation monitoring		
Financial provision for long-term maintenance and/or environmental costs: The financial provision for vegetation includes seeding, euphorbias planting and the removal of alien plants, R743 748,64		
Uncertainties associated with the preferred closure option, which list will be used to identify and define any additional work that is needed to reduce the level of uncertainty: It is uncertain if the vegetation will aid in safety.		
Stakeholder expectations and / or comments: None		
Legal compliance and standards: Refer to Part A(d) for legal compliance and standards: Regulation 73 of the MPRDR (GN 349 of 2011 i.t.o. MPRDA), GN 632 of 2015 i.t.o. NEMWA. Regulation 4 of GN 632 of 2015 under NEMWA (Regulations Regarding the Planning and Management of Mine Residue) under NEMWA		

3.9 Environmental component: Air quality

Activity: Various sources of potential air pollution had been identified as part of the aspect and impact identification process. These potential dust sources include the slimes dams, plant operations, waste rock dumps and plant discard dumps, mining activities, haul roads and conveyor belts. Considering the management measures identified with regards to rehabilitation and closure it is foreseen that the potential impact of these sources on air quality will be negligible.

Method for assessing risks: Information for this risk was extracted from the Approved EMP (Shangoni Management Services, 2006).

			Before management	With management
CONSEQUENCE	**Nature / Intensity / Severity of Impact**			
	N/A	No severity and no sensitive resources.	0	0
	Spatial extent of Impact			
	N/A		0	0
	Duration of Impact			
	N/A		0	0
LIKELIHOOD	**Probability of potential occurrence of the Impact**			
	Improbable	Not probable	0	0
	Frequency of potential occurrence of the Impact			
	N/A		0	0
Significance before and after management			0	0
Acceptable without further mitigation: Acceptable.				
Residual and latent risks:				

	Before management	With management
No residual or latent risks.		
Screening-Level Risk Assessment: These risks are insignificant		
Environmental objective: Ensure air quality is not affected severely by rehabilitation operations		
Management measures to be applied (Alternative risk prevention or management strategies): None necessary.		
Management timeframe and schedule: N/A		
Responsibilities for implementation and long-term maintenance: N/A		
Monitoring programmes: N/A		
Financial provision for long-term maintenance and/or environmental costs: N/A		
Uncertainties associated with the preferred closure option, which list will be used to identify and define any additional work that is needed to reduce the level of uncertainty: N/A		
Stakeholder expectations and / or comments: None		
Legal compliance and standards: Refer to Part A(d) for legal compliance and standards: GN 351 of 2014 (Regulations Regarding the Phasing-out and Management of Ozone- Depleting Substances) under NEMAQA Regulations 9(f) & 11 of GN 632 of 2015 (Regulations Regarding the Planning and Management of Residue Stockpiles and Residue Deposits) under NEMWA		

3.10 Environmental component: Radiation

Activity: No residual impact with regards to radiation is envisaged. Radiation sources will be removed and disposed at the appropriate sites.

Method for assessing risks: Information for this risk was extracted from the Approved EMP (Shangoni Management Services, 2006).

			Before management	With management
CONSEQUENCE	**Nature / Intensity / Severity of Impact**			
	N/A	No severity and no sensitive resources.	0	0
	Spatial extent of Impact			
	N/A		0	0
	Duration of Impact			
	N/A		0	0

			Before management	With management
LIKELIHOOD	**Probability of potential occurrence of the Impact**			
	Improbable	Not probable	0	0
	Frequency of potential occurrence of the Impact			
	N/A		0	0
Significance before and after management			0	0
Acceptable without further mitigation: Acceptable.				
Residual and latent risks: No residual or latent risks.				
Screening-Level Risk Assessment: These risks are insignificant				
Environmental objective: N/A				
Management measures to be applied (Alternative risk prevention or management strategies): None necessary.				
Management timeframe and schedule: N/A				
Responsibilities for implementation and long-term maintenance: N/A				
Monitoring programmes: N/A				
Financial provision for long-term maintenance and/or environmental costs: N/A				
Uncertainties associated with the preferred closure option, which list will be used to identify and define any additional work that is needed to reduce the level of uncertainty: N/A				
Stakeholder expectations and / or comments: None				
Legal compliance and standards: Refer to Part A(d) for legal compliance and standards. None are applicable.				

3.11 Environmental component: Noise, vibration, and shock

Activity: No residual impact caused by noise is envisaged after closure. This is due to the closure of the plant operations and mining activities which were mainly responsible for the noise generated on the mine.

Method for assessing risks: Information for this risk was extracted from the Approved EMP (Shangoni Management Services, 2006).

			Before management	With management
CONSEQUENCE	**Nature / Intensity / Severity of Impact**			
	N/A	No severity and no sensitive resources.	0	0
	Spatial extent of Impact			
	N/A		0	0
	Duration of Impact			
	N/A		0	0
LIKELIHOOD	**Probability of potential occurrence of the Impact**			
	Improbable	Not probable	0	0
	Frequency of potential occurrence of the Impact			
	N/A		0	0
Significance before and after management			0	0

Acceptable without further mitigation: Acceptable.
Residual and latent risks: No residual or latent risks.
Screening-Level Risk Assessment: These risks are insignificant
Environmental objective: N/A
Management measures to be applied (Alternative risk prevention or management strategies): Some structures that have been damaged due to mining activities (blasting and shock) will be identified and appropriate action initiated prior to the mining operations closing.
Management timeframe and schedule: N/A
Responsibilities for implementation and long-term maintenance: N/A
Monitoring programmes: N/A
Financial provision for long-term maintenance and/or environmental costs: N/A
Uncertainties associated with the preferred closure option, which list will be used to identify and define any additional work that is needed to reduce the level of uncertainty: N/A
Stakeholder expectations and / or comments: None
Legal compliance and standards: Refer to Part A(d) for legal compliance and standards. None are applicable.

3.12 Environmental component: Traffic

Activity: It is foreseen that no residual impact on traffic will take place after closure. Traffic will decrease in the area.

Method for assessing risks: Information for this risk was extracted from the Approved EMP (Shangoni Management Services, 2006).

			Before management	With management
CONSEQUENCE	**Nature / Intensity / Severity of Impact**			
	N/A	No severity and no sensitive resources.	0	0
	Spatial extent of Impact			
	N/A		0	0
	Duration of Impact			
	N/A		0	0
LIKELIHOOD	**Probability of potential occurrence of the Impact**			
	Improbable	Not probable	0	0
	Frequency of potential occurrence of the Impact			
	N/A		0	0
Significance before and after management			0	0

Acceptable without further mitigation: Acceptable.
Residual and latent risks: No residual or latent risks.
Screening-Level Risk Assessment: These risks are insignificant
Environmental objective: N/A
Management measures to be applied (Alternative risk prevention or management strategies): None necessary.
Management timeframe and schedule: N/A
Responsibilities for implementation and long-term maintenance: N/A
Monitoring programmes: N/A
Financial provision for long-term maintenance and/or environmental costs: N/A
Uncertainties associated with the preferred closure option, which list will be used to identify and define any additional work that is needed to reduce the level of uncertainty: N/A
Stakeholder expectations and / or comments: None
Legal compliance and standards:

	Before management	With management
Refer to Part A(d) for legal compliance and standards. None are applicable.		

3.13 Environmental component: Archaeological, historical and cultural aspects

Activity: The impact that mining will have on these aspects identified in the heritage assessment will cease to exist after closure due to no mining activities taking place anymore.

Method for assessing risks: Information for this risk was extracted from the Approved EMP (Shangoni Management Services, 2006).

			Before management	With management
CONSEQUENCE	**Nature / Intensity / Severity of Impact**			
	N/A	No severity and no sensitive resources.	0	0
	Spatial extent of Impact			
	N/A		0	0
	Duration of Impact			
	N/A		0	0
LIKELIHOOD	**Probability of potential occurrence of the Impact**			
	Improbable	Not probable	0	0
	Frequency of potential occurrence of the Impact			
	N/A		0	0
Significance before and after management			0	0
Acceptable without further mitigation: Acceptable.				
Residual and latent risks: No residual or latent risks.				
Screening-Level Risk Assessment: These risks are insignificant				
Environmental objective: N/A				
Management measures to be applied (Alternative risk prevention or management strategies): In the event of any archaeological, historical or cultural resource being uncovered, all work must stop and a specialist must be contacted.				
Management timeframe and schedule: N/A				
Responsibilities for implementation and long-term maintenance: N/A				
Monitoring programmes: N/A				
Financial provision for long-term maintenance and/or environmental costs: N/A				

	Before management	With management
Uncertainties associated with the preferred closure option, which list will be used to identify and define any additional work that is needed to reduce the level of uncertainty: N/A		
Stakeholder expectations and / or comments: None		
Legal compliance and standards: Refer to Part A(d) for legal compliance and standards: National Heritage Resources Act no 25 of 1999 (NHRA), Section 15(1) of the National Forest Act No 84 of 1998 (NFA)		

3.14 Environmental component: Socio-economic

Activity: Job creation and returning the land to grazing for the community

Method for assessing risks: Information for this risk was extracted from the needs and desirability section in this BAR.

			Before management	With management
CONSEQUENCE	**Nature / Intensity / Severity of Impact**			
	Medium	Unemployment is a significant problem in the area. Job creation will therefore have a medium to high and positive nature on the area.	4	5
	Medium	The community is dependent on grazing as income. Returning this area for grazing will have a medium to high and positive nature on the area.	4	5
	Spatial extent of Impact			
	On-site	Impact occurs on-site	1	1
	Duration of Impact			
	Short-term	Job opportunities for rehabilitation will only be short-term.	1	1
	Permanent	Returning the land for grazing will be permanent.	4	4
LIKELIHOOD	**Probability of potential occurrence of the Impact**			
	Highly probable	Job opportunities will be created. Using local people will ensure definite job opportunities.	3	4
	Highly probable	The land will be returned for grazing. With adequate rehabilitation, this will be a definite impact.	3	4
	Frequency of potential occurrence of the Impact			
	Annually	Both are once-off impacts	1	1
Significance before and after management: Job opportunities **(Positive)**			10	12
Significance before and after management: Returning land for grazing **(Positive)**			12	15
Acceptable without further mitigation: Rehabilitation to take place. Acceptable once the community is satisfied with rehabilitation				

	Before management	With management
Residual and latent risks: N/A		
Screening-Level Risk Assessment: This risk is ranked as a potential significant positive risk.		
Environmental objective: • To ensure local job opportunities. • To return the land for grazing.		
Management measures to be applied (Alternative risk prevention or management strategies): The community must be employed for decommissioning and rehabilitation activities, as far as possible. Proper rehabilitation will also ensure that the land can be return to grazing.		
Management timeframe and schedule: Until DMR states otherwise.		
Responsibilities for implementation and long-term maintenance: Mine manager		
Monitoring programmes: N/A		
Financial provision for long-term maintenance and/or environmental costs: N/A		
Uncertainties associated with the preferred closure option, which list will be used to identify and define any additional work that is needed to reduce the level of uncertainty: None		
Stakeholder expectations and / or comments: According to Mr Mphofelo: “we have higher rate of unemployment that will led our community members to higher degree of poverty”.		
Legal compliance and standards: Refer to Part A(d) for legal compliance and standards: • Section 24R of NEMA, Appendix 5 of the EIA Regulations, sections 43, 56, 61 of MPRDA (rehabilitation and closure) • Section 2(3 & 4), of NEMA, section 2, 2(a)(ii), 22(2)(d) of NWA, GN 527 of 2004 i.t.o. MPRDA, section 37 of MPRDA, section 2(a)(ii) of Section 2(3 & 4) of NEMA, section 2 of NWA, section of, and section of NWA (Sustainable development principles)		

3 Latent risk assessment

This section substantiation why each risk is latent, including why the risk **was not or could not be mitigated during concurrent** rehabilitation and remediation or during the implementation of the final rehabilitation, decommission and closure plan.

It also includes a detailed description of the **drivers that could result in the manifestation of the risks**, to be presented within the context of closure actions already having been implemented during the execution of concurrent rehabilitation or during the implementation of the final rehabilitation, decommission and closure plan; as well as a description of the expected **timeframe in which the risk is likely to manifest**, typically as expected years after closure, and the duration of the impact, including motivation to support these timeframes; a detailed description of the **triggers which can be used to identify that the risk is imminent or has manifested**, how this will be measured and any cost implications thereof; **results and findings** of the risk assessment; and an explanation of **changes to the risk assessment results** as applicable in annual updates to the plan.

Management activities for latent risks must include:

1. monitoring of results and findings, which informs adaptive or corrective management and/or risk reduction activities;
2. an assessment of alternatives to mitigate or manage the impacts once the risk has become manifested, which must be focussed on practicality as well as the cost of the implementation;
3. motivation, why the selected alternative, is the appropriate approach to mitigate the impact; and
4. a detailed description of how the alternative will be implemented.

No latent risks are envisaged at this point.

4 Alternative options

Alternative options must include the potential impacts of the alternative land use or development, as well as an identification of the alternative land uses which will be impacted upon. No proposed development footprint or alternatives are considered; therefore, no impacts are listed.

5 Cumulative impacts

Refer to Part A(h)(v)(3) for all cumulative impacts.

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

Refer above.

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

No alternatives are applied for.

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

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

ix) Motivation where no alternative sites were considered

The final decommissioning and rehabilitation have been discussed with the community. Furthermore, the earthworks and sloping of the mine residue and the area have been planned with the aid of a specialist. The activities in this BAR is the most effective way to rehabilitate the area.

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

The final decommissioning and rehabilitation have been discussed with the community. Furthermore, the earthworks and sloping of the mine residue and the area have been planned with the aid of a specialist. The activities in this BAR is the most effective way to rehabilitate the area.

i) 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(h)(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.

j) 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(h)(v) for a complete impact assessment. Also, refer to Addendum 6 for the supporting impact assessment conducted by the EAP.

k) Summary of specialist reports

Table 28: Summary of specialist reports

List of studies undertaken	Recommendations for specialist reports	Specialist recommendations that have been included in the report	Reference to applicable section of report where specialist recommendations have been included
Earthworks plan	All sloping included in this report	This plan was incorporated into the BAR.	Part B(1)(i)(c)

Refer to Addendum 3 attached for of the specialist reports.

l) Environmental impact statement

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

Environmental component	Description of impact
Geology and the mineral resource	Sloping of mine residue over economic viable geology.
Topography	Change in topography due to sloping of the slimes dam, waste rock dumps and the pits.
Soils	Soil erosion
	Soil pollution
Land capability, surrounding land use and landscape character	Rehabilitation of area to return land to community.
Vegetation	Establishment of alien vegetation
	Incorrect replanting of indigenous vegetation.
Groundwater	Seepage from already existing mine residue.
Surface water	Run-off from already existing mine residue.
Community safety	Safety hazard form non-operational slimes dam and highwalls of the open pits.
Air quality	None envisaged
Radiation	None envisaged
Noise, vibration, and shock	None envisaged
Traffic	None envisaged
Archaeological, historical and cultural aspects	None envisaged
Socio-economic	Job creation
	Returning land for grazing.

(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

This application is for the rehabilitation of an already disturbed area and will, therefore, have a net positive implication on the environment.

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

Refer to Part A(h)(v) for all Proposed impact management objectives and the impact management outcomes.

n) Aspects for inclusion as conditions of Authorisation

The mine already has a mining right and EMP. The commitments in the EMP must also be adhered to where it is applicable. This will include for instance waste management, environmental emergencies, environmental awareness and handling of any hazardous substances.

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

This BAR is compiled using already existing information and the Earthworks plan. No additional studies have been done.

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 decommissioning of old redundant infrastructure and the rehabilitation of the area is necessary as part of mining.

ii) Conditions that must be included in the authorisation

The mine already has a mining right and EMP. The commitments in the EMP must also be adhered to where it is applicable. This will include for instance waste management, environmental emergencies, environmental awareness and handling of any hazardous substances.

q) Period for which the Environmental Authorisation is required

Until the end of rehabilitation.

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 Basic Assessment Report and the EMP.

s) Financial Provision

i) Explain how the aforesaid amount was derived

Havercroft is non-operational and in the process to close-down. Closure costs must, therefore, be calculated with an accuracy of ±90%. 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 29). 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 the 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 afterward.

Table 29: 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 the 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 leveling of the dumps, seeding of the trees and grass.

1 Auditable calculations of costs per activity or infrastructure

Table 30: Tariffs used for quantum determination

Rehabilitation and Demolition	Unit	Rates
800mm thick /deep Reinforced in-situ concrete structures: Demolition and removal to demolition site	m³	R 502.27
400mm thick /deep reinforced concrete	m³	R 447.27
250mm thick /deep reinforced concrete	m³	R 350.00
340mm thick /deep concrete slabs	m³	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.	m²	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 the 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 the wall at 1400mm high in middle and to one side of the 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	m³	R 435.00
Excavating foundations 600 x 230 x 655mm deep strip footings	m³	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)	m²	R 53.13
Medium steel construction buildings (corrugated iron cladded workshops and sheds with concrete floors)	m²	R 290.00
Dismantle, break down and remove plant structure, not exceeding 15m height	m³	R 171.85

Rehabilitation and Demolition	Unit	Rates
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 a 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
Disconnect and remove transformers, demolish transformer room brick building, 3 x 3 x 4m high.	no	R 10,850.00
Remove fuel pumps & tank	m^3	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	m^3	R 450.00
Permatank	m^3	R 850.00
Overland conveyor	m	R 540.00

Rehabilitation and Demolition	Unit	Rates
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
Sloping of open pit (also include sloping of WRD)	m³	R 8.09
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.

2 List of surface infrastructure

Havercroft Operation consists of the following infrastructures (refer to Figure 5 for the site layout plan).

- Plant,
- Workshops,
- Offices,
- Slimes Dam,
- Quarries (1 - 15),
- Return water dam, and
- A Waste rock dump

3 Cost assumptions based on final closure plan

3.1 Pipelines

Various pipelines traverse the mining area. These pipes are steel pipes. None of these pipes are in use anymore. All steel pipes will be removed to other mines within the Imerys Group. These pipes will then be reused as part of their operations.

No additional financial provisioning for monitoring, maintenance and post-closure management is necessary.

3.2 Plant area and other buildings

The plant is currently non-operational. Associated buildings are the workshops. There is still scrap metal and plant equipment that need to be removed.

All hazardous materials such as hydrocarbons, fluorescent tubes, etc. will be removed by a licensed waste contractor to a licensed disposal area. The mine will obtain all the correct documentation such as safe disposal certificates and a copy of the disposal site license. All salvageable material will be removed to either a steel merchant or other mine operations. Concrete will be removed to a depth of 1m below the surface. Building rubble (inert waste) could be used for backfilling of the quarries, however, the disposal of more than 25tons need a waste license excluding the disposal of such waste for the purposes of leveling which has been authorised by or under other legislation. This will be discussed with DMR prior to disposal. Once all salvageable infrastructure has been removed and foundations are broken the plant area should be sloped to allow for free drainage to the east. There are also small stockpiles and walls from old return water dams that should be graded to fill unnatural depressions around the plant area. High walls should be broken and sloped to allow for vegetation growth.

No monitoring is necessary for the removal of the plant structures. Monitoring of the revegetation, as well as any erosion, will be necessary

It is assumed that all infrastructure will be removed and either disposed of or sold as scrap. Resloping of the area is based on surveyor data received from the mine.

3.3 Waste rock dump

There is a large waste rock dump to the north of the mine, just south of the slimes dam. On the western side is natural vegetation as well as a servitude for a high voltage power line.

On the western side is natural vegetation as well as a servitude for a high voltage power line. It is therefore proposed to slope most of the material to the north in the direction of the tailings facility and to the east towards the plant area.

Once the sloping is finalised it is also recommended to add contour paddocks along the side slopes of the waste rock dump no more than 20m apart. Previous contours of 50m apart have shown erosion to form along the slope.

The 3d rehabilitation models indicate the sloping and moving of material required on the left, with the final result on the right. This model consists of the only cut and fill and does not require any moving of material into or out of the site.

Monitoring of the revegetation, as well as any erosion, will be necessary. The water qualities, both surface, and groundwater will be monitored

Resloping of the area is based on surveyor data received from the mine. There are no groundwater qualities to confirm seepage potential.

3.4 Quarries

There are 15 quarries at Havercroft. These quarries are located along a mountainous line from north to south. These quarries have a steep high wall on the western side.
It is proposed to plant a thick row of euphorbias on the top of the high walls. This wil be done to prevent access of people and animals to these high walls.

Only the quarries where the need for earthworks has been identified are included in the description for sloping. Safeguarding of high walls are encouraged but has not been included in the modeling as there is a major safety concern to work above the high walls with machinery. All high walls have been modeled to remain in place due to this safety risk.

Table 31: Quarries rehabilitation

Quarry	Rehabilitation recommendation
Q1	Push remainder of OB opposite of high wall into the bottom of the quarry. Only light grading is required.
Q2	Push bottom OB stockpile into the quarry.
	Dig a trench in O/B stockpile located within drainage line above the high wall to allow for free drainage into the quarry that will assist with vegetation growth.

Quarry	Rehabilitation recommendation
Q3	General sloping for free drainage should be established. This area is also identified as a good location for a drinking hole. It is recommended to ensure that all slopes towards the water are safe and stable.
Q5	Break bench opposite of high wall. Potential traffic of locals and animals are expected to come from the east which would make this bench on the opposite side a potential safety risk.
Q6	Break lower benches that is easily reachable and push material to the bottom of the quarry.
Q11	Two OB stockpiles opposite of high wall should be pushed into the bottom of the quarry.
Q12	Push OB stockpile into quarry bottom.
Q13 & 14	Push OB stockpiles into quarry bottom.
Q15	OB stockpile should be brought back into the quarry. Note specifically not to push OB further down that may cause further disturbance and more difficult to move into the quarry.

Monitoring of the revegetation, as well as any erosion, will be necessary. The water qualities, both surface and groundwater will be monitored.

Resloping of the area is based on surveyor data received from the mine.

3.5 Primary and secondary access roads

There are various roads traversing the area. These roads will be kept after closure for farming activities. Roads will only be removed if requested by the community.

Monitoring of any erosion will be necessary.

It is assumed that some roads will be retained for farmers.

4 Latent or residual impacts

Refer to Part B(d)(2) for residual impacts.

5 Closure cost estimation

The following table contains a summary of the calculations made for the closure cost based on the **Final** Closure Plan and Rehabilitation Plan (BECS Environmental, 2016).

Table 32: Summary of the closure cost calculation until closure

Item	Size (m / m² / m³)	Rate	Final cost
Infrastructure removal			
Pipelines*	-	R0.00	

Item	Size (m / m² / m³)	Rate	Final cost
Plant area and other buildings	2.14	R171.85	R367.76
Primary and secondary access roads	42,760.00	R14.89	R636,696.40
Sloping			
Waste rock dump and plant area	313,973.00	R8.09	R10,630,041.57
Quarry 1	3,051.00	R8.09	R24,682.59
Quarry 2	33,183.00	R8.09	R268,450.47
Quarry 3	7,858.50	R8.09	R63,575.27
Quarry 5	1,236.00	R8.09	R9,999.24
Quarry 6	5,926.00	R8.09	R47,941.34
Quarry 11	39,776.00	R8.09	R321,787.84
Quarry 12	21,198.00	R8.09	R171,491.82
Quarries 13 & 14	37,887.00	R8.09	R306,505.83
Quarry 15	2,545.00	R8.09	R20,589.05
Vegetation			
Seeding	209,449.00	R3.36	R703,748.64
Euphorbias planting	Once-off	R20,000.00	R20,000.00
Removal of alien planta	Once-off	R20,000.00	R20,000.00
Monitoring			
Soil erosion, vegetation growth, and alien vegetation monitoring	Annual for 5 years	R20,000.00	R150,000.00
Groundwater monitoring	Quarterly for 5 years	R20,000.00	R600,000.00
Sub-total			R13,995,877.81
P&G (13.5%)			R1,889,443.50
Contingency (10%)			R1,399,587.78
Total			**R17,284,909.10**

* No additional costs.

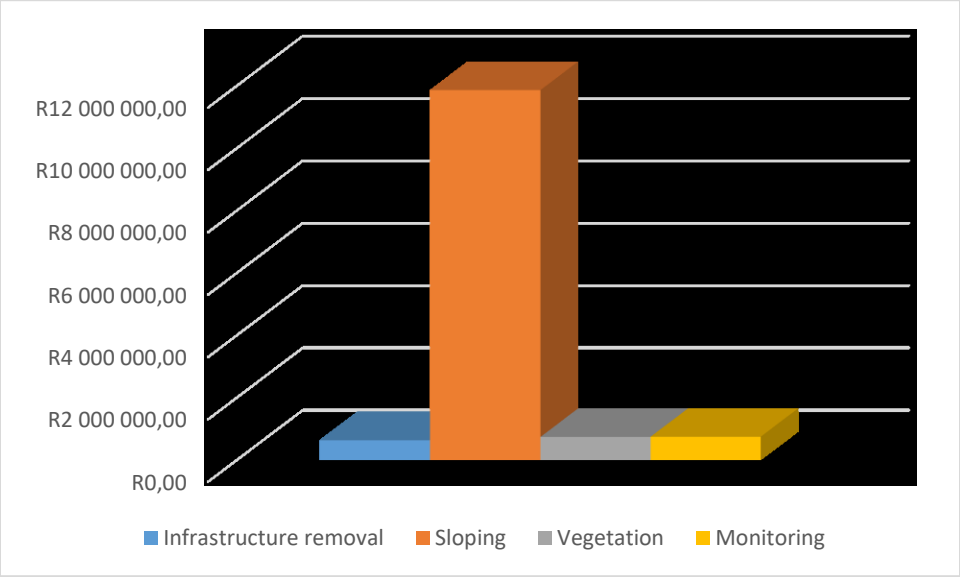


Figure 14: Financial provision summary

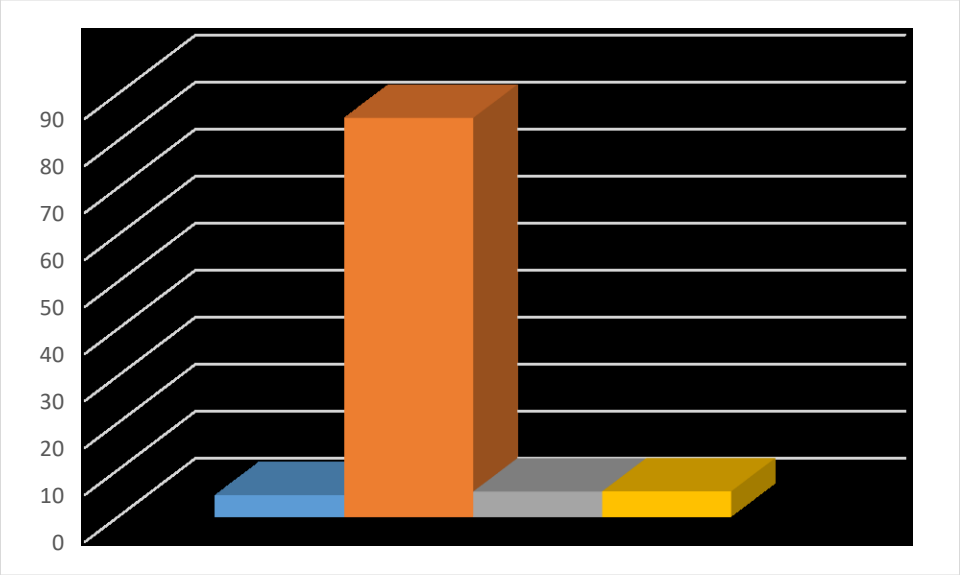


Figure 15: Percentage of financial provision

Referring to Figures 14 and 15 above, it is evident that sloping will be almost 85% of the entire financial provision.

ii) Confirm that this amount can be provided for from operating expenditure

The mine has provision for the rehabilitation of the area.

t) Specific 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 the needs and desirability of this BAR for a full description.

(2) Impact on any national estate referred to in section 3(2) of the National Heritage Resources Act

None envisaged.

u) Other matters required in terms of sections 24(4)(a) and (b) of the Act

None envisaged.

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

Refer to Part A(h)(v) of this BAR.

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 quarries will be utilised and optimised to complement 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.

This end land use is then also the closure vison of the mine.

2 Residual impacts

Geology and the mineral resource:

Considering the fact that the mining of Andalusite goes hand in hand with the extraction of the ore body the impact on the geology (mineral wise) will be permanent. As part of mine planning, the effects of mining on the geological features have been kept to a minimum to minimise the potential risk to the employees and the environment during mining. The extraction of ore takes place from the various pit areas. The permanent removal of geology will be a residual impact.

Topography:

The mining activity will have permanent impacts on the topography of the area. This is a result of the fine tailings dam, WRDs and depression where the quarries were mined. The only measures that can be taken to minimise the impact on the topography are to ensure that effective rehabilitation is done in accordance with the proposed rehabilitation measures. The residual impact on the topography will be minimised as far

as possible by applying the rehabilitation approaches. The impact is however permanent and will continue after mining. Rehabilitation measure can minimise the visual effect and partially the topography effect due to sloping and terracing of areas.

Soils:
Various activities on the mine could have and can result in soil pollution. These activities include the workshop activities, use of pesticides, storage and handling of chemicals and the storage and disposal of waste. The potential does exist that polluted soil (due to spillages, storage etc.) may be present after closure.

Prior to the application for closure, a survey will be conducted to identify all the polluted areas and appropriate actions will be taken to remediate the effect of the pollution on the surrounding soils. This will ensure no residual impacts after closure.

Land capability, surrounding land use and landscape character:
The areas that have been sterilised by the waste structures (WRDs, fine tailings dams) will not be rehabilitated back to the previous land capability. Objectives have been set for mine closure and the current mining area will be rehabilitated to such that it can be re-used for the pre-mining land use namely game and cattle farming.

Considering the closure objectives, the impact on the land capability will be limited and the residual impact on land use will be negligible.

Vegetation:
Although vegetation was destroyed as part of the mining activities, vegetation was and will be re-introduced to various rehabilitated areas on site as per the rehabilitation plan scheduling and rehabilitation procedure.

The only residual impact that is foreseen is the ingression of invader plants. To combat this action plans will be developed to identify all the invader plants on site and develop plans to eradicate such invader plants. The re-vegetation of areas will only be done using indigenous plants.

Clear objectives have been set with regards to mitigation of the impact on vegetation. Considering the effective implementation of the actions the residual impact of vegetation will be negligible.

Air quality:
Various sources of potential air pollution had been identified as part of the aspect and impact identification process. These potential dust sources include the fine tailings dams, plant operations, WRDs and plant

discard dumps, mining activities, haul roads and conveyor belts. Considering the management measures identified with regards to rehabilitation and closure it is foreseen that the potential residual impact of these sources on air quality will be negligible.

It is foreseen that some level of post-closure maintenance would need to be done on the fine tailings dams and WRDs to ensure the vegetation cover is acceptable. The financial provision has been calculated in such a way as to consider this post-closure cost. The detail with regards to the post-closure actions will be developed in due course.

The plant will have no residual impact on the air quality because it will not be operational after closure. The plant and related infrastructure will most probably be demolished.

Radiation:
No residual impact with regards to radiation is envisaged. Radiation sources will be removed and disposed at the appropriate sites.

Noise, vibration, and shock:
No residual impact caused by noise is envisaged after closure. This is due to the closure of the plant operations and mining activities which were mainly responsible for the noise generated on the mine. Blasting has also stop thus no vibration and shock will take place. Some structures that have been damaged due to mining activities (blasting and shock) will be identified and appropriate action initiated prior to the mining operations closing.

Visual aspects:
The potential impacts associated with the visual issues and change in topography will be addressed as part of the implementation of closure objectives and mitigation measures to minimise the impacts. Visual impacts will be present after closure. These impacts will be minimised as far as practical by means of effective rehabilitation practices.

Traffic:
It is foreseen that no residual impact on traffic will take place after closure. Traffic will decrease in the area.

Archaeological, historical and cultural aspects:
The impact that mining will have on these aspects identified in the heritage assessment will cease to exist after closure due to no mining activities taking place anymore.

Groundwater:

The pH is likely to be neutral to slightly alkaline and heavy metal solubilisation will therefore be minimal. Further, it can be determined that the waste present a slight/ low risk to the environment posed by the mine residue. The pH is likely to be neutral to slightly alkaline, therefore the severity of acid mine drainage will be negligible. Residual impacts on groundwater will only be known with adequate groundwater monitoring.

Surface water:
Residual impacts on surface water will only be known with adequate surface water monitoring.

Community safety:
According to the Professional Engineer, the Fine Tailings Dam will have a low Zone of influence due to the fact that no wet tailings are deposited on the dam anymore.

3 Closure objectives

Broad future land use objectives

The Broad future land use objectives for Havercroft Mine Operation are as follow:

1. To rehabilitate the land to a level where natural topography, vegetation, and land use approach the original state as closely as possible.
2. That stormwater control is permanent in view of the large volumes of fine erodible materials that have been created.
3. That the water quality and catchment yield return to the original state as closely as possible.

The rehabilitation of Havercroft will focus on sloping of quarries as far as possible, and sloping and levelling of any additional overburden; removal of alien vegetation and establishment of natural vegetation on all disturbed areas to also prevent erosion; adequate stormwater control to prevent siltation and pollution of the Rivers and Spruit; and removal of all old infrastructure.

Specific closure vision, objectives, and targets

- Pipelines: To remove all pipes in accordance with all environmental principles as well as the requirements of the MHSA.
- Plant area and other buildings: To keep the existing terraces with only minor cut and fill operations, and to allow a gradual drainage to the east of the plant.
- WRD: To prevent seepage and erosion from WRD.
- Quarries: To allow free flowing of surface water; to promote even vegetation growth, and to ensure the safety of quarry for community and animals.
- Primary and secondary access roads: To remove any unnecessary roads.

ii) Volumes and rate of water use required for the operation

None required.

iii) Has a water use license has been applied for?

Havercroft Operations has an IWUL. This IWUL has already expired. The mine is waiting for feedback from DWS whether they need to reapply for an IWUL.

ix) Impacts to be mitigated in their respective phases

Refer to the tables below for the Impacts to be mitigated in their respective phases, Impact management outcomes, and Impact management actions.

1 Removal of pipelines

Phase	Decommissioning and rehabilitation
Potential impact	Incorrect disposal of pipes
Aspects affected	Visual
Size and scale of disturbance	Unknown – will only be calculated during removal
Mitigation measures	Correct waste disposal as per the mine's waste procedure
Mitigation type	Control
Standard to be achieved	Rehabilitate
Compliance with standards	Guidelines for the rehabilitation of mined land (2007)
Time period for implementation	Until end of rehabilitation (end 2019)

2 Removal of plant area and other buildings

Phase	Decommissioning and rehabilitation
Potential impact	Incorrect disposal of building rubble
Aspects affected	Visual
Size and scale of disturbance	2.14m³
Mitigation measures	Correct waste disposal as per the mine's waste procedure
Mitigation type	Control
Standard to be achieved	Rehabilitate
Compliance with standards	Guidelines for the rehabilitation of mined land (2007)
Time period for implementation	Until end of rehabilitation (end 2019)

Phase	Decommissioning and rehabilitation
Potential impact	Incorrect disposal of hazardous material
Aspects affected	Soil pollution

Size and scale of disturbance	2.14m³
Mitigation measures	Correct waste disposal as per the mine's waste procedure
Mitigation type	Control
Standard to be achieved	Rehabilitate
Compliance with standards	Guidelines for the rehabilitation of mined land (2007)
Time period for implementation	Until end of rehabilitation (end 2019)

3 Sloping of WRD and plant area

Phase	Decommissioning and rehabilitation
Potential impact	Incorrect sloping leading to sedimentation of river down slope
Aspects affected	Water pollution
Size and scale of disturbance	1,313,973.00m³
Mitigation measures	All quarries will be sloped as per Part B(1)(i)(c) to reduce erosion and subsequent sedimentation. The slimes dam will be revegetated. This will help to reduce any form of sedimentation from the dam.
Mitigation type	Control
Standard to be achieved	Rehabilitate
Compliance with standards	Guidelines for the rehabilitation of mined land (2007)
Time period for implementation	Until end of rehabilitation (end 2019)

Phase	Decommissioning and rehabilitation
Potential impact	Soil erosion
Aspects affected	Soil
Size and scale of disturbance	1,313,973.00m³
Mitigation measures	See Part B((1)(i)(c) of this BAR. In short: • The area should be re-landscaped and resemble the landform prior to the open cast activities as far as possible. • Revegetation will be implemented to reduce erosion.

	• Prior to the application for closure, a survey will be conducted to identify all the polluted areas and appropriate actions will be taken to remediate the effect of the pollution on the surrounding soils.
Mitigation type	Control
Standard to be achieved	Rehabilitate
Compliance with standards	Guidelines for the rehabilitation of mined land (2007)
Time period for implementation	Until end of rehabilitation (end 2019)

Phase	Decommissioning and rehabilitation
Potential impact	Rehabilitated soil could become infested with alien and invasive plant species
Aspects affected	Vegetation
Size and scale of disturbance	1,313,973.00m³
Mitigation measures	See Part B((1)(i)(c) of this BAR. In short: • All alien seedlings and saplings must be removed as they become evident for the duration of operation and after closure for at least five years. • Manual / mechanical removal is preferred to chemical control. • Implement an alien invasive plant monitoring and management plan whereby the spread of alien and invasive plant species into the rehabilitated areas are regularly removed and re-infestation monitored for at least five years. • The areas should be planted within indigenous vegetation typical of the area.
Mitigation type	Control
Standard to be achieved	Rehabilitate
Compliance with standards	Guidelines for the rehabilitation of mined land (2007)
Time period for implementation	Until end of rehabilitation (end 2019)

Phase	Decommissioning and rehabilitation
Potential impact	Dust generation

Aspects affected	Air quality
Size and scale of disturbance	1,313,973.00m³
Mitigation measures	None necessary, will cease once rehabilitation is finished
Mitigation type	N/A
Standard to be achieved	N/A
Compliance with standards	N/A
Time period for implementation	N/A

Phase	Decommissioning and rehabilitation
Potential impact	Noise generation
Aspects affected	Environmental noise
Size and scale of disturbance	1,313,973.00m³
Mitigation measures	None necessary, will cease once rehabilitation is finished
Mitigation type	N/A
Standard to be achieved	N/A
Compliance with standards	N/A
Time period for implementation	N/A

4 Sloping of overburden at quarries

Phase	Decommissioning and rehabilitation
Potential impact	Soil erosion
Aspects affected	Soil
Size and scale of disturbance	152,660.50m³
Mitigation measures	See Part B((1)(i)(c) of this BAR. In short: • The area should be re-landscaped and resemble the landform prior to the open cast activities as far as possible. • Revegetation will be implemented to reduce erosion.

	• Prior to the application for closure, a survey will be conducted to identify all the polluted areas and appropriate actions will be taken to remediate the effect of the pollution on the surrounding soils.
Mitigation type	Control
Standard to be achieved	Rehabilitate
Compliance with standards	Guidelines for the rehabilitation of mined land (2007)
Time period for implementation	Until end of rehabilitation (end 2019)

Phase	Decommissioning and rehabilitation
Potential impact	Rehabilitated soil could become infested with alien and invasive plant species
Aspects affected	Vegetation
Size and scale of disturbance	152,660.50m³
Mitigation measures	See Part B((1)(i)(c) of this BAR. In short: • All alien seedlings and saplings must be removed as they become evident for the duration of operation and after closure for at least five years. • Manual / mechanical removal is preferred to chemical control. • Implement an alien invasive plant monitoring and management plan whereby the spread of alien and invasive plant species into the rehabilitated areas are regularly removed and re-infestation monitored for at least five years. • The areas should be planted within indigenous vegetation typical of the area.
Mitigation type	Control
Standard to be achieved	Rehabilitate
Compliance with standards	Guidelines for the rehabilitation of mined land (2007)
Time period for implementation	Until end of rehabilitation (end 2019)

Phase	Decommissioning and rehabilitation
Potential impact	Dust generation

Aspects affected	Air quality
Size and scale of disturbance	152,660.50m³
Mitigation measures	None necessary, will cease once rehabilitation is finished
Mitigation type	N/A
Standard to be achieved	N/A
Compliance with standards	N/A
Time period for implementation	N/A

Phase	Decommissioning and rehabilitation
Potential impact	Noise generation
Aspects affected	Environmental noise
Size and scale of disturbance	152,660.50m³
Mitigation measures	None necessary, will cease once rehabilitation is finished
Mitigation type	N/A
Standard to be achieved	N/A
Compliance with standards	N/A
Time period for implementation	N/A

5 Removal of roads

Phase	Decommissioning and rehabilitation
Potential impact	Dust generation
Aspects affected	Air quality
Size and scale of disturbance	42,760.00m²
Mitigation measures	None necessary, will cease once rehabilitation is finished
Mitigation type	N/A
Standard to be achieved	N/A
Compliance with standards	N/A
Time period for implementation	N/A

e) Impact management outcomes

Refer to Part B(1)(d)(ix) above

f) Impact management actions

Refer to Part B(1)(d)(ix) above

i) Financial provision

(a) Describe the closure objectives and the extent to which they have been aligned to the baseline environment described under the Regulation

Refer to Part B(1)(d)(i) for closure objectives.

(b) Confirm specifically that the environmental objectives in relation to closure have been consulted with landowner and interested and affected parties

Refer to Part A(h)(ii) for public participation.

(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

The following is extracted from Final Closure Plan and Rehabilitation Plan: As part of Closure Application (BECS Environmental, 2016) with Earthworks Report (Rational Environmental, 2016).

1 Removal of pipelines

All steel pipes will be removed to other mines within the Imerys Group. These pipes will then be reused as part of their operations.

2 Removal of plant area and other buildings

All hazardous materials such as hydrocarbons, fluorescent tubes, etc. will be removed by a licensed waste contractor to a licensed disposal area. The mine will obtain all the correct documentation such as safe disposal certificates and a copy of the disposal site license. All salvageable material will be removed to either a steel merchant or other mine operations. Concrete will be removed to a depth of 1m below the surface. Building rubble (inert waste) could be used for backfilling of the quarries, however, the disposal of more than 25tons need a waste license excluding the disposal of such waste for the purposes of leveling which has been authorised by or under other legislation. This will be discussed with DMR prior to disposal.

Once all salvageable infrastructure has been removed and foundations are broken the plant area should be sloped to allow for free drainage to the east. There are also small stockpiles and walls from old return water dams that should be graded to fill unnatural depressions around the plant area. High walls should be broken and sloped to allow for vegetation growth.

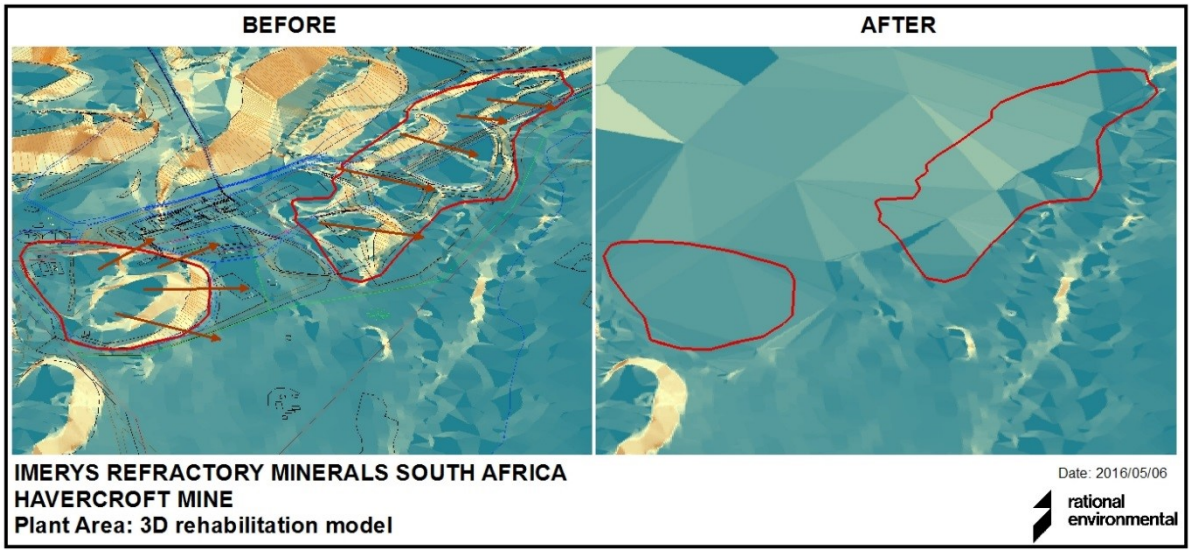


Figure 16: 3D Rehabilitation model of the plant area

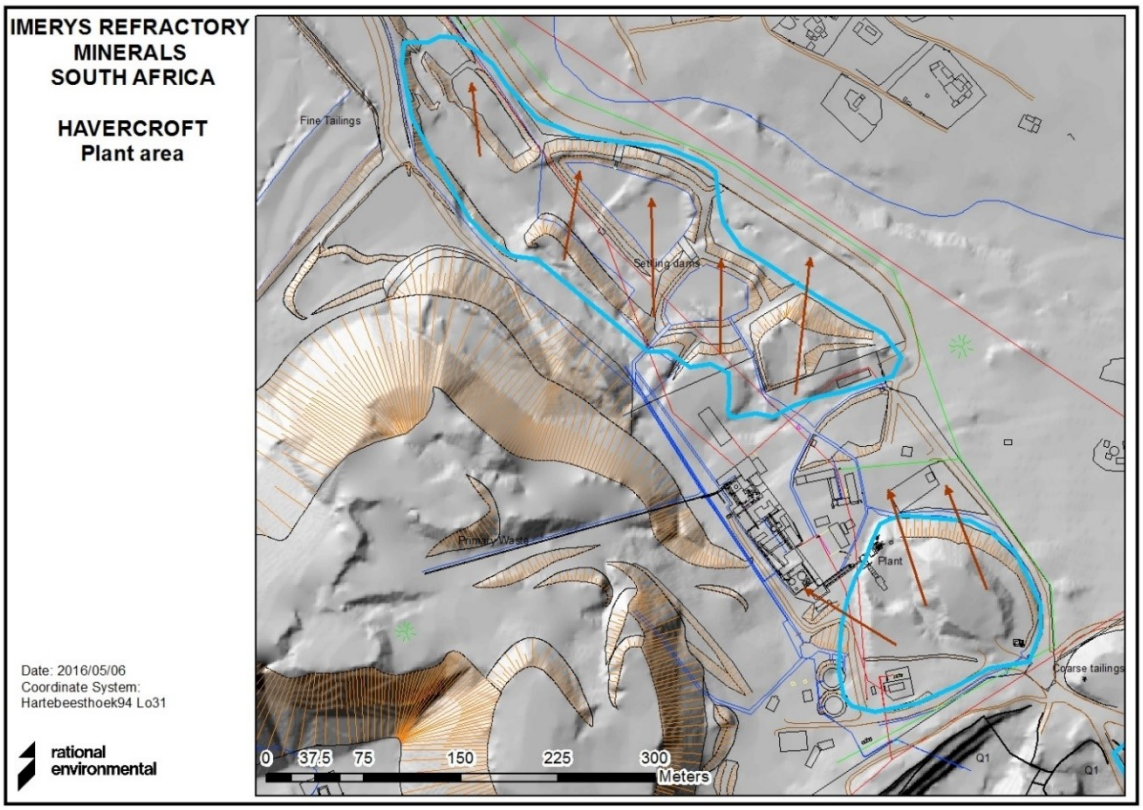


Figure 17: Rehabilitation of the plant area

3 Waste rock dump

On the western side is natural vegetation as well as a servitude for a high voltage power line. It is therefore proposed to slope most of the material to the north over the tailings facility and to the east towards the plant area.

Once the sloping is finalised it is also recommended to add contour paddocks along the side slopes of the WRD no more than 20m apart. Previous contours of 50m apart have shown erosion to form along the slope.

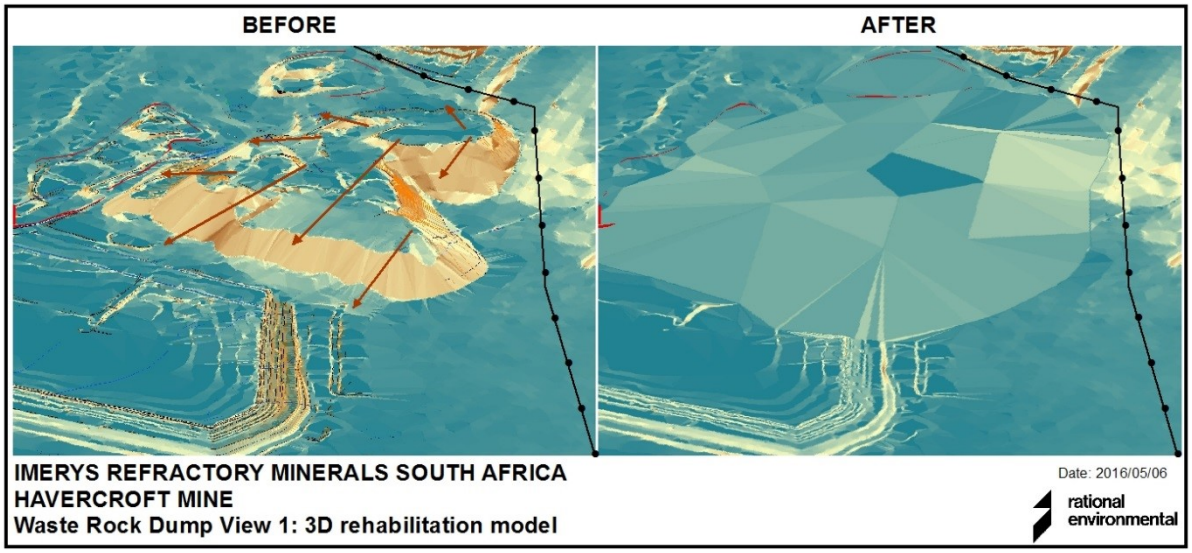


Figure 18: Waste rock dump view 1: 3D rehabilitation model

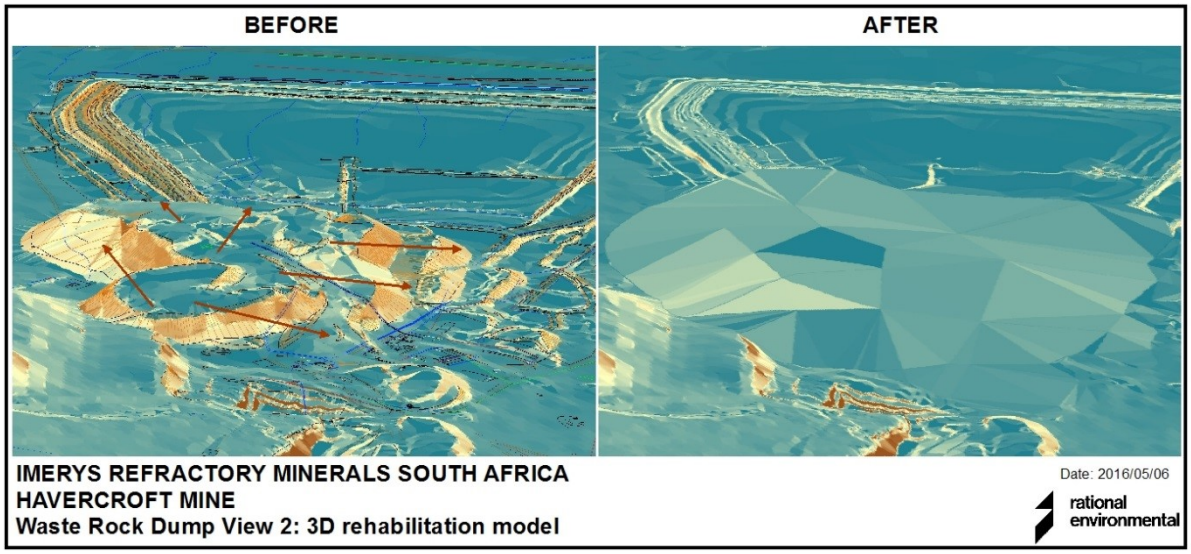


Figure 19: Waste rock dump view 2: 3D rehabilitation model

The 3d rehabilitation models indicate the sloping and moving of material required on the left, with the final result on the right. This model consists of only cut and fill and does not require any moving of material into or out of the site.

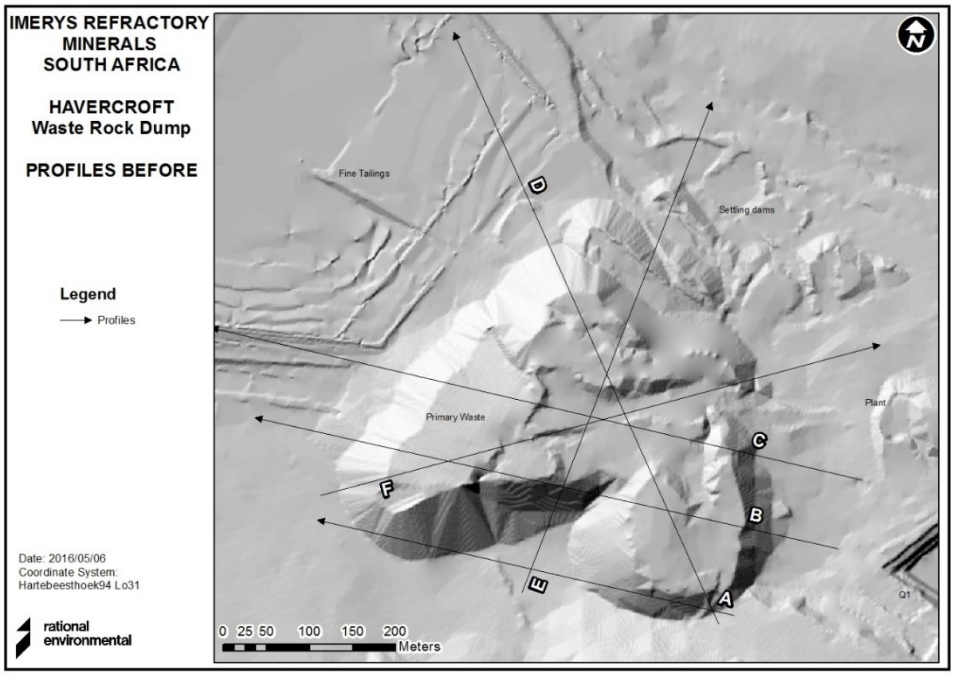


Figure 20: Waste rock dump profile before sloping

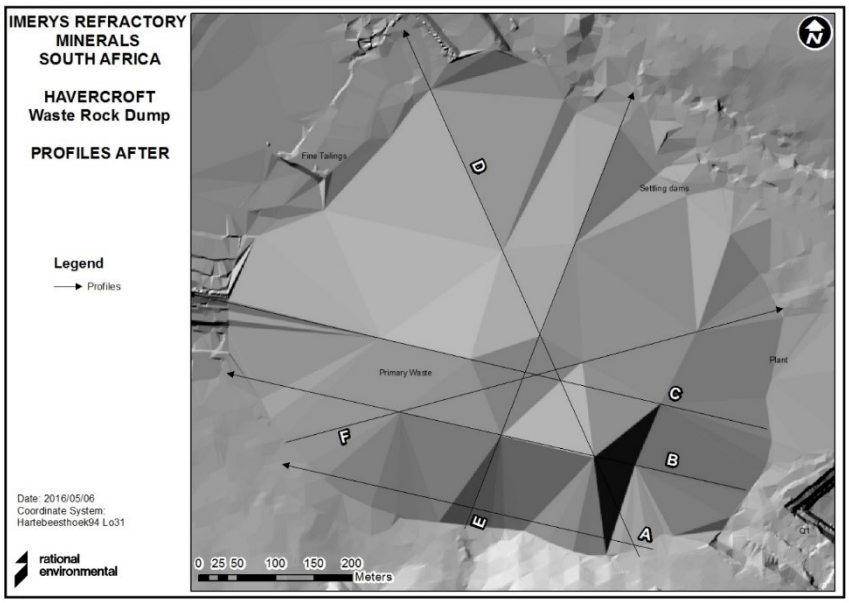


Figure 21: Waste rock dump profile after sloping

The cross-section profiles provide more detail on the required sloping and shape of the final WRD.

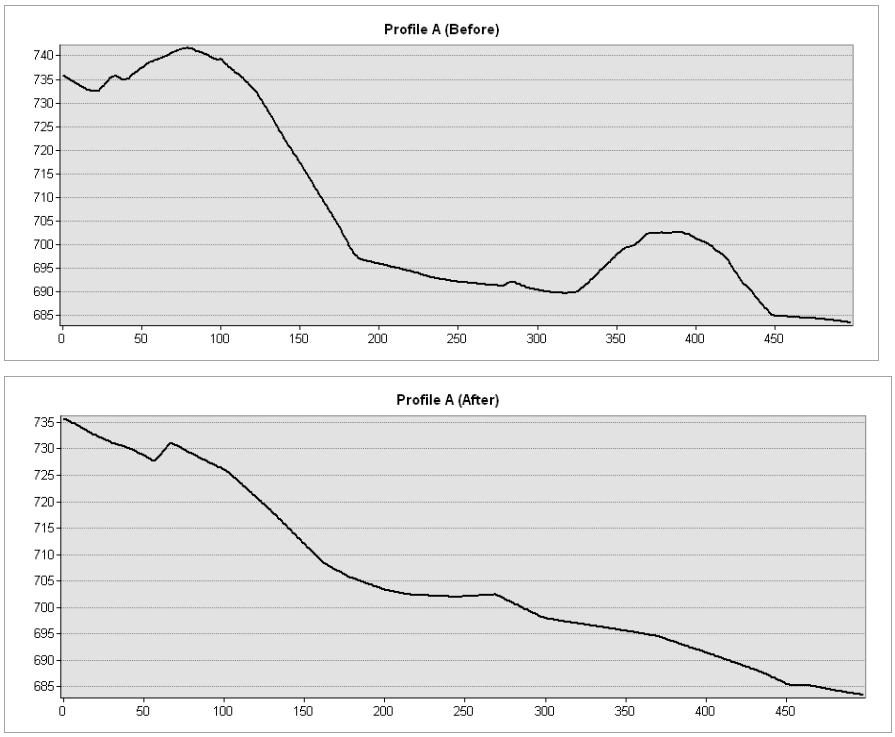


Figure 22: Profile A

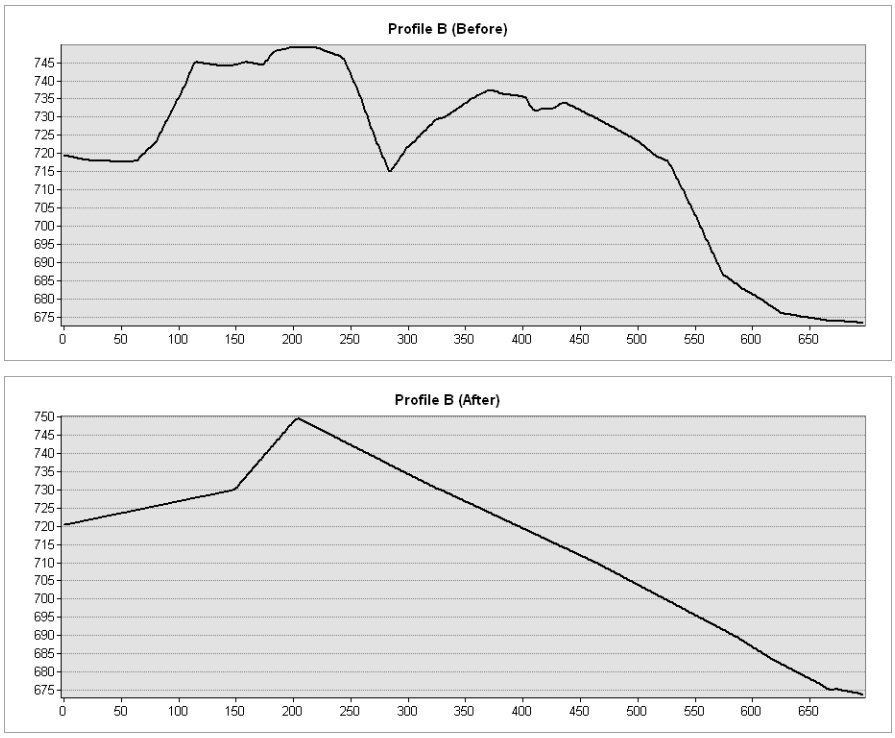


Figure 23: Profile B

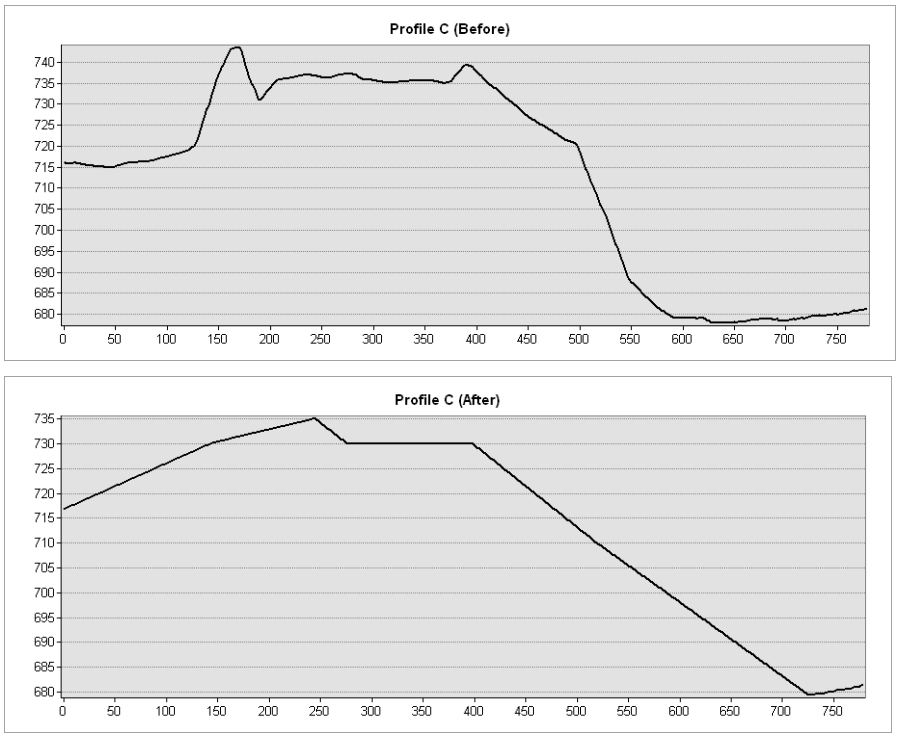


Figure 24: Profile C

Figure 25: Profile D

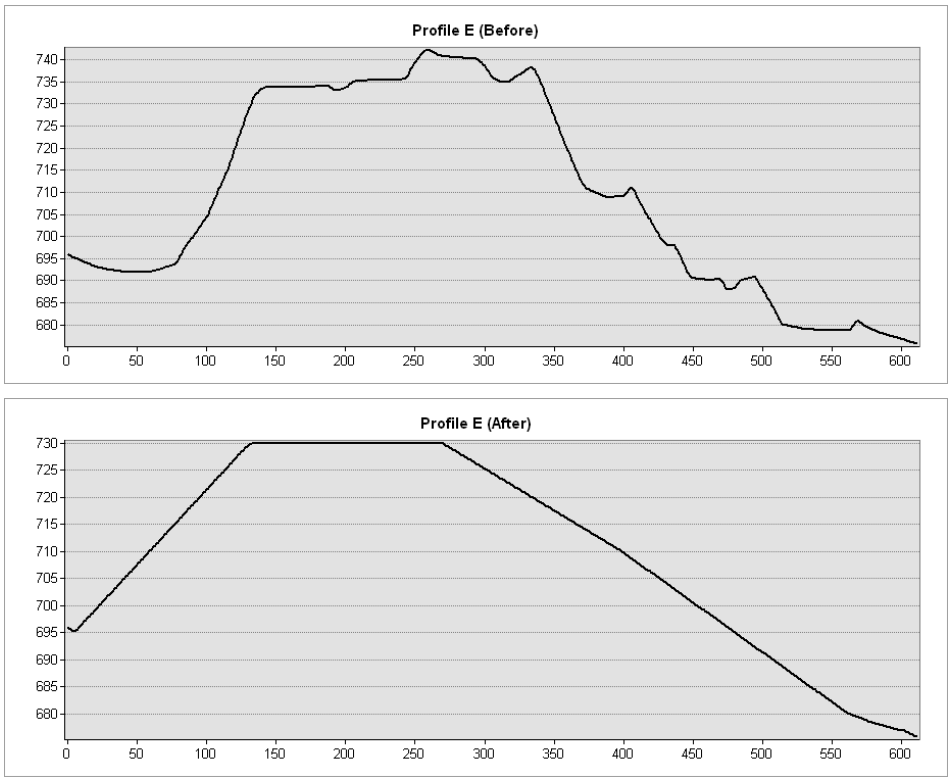


Figure 26: Profile E

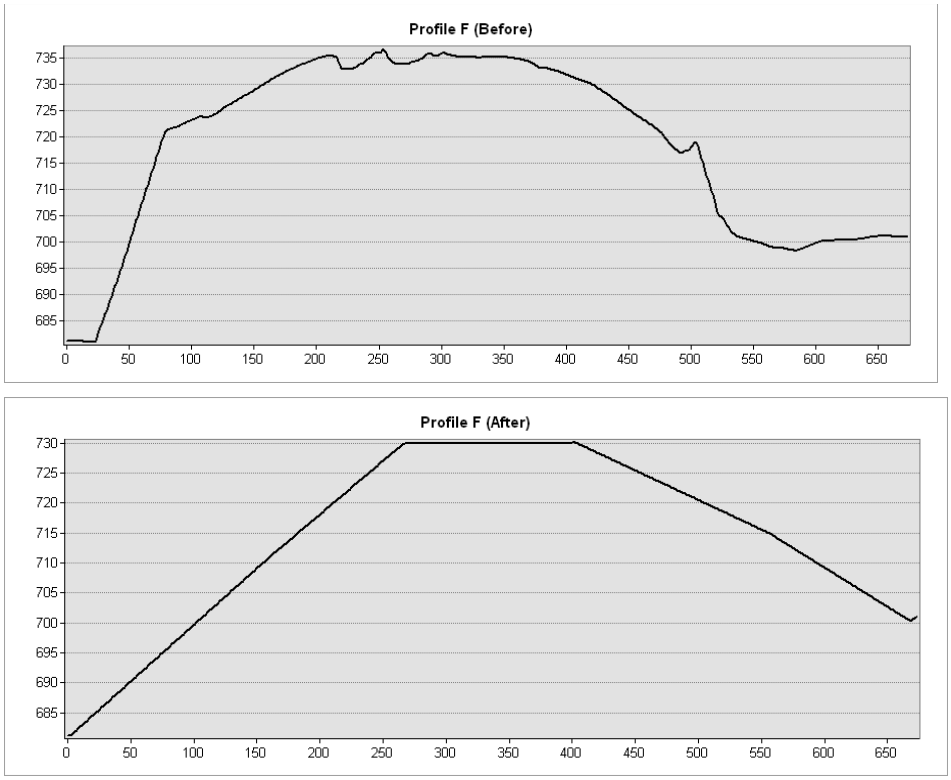


Figure 27: Profile F

4 Quarries

It is proposed to plant a thick row of euphorbias on the top of the high walls. This wil be done to prevent access of people and animals to these high walls.

Only the quarries where the need for earthworks has been identified are included in the description for sloping. Safeguarding of high walls are encouraged but has not been included in the modeling as there is a major safety concern to work above the high walls with machinery. All high walls have been modeled to remain in place due to this safety risk.

Quarry	Rehabilitation recommendation
Q1	Push remainder of OB opposite of high wall into the bottom of the quarry. Only light grading is required.
Q2	Push bottom OB stockpile into the quarry.
	Remove OB stockpile located within drainage line above the high wall to allow for free drainage into the quarry that will assist with vegetation growth.
Q3	General sloping for free drainage should be established. This area is also identified as a good location for a drinking hole. It is recommended to ensure that all slopes towards the water are safe and stable.
Q5	Break bench opposite of high wall. Potential traffic of locals and animals are expected to come from the east which would make this bench on the opposite side a potential safety risk.
Q6	Break lower benches that is easily reachable and push material to the bottom of the quarry.
Q11	Two OB stockpiles opposite of high wall should be pushed into the bottom of the quarry.
Q12	Push OB stockpile into quarry bottom.
Q13 & 14	Push OB stockpiles into quarry bottom.
Q15	OB stockpile should be brought back into the quarry. Note specifically not to push OB further down that may cause further disturbance and more difficult to move into the quarry.

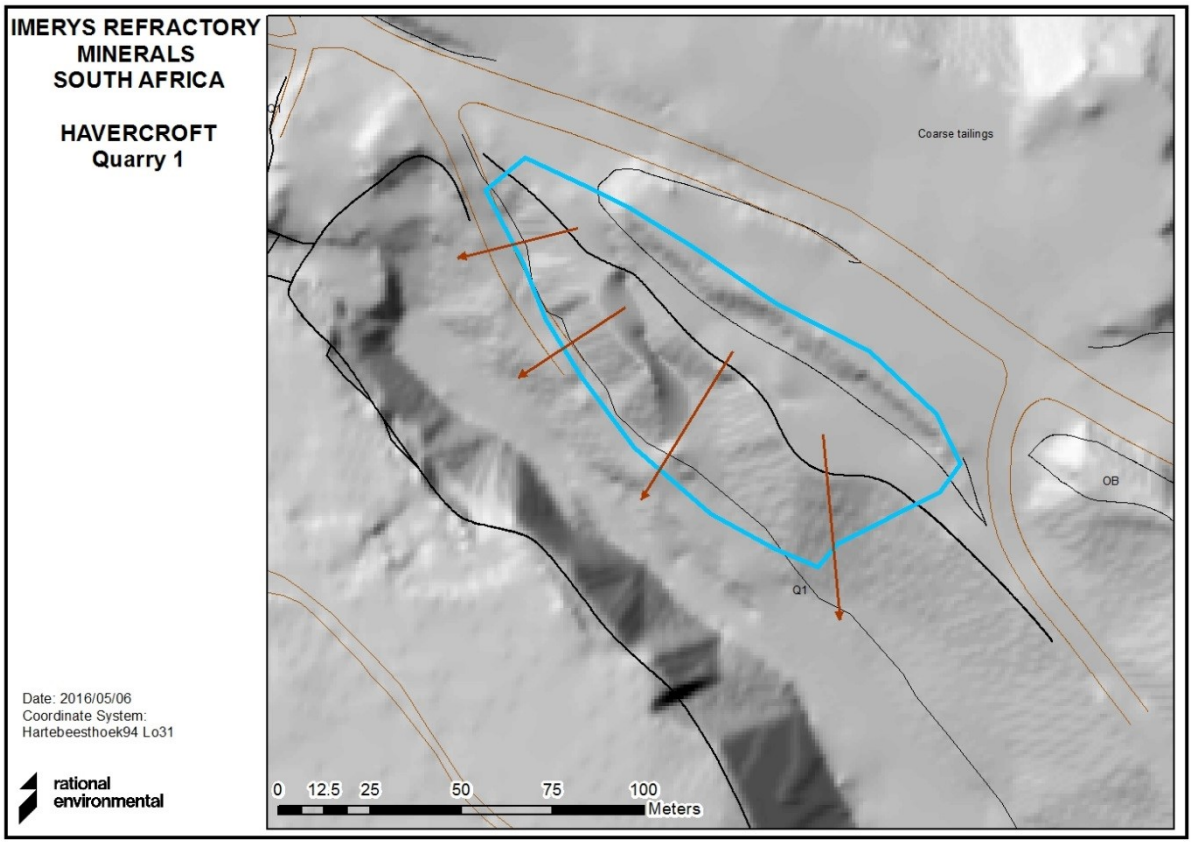


Figure 28: Sloping of Quarry 1

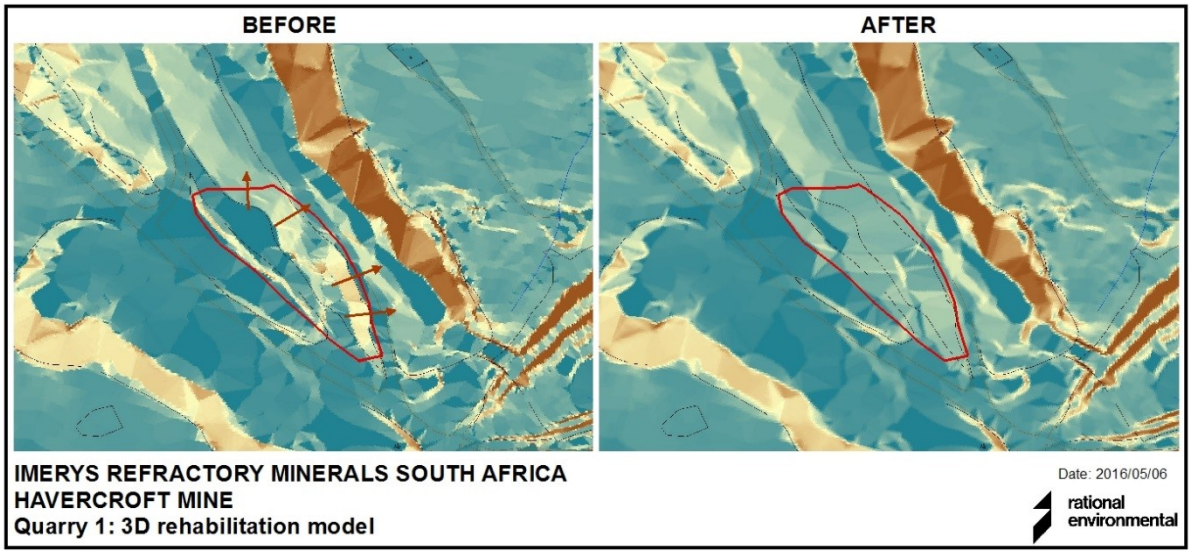


Figure 29: 3D rehabilitation model of Quarry 1

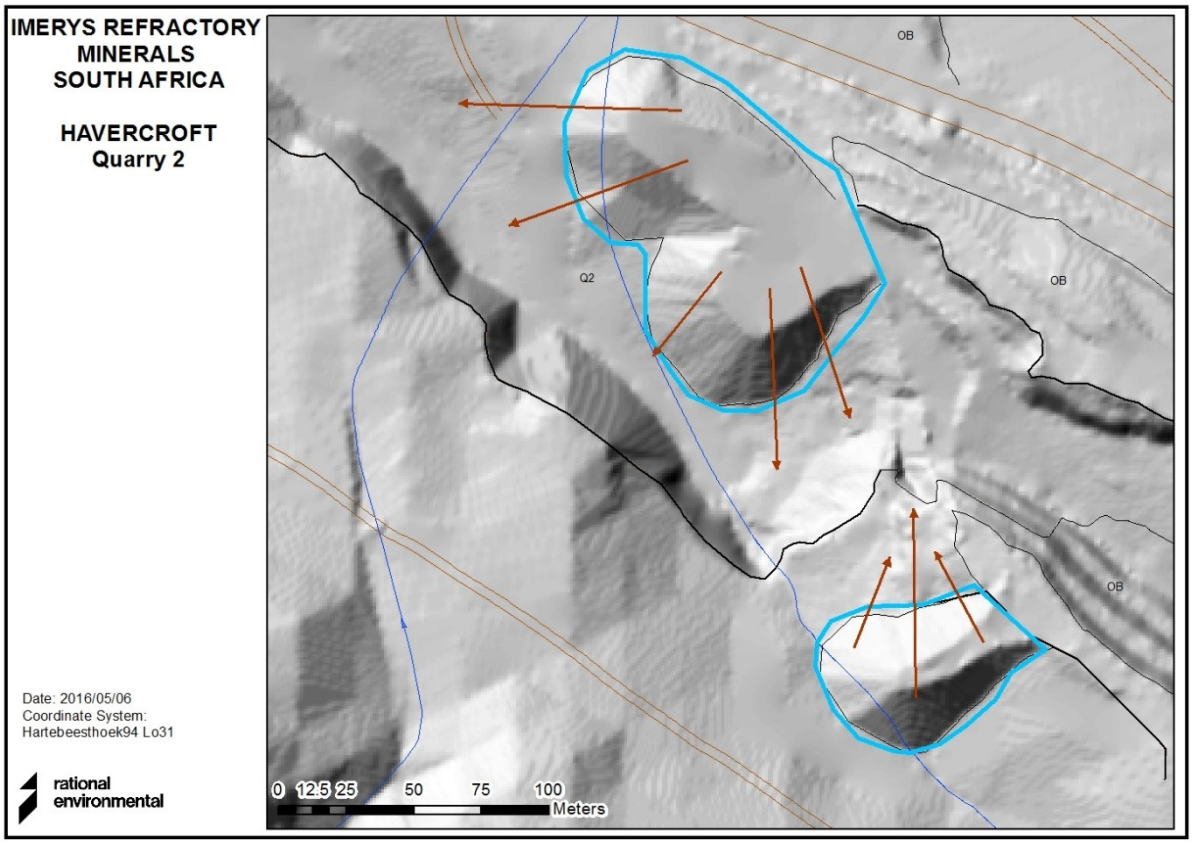


Figure 30: Sloping of Quarry 2

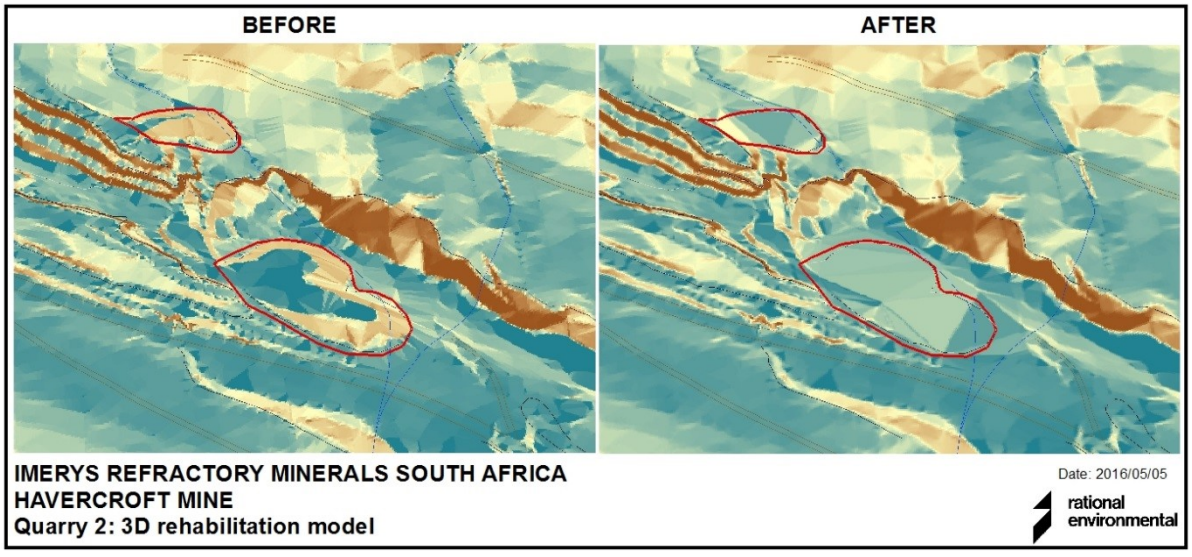


Figure 31: 3D rehabilitation model of Quarry 2

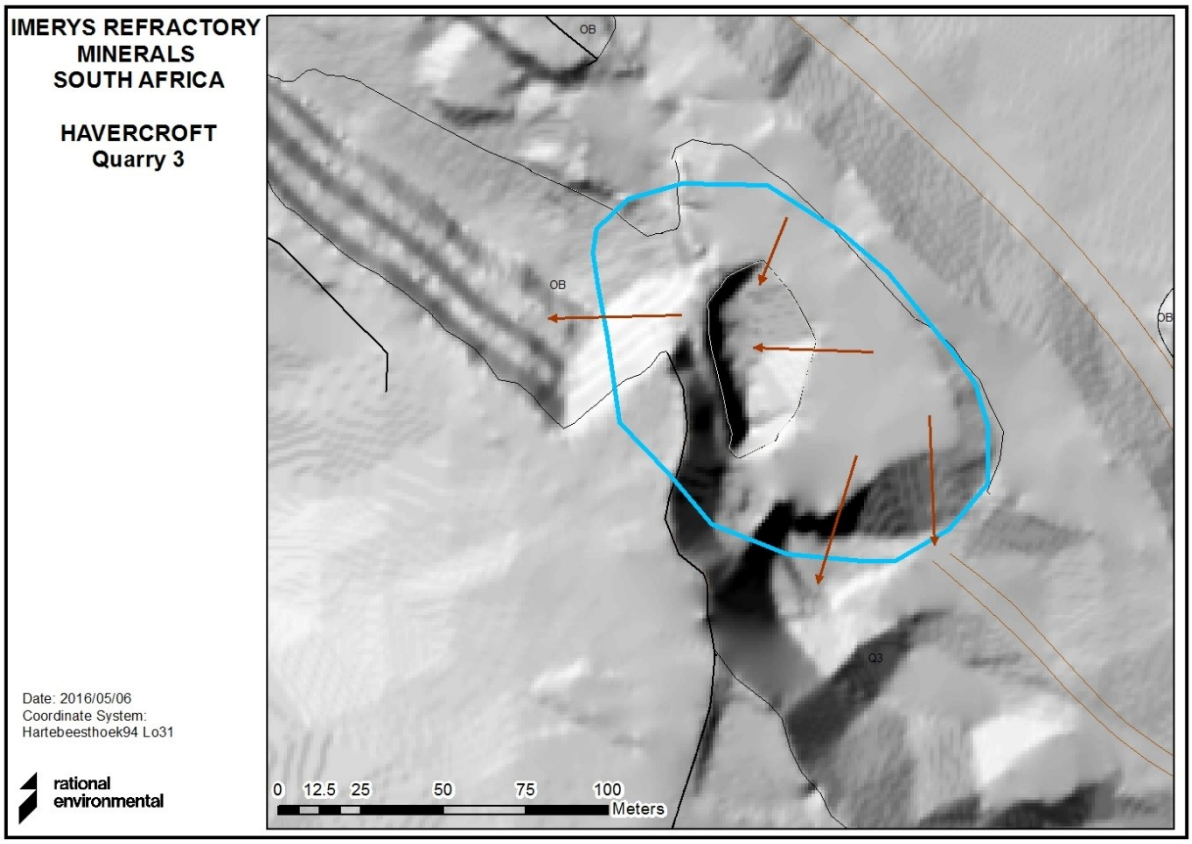


Figure 32: Sloping of Quarry 3

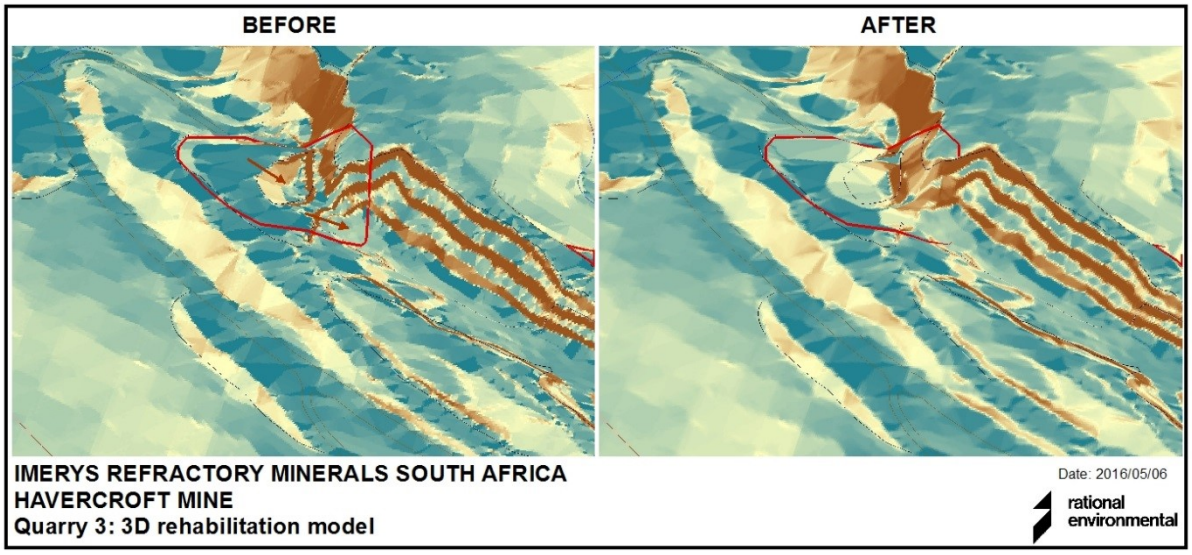


Figure 33: 3D rehabilitation model of Quarry 3

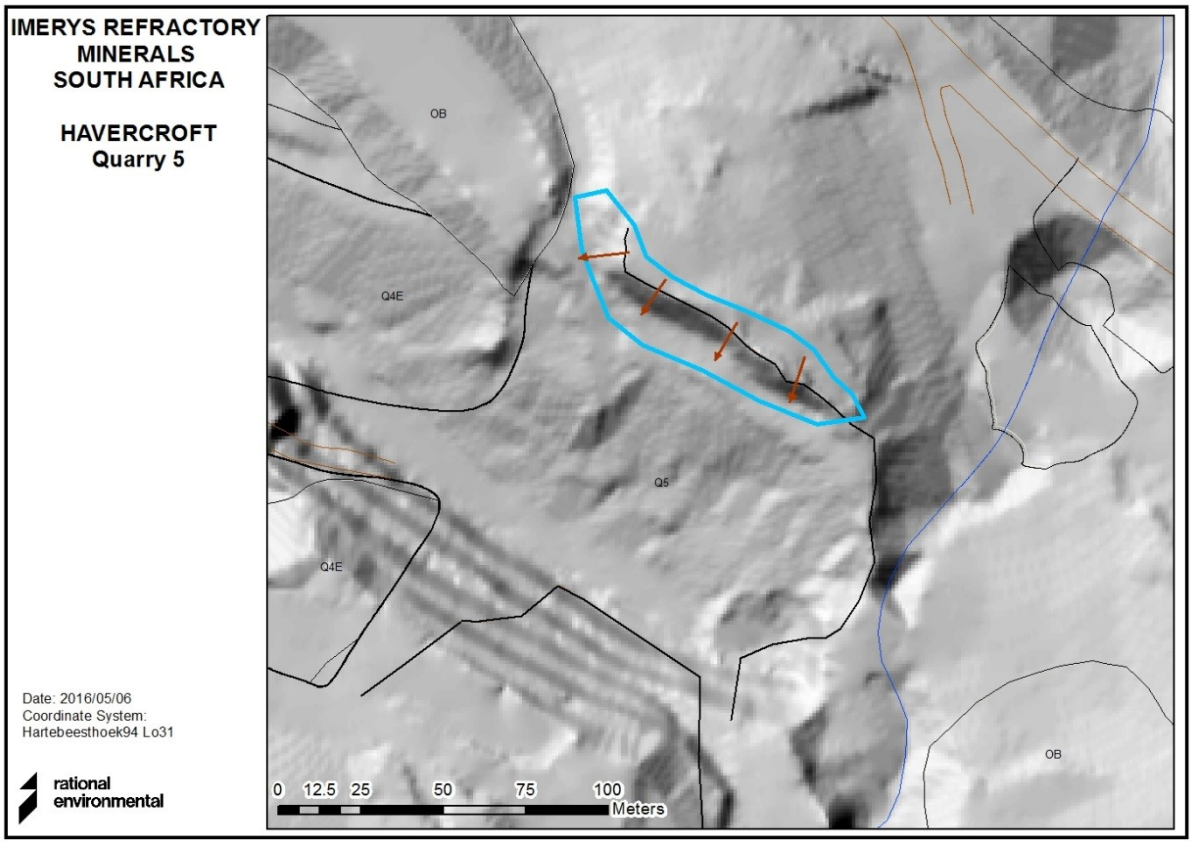


Figure 34: Sloping of Quarry 5

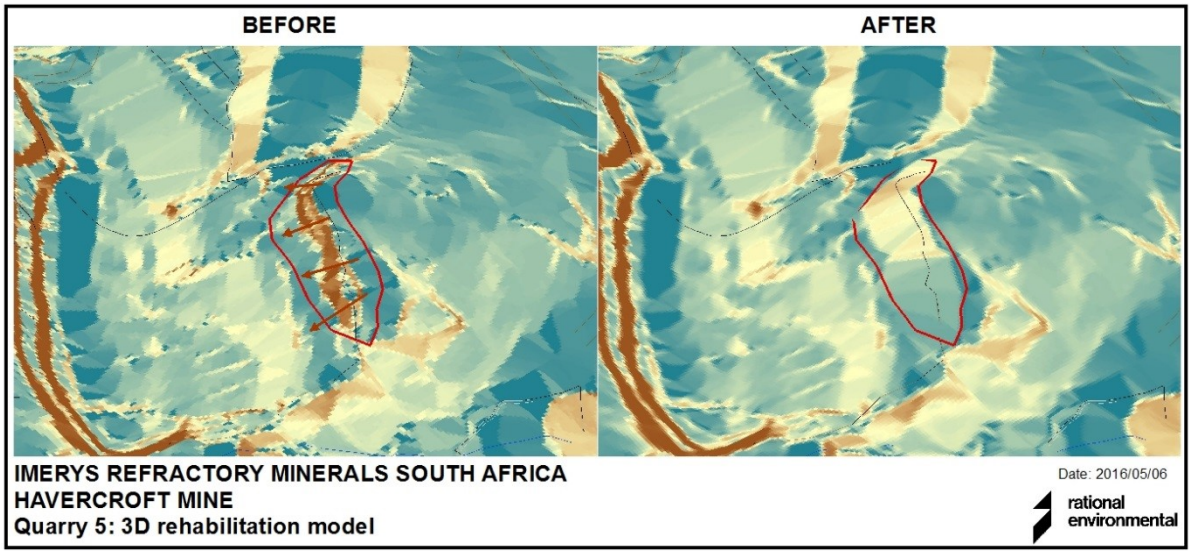


Figure 35: 3D rehabilitation model of Quarry 5

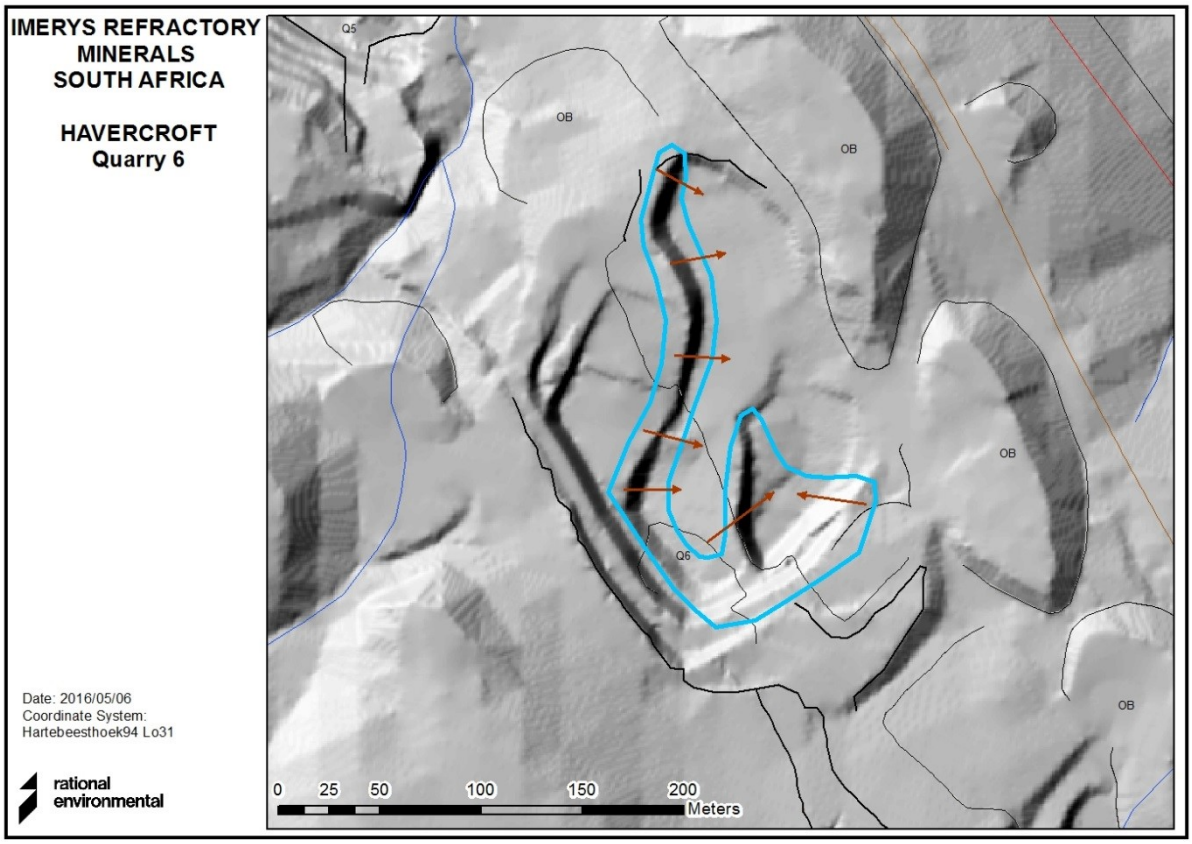


Figure 36: Sloping of Quarry 6

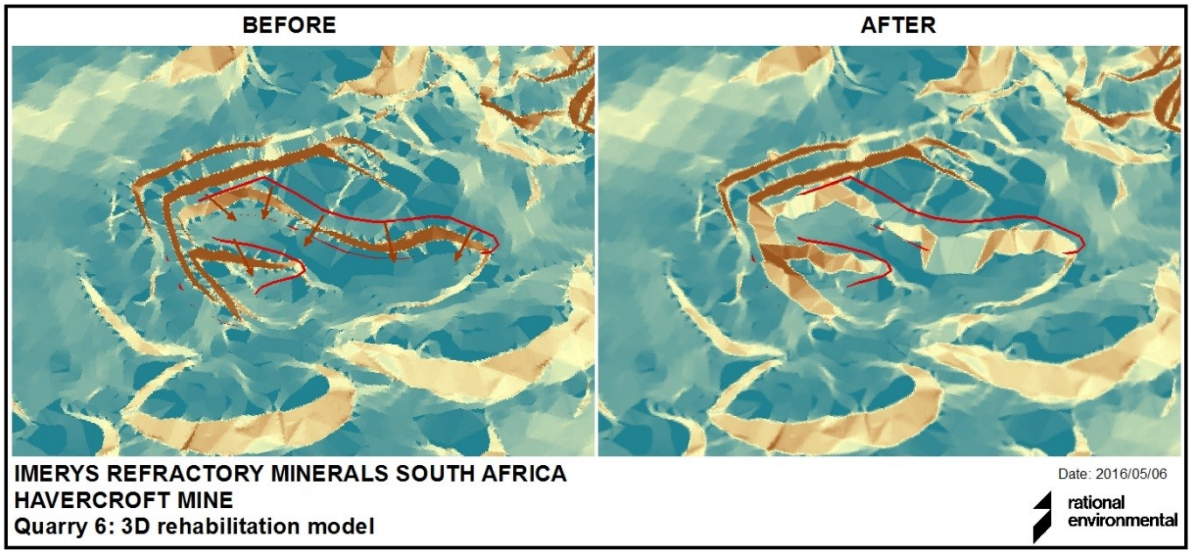


Figure 37: 3D rehabilitation model of Quarry 6

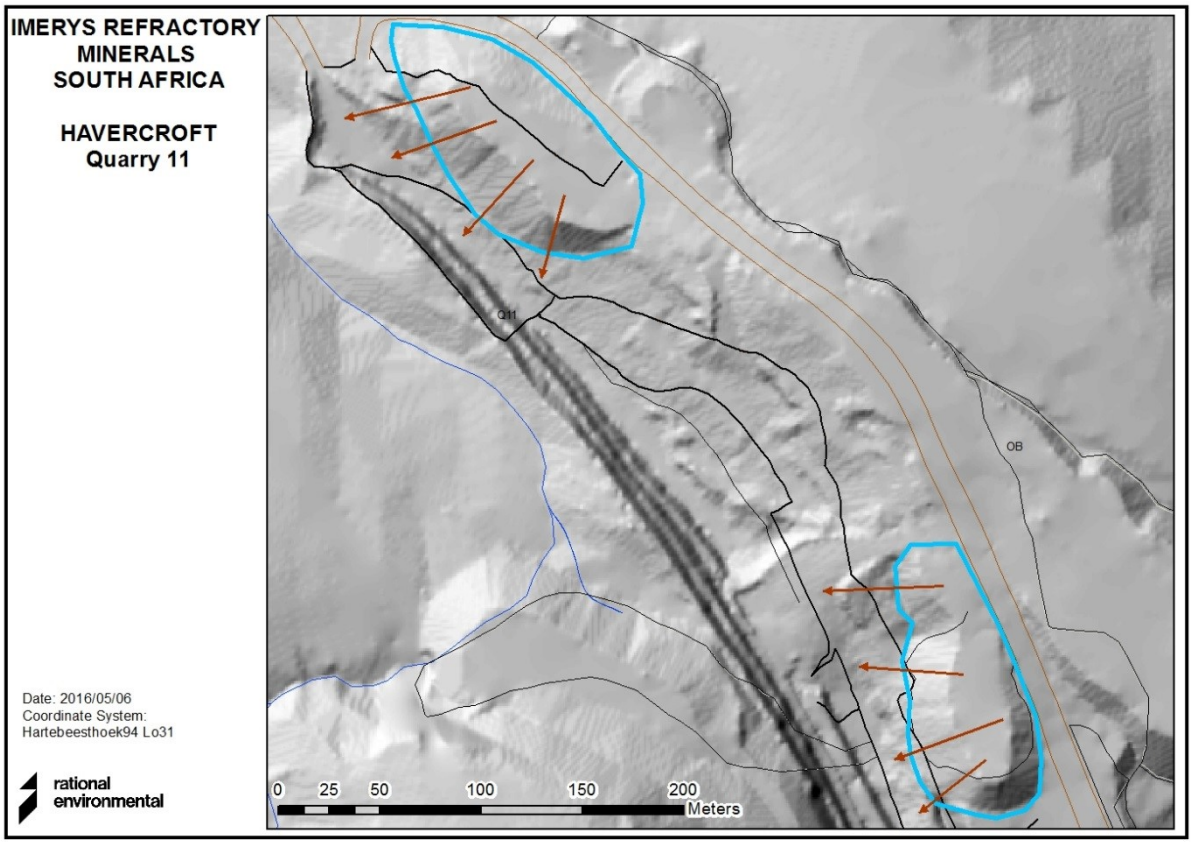


Figure 38: Sloping of Quarry 11

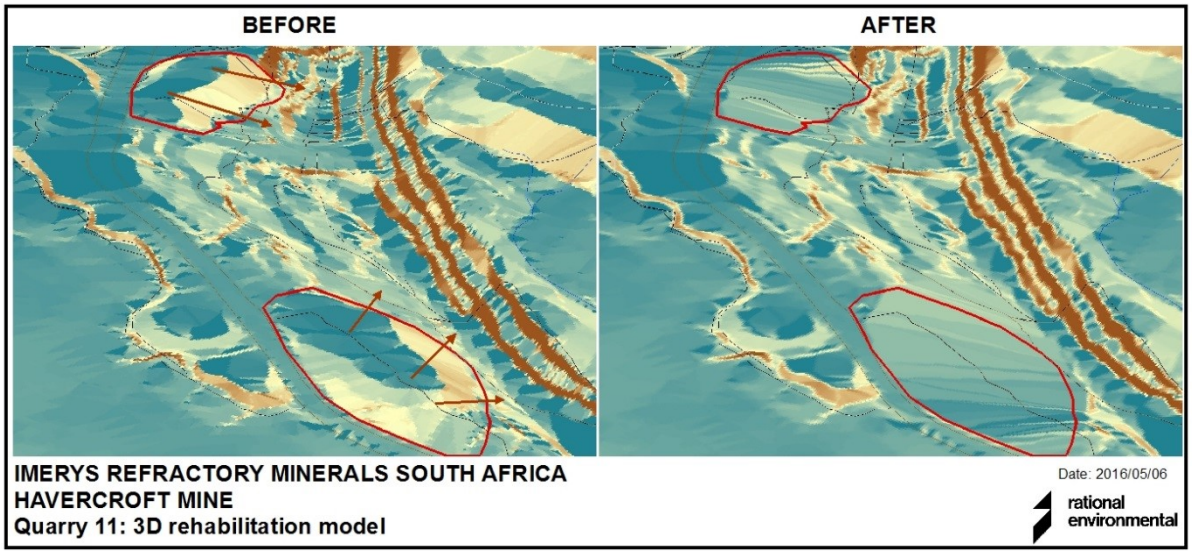


Figure 39: 3D rehabilitation model of Quarry 11

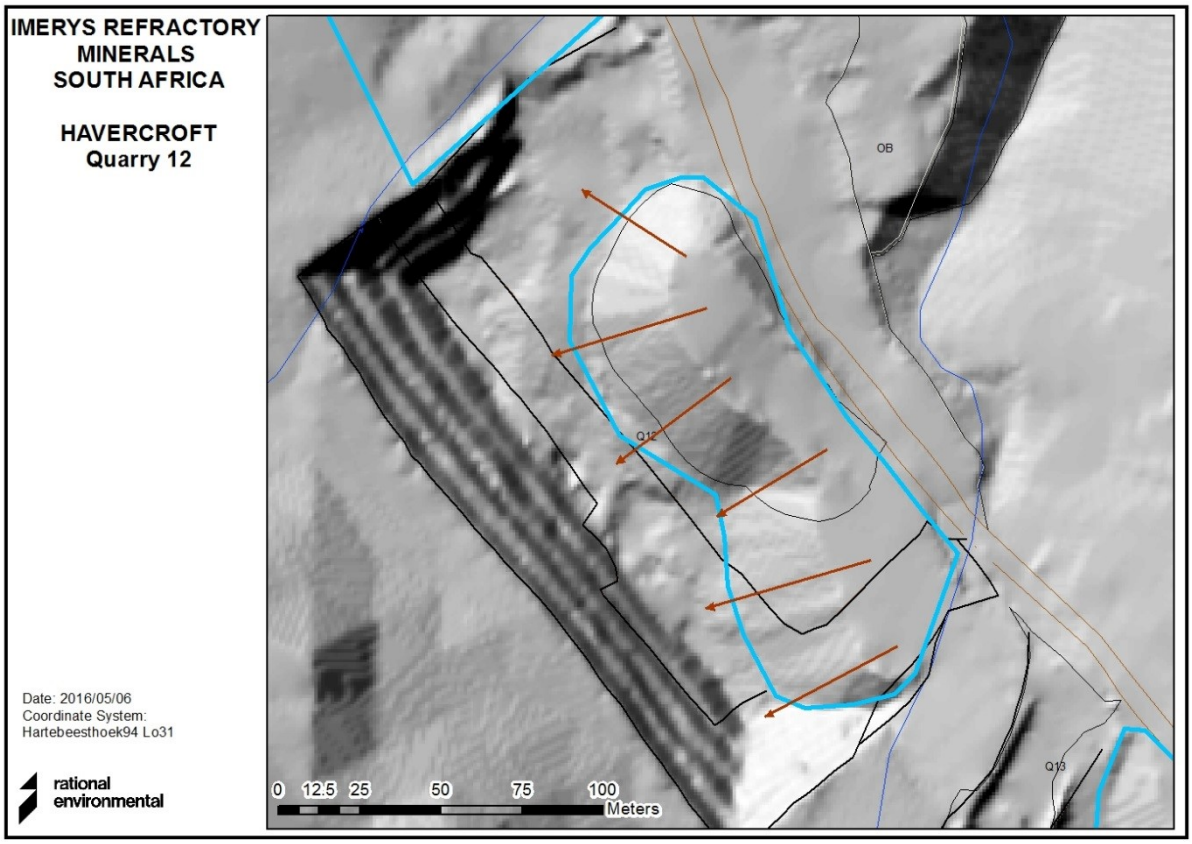


Figure 40: Sloping of Quarry 12

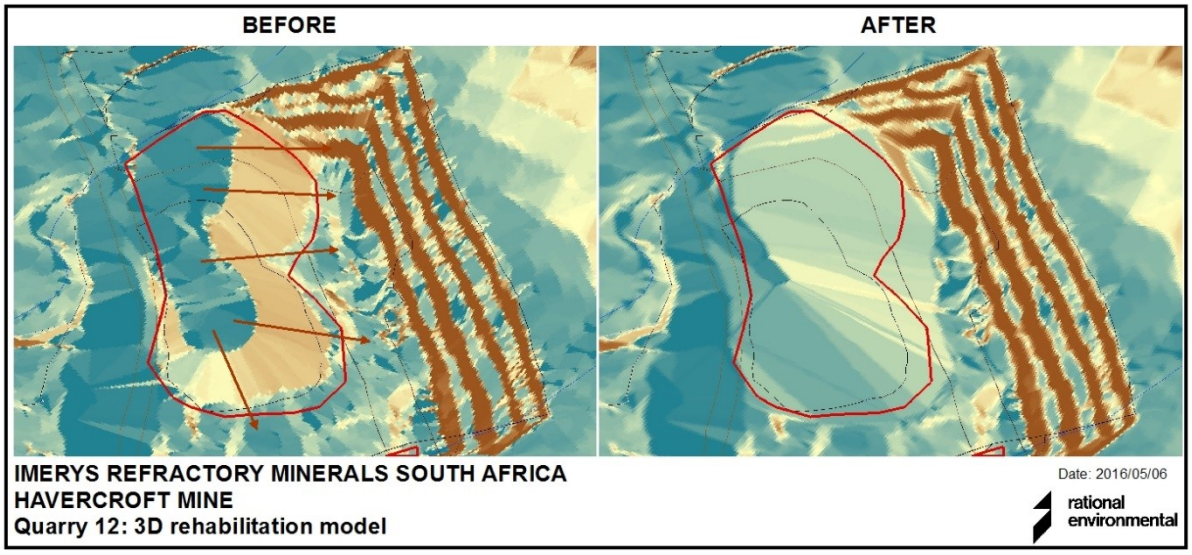


Figure 41: 3D rehabilitation model of Quarry 12

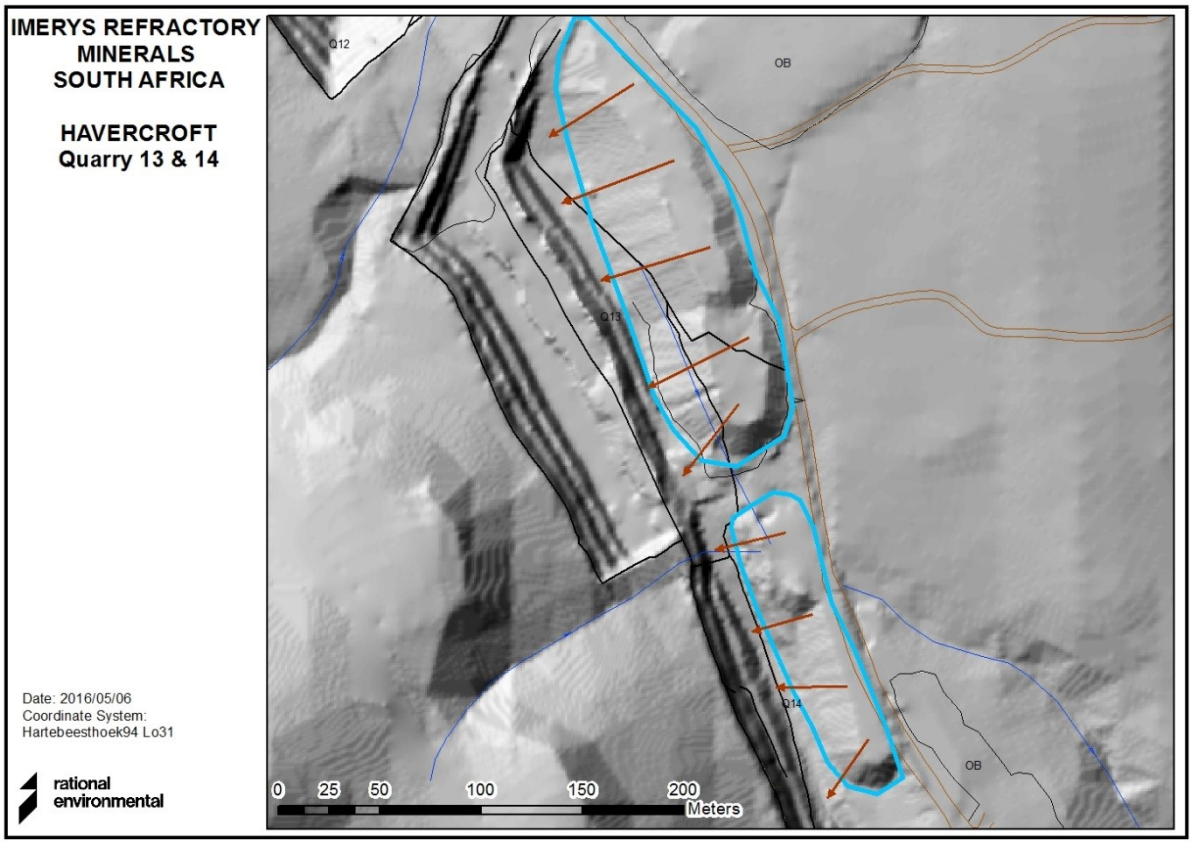


Figure 42: Sloping of Quarry 13 & 14

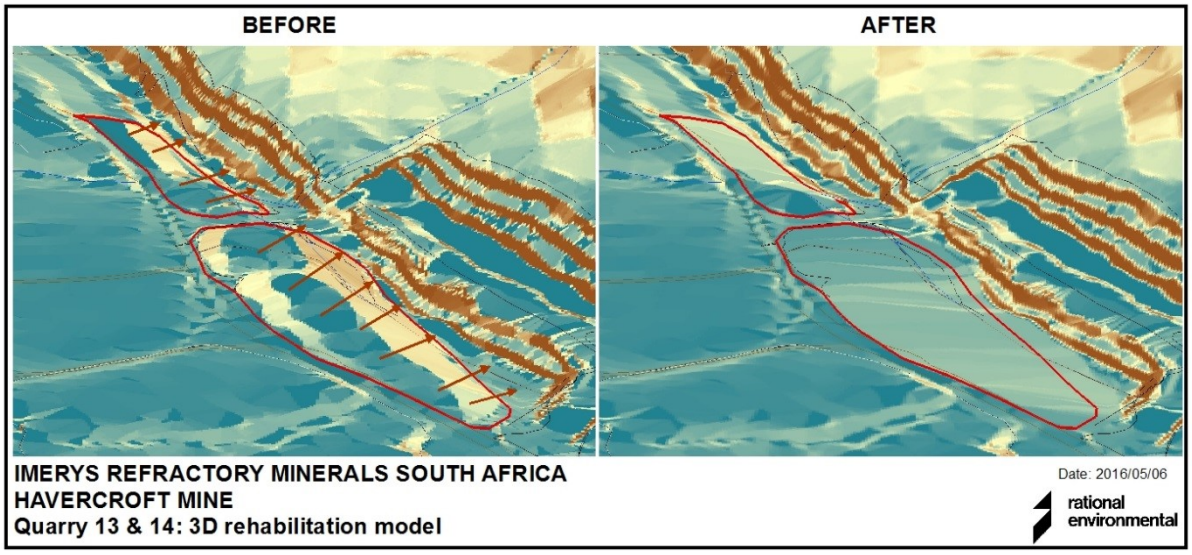


Figure 43: 3D rehabilitation model of Quarry 13 & 14

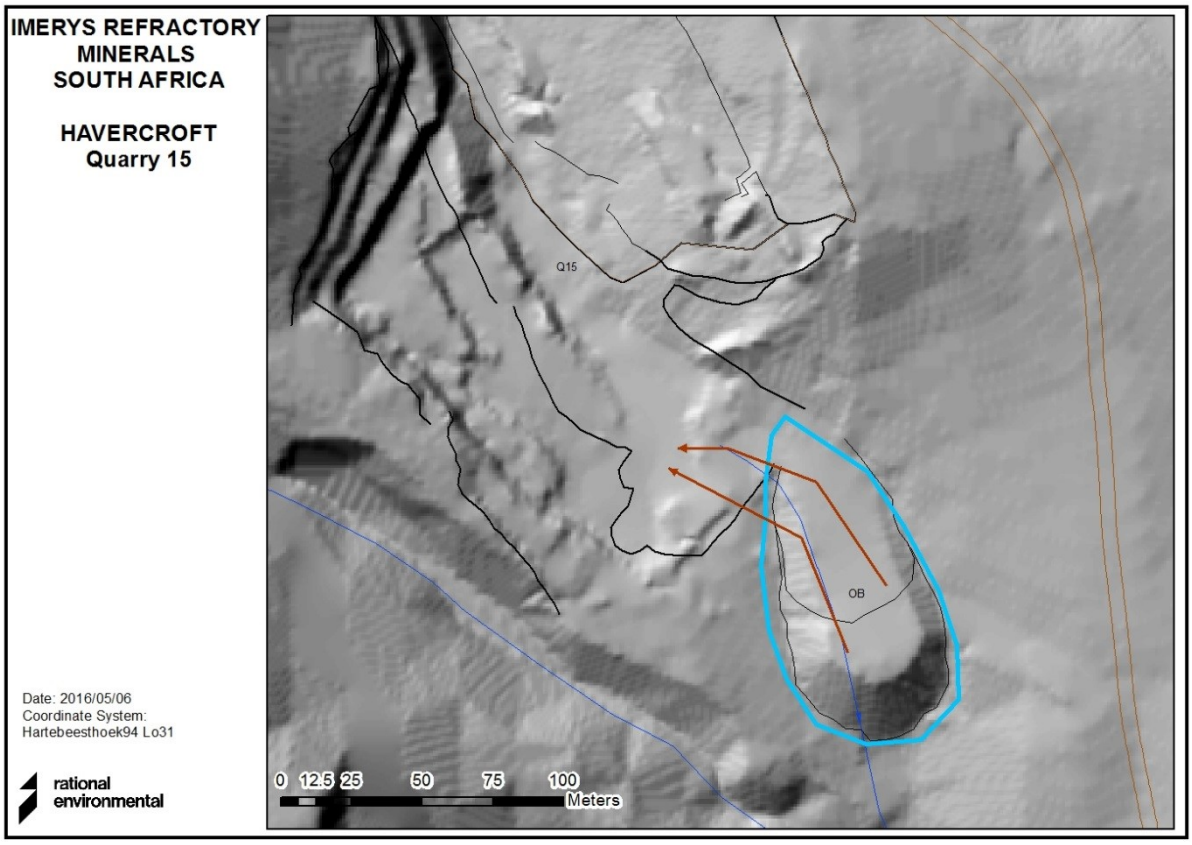


Figure 44: Sloping of Quarry 15

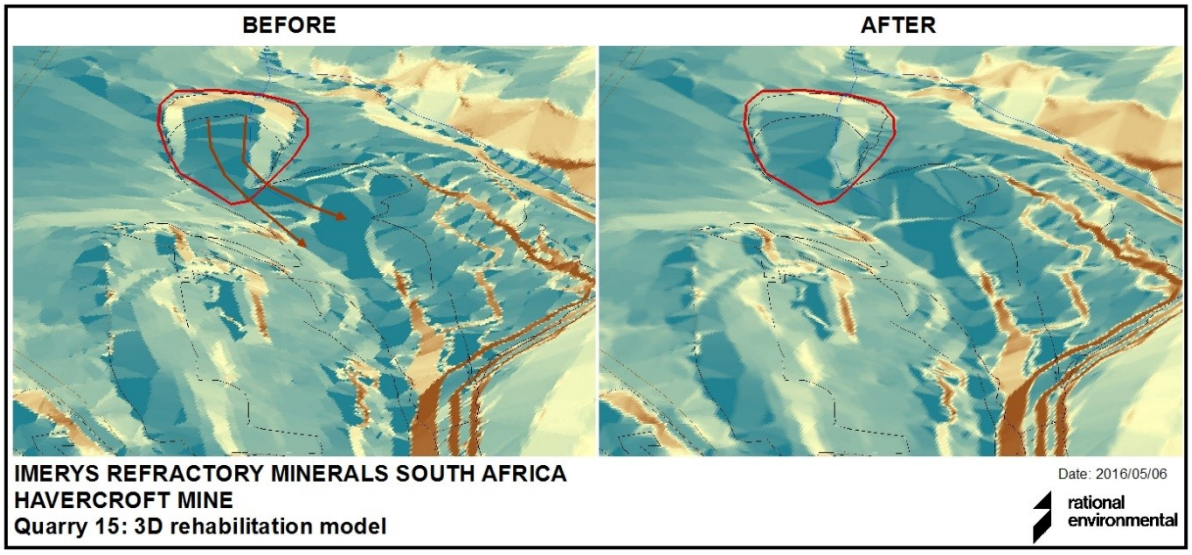


Figure 45: 3D rehabilitation model of Quarry 15

5 Primary and secondary access roads

Remove all hydrocarbon spillages and dispose as hazardous waste. Rip all roads. Ripping is done by using a dozer with one or two ripper tines. Ripping must penetrate through soil into the underlying overburden materials in order to ensure free drainage and to ensure root penetration.

6 Revegetation

6.1 Preparation for re-vegetation

6.1.1 Landform re-creation shaping

The following was extracted from the Guidelines for the Rehabilitation of Mined Land (Chamber of Mines of South Africa/Coaltech, 2007).

Once the earthworks are finished as per the Earthworks Report, the shaping of the area must take place. The three primary slope forms are concave, convex and rectilinear. The action of a bulldozer tends to produce convex or rectilinear slopes. **Concave slope** form is most stable, is least affected by erosion, and yields the least amount of sediment to streams. Convex slopes erode most rapidly, yield most sediment and tend to change shape fastest. Rectilinear slopes are intermediate in behaviour, although long rectilinear slopes can be severely eroded in a single heavy rain-storm (Schaefer et. al., 1979). Therefore, the mine must aim to create concave slopes as far as possible. Large stones/rocks should as far as possible be buried below the final level of graded spoil to permit ripping and scarifying operations

Erosion on newly rehabilitated slopes is always a major concern. The idea is to avoid the construction of drainage channels on the rehabilitated ground. However, this is frequently not the case and erosion control structures have to be inserted into the rehabilitated profile to control runoff water flow and minimise erosion. The eventual drainage pattern of a mined-out area will be a function of original topography, mining method, and regrading strategy. Contour systems and grassed waterways are anti-erosion measures designed to shorten the hydraulic length of slopes by intercepting overland flow (contour structure) and to conduct the latter to a safe discharge point (waterways). It should be emphasised that the two are complementary and that waterways must be provided if contour bank is installed. Refer to Figure 46 below for an illustration of two typical cross-sectional shapes of a channel. Another drainage structure that can be used is a toe berm. This is a berm or bench of compacted and vegetated soil constructed at the toe of the outer slope for reducing the velocity of run-off and trapping sediment. It is useful to control excessive erosion until the slope has been stabilised by vegetation. The width of the berm should be 1m for every 10m of slope length. The bench section of the berm should be sloped a minimum of 1% and a maximum of 3% away from the slope and its outer slope should be 1v:2h or flatter. It should be compacted and vegetated immediately. Refer to Figure 47 for an illustration of three different toe berms.

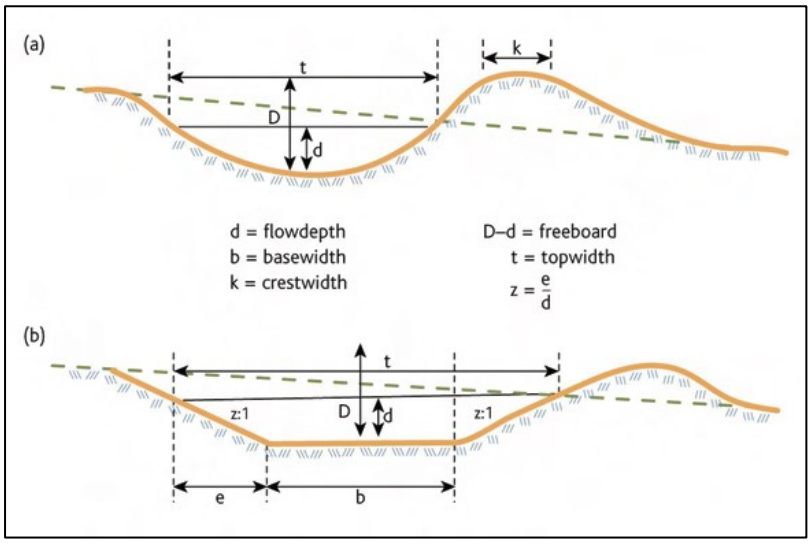


Figure 46: Two typical cross-sectional shapes of a channel

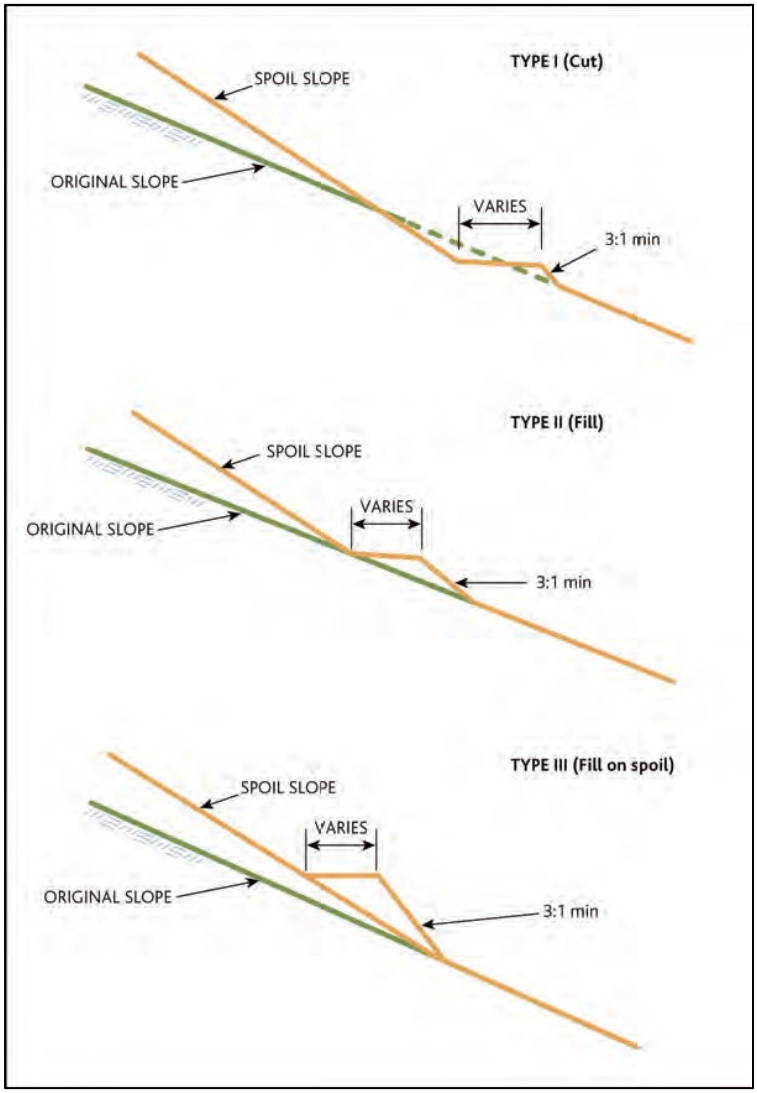


Figure 47: Sections illustrating toe berm construction (Reclamation Manual for Coal Surface Mining, State of Virginia, USA)

6.1.2 Soil replacement

The following was extracted from the Guidelines for the Rehabilitation of Mined Land (Chamber of Mines of South Africa/Coaltech, 2007).

Soil compaction is caused by the techniques and equipment used in the stripping, transport, stockpiling and replacement of soil materials during the mining and rehabilitation processes. Additional compaction occurs during the leveling of the replaced soil and during its preparation for planting. Apart from compaction of the replaced soil, compaction also occurs in the overburden materials that are handled and thus disturbed during the mining process. Once the final landform has been created, soil replacement can begin. Compaction should be minimised by use of appropriate equipment and replacing Soils to the greatest possible thickness in single lifts. Soils should be moved when dry to minimise compaction. If they must be moved when wet, shovel and truck should be used as bowl scrapers create massive compaction when moving wet soils. Minimise compaction during smoothing of replaced soils by using dozers rather than graders as tracks exert a lower bearing pressure and therefore compact less than wheeled systems. Following placement, all soils should be ripped to full rooting depth. Where natural revegetation is not possible, the soils should be tilled to produce a seedbed suitable for the plant species selected for seeding. Break and loosen the soil crust with hand tools e.g. garden rakes for broadcast sowing or break and loosen the soil crust with sharp-pointed hoes or forks for row sowing.

This section was compiled using the information from the Rehabilitation Recommendations after Alien Plant Control' (Campbell, 2001).

Fertilizers necessary for the re-establishment of vegetation will be determined as necessary. It is very important to note that during the application, the dry fertilizer may not come into contact with the grass seed. To ensure this, the seed must be covered with soil before the application of fertilizer. Further, please note, the application should take place before or after good rains. Steps to be followed:

1. Broadcast the fertilizers over the sown area.
2. If the planting method is using sods, the fertilizer should be placed in holes.
3. If the planting method is using runners or tufts, the fertilizer should be placed in furrows.
4. Divide the fertilizer into two equal parts and use each portion to cover the entire area. Please remember, fertilizers should not come into direct contact with the seeds.

Phosphorous is important in root development and seedling establishment; the application may be needed. Nitrogen is needed in the largest amounts by grass species. The following reduce the amount of nitrogen in the soil:

1. Soils with low organic carbon content as with soils occurring on site;
2. Leached and eroded soils; and
3. Intense burns.

Potassium increases the cold tolerance of plants. The presence of wood ash after a fire adds some potassium to the soil in the form of potash. Manure supplies all of the three above minerals / organic matter to the soils. Organic matters improve physical attributes of soil including water infiltration, water holding capacity, aeration, tilth, a decrease in soil compaction, and chemical attributes such as cation exchange, etc. Poultry manure is three times higher in nitrogen and phosphorous than cattle manure. The following should be done in regards to applying manure to soil:

1. Spread and work the manure into the soil to prevent loss of nitrogen to the air.
2. For cattle manure, 8t/ha for grass establishment must be applied.
3. For chicken manure, 2t/ha for grass establishment must be applied.
4. Chicken litter should be thinly spread. A high concentration can damage or even kill germinating grass seedlings.
5. Store manure in heaps and only for short periods to prevent loss of nutrients.
6. As manure may lead to bad odors, it is advised to use commercial fertilizers as well.

Organic matter is most important for the amelioration of the topsoil. Organic material must be applied to the topsoil as well as worked into the entire depth of the rooting zone.

6.2 Re-vegetation and alien control

When considering which vegetation to use in rehabilitation, it is important to consider the natural vegetation of the site before mining (if known) and the natural and/or indigenous vegetation of the surrounding properties. This will guide the selection of vegetation species to ensure that vegetation used in rehabilitation is similar to that of the original vegetation and/or similar to surrounding properties. By using species indigenous to the area in which the mine is located, it will also facilitate the creation of habitats similar to those that should occur on the mining site. This will facilitate the re-colonization of the site by indigenous fauna.

6.2.1 Veld types

Veld types were delineated per Mucina & Rutherford's "The Vegetation of South Africa, Lesotho and Swaziland". The area is situated within the Sekhukhune Plains Bushveld vegetation unit. This vegetation type includes specific species compositions and vegetation structure. Seeds obtained from the mining area can be used for revegetation of the slimes dam as well as the quarries, however, please note, it is unclear whether these seeds will germinate and whether these seeds are all natural vegetation species. It is therefore suggested that seeds are planted using either a rehabilitation (revegetation) specialist or the species described below.

6.2.2 Grass species

The selection of grass species to be used in the rehabilitation of the mining area has been compiled using the information from Mucina & Rutherford's "The Vegetation of South Africa, Lesotho and

Swaziland' and the Grab-a-Grass Dial provided by the ARC with the supporting document 'Rehabilitation Recommendations after Alien Plant Control' (Campbell, 2001). This dial provides guidance with regards to the selection of grass species based on the characteristics of the grass species, the conditions in which they would be planted and the purpose of the vegetation cover (in this case for soil stability and soil cover). Per Mucina & Rutherford, these vegetation types include grass cover; therefore, rehabilitation will focus on the establishment of grass cover, with the species selected being determined by several factors. Based on the information provided on the Grab-a-Grass Dial, selection criteria have been identified for use in the selection of grass species. The list provided below gives the selection criteria.

1. The first step is to decide on the final land use of the area. This includes the type of soil-binding the grass provides.
2. It is important to know how easily the grass can establish together with the lifespan of the grass, whether it is annual or perennial grass species. This may enhance the establishment of a grass species and help reduce the invasiveness of a grass species.
3. The third step is to consider whether the grass is indigenous and the invasiveness of non-indigenous grasses.
4. The climatic conditions of the site
    I. What is the minimum MAR needed for successful grass establishment?
    II. Is the grass tolerant to drought?
    III. Is the grass tolerant to frost?
5. Soil types where vegetation will be planted.
    I. What type of soil fertility is needed for the grass to grow?
    II. What type of texture is the soil?
    III. Is the grass tolerant to waterlogging?
6. What type of planting method should be used?
7. What is the planting time of the grass species?

The grass species suitable for use in rehabilitation in this area and the characteristics of each species have been extracted from the reference material (the Grab-a-Grass Dial) and presented in Table 33. Commercial grasses are commercially available species. Veld grasses are not usually commercially available and are harvested from the veld. Therefore, only small amounts are available. Veld seeds are also usually dormant that requires a period of after-ripening or has a low percentage viability. These grasses are more difficult to establish. It is also important to note that in the veld, grasses do not occur isolated, but are mixed with other seeds. To reduce the chances of mixing the selected seeds with other seeds, choose patches that are dominated by the chosen grass for seeds. All grass seeds bought should be accompanied by a certificate. Livestock should be excluded from rehabilitation site as far as possible.

<u>End land use aims</u>

It is necessary to decide what the end land use will be after rehabilitation. The end land-use has been identified as grazing. At present, the aim is to control soil erosion and obtain a vegetation cover. For the controlling of soil erosion, creepers are better than tufts, however, creepers are usually invasive. *Urochloa mosambicensis* was identified as a creeper to be used and this plant has a low invasiveness. Species that establish easily are *Panicum maximum* and *Urochloa mosambicensis*. *Cenchrus ciliaris, Panicum maximum,* and *Urochloa mosambicensis* have a high grazing value. These grasses will be suitable for grazing as part of end land use. *Enneapogon cenchroides* has a low grazing value and should be used on an area such as the Slimes Dam to prevent grazing as much as possible.

Tolerance to local climate

The mean monthly rainfall of the area is 559mm, which is higher than that of the surrounding area because of the microclimate (topography and aspect) (approved EMP, 1999). *Enneapogon cenchroides* might be affected by the amount of rainfall. As South Africa is prone to drought and the site is situated within a drought-prone area, the ability of selected species to endure drought periods is very important. All species can tolerate drought, except *Panicum maximum* which can tolerate drought on a medium level.

Tolerance to soil characteristics

Topsoil is minimal and in many areas absent. Topsoil that does occur will have low soil fertility. *Cenchrus ciliaris, Enneapogon cenchroides, and Cenchrus ciliaris & Enneapogon cenchroides* mix can grow on soil with low soil fertility. Soils are mostly stony, *Enneapogon cenchroides* and *Cenchrus ciliaris* & *Enneapogon cenchroides* mix can grow in this texture. None of these species can easily grow in water-logged areas. This might pose a problem in some of the quarries if the overburden being sloped becomes waterlogged. The quarries might only have a stony substrate with minimal to no topsoil.

Indigenous and invasiveness

All grasses are indigenous with low invasive status except *Panicum maximum* with medium invasive status.

Seed harvesting of veld grasses

The following is extracted from Agri-Facts (Brooks et al., nd).

Grasses need 20-30 days after flowering for seeds to properly mature. This will vary because the period of flowering and seed development lasts from several days to two weeks. Thus, seed heads emerge at different times, which cause uneven ripening. Hot, dry weather shortens the ripening time. The ideal time to swath is when the seed is at the medium to hard dough stage and still firmly attached. Moisture testing of the entire seed head (35-50%) is also a useful indicator of when to swath. Most grasses will hold their seed for 10-15 days, but the time from medium dough to seed shatter can be as short as three or four days. Seed shattering will depend on the grass species, stage of maturity, the variety, the degree of lodging, and wind, rain or hail.

Check fields often to determine when the crop is ready to harvest. A crop is ready to harvest when the seed is at the medium to hard dough stage (moderate to hard pressure with a thumbnail will dent the seed of large-seeded species). Swath when 75% of the seed heads have matured. Grass seed heads generally ripen from the top down. When the tips begin to shatter, the crop is ready to harvest. Harvest immediately if seed heads shatter when gently struck against the palm. A crop is ready to swath if seed heads shatter when roughly struck against the palm.

Table 33: Grass species to be used

Scientific name	Comm / Veld	Soil binding	Use	Grazing value	Establish easily?	Life span	Indigenous	Invasive	MAR required	Tolerance to drought	Tolerance to frost	Tolerance to water logging	Soil fertility needed	Soil texture	Planting method	Planting time
Cenchrus ciliaris	Comm	Tuft	P	High	No	Per	Yes	Low	250-900	Yes	Med	No	Low	S-C	S	Spr-Aut
Panicum maximum	Comm	Tuft	P	High	Yes	Per	Yes	Med	500+	Med	Med	No	Med	S-C	S	Spr-Aut
Enneapogon cenchroides	Veld	Tuft		Low	Med	Ann	Yes	Low	150-400	Yes	Yes	No	Low	S-Stony	S	Spr
Urochloa mosambicensis	Veld	Creep		High	Yes	WP	Yes	Low	350+	Yes	Med	No	Med	L-C	S	Spr
Cenchrus ciliaris & Enneapogon cenchroides mix	Veld	Tuft		Med	Med	Per	Yes	Low	250-600	Yes	Med	No	Low	S-L, Stony	S	Spr

Soil texture: NA = non-acidic; S = sand; SL = sandy loam; L = loam; LC = loamy clay; C = clay

Life span: Ann = annual (lives 1 year), WP = Weak perennial, Per = perennial (lives many years)

Planting time:

Planting method = S = seeds

Use: P = pasture

Planting time: Spring = Spring+ Summer (Plant after first reliable rains); Spring/Autumn = Plant during Spring+ Summer+ Autumn

In most cases, a conventional grain combine can be used to harvest either a standing or swathed grass crop. Adjust the combine as recommended by the manufacturer and thoroughly clean the combine before harvest. Air intake should be based on seed weight. Shut off the air intake when harvesting light chaffy seed, such as orchard grass. For heavier seeds, air intake can be increased slightly. It is important that an even continuous flow of material is fed into the combine. Be careful to prevent seed being carried through the combine in the straw and chaff.

Swath easily shattered grasses in the early morning or in the evening when air humidity is higher. Under low humidity, drying in the swath from 5 to 10 days will usually allow the seed to dry enough for harvest and safe storage.

Time of sowing

Moisture is the most important factor for germination of seed. Seed should be planted after the first reliable rains. All the grasses should be planted in spring. The first rains in the area occur in September; therefore, grass seeds would most likely be planted in September after the first rains. Seed must not be planted in December or January, as this time of the year is too hot for the germination of seeds. *Cenchrus ciliaris* and *Panicum maximum* can also be planted in autumn. This must be done at least ten weeks before the expected frost. When grasses are established vegetatively, planting should be done from spring to mid-summer preferably soon after the soils are wetted by good rains. Planting should be done directly after removal of alien plants. Bare soil may lead to erosion, etc. It is also important to keep on with alien control.

Most indigenous grasses have a dormancy period before seeds germinate. Seeds should usually be left to rest for a whole season if obtained from the veld. Seeds purchased from a seed merchant can usually be sowed immediately. Seed should not be stored for more than three years. Seed should be stored in a cool dry place below 25°C away from direct sunlight.

Planting Methods

There are different types of planting methods and plant uses. As the Grab-a-Grass Dial include many types of planting and uses; which has no reference to the grass species chosen, only those relevant to the grasses to be used will be described.

1. Seeds

Melinis repens and *Setaria sphacelata* can be planted by using this method. When planting grasses using seed, the seeds should be mixed with river sand or lime to make it bulkier. Lime also acts as a marker to indicate where sowing has taken place. The type of sowing depends on the terrain. The bulking of seeds is also advantageous for sowing rate is low or if the seed is easily blown by the wind. Generally, all seeds must be covered with a thin layer of soil. This will not be possible on the mine residues. Sowing should take place to a depth of 0.5cm. Compaction results in the close contact between seeds and soil. This leads to maximum moisture retaining and optimal seedling establishment.

a. Broadcast Sowing

This type of sowing is suitable for flat ground and gentle slopes of 0% to 10%. This type of sowing involves the evenly spreading of seeds over an area. Steps to take for sowing:

- Spread either by hand or cyclone seeder.
- To ensure that the seed is evenly applied, the seed must be divided into two even portions.
- Two seeders (seeders being by hand or cyclone seeder) move in the opposite direction with seeds.
- Areas where indigenous grasses are already established, seed should only be applied to bare soil patches.
- Control the depth of the seeds by using hand tools. The back of garden rakes can be used to cover seeds or by sweeping with small branches.

b. Row Sowing

This type of sowing is suitable for shorter, gentle to steep slopes. Sharp-pointed hoes or forks must be used to make shallow furrows. Rows of grass seed will help trap silt and therefore help stabilize the area. The furrows must be space approximately 30-50cm apart on the natural contours. Please be advised, contours should be made parallel with the horizon and not vertical.

- Seed must be divided into two equal portions.
- Cover all furrows with each of these portions. Short sticks should be used to cover the seed. Rows can also be scuffed with the shoe.
- As with broadcast sowing, only sow in bare areas.

c. Hydroseeding

The mixture is prepared by mixing the mulch, seed, fertiliser, pigment, and water in the specified proportions. All ingredients shall be thoroughly mixed to form a homogenous slurry. Seed must be uniformly sown over all areas to be planted.

2. Barrier lines

Barrier lines are necessary on slopes. This is to prevent soil loss due to water flow. The aim is not to divert water flow but to merely slow it. There are two types of barrier lines that can be used. The first is using loose non-vegetative material and secondly, planting of vegetation. Stumps form invasive plants can be used as vegetation barrier lines. This should be sowed in three lines of 15cm apart. This is followed by 3 rows of another indigenous grass species also sowed 15cm apart. Barrier lines should be established horizontally as with contour lines. The following type of material can be used for non-vegetative barrier line:

- Brushwood;
- Branches;
- Thatch; or

- Stones.

Barrier lines using non-vegetative material depend on the slope of the area and the length of the slope. The following calculations must be done to find the slope percentage:

1. Measure the length of the slope from the top to the bottom (a).
2. Measure the difference in altitude from the top to the bottom (b).
3. Divide (a) into (b) and multiply by 100. This will be the slope percentage.

Refer to Figure 48 for the calculations of barrier lines.

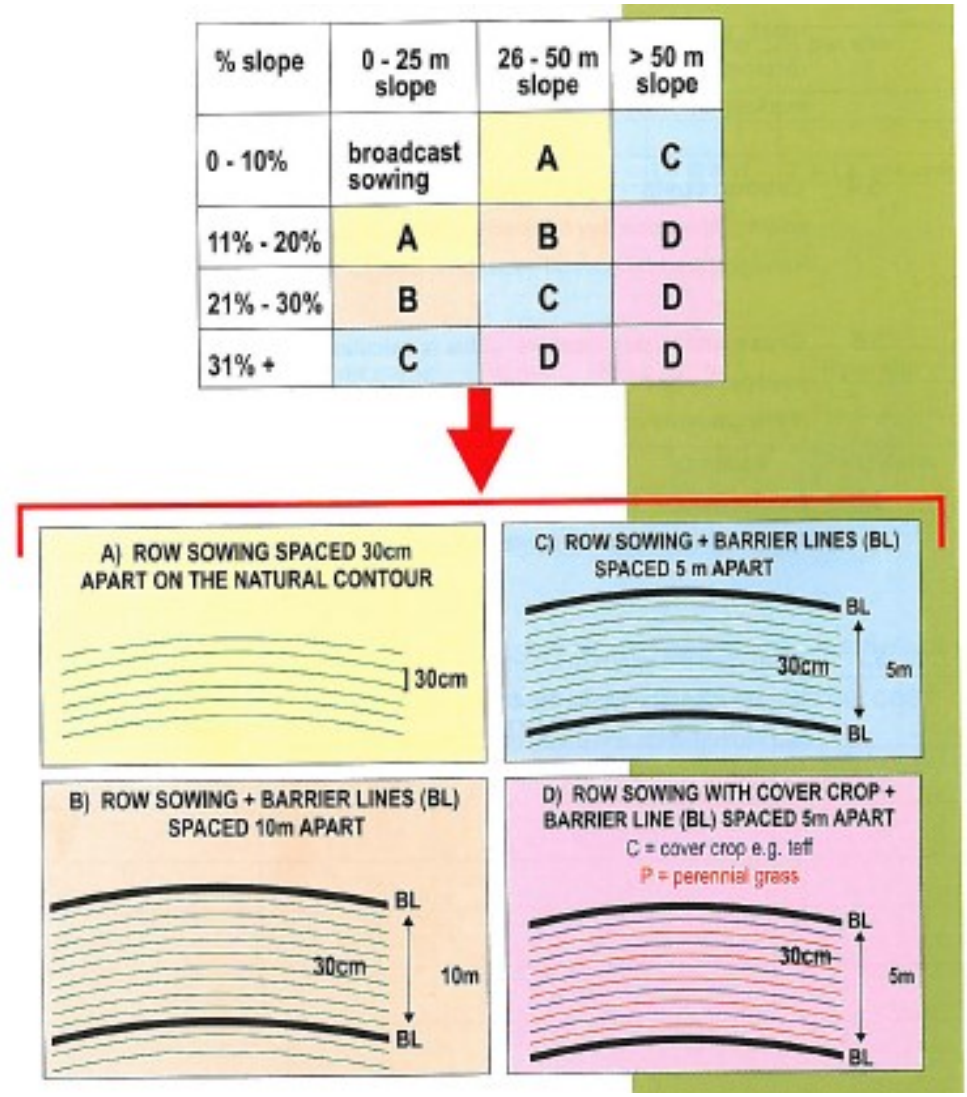


Figure 48: Calculating barrier spacing (Taken by Campbell, 2001)

3. Brushwood

Brushwood helps to prevent the loss of topsoil and seeds after heavy rains or during strong winds. The area is characterised by hot summers and late afternoon showers during this period. Wind is mild, except for short periods during thunderstorms when strong winds may occur. Therefore, brushwood is

necessary on the site. Brushwood also breaks down and helps add organic carbon to the soil. Steps to take in placing brushwood on site:

1. Brushwood; which is twigs and small branches should be cut and placed evenly over the area.
2. The brushwood should be trampled to get good contact with the soil. Please be advised not to disturb seeds or soil covering the seeds.
3. Brushwood should be approximately 0.5-1m high. Too large heaps of brushwood will kill seeds.
4. As the placement of brushwood is labour intensive, only use it in areas where practical.

When placing branches against a slope to control erosion, the broad end of the branches (crown part) must be put uphill. This wider area of twigs and leaves will ensure that more soil and silt will be trapped. Steps to take on steep slopes:

1. Place brushwood horizontal with soil (parallel with natural contours).
2. Fasten brushwood with iron pegs or stabilize by using big rocks and branches.

6.2.3 Alien control

Information for this section was obtained from 'Rehabilitation Recommendations after Alien Plant Control' (Campbell, 2001) as well as from Bromilow (2010). The control of alien plants is a very important part of the rehabilitation of the site. Alien control should take place before and during the establishment of vegetation on site. There are three phases included in the control of alien plants. These phases are as follow:

1. The initial control. This is a very drastic reduction or eradication of the existing alien plant species on site.
2. The follow-up control. This phase will take place during the planting of vegetation. Alien vegetation seedlings, root suckers, and coppice regrowth must be removed.
3. Maintenance control. This phase occurs when re-vegetation has already taken place and the alien infestation will no longer be a significant problem. This phase will take place two to three times each year during spring, mid-summer and autumn.

1. Alien vegetation control methods

Control strategies depend on a different factor. These factors are:

- The type of alien plant species;
- The growth habit of these alien species;
- The density of alien plants;
- The terrain;
- The rehabilitation requirements;
- The availability of resources; and
- The urgency/speed of alien control necessary.

Alien species observed on the site are given below. Please note, this list will be extended once rehabilitation is underway.

Table 34: Alien species occurring on site

Scientific name	Common name	Plant type	NEMBA Category*
Nicotiana glauca	Wild tobacco	Tree	1b
Senna didymobotrya	Peanut butter cassia	Shrub	1b

1b – Spreading or allowing to spread prohibited

Table 35: Alien vegetation control methods

Alien Species Description	Method of Eradication
Nicotiana glauca It is a slender, evergreen shrub or small tree up to 6m in height. It is blue-green all over and sometimes with purplish tints. It can form dense stands along riverbeds after floods. The leaves are blue-green and leathery on long petioles. Blades up to 200mm long x 120mm wide on young growth. Flowers are yellow and tubular in shape from 30 – 50mm long in terminal dropping clusters all year. Fruits are brown and four-valved. http://www.agis.agric.za/wip/CategoryList.jsp?category=389	There is no chemical control for this plant. Mechanical removal includes hand pull and felling of plants. Campbell, 2001
Senna didymobotrya Evergreen, rounded shrub or small tree 1-3(-6) m high; young shoots softly downy; flowers and cut stems smell of peanut butter. Leaves: dark green, with 8-21 pairs of ovate-oblong leaflets 20-50 mm long, bases asymmetric, tips shortly pointed; stipules ovate, with a tapering point, persistent. Flowers: bright yellow, buds dark brown, in narrow, erect racemes up to 450 mm long, all year. Fruits: Pods, green turning dark brown, softly downy, flattened, ± 100 mm long x 20 mm wide, long-beaked. http://www.agis.agric.za/wip/	There is no chemical control for this plant. Mechanical removal includes hand pull of plants. Campbell, 2001

2. Disposal of alien vegetation

Small amounts of cut material can be left on the site to and add to organic material provision, however, please note, if seeds are left with the cut material, the infestation will occur. Most of the plant material will be used as part of mulching of the tailings dam.

3. Follow-Up Control

It is very important to do a follow-up control after the initial alien control programme as alien vegetation will re-establish very easily. For the follow-up control, the re-establishment must be evaluated to see if there is a dense regrowth or low-medium dense regrowth. Dense regrowth is usually in the form of seedlings, root suckers or stump coppice.

a. Chemical Control – Foliar Applications

Use knapsack sprayers with flat fan nozzles if the regrowth is uniform and less than 1m tall. This must be done as quickly as possible with enough people. If there are large assessable areas, a

tractor-mounted tractor can be used. See, if there are indigenous species occurring in the same area, use selective registered herbicides only.

b. Mechanical Control

If plants are uprooted, it will result in soil erosion. It is advised to cut the plant so that coppice growth can take place. The coppice growth can then be sprayed with herbicides. Plant grass after the area has been cleared of alien plants to prevent more regrowth.

Areas that only have a low-medium dense regrowth must be a high priority to control. If such areas are left uncontrolled, high dense regrowth will take place.

c. Chemical Control

Plant cut and control: Plants should be cut to a height of less than 15cm tall. Herbicide should be applied to the stumps by using hand sprayers, paint brushes or knapsack sprayers. Dye the stumps that are sprayed. This way it is easy to see what plants have been treated. Please note the herbicide should be applied to the cut area of the stump and not on the sides of the stump. Spray on coppice regrowth: Regrowth can be sprayed to a height of 1m tall. Use knapsack sprayers.

d. Mechanical Control

Hand pull of seedling can take place in wet soils. Please ensure that workers wear gloves for protection as some of the plants are irritants or poisonous.

7 Rehabilitation schedule

The rehabilitation schedule provides detail on which specific activities should be undertaken to effect closure in identified mine areas or zones. The conceptual closure plan provides high level detail on the schedule for the LOM, with more detailed focussed on the construction and first year operational phase. As operations continue the closure schedule will be adjusted and become more detailed. The closure schedule should describe timeframes for:

- Planned mine infrastructure construction period;
- Commissioning of pollution control infrastructure;
- The rehabilitation schedule (refers to the rate of rehabilitation and typically includes levelling, topsoiling and revegetation);
- Timeframes for selected specialist studies expected; and
- Socio economic interactions

The schedule for rehabilitation must be discussed with the community. Once this has been finalised, it will be included.

(d) Explain why it can be confirmed that the rehabilitation plan is compatible with the closure objectives

This BAR is for rehabilitation of the area.

(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) for a complete description of the financial provision.

(f) Confirm that the financial provision will be provided as determined

Refer to Part A(s) for a complete description of the financial provision.

j) Mechanisms for monitoring compliance with and performance assessment against the environmental management programme and reporting thereon

i) Monitoring of impact management actions

Monitoring of any rehabilitation is absolutely necessary to ensure that the integrity and performance of the rehabilitation method are still in line with the original objectives and purposes of the method. It is very important that monitoring takes place continuously throughout and after rehabilitation. The main goals behind a monitoring program are (van Deventer, 2009):

1. To meet legal requirements. In the EMP, a description of methods to be followed to monitor compliance with the approved rehabilitation plan is included. Closure application should also be substantiated with adequate monitoring data. Closure objectives must be specified upfront and accepted by all parties. Objectives must be prescribed for at least the following:
    - Topographical reshaping
    - Erosion (surface stability);
    - Vegetation cover (species diversity, abundance);
    - Surface water drainage systems;
    - Surface water quality
    - Groundwater quality
    - Miner residue characteristics with respect to plant growth (soil quality)

2. Evaluating mine residue and vegetation quality. Dynamic assessment requires a monitoring system to provide a regular surveillance of mine residue and vegetation quality attributes or indicators.
3. Land management. The annual results of the monitoring program will determine the actions to be taken for the following year to ensure the site is improving in the direction of the stipulated end result.
4. Improving our understanding of new ecosystems. For the new ecosystem, the biological productivity, stocks and exchange of nutrients, and the regulation of other ecological processes need to be characterized, quantified and modeled.

Refer below for the parameters of monitoring. This includes an explanation of the approach that will be taken to analyse monitoring results and how these results will be used to inform adaptive or corrective management and/or risk reduction activities.

Parameters to be monitored	Frequency of monitoring	Period of monitoring	Responsible person	Explanation of the approach that will be taken to address and close out audit results and schedule
Topographical reshaping				
After reshaping the resultant topography must be surveyed to determine the degree to which the final topography meets planned objectives, particularly in terms of surface drainage and in terms of slope required to meet land capability objectives.	Once after reshaping	Once after reshaping	Mine surveyor	Deviations from plan must be documented, and the final reshaped surface should be signed off by the responsible person prior to the replacement of topsoil.
Erosion monitoring				
The primary objective of the closure of any sloped area is to create a rehabilitated surface and topography that has the capacity to be stabilised under all environmental conditions e.g. severe rain events, veld fires, droughts etc. Erosion status of the rehabilitated land should be monitored and zones with excessive erosion should be identified for remedial action. Erosion can be quantified by insertion of marked stakes into the rehabilitated profile and recording the rate at which the stakes are uncovered. However, the norm is simply the recording of the existence of erosion in a particular location. Key objectives to improve surface stability are; • Minimisation of surface erosion (wind and water) • Establishment of a plant community that is self-sustaining or any other cover material which complies to surface stability Achievement of these objectives should be demonstrated by monitoring of the rehabilitated	Monthly	Five years after rehabilitation	Mine manager	It is much simpler, and cheaper, to treat this type of erosion in the early stages of formation than to try to repair the damage once a deep gulley has formed. Small ruts that are just starting to open up can be easily controlled by filling them with brush, straw, manure or even stones. Treatments should be concentrated in areas of clearly active soil erosion, rather than relatively stable (vegetated) gulleys). An extremely important principle with any soil erosion control method is that when natural materials are gathered for use in control structures, care must be taken to ensure that the removal (for example, of stones) does not become the cause of a new erosion problem at the source of the material. Stones, for example, should only be collected along roads, where they are displaced during road-making, or from piles of stones cleared off irrigation lands. Similarly, natural vegetation should not be destroyed by vehicles collecting or delivering materials for gulley control. (http://www.ostrichsa.co.za/downloads/bio_diversity/rehabilitation.pdf)

Parameters to be monitored	Frequency of monitoring	Period of monitoring	Responsible person	Explanation of the approach that will be taken to address and close out audit results and schedule
areas. The key objective of surface stability monitoring lies in being able to demonstrate in a quantified manner the stability of surface rehabilitation works. The monitoring programme should be developed such that loss of soil can be quantified and the stability of the vegetated areas be assessed.				
Vegetation monitoring				
Vegetation establishment on new ecosystems or on disturbed systems should yield a self-sustaining community that is dynamic and able to change as the rehabilitated site ages and matures. The success of re-established plant community must be demonstrated through appropriate monitoring. The monitoring program must quantify the established plant community in terms of: 1. Species abundance (diversity) a. Improvement on contact cover b. Canopy cover c. Rooting depth d. Reproductive performance - Sexual reproduction 2. Asexual reproduction a. Microbial activity and biomass	Refer to Figure 49 below.	Five years after rehabilitation	Mine manager	Refer to step 4 and 5 in parameters to be monitored

Parameters to be monitored	Frequency of monitoring	Period of monitoring	Responsible person	Explanation of the approach that will be taken to address and close out audit results and schedule
b. Frequency – once a year c. Remarks The vegetation-monitoring programme must be developed for each case of implementation, without compromising the integrity of data gathered. A qualified ecologist with experience in assessment of rehabilitated plant communities must design the monitoring programme. The rehabilitation of grass species will potentially take place over 5 years depending on the progress of the rehabilitation plan. After this initial monitoring, a less comprehensive monitoring will be done. Refer to Figure 49 for a diagram of the vegetation monitoring to be done on the site. It is important to note that throughout all the monitoring phases, alien vegetation should be noted and included in an Alien Invasive Vegetation Control Programme. It is the objective to eradicate all alien plants during the control programme; however, it is very likely that alien vegetation will re-occur after such initial control. To combat this, an Alien Invasive Vegetation Control Programme is set out. There are five steps to this control programme. They are as follows: Please note, this alien vegetation monitoring must also be				

Parameters to be monitored	Frequency of monitoring	Period of monitoring	Responsible person	Explanation of the approach that will be taken to address and close out audit results and schedule
done after concurrent rehabilitation and the re-vegetation and removal of plants during concurrent rehabilitation have taken place. **Step 1: Information gathering** This first step is done to create a map, indicating the different infestation areas on the site. The following should be done to create such a map: 1. Alien plant infestations should be divided into control areas. To do this, natural or man-made barriers can be used. These barriers include roads, rivers, and fences. These barrier areas should be numbered for record purposes. 2. A detailed alien plant survey should be done in each area. The following should be recorded – • All alien plant species present and their growth habit (shrubs, trees, coppice, saplings, seedlings), • Percent density of each alien plant species (75-100% is very dense, 50-75% is dense, 25-50% is medium dense, 5-25% is sparse and 0-5% is scattered), • The terrain.				

Parameters to be monitored	Frequency of monitoring	Period of monitoring	Responsible person	Explanation of the approach that will be taken to address and close out audit results and schedule
3. Rank the areas into high, medium and low priority areas. This depends on the biodiversity; water yield and carrying capacity. 4. Identify suitable grass species for establishment and availability, per land use aims. 5. Place all above information on a 1:1 000 maps. **Step 2: Planning** This step is to establish integrated control strategies in each control (barrier) area as identified in Step 1. The following should be done: 1. List the required resources for each high priority control area (e.g. labour, herbicides, and equipment) and the current management practices on the property. 2. Evaluated and select appropriate control methods, using registered herbicides. 3. Calculate the costs for the high priority control areas. 4. Secure a long-term commitment to rehabilitation. **Step 3: Management** 1. Draw up an Annual Plan of Operations (APO) for high priority control areas. This				

Parameters to be monitored	Frequency of monitoring	Period of monitoring	Responsible person	Explanation of the approach that will be taken to address and close out audit results and schedule
plan must be updated each year. It includes a budget for the required resources for control strategies during the first year. This determines the scale of work. a. 75% for follow-up work and rehabilitation of previously cleared areas' b. 20% for initial control of new area' and c. 5% for an emergency. 2. Establish an emergency fund to cope with catastrophes such as mass seeding generation, fire, flood, etc. 3. Allocate resources to high priority control areas. 4. Draw up timetables for control operations, including a "catch-up" for in case operations fall behind. 5. The plan must be flexible and adjusted as progress is made. **Step 4: Implementation** Train the labourers incorrect control and grass planting methods. **Step 5: Record keeping** 1. Keep simple records of daily operations, e.g. record of labour days, herbicide used, and volumes and equipment used.				

Parameters to be monitored	Frequency of monitoring	Period of monitoring	Responsible person	Explanation of the approach that will be taken to address and close out audit results and schedule
2. Monitor progress with the control work (after the first year) by recording information on maps. 3. The information from these records must be fed back into the budget to update and amend the APO for the following year.				
Surface water drainage systems				
The functionality of the surface water drainage systems should be checked annually, preferably after the first major rains of the season, and then after any major storm. This is both to ensure that the drainage of the re-created profile matches the plan, and to permit early repair of drainage structures that are not functioning efficiently.	During rainy season	Five years after rehabilitation	Mine manager	Repair drainage structures that are not functioning efficiently.
Surface water quality				
Surface water upstream and downstream of the Olifants and Mogomotsi Rivers must be monitored to assess the quality of the water from the mining area.	Monthly	Five years after rehabilitation	Mine manager	If water results from the mine indicate quality above the acceptable limits, this will be discussed with DWS and the users of the Spekboom River.
Groundwater quality				
The mine has no current groundwater monitoring. It is advised that groundwater monitoring take place downslope from the WRD and the slimes dams. The mine will drill two BHs to monitor groundwater qualities.	Quarterly	Five years after rehabilitation	Mine manager	If water results from the mine indicate quality above the acceptable limits, this will be discussed with DWS and the groundwater users in the area.
Mine residue characteristics with respect to plant growth (soil quality)				

Parameters to be monitored	Frequency of monitoring	Period of monitoring	Responsible person	Explanation of the approach that will be taken to address and close out audit results and schedule
Soil quality monitoring will only be done if necessary and until natural vegetation is in place.			Mine manager	

ii) Monitoring and reporting frequency

Refer above

iii) Responsible persons

Refer above

iv) Time period for implementing impact management actions

Refer above

v) Mechanism for monitoring compliance

Refer above

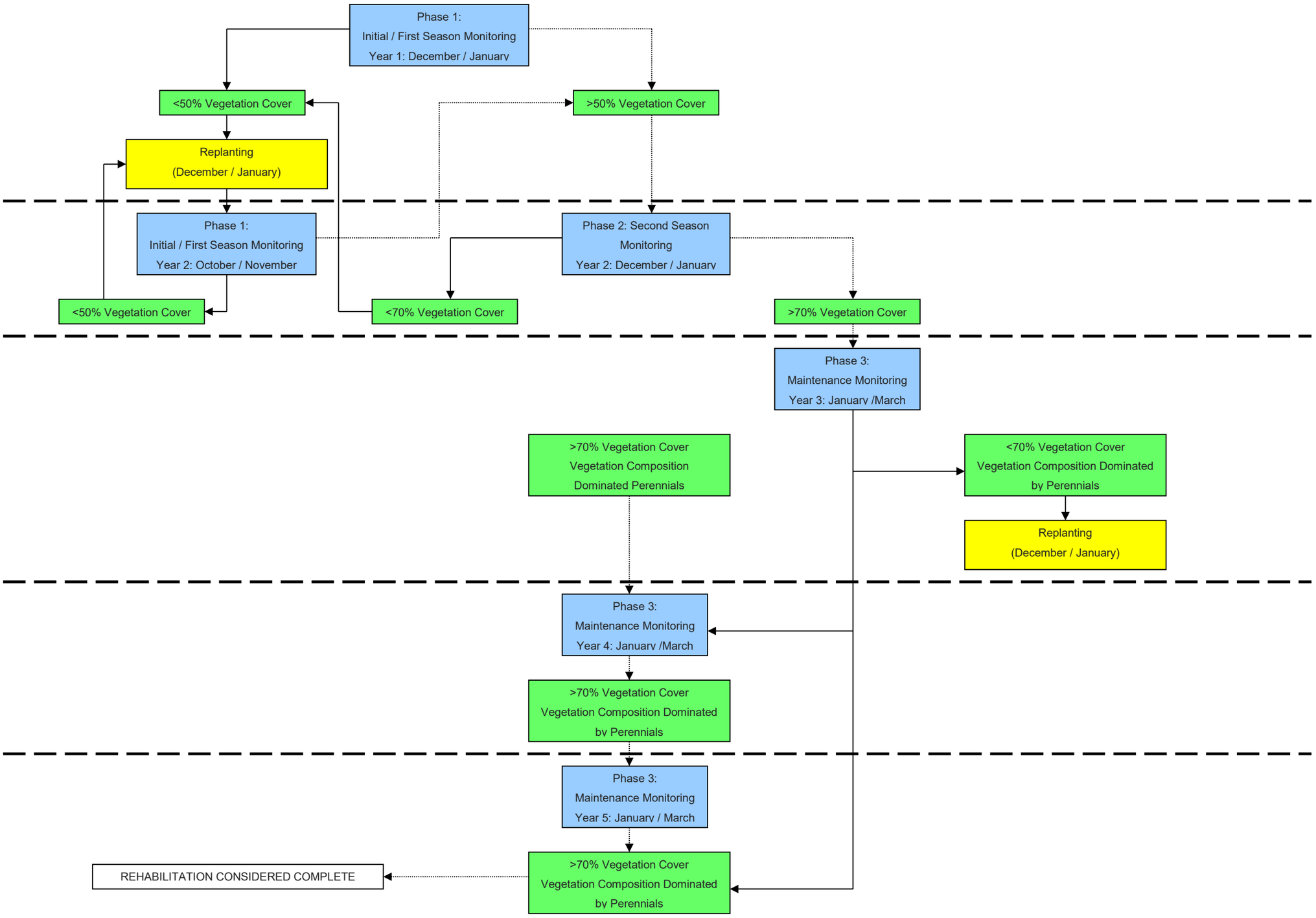


Figure 49: Summary of vegetation monitoring

l) Indicate the frequency of the submission of the performance assessment / environmental audit report

The monitoring plan will be audited to ensure effective implementation. The Health Safety and Environmental Manager will conduct internal audits and an EAP will conduct external audits. This will be done annually.

m) 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. The 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) and is an awareness for the entire mine therefore both Havercroft and Annesley Operations.

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 Annesley Andalusite 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 Annesley Andalusite 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 Annesley Andalusite 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 will also is given to employees of Annesley Andalusite 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 will 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 in the attendance records.

n) Specific information required by the Competent Authority

1 Financial provision

The financial provision will be reviewed on an annual basis.

2 Potential risk of acid mine drainage

According to the Geohydrological Evaluation (Aurecon, 2010):

'It was proven at the Havercroft Andalusite Mine that the stable & inert nature of the andalusite and gangue increases the water quality by absorbing certain elements'.

It can, therefore, be assumed that the risk of AMD or potential groundwater contamination associated with the mineral to be mined is therefore minimal to zero.

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 ☒

Full names and surname of the EAP	Salome Beeslaar
Signature of the EAP	
Name of Company	BECS Environmental
Date	

-END-

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