

Proposed Swartberg Haul Road at Black Mountain Mine, Aggeneys

Basic Assessment Report and Environmental Management Programme

Report Prepared for

Black Mountain Mining (Pty) Ltd



Report Number 536396



Report Prepared by



November 2018

Proposed Swartberg Haul Road at Black Mountain Mine, Aggeneys

Basic Assessment Report and Environmental Management Programme

Black Mountain Mining (Pty) Ltd

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SRK Project Number 536396

November 2018

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Executive Summary

BASIC ASSESSMENT PROCESS FOR THE PROPOSED SWARTBERG HAUL ROAD AT BLACK MOUNTAIN MINE, AGGENEYS

November 2018

SRK Project No: 536396

1 INTRODUCTION AND BACKGROUND

Black Mountain Mining (Pty) Ltd (BMM) mines and processes copper, lead and zinc at the Black Mountain and Gamsberg Mines near the town of Aggeneys in the Northern Cape. The Black Mountain Mine ('the Mine'), west of Aggeneys, comprises a processing area (including waste management and ancillary facilities) and two underground shafts: Deeps shaft and Swartberg shaft.

Trucks transport ore and waste rock from the Swartberg shaft using an existing haul road to the processing area. The haul road intersects numerous ancillary roads in the processing area. Access to the Waste Rock Dump (WRD) at this intersection requires heavy vehicles to turn sharply which presents traffic issues and safety concerns.

To alleviate traffic and safety concerns, and to optimise haul distances at the Mine, BMM proposes to construct a new haul road from the top of the WRD to the weighbridge area located adjacent to the existing haul road ('the project').

Key aspects of the project include:

- **Construction of a new haul road:** The new haul road will be 8 m wide to allow for 2-way truck traffic and ~ 1.2 km long;
- **Establishment of laydown areas:** Construction laydown areas will be located within the existing disturbed footprint of the weighbridge area and WRD;
- **Installation of river crossings:** The new haul road will cross eleven ephemeral drainage lines, requiring the installation of eleven pre-cast cement culverts and/or the construction of low-level drift crossings; and
- **Alterations to existing powerline:** An existing 66 kV powerline is located in close proximity to and will traverse the new haul road. BMM will raise the powerline to ensure heavy vehicles can pass safely beneath.

SRK Consulting (South Africa) (Pty) Ltd (SRK) was appointed by the BMM to undertake the Basic Assessment (BA) process required in terms of the National Environmental Management Act 107 of 1998 (NEMA). The BA process was undertaken in accordance with Section 23 of the Environmental Impact Assessment (EIA) Regulations, 2014.

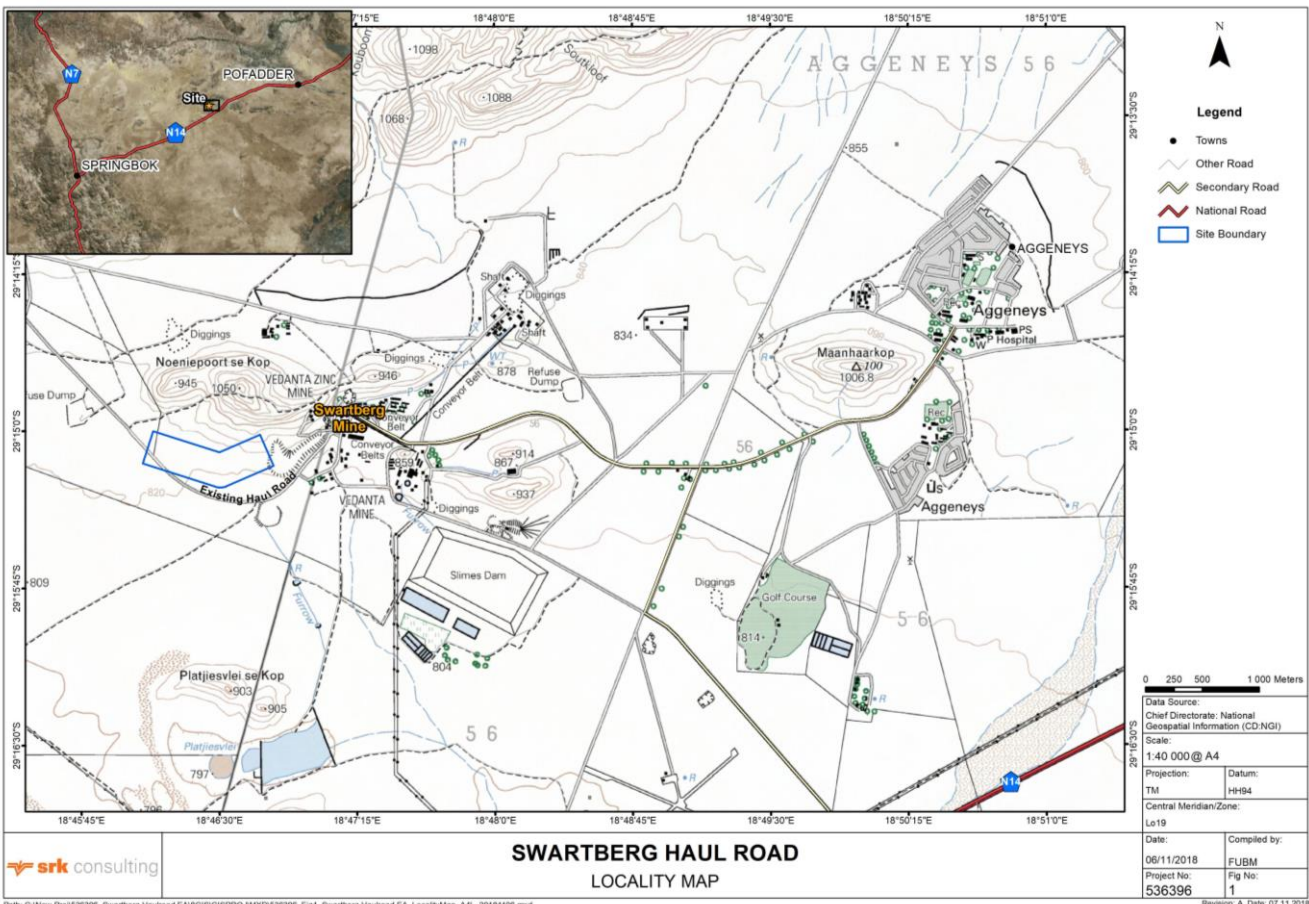


Figure 1: Locality Plan

2 GOVERNANCE FRAMEWORK

Sections 24 and 44 of NEMA make provision for the promulgation of regulations that identify activities which may not commence without an Environmental Authorisation (EA) issued by the competent authority, in this case, the Department of Mineral Resources (DMR).

SRK has determined that the proposed project triggers activities listed in terms of Listing Notices (LN) 1 and 3 of the EIA Regulations, 2014, requiring a BA process.

Table 1: Listed activities triggered by the project

No	Description
LN 1	
12	The development of structures with a physical footprint of more than 100 m ² within 32 metres of a watercourse.
19	The infilling or depositing of any material of more than 10 m ³ into, or the excavation of soil of more than 10 m ³ from a watercourse.
24	The development of a road, where no reserve exists, where the road is wider than 8 m.
LN 3	
4	The development of a road wider than 4 m with a reserve less than 13,5 m within a CBA.
12	The clearance of an area of 300 m ² or more of indigenous vegetation within a CBA.

Water Use Authorisation (WUA) in terms of the National Water Act 36 of 1998 (NWA) will be required from the Department of Water and Sanitation for water use activities listed in sections 21 (c) and (i).

In addition to EA and WUA, various other permits or licences are required before the project may proceed.

3 ENVIRONMENTAL PROCESS

Appendix 1 of the EIA Regulations, 2014, define the detailed approach to the BA process (see Figure 2).

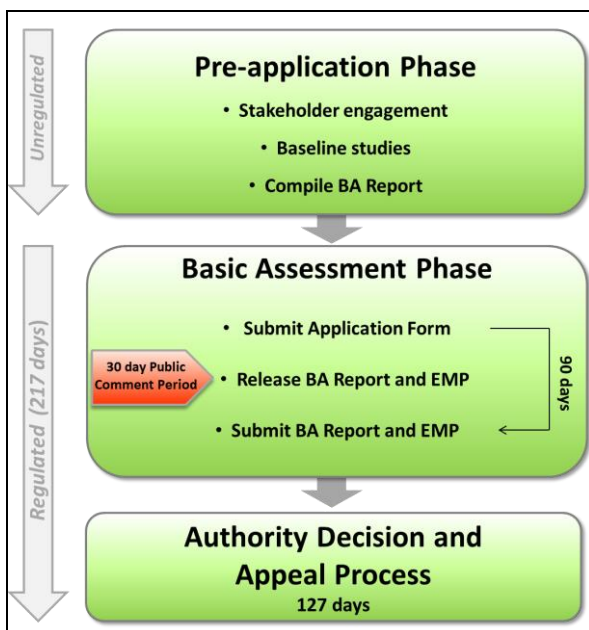


Figure 2: BA Process

The main objectives of the BA process are to identify and assess potential issues and environmental impacts and to provide feasible mitigation measures to address any significant impacts identified.

4 DESCRIPTION OF THE SITE AND ENVIRONMENT

The site is located within the BMM Mining Right Area to the west of the WRD and north of an existing haul road on the lower slopes of Noeniepoort.

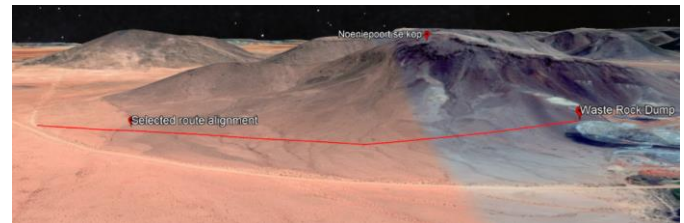


Figure 3: Topography surrounding the site

The site is drained by a number of poorly defined ephemeral drainage lines (see Figure 4). The drainage lines that occur on site are only likely to convey water during rare, heavy thunderstorms in the rainy season and may not flow at all the rest of the year. As such, the drainage lines are neither riparian habitats nor wetlands.



Figure 4: Rocky drainage line

Although the drainage lines are considered to be mostly unmodified, the drainage lines are not considered to be ecologically important or sensitive.

The site falls within the Nama-Karoo Biome and the Bushmanland Bioregion and is identified to fall within Bushmanland Sandy Grassland and Aggeney's Gravel Vygieveld vegetation types (Figure 4).

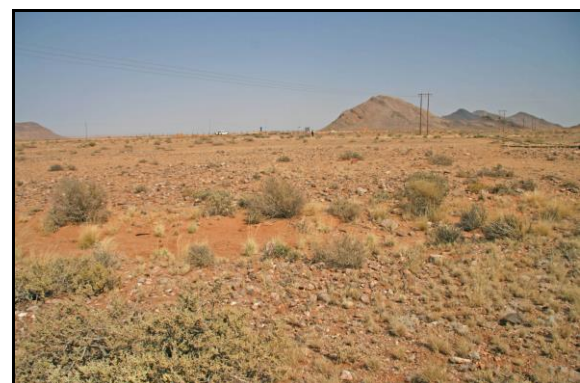


Figure 5: Vegetation at the site

The site does not fall within any formally protected areas, but a small portion of the haul road will occur within an area identified as a Critical Biodiversity Area. The vegetation on the site is not considered to be sensitive.

Two protected species were recorded on site, however, none of the plant species recorded on site are listed as ‘critically endangered’ or ‘endangered’ species.

5 ALTERNATIVES

BMM considered four haul road alignment alternatives.

The route alternative selected for assessment was determined based on ecological, safety and design (e.g. slopes, fill material requirements, etc.) considerations. The terrain along the selected route is less undulating and less rocky for most of the route, especially in the western section. Consequently, the drainage lines do not form such deep incisions.

BMM does not consider the other route alternatives to be feasible based on the financial and technical requirements to address the safety and design considerations.

Table 2: Summary of Impacts

Impact	Significance rating		Key mitigation/optimisation measures
	Without	With	
CONSTRUCTION PHASE IMPACTS			
Soil compaction caused by construction traffic	VL	VL	<ul style="list-style-type: none"> Restrict construction activities to the project footprint areas.
Loss of land capability	L	L	<ul style="list-style-type: none"> Rehabilitate disturbed areas as soon as possible
Impaired air quality from suspended particulates affecting receptors	VL	I	<ul style="list-style-type: none"> Implement dust suppression measures on access roads.
Loss of vegetation	L	VL	<ul style="list-style-type: none"> Limit vegetation clearance to what is absolutely essential.
Loss of threatened floral species	L	VL	<ul style="list-style-type: none"> Limit vegetation clearance to what is absolutely essential.
Disturbance to terrestrial fauna and loss of habitat during construction	L	VL	<ul style="list-style-type: none"> Limit vehicle speeds on internal and haul roads to 40 km/hr. Prohibit construction activities and driving at night.
Degradation of ephemeral drainage lines	VL	VL	<ul style="list-style-type: none"> Construct watercourse crossings / culverts during dry conditions only.
• OPERATIONAL PHASE IMPACTS			
Soil erosion caused by operational activities	L	VL	<ul style="list-style-type: none"> Implement drainage control measures and install culverts.
Soil compaction caused by hauling	L	L	<ul style="list-style-type: none"> Restrict hauling to designated haul roads.
Loss of land capability	L	L	<ul style="list-style-type: none"> Restrict activities to the project footprint areas.
Increased dustfall associated with hauling activities	VL	VL	<ul style="list-style-type: none"> Implement existing dust suppression measures at the Mine.
Degradation of ephemeral drainage lines	VL	VL	<ul style="list-style-type: none"> Inspect watercourses annually for evidence of erosion at crossings. Respond to erosion reports by closing gullies and revegetating river.
Loss of vegetation	VL	VL	<ul style="list-style-type: none"> Limit vegetation clearance to what is absolutely essential.
Increased faunal mortalities	VL	VL	<ul style="list-style-type: none"> Limit night driving as far as possible.
Loss of palaeontological resources during road construction	L	VL	<ul style="list-style-type: none"> Limit the footprint of construction activities to what is essential.

7 FINDINGS AND RECOMMENDATIONS

The project will result in unavoidable, minor adverse environmental impacts. None of these impacts are considered unacceptably significant and can all be managed to tolerable levels through the effective implementation of recommended mitigation measures.

6 ASSESSMENT OF POTENTIAL IMPACTS

Potential impacts associated with the projects were assessed according to SRK’s standard Impact Assessment methodology. For all potentially significant impacts, the significance of the anticipated impact was rated without and with recommended mitigation measures. These impacts are presented in Table 2.

The key mitigation measures on which the significance rating is based (where applicable) are described below.

Impact Significance Ratings Legend:

Rating	+ve	-ve
Insignificant	I	I
Very Low	VL	VL
Low	L	L
Medium	M	M
High	H	H
Very High	VH	VH

Key recommendations, considered essential, include:

- Implement the Environmental Management Programme (EMPr) to guide construction, operation and maintenance and to provide a framework for ongoing assessment of environmental performance;
- Designate the Environmental Manager / Officer at BMM to oversee the implementation of the EMPr and

supervise any construction activities (particularly within the drainage lines);

- Minimise the physical footprint of the development and areas disturbed by construction activities to the smallest extent possible;
- Rehabilitate all areas disturbed by construction activities (outside of the project footprint); and
- Obtain other permits and authorisations as may be required.

8 STAKEHOLDER ENGAGEMENT

Stakeholder engagement is a key component of the BA process and is being undertaken in accordance with the requirements of the EIA Regulations, 2014.

The public comment period is currently underway and will be completed on **18 January 2019**, following which the BA

report (BAR) will be submitted to DMR, including stakeholder comments, for their consideration.

If substantial changes are made to the BAR in response to stakeholder comments, the BAR will be released for a second public comment period prior to submission to DMR. The stakeholder engagement activities are summarised in Table 3.

Table 3: Stakeholder engagement during the BA process

Activity	Date
Submission of Application form to DMR	26 November 2018
Release BAR to the Public	26 November 2018
Advertise the BAR (local newspaper)	23 November 2018
Comment period	27 November 2018 – 18 January 2019

HOW YOU CAN YOU PARTICIPATE IN THE BA PROCESS

This BAR is not a final report and can be amended based on comments received from stakeholders. Stakeholders are therefore urged to participate.

Interested and Affected Parties (IAPs) are invited to comment, and/or to register on the project database. IAPs should refer to the SRK project number, and must provide their comments together with their name, contact details (preferred method of notification, e.g. email), and an indication of any direct business, financial, personal or other interest which they have in the application, to the contact person below, by **18 January 2019**.

Relevant Organs of State have been automatically registered as stakeholders. According to the EIA Regulations, 2014 all other **persons must request in writing to be placed on the register, submit written comments or attend meetings in order to be registered as stakeholders** and be included in future communication for the project.

REGISTER OR PROVIDE YOUR OPINION

Register or send written comment to:

Amy Hill

SRK Consulting

Email: ahill@srk.co.za

Postnet Suite #206, Private Bag X18,
Rondebosch, 7701

Tel: + 27 21 659 3060

Fax: +27 86 530 7003

REVIEW THE REPORT

Copies of the BAR are available for public review at the following locations:

- Aggeney's Public Library;
- BMM's security offices at the Mine;
- SRK's Cape Town office; and
- SRK's website: www.srk.co.za – click on the 'Library' and then 'Public Documents' links.



Profile and Expertise of EAPs

SRK Consulting (South Africa) Pty Ltd (SRK) has been appointed by Black Mountain Mining (Pty) Ltd (BMM) as the independent consultants to undertake the Basic Assessment (BA) process required in terms of the National Environmental Management Act 107 of 1998 (NEMA).

SRK Consulting comprises over 1 400 professional staff worldwide, offering expertise in a wide range of environmental and engineering disciplines. SRK's Cape Town environmental department has a distinguished track record of managing large environmental and engineering projects and has been practising in the Western Cape since 1979. SRK has rigorous quality assurance standards and is ISO 9001 accredited.

As required by NEMA, the qualifications and experience of the key independent Environmental Assessment Practitioners (EAPs) undertaking the BA are detailed below and Curriculum Vitae provided in Appendix A.

Project Director: Christopher Dalgliesh, BBusSc (Hons), MPhil (EnvSci)

Certified with the Interim Board for Environmental Assessment Practitioners South Africa (CEAPSA)

Chris Dalgliesh is a Partner and Principal Environmental Consultant with over 25 years' experience, primarily in South Africa, Southern Africa, West Africa and South America (Suriname). Chris has worked on a wide range of projects, notably in the natural resources, Oil & Gas, waste, infrastructure (including rail and ports) and industrial sectors. He has directed and managed numerous Environmental and Social Impact Assessments (ESIAs) and associated management plans, in accordance with international standards. He regularly provides high level review of ESIAs, frequently directs Environmental and Social Due Diligence studies for lenders, and also has a depth of experience in Strategic Environmental Assessment (SEA), State of Environment Reporting and Resource Economics. He holds a BBusSci (Hons) and M Phil (Env) and is a Certified Environmental Practitioner of South Africa (CEAPSA).

Project Reviewer: Scott Masson, BSc (Hons) (EnvMan); MLA (L.Arch.)

CEAPSA

Scott Masson is a Senior Environmental Consultant and has been involved in the environmental and landscape architectural field for the past 10 years. His expertise includes Visual Impact Assessment, ESIAs, EMPs, Integrated Water and Waste Management Plans, and environmental planning and sensitivity studies. Scott holds a BSc (Hons) in Environmental Management, a MLA in Landscape Architecture and is a CEAPSA.

Project Manager: Amy Hill, BSc Hons (Biodiversity and Ecology)

Amy Hill is an Environmental Consultant at SRK Consulting and has 4 years of experience in the biodiversity and ecology sector. She has experience in managing a number of Basic Assessment and Water Use Authorisation processes and has contributed to numerous Environmental Impact Assessment processes, notably in the commercial and industrial sectors. Amy has drafted Environmental Management Plans, performed Environmental Control Officer duties and coordinated stakeholder engagement processes. She holds a BSc (Hons) in Biodiversity and Ecology from the University of Stellenbosch.

Statement of SRK Independence

Neither SRK nor any of the authors of this Report have any material present or contingent interest in the outcome of this Report, nor do they have any pecuniary or other interest that could be reasonably regarded as being capable of affecting their independence or that of SRK.

SRK has no beneficial interest in the outcome of the assessment which is capable of affecting its independence.

Disclaimer

The opinions expressed in this report have been based on the information supplied to SRK by BMM. SRK has exercised all due care in reviewing the supplied information, but conclusions from the review are reliant on the accuracy and completeness of the supplied data. SRK does not accept responsibility for any errors or omissions in the supplied information and does not accept any consequential liability arising from commercial decisions or actions resulting from them. Opinions presented in this report apply to the site conditions and features as they existed at the time of SRK's investigations, and those reasonably foreseeable. These opinions do not necessarily apply to conditions and features that may arise after the date of this Report, about which SRK had no prior knowledge nor had the opportunity to evaluate.

Swartberg Haul Road: EAP Affirmation

Section 16 (1) (b) (iv), Appendix 1 Section 3 (1) (r), Appendix 2 Sections 2 (i) and (j) and Appendix 3 Section 3 (s) of the Environmental Impact Assessment (EIA) Regulations, 2014 (promulgated in terms of the NEMA), require an undertaking under oath or affirmation by the EAP in relation to:

- The correctness of the information provided in the report;
- The inclusion of comments and inputs from stakeholders and interested and affected parties;
- Any information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested or affected parties; and
- The level of agreement between the EAP and interested and affected parties on the Plan of Study for undertaking the environmental impact assessment.

SRK and the EAPs managing this project hereby affirm that:

- To the best of our knowledge the information provided in the report is correct, and no attempt has been made to manipulate information to achieve a particular outcome. Some information, especially pertaining to the project description, was provided by the applicant and/or their sub-contractors. In this respect, SRK's standard disclaimer (inserted in this report) pertaining to information provided by third parties applies.

Table of Contents

1. IMPORTANT NOTICE.....	2
2. OBJECTIVE OF THE BASIC ASSESSMENT PROCESS.....	3
3. CONTACT PERSON AND CORRESPONDENCE ADDRESS	4
a) Details of EAP	4
i. Details of the EAP	4
ii. Expertise of the EAP	4
b) Location of the overall Activity.	4
c) Locality map	5
d) Description of the scope of the proposed overall activity	7
i. Listed and specified activities.....	7
ii. Description of the activities to be undertaken	8
e) Policy and Legislative Context	11
f) Need and desirability of the proposed activities.	12
g) Motivation for the overall preferred site, activities and technology alternative.	13
h) Full description of the process followed to reach the proposed preferred alternatives within the site.	13
i. Details of the development footprint alternatives considered.	14
ii. Details of the Public Participation Process Followed	15
iii. Summary of issues raised by I&As	16
iv. The Environmental attributes associated with the alternatives	16
v. Impacts and risks identified including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts	34
vi. Methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks;	43
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.....	45
viii. The possible mitigation measures that could be applied and the level of risk	45
ix. Motivation where no alternative sites were considered	46
x. Statement motivating the alternative development location within the overall site	46
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	46
j) Assessment of each identified potentially significant impact and risk	47
k) Summary of specialist reports.....	50
l) Environmental impact statement.....	52
i. Summary of the key findings of the environmental impact assessment;	52
ii. Final Site Map	53
iii. Summary of the positive and negative impacts and risks of the proposed activity and identified alternatives	53
m) Proposed impact management objectives and the impact management outcomes for inclusion in the EMPr	53
n) Aspects for inclusion as conditions of Authorisation.....	53

o)	Description of any assumptions, uncertainties and gaps in knowledge.	53
p)	Reasoned opinion as to whether the proposed activity should or should not be authorised	54
i.	Reasons why the activity should be authorized or not.....	54
ii.	Conditions that must be included in the authorisation	55
q)	Period for which the Environmental Authorisation is required.	55
r)	Undertaking.....	55
s)	Financial Provision.....	55
t)	Explain how the aforesaid amount was derived.	55
i)	Confirm that this amount can be provided for from operating expenditure.	55
u)	Specific Information required by the competent Authority	56
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). the EIA report must include the:-	56
v)	Other matters required in terms of sections 24(4)(a) and (b) of the Act.....	56
4.	Draft environmental management programme	57
a)	Details of the EAP	57
b)	Description of the Aspects of the Activity.....	57
c)	Composite Map.....	57
d)	Description of Impact management objectives including management statements.....	57
ii.	Determination of closure objectives.	57
iii.	Volumes and rate of water use required for the operation.....	58
iv.	Has a water use licence has been applied for	58
e)	Impacts to be mitigated in their respective phases.....	59
f)	Impact Management Outcomes.....	74
g)	Impact Management Actions	74
h)	Financial Provision	75
i.	Determination of the amount of Financial Provision.	75
i)	Explain why it can be confirmed that the rehabilitation plan is compatible with the closure objectives.	75
j)	Calculate and state the quantum of the financial provision required to manage and rehabilitate the environment in accordance with the applicable guideline.	75
k)	Confirm that the financial provision will be provided as determined.....	75
l)	Mechanisms for monitoring compliance with and performance assessment against the environmental management programme and reporting thereon, including.....	76
m)	Indicate the frequency of the submission of the performance assessment/ environmental audit report.	77
n)	Environmental Awareness Plan	77
ii.	Manner in which the applicant intends to inform his or her employees of any environmental risk which may result from their work.....	77
iii.	Manner in which risks will be dealt with in order to avoid pollution or the degradation of the environment.....	77
o)	Specific information required by the Competent Authority	77
5.	UNDERTAKING.....	78

Appendices

Appendix A	Curriculum Vitae of the EAP
Appendix B	Site Map
Appendix C	Stakeholder Database
Appendix D	Ecology Impact Assessment
Appendix E	Previous Archaeology, Palaeontology and Heritage Specialist Study Conducted Near the Site

List of Tables

Table 1:	Description of properties	4
Table 2:	NEMA listed Activities (2014) applicable to the project	7
Table 3:	Listed activities	8
Table 4:	Alternatives considered for the development of the haul road	14
Table 5:	Rainfall recorded at Aggeneys weather station from 1986 - 2018.....	18
Table 6:	Temperature data (°C) for Pofadder weather station over a 29 year period	19
Table 7:	Key socio-economic statistics	30
Table 8:	Significance of soil compaction caused by construction traffic.....	35
Table 9:	Significance of loss of land capability during construction.....	35
Table 10:	Significance of soil erosion caused by Operational activities	36
Table 11:	Significance of soil compaction caused by hauling during Operational activities	36
Table 12:	Significance of loss of land capability during Operational activities.....	37
Table 13:	Significance of impaired air quality from suspended particulates affecting receptors during construction.....	37
Table 14:	Significance of increased dustfall associated with hauling activities	38
Table 15:	Significance of loss of vegetation.....	39
Table 16:	Significance of loss of threatened floral species during construction	39
Table 17:	Significance of disturbance to terrestrial fauna and loss of habitat during construction	40
Table 18:	Significance of increased terrestrial mortalities during Operational activities.....	41
Table 19:	Significance of degradation of drainage lines during construction	42
Table 20:	Significance of loss of palaeontological resources during road construction	43
Table 21:	Criteria used to determine the consequence of the impact	43
Table 22:	Method used to determine the consequence score.....	44
Table 23:	Probability classification	44
Table 24:	Impact significance ratings.....	44
Table 25:	Impact status and confidence classification.....	44
Table 26:	Summary of potential impacts.....	47
Table 27:	Environmental management and mitigation measures that must be implemented during the <i>Design Phase</i>	59
Table 28:	Environmental management and mitigation measures that must be implemented during the <i>Construction Phase</i>	61
Table 29:	Environmental management and mitigation measures that must be implemented during the <i>Operational Phase</i>	70
Table 30:	Environmental management and mitigation measures that must be implemented during the <i>Maintenance Phase</i>	72

List of Figures

Figure 1:	Locality map	6
Figure 2:	Existing and proposed infrastructure / haul roads	9
Figure 3:	Haul road intersection at the processing area	10
Figure 4:	Proposed haul road alignment alternatives	13
Figure 5:	Topography surrounding the site	17
Figure 6:	Ephemeral drainage lines and proposed crossings.....	20
Figure 7:	Vegetation types at the site.....	21
Figure 8:	Plant communities, selected alternative (1) and alternatives screened out (2-4)	22
Figure 9:	Plant communities on site	24
Figure 10:	Environmental sensitivity	26
Figure 11:	Vegetation sensitivity, selected alternative (1) and alternatives screened out (2-4)	Error! Bookmark not defined.
Figure 12:	Specific environmental features and infrastructure on the site.....	32
Figure 13:	Current land use.....	33

Acronyms and Abbreviations

BA	Basic Assessment
BAR	Basic Assessment Report
BMM	Black Mountain Mining (Pty) Ltd
CBA	Critical Biodiversity Area
DMR	Department of Mineral Resources
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMF	Environmental Management Framework
GDPR	Regional Gross Domestic Product
GN	Government Notice
ha	Hectares
IDP	Integrated Development Plan
IUCN	International Union for Conservation of Nature
KLM	Khâi-Ma Local Municipality
km	Kilometres
LM	Local Municipality
LN	Listing Notice
MPRDA	Mineral and Petroleum Resources Development Act 28 of 2002
MSDS	Material Safety Data Sheet
NCDENC	Northern Cape Department of the Environment and Nature Conservation
NCNCA	Northern Cape Nature Conservation Act 9 of 2009
NDM	Namakwa District Municipality
NEMA	National Environmental Management Act 107 of 1998
NEM:BA	National Environmental Management: Biodiversity Act 10 of 2004
NHRA	National Heritage Resources Act 25 of 1999
NWA	National Water Act 36 of 1998
PES	Present Ecological State
PGDS	Provincial Growth and Development Strategy
PSDF	Provincial Spatial Development Framework
RDL	Red Data List
S&EIR	Scoping and Environmental Impact Reporting
SAHRA	South African National Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System
SANBI	South African National Botanical Institute
SANS	South African National Standard
SCC	Species of Conservation Concern
SDF	Spatial Development Framework

SEMP	Strategic Environmental Management Programme
SoW	Scope of Work
SRK	SRK Consulting (South Africa) (Pty) Ltd
StatsSA	Statistics South Africa
ToR	Terms of Reference
WRD	Waste Rock Dump
WUA	Water Use Authorisation

Glossary

Avifauna	The collective birds of a given region.
Baseline	Information gathered at the beginning of a study which describes the environment prior to development of a project and against which predicted changes (impacts) are measured.
Community	Those people who may be impacted upon by the construction and operation of the project. This includes neighbouring landowners, local communities and other occasional users of the area
Construction Phase	The stage of project development comprising site preparation as well as all construction activities associated with the development.
Consultation	A process for the exchange of views, concerns and proposals about a project through meaningful discussions and the open sharing of information.
Critical Biodiversity Area	Areas of the landscape that must be conserved in a natural or near-natural state in order for the continued existence and functioning of species and ecosystems and the delivery of ecosystem services.
Cumulative Impacts	Direct and indirect impacts that act together with current or future potential impacts of other activities or proposed activities in the area/region that affect the same resources and/or receptors.
Ecological Support Area	Areas which play an important role in supporting the ecological functioning of critical biodiversity areas and/or in delivering ecosystem services that support socio-economic development.
Ecology	The study of the interrelationships of organisms with and within their physical surroundings
Ecosystem	The interconnected assemblage of all living organisms that occupy a given area and the physical environment with which they interact.
Environment	The external circumstances, conditions and objects that affect the existence of an individual, organism or group. These circumstances include biophysical, social, economic, historical and cultural aspects.
Environmental Authorisation	Permission granted by the competent authority for the applicant to undertake listed activities in terms of the NEMA EIA Regulations, 2014.
Environmental Impact Assessment	A process of evaluating the environmental and socio-economic consequences of a proposed course of action or project.
Environmental Management Programme	A description of the means (the environmental specification) to achieve environmental objectives and targets during all stages of a specific proposed activity.
Ephemeral	A water body that does not flow or contain water year-round, in response to seasonal rainfall and run-off.
Fauna	The collective animals of a particular region, habitat or geological period.
Flora	The collective plants of a particular region, habitat or geological period.
Heritage Resources	Refers to something tangible or intangible, e.g. a building, an area, a ritual, etc. that forms part of a community's cultural legacy or tradition and is passed down from preceding generations and has cultural significance.

Hydrology	(The study of) surface water flow.
Impact	A change to the existing environment, either adverse or beneficial, that is directly or indirectly due to the development of the project and its associated activities.
Inselberg	An isolated hill or mountain rising abruptly from a plain.
Independent EAP	An independent person with the appropriate qualifications and experience appointed by the Applicant to manage the Environmental Impact Assessment process on behalf of the Applicant.
Integrated Environmental Management	The practice of incorporating environmental management into all stages of a project's life cycle, namely planning, design, implementation, management and review.
Mitigation measures	Design or management measures that are intended to minimise or enhance an impact, depending on the desired effect. These measures are ideally incorporated into a design at an early stage.
Life of Mine	The time in which the ore reserves of a mine will be extracted.
Mining Right	A right to enter upon and occupy a specific piece of ground (in South Africa) for the purpose of working it for the extraction or collection of minerals.
Operational Phase	The stage of the works following the Construction Phase, during which the development will function or be used as anticipated in the Environmental Authorisation.
Perennial river	A river that flows year-round
Red Data List	Species of plants and animals that because of their rarity and/or level of endemism are included on a Red Data List (usually compiled by the IUCN) which provides an indication of their threat of extinction and recommendations for their protection.
Specialist study	A study into a particular aspect of the environment, undertaken by an expert in that discipline.
Stakeholders	All parties affected by and/or able to influence a project, often those in a position of authority and/or representing others.
Sustainable development	Sustainable development is generally defined as development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs. NEMA defines sustainable development as the integration of social, economic and environmental factors into planning, implementation and decision-making so as to ensure that development serves present and future generations.



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: Black Mountain Mining (Pty) Ltd
CONTACT PERSON: Pieter David Venter
TEL NO: +27 54 983 9835 / 9802
FAX NO:
POSTAL ADDRESS: Private Bag X01, Aggeneys, 8893
PHYSICAL ADDRESS: 1 Penge Road, Aggeneys, 8893
FILE REFERENCE NUMBER SAMRAD: NC-00066-MR/102

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 Environmental Assessment Practitioner (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. OBJECTIVE 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 the these aspects to determine:
 - (i) the nature, significance, consequence, extent, duration, and 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.

PART A

SCOPE OF ASSSSMENT AND BASIC ASSESSMENT REPORT

3. CONTACT PERSON AND CORRESPONDENCE ADDRESS

a) Details of EAP

i. Details of the EAP

Name of the Practitioner: Scott Masson of SRK Consulting (South Africa) (Pty) Ltd ("SRK").
 Tel No.: +27-(0)21-659-3071
 Fax No. +27-(0)86-530-7003
 e-mail address: smasson@srk.co.za

ii. Expertise of the EAP

1) The Qualifications of the EAP

(with evidence)

Profession: Senior Environmental Consultant
 Education: MLA (Landscape Architecture), University of Cape Town, 2008
 BSc (Hons), (Environmental Management), University of Cape Town, 2004
 Registrations / CEAPSA
 Affiliations: Member of National Association for Clean Air

Refer to Appendix A for the Curriculum Vitae of Scott Masson.

2) Summary of the EAP's past experience.

(In carrying out the Environmental Impact Assessment Procedure)

Scott Masson is a Senior Environmental Consultant and has been involved in the environmental and landscape architectural field for the past 10 years. His expertise includes Visual Impact Assessment, Environmental Impact Assessment, Environmental Management Programmes, Integrated Water and Waste Management Plans, and environmental planning and sensitivity studies.

b) Location of the overall Activity.

Table 1 presents the location and associated cadastral details associated with the proposed site.

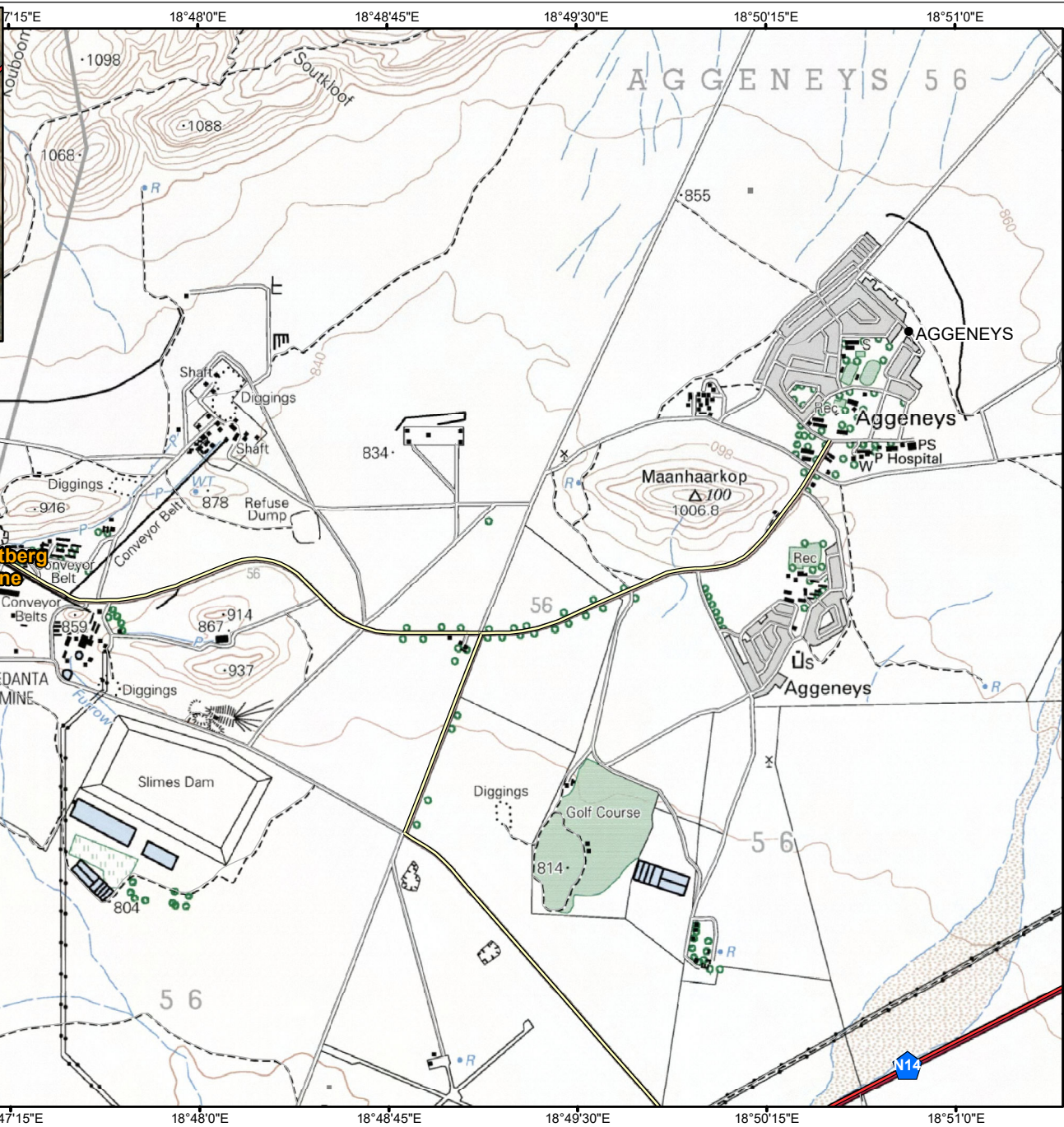
Table 1: Description of properties

Farm Name:	Portion 4, Farm Zuurwater No 62
Application area (Ha)	The proposed haul road will be approximately 1.2 km long and 8 m wide. As such, the disturbance footprint is expected to be ~ 1 ha.
Magisterial district:	Namakwa District Municipality (NDM)
Distance and direction from nearest town	The site is approximately 6 km west of Aggeneys (nearest town).
21 digit Surveyor General Code for each farm portion	C0530000000006200004

c) Locality map

(show nearest town, scale not smaller than 1:250000)

The proposed haul road will be located within BMM's existing mining right area which covers a total area of approximately 24 ha. The study area for the purposes of the BA process comprised a 300 m corridor (i.e. 150 m on each side of the selected route) extending the full length of the proposed haul road route (the site). Figure 1 illustrates the location of the site in relation to the regional setting.



N

Legend

- Towns
- Other Road
- Secondary Road
- National Road
- Site Boundary

0 250 500 1 000 Meters

Data Source:
Chief Directorate: National Geospatial Information (CD:NGI)

Scale:
1:40 000 @ A4

Projection: TM	Datum: HH94
Central Meridian/Zone: Lo19	
Date: 06/11/2018	Compiled by: FUBM
Project No: 536396	Fig No: 1



SWARTBERG HAUL ROAD LOCALITY MAP

d) Description of the scope of the proposed overall activity

Provide a plan drawn to a scale acceptable to the competent authority but not less than 1:10 000 that shows the location, and area (hectares) of all the aforesaid main and listed activities, and infrastructure to be placed on site

i. Listed and specified activities

In terms of Section 24 of the National Environmental Management Act 107 of 1998 (NEMA), an application for Environmental Authorisation (EA) must be submitted to the competent authority for activities listed in the Environmental Impact Assessment (EIA) Regulations, 2014, promulgated in terms of Section 24(5) of NEMA (GN 982 as amended by GN 326), and EA obtained prior to the commencement of those activities. Listing Notices 1-3 in terms of NEMA list activities that require EA ("NEMA listed activities").

Activities listed in Listing Notice (LN) 1 and LN3 require a Basic Assessment (BA) process, while activities listed in LN2 require Scoping and Environmental Impact Reporting (S&EIR).

The proposed project includes activities that are listed in terms of the EIA Regulations, 2014 (see Table 2).

Table 2: NEMA listed Activities (2014) applicable to the project

No.	Listed activity	Description
Listing Notice 1 (GN R983)		
12	The development of infrastructure or structures with a physical footprint of 100 square metres or more within a watercourse.	The haul road will cross 11 drainage lines. Pre-cast cement culverts and/or low-level drift crossings will be constructed at each crossing. The crossings / culverts will be at least 8 m wide and will vary in length depending on the width of the drainage line. The <u>cumulative</u> development footprint of all crossings / culverts will be in excess of 100 m ² .
19	The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse.	The installation / construction of 11 pre-cast cement culverts and/or low-level drift crossings within drainage lines is likely to trigger this activity.
24	The development of a road wider than 8 metres outside of an urban area.	The haul road will be approximately 8 m wide, with an additional disturbance footprint of approximately 1 m on either side. The haul road will be approximately 1.2 km long.
Listing Notice 3 (GN R985)		
4.	The development of a road wider than 4 metres with a reserve less than 13,5 metres in the Northern Cape: (ii) Outside urban areas: (ee) In Critical Biodiversity Areas (CBAs) as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans	A portion of the new haul road (~ 160 m) with a width of 8 m will occur within an area identified as CBA 1 in terms of the 2016 Northern Cape Critical Biodiversity Area Map (SANBI) which updates, revises and replaces all older systematic biodiversity plans and associated products for the province including the: <ul style="list-style-type: none"> • Namakwa District Biodiversity Sector Plan; • Cape Fine-Scale Plan; and • Richtersveld Municipality Biodiversity Assessment.

No.	Listed activity	Description
12	The clearance of an area of 300 square metres or more of indigenous vegetation in the Northern Cape: (ii) Within CBAs identified in bioregional plans.	A portion of the new haul road (~1 280 m ²) will occur within an area identified as CBA 1 in terms of the 2016 Northern Cape Critical Biodiversity Area Map (SANBI) which updates, revises and replaces all older systematic biodiversity plans and associated products for the province including the: <ul style="list-style-type: none"> Namakwa District Biodiversity Sector Plan; Cape Fine-Scale Plan; and Richtersveld Municipality Biodiversity Assessment.

The proposed development activities, extent and relevant applicable listing notice are included in Table 3.

Table 3: Listed activities

NAME OF ACTIVITY <i>(E.g. For prospecting - drill site, site camp, ablution facility, accommodation, equipment storage, sample storage, site office, access route etc...etc...etc</i> <i>E.g. for mining,- excavations, blasting, stockpiles, discard dumps or dams, Loading, hauling and transport, Water supply dams and boreholes, accommodation, offices, ablution, stores, workshops, processing plant, storm water control, berms, roads, pipelines, power lines, conveyors, etc...etc...etc.)</i>	Aerial extent of the Activity Ha or m ²	LISTED ACTIVITY Mark with an X where applicable or affected.	APPLICABLE LISTING NOTICE <i>(GNR 544, GNR 545 or GNR 546)</i>
Construction of the haul road	~ 1 ha	X	GN R983 (Activity 24), GN R985 (Activity 4)
Site clearance	9 600 m ² (of which ~ 1 280 m ² will occur within an area identified as CBA1)	X	GN R985 (Activity 12)
Drainage line crossings	In excess of 100 m ²	X	GN R983 (Activity 12 and 19)
Laydown areas	Less than 1 ha	-	-
Source material from existing borrow pit	-	-	-
Raising of an existing 66 kV powerline	Raised by 8 -10 m	-	-

ii. Description of the activities to be undertaken

(Describe Methodology or technology to be employed, including the type of commodity to be prospected/mined and for a linear activity, a description of the route of the activity)

Black Mountain Mining (Pty) Ltd (BMM) mines and processes copper, lead and zinc at the Black Mountain and Gamsberg Mines near the town of Aggeneys in the Northern Cape. The Black Mountain Mine ('the Mine'), west of Aggeneys, comprises a processing area (including waste management and ancillary facilities) and two underground shafts:

- Deeps shaft (produces copper, lead and zinc, with silver as a by-product); and
- Swartberg shaft (produces primarily copper and lead, with silver as a by-product).

The Mine has been in operation since 1980.

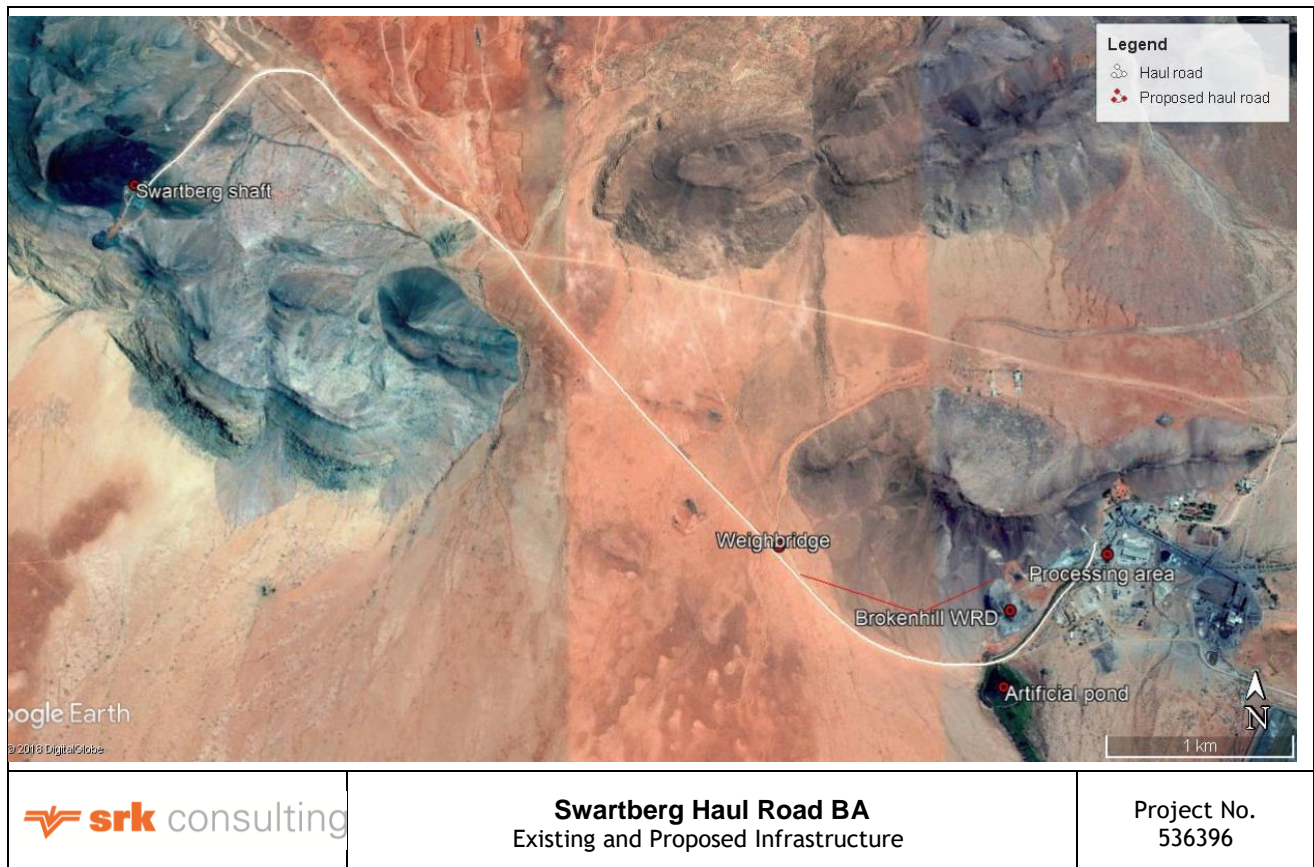


Figure 2: Existing and proposed infrastructure / haul roads

Trucks transport ore and waste rock from the Swartberg shaft using an existing haul road to the processing area (see Figure 2). Currently 30 to 40 loads of ore and waste rock are transported per day by five to seven trucks, which is expected to increase in future. The haul road intersects numerous ancillary roads in the processing area (see Figure 3). Access to the Brokenhill Waste Rock Dump (WRD) at this intersection requires heavy vehicles (transporting ~34 tonne loads) to turn sharply which presents traffic issues and safety concerns.

To alleviate traffic and safety concerns, and to optimise haul distances at the Mine, BMM proposes to construct a new haul road from the top of the WRD to the weighbridge area located adjacent to the existing haul road (see Figure 3).

The project will occur entirely within BMM's approved Mining Right Area.

Key aspects of the project include:

- Construction of a new haul road: The new haul road will be 8 m wide to allow for 2-way truck traffic and ~ 1.2 km long. Additional fill, if required, will be sourced from BMM's existing (approved) borrow pit south-east of the processing area;
- Establishment of laydown areas: Laydown areas will be located within the existing disturbed footprint of the weighbridge area and WRD;
- Installation of river crossings: The proposed haul road will cross 11 ephemeral drainage lines, requiring the installation of eleven pre-cast cement culverts and/or construction of low-level drift crossings; and
- Alterations to existing powerline: An existing 66 kV powerline is located in close proximity to and over the proposed haul road. BMM will raise the powerline to ensure heavy vehicles can pass safely beneath.

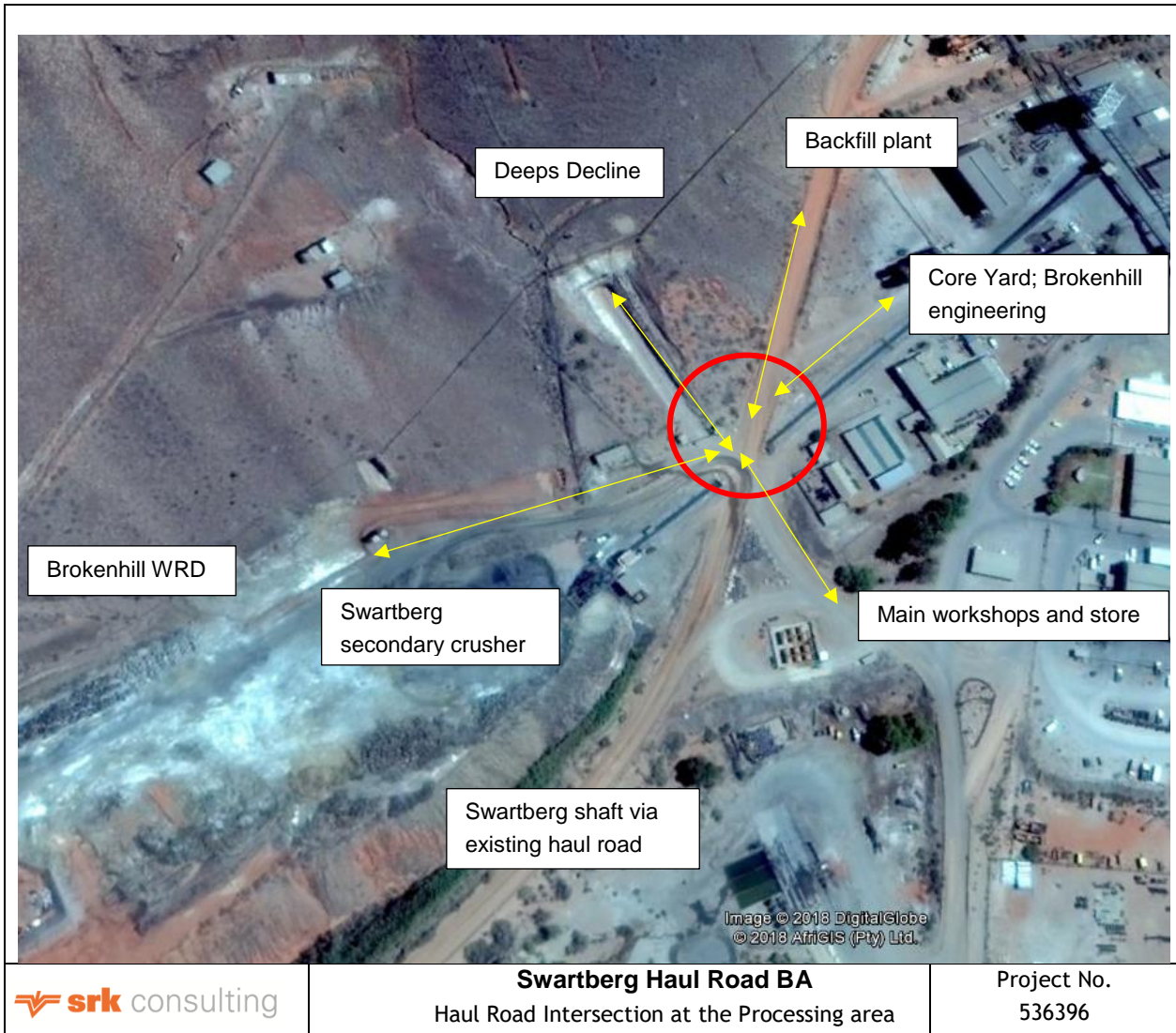


Figure 3: Haul road intersection at the processing area

e) Policy and Legislative Context

APPLICABLE LEGISLATION AND GUIDELINES USED TO COMPILE THE REPORT (a description of the policy and legislative context within which the development is proposed including an identification of all legislation, policies, plans, guidelines, spatial tools, municipal development planning frameworks and instruments that are applicable to this activity and are to be considered in the assessment process)	REFERENCE WHERE APPLIED	HOW DOES THIS DEVELOPMENT COMPLY WITH AND RESPOND TO THE LEGISLATION AND POLICY CONTEXT. (E.g. In terms of the National Water Act a Water Use License has/ has not been applied for)
Mineral and Petroleum Resources Development Act, 2002 (MPRDA)	BMM holds an approved Mining Right for the Mine. In terms of Section 102 of the MPRDA, BMM must submit an application to amend the approved EMPr to include the project through the BA process.	The Section 102 application was submitted to the Department of Mineral Resources (DMR) on 26 November 2018.
National Environmental Management Act 107 of 1998 (NEMA)	BMM has a responsibility to ensure that the proposed activities and the BA process conform to the principles of NEMA. The proponent is obliged to take actions to prevent pollution or degradation of the environment in terms of Section 28 of NEMA, and to ensure that the environmental impacts associated with the project are considered and mitigated where possible.	An application for EA was submitted to the DMR on 26 November 2018.
EIA Regulations, 2014 (GN R982) as amended by GN R 326 on 7 April 2017	BMM is obliged to apply for EA for the activities listed in Table 2 and to undertake a BA process in support of the application, in accordance with the procedure stipulated in the EIA Regulations 2014.	
National Environmental Management: Biodiversity Act 10 of 2004 (NEM:BA)	<p>One Threatened or Protected Species (ToPS) [quiver tree (<i>Aloidendron dichotomum</i>)] was recorded on site, however, this is located at least 50 m north of the selected route and will not be displaced on account of the road construction / operation.</p> <p>The site is not situated in any threatened ecosystem as both the Aggeneys Gravel Vygieveld and the Bushmanland Sandy Grassland vegetation type on site have a "least threatened" status.</p>	The status of the site in terms of NEM:BA, and the impact of the project on the biodiversity of the area, has been considered and assessed as part of the BA.
National Water Act 36 of 1998 (NWA)	The construction of the haul road (specifically the installation of cement culverts and/or low-level drift crossings in the drainage lines) triggers water use activities in terms of section 21 (c) and (i) of the NWA.	BMM will apply for Water Use Authorisation (WUA) from the Department of Water and Sanitation (DWS) contemporaneously with the EA application process.
National Heritage Resources Act 25 of 1999 (NHRA)	Section 38 of the National Heritage Resources Act 25 of 1999 (HNRA) requires that any person who intends to undertake certain categories of development (including the construction of linear infrastructure exceeding 300 m in length) must notify the South African Heritage Resource Agency	Details regarding the location, nature and extent of the proposed development were submitted to the South African Heritage Resources Information System (SAHRIS) in November 2018.

	(SAHRA) at the very earliest stage of initiating such a development and must furnish details of the location, nature and extent of the proposed development.	
Northern Cape Nature Conservation Act (2009) (NCNCA)	No person may, without a permit, pick, import, export, transport, possess, cultivate or trade in a specimen of a specially protected plant or a protected plant species. Two specially protected and 21 protected plant species were recorded on site.	Permits will have to be obtained from the Northern Cape Department of Nature Conservation (NCDENC) for the removal of all protected plant species.
Northern Cape Provincial Growth and Development Strategy (2011) (PGDS)	The PGDS defines a vision for the Northern Cape: 'building a prosperous, sustainable growing provincial economy to eradicate poverty and improve development for a caring society'. The overarching objective of the PGDS is to ensure the integration of development processes and, in particular, to facilitate sustainable development throughout the province.	Mining is recognised as a significant sector contributing to the regional and national economies. The proposed development will improve the operation of an existing mine.
Northern Cape Provincial Spatial Development Framework (2012) (PSDF)	The PSDF recognises the mining industry to be of national and international importance.	
Namakwa District Biodiversity Sector Plan (2008)	The Namakwa District Biodiversity Sector Plan is intended to help guide land-use planning, environmental assessments and authorisations; and, natural resource management in order to promote development which occurs in a sustainable manner.	This document was considered during the compilation of the BA Report (BAR), EMPr and in the Ecology Impact Assessment.
Environmental Management Framework (EMF) and Strategic Environmental Management Plan (SEMP) for the Namakwa District Municipality (2011)	The EMF and SEMP identifies a number of strategic management measures to ensure that environmental resources in the NDM are managed sustainably. One such measure is the encouragement of mining where environmental impacts are deemed to be acceptable, the appropriate environmental controls are in place and economic benefits will exceed potential environmental impacts.	Environmental and socio-economic impacts have been assessed in the BAR.
Namakwa District Municipality Integrated Development Plan (2017 -2022) (IDP)	The IDP recognises the mining industry as a main economic sector and important job driver in the region. It further recognises the closure of mines as having a negative socio-economic impact.	Mining is recognised as a significant sector contributing to the regional and national economies. The proposed development will improve the operation of an existing mine.
Khai-Ma Local Municipality IDP	The IDP recognises the mining industry as the "backbone" of the region's economy.	

f) Need and desirability of the proposed activities.

(Motivate the need and desirability of the proposed development including the need and desirability of the activity in the context of the preferred location).

Trucks transport ore and waste rock from the Swartberg shaft to the processing area using an existing haul road. The haul road intersects numerous ancillary roads in the processing area (see Figure 3). Access to the WRD at this intersection requires heavy vehicles to negotiate a sharp bend which presents logistical traffic issues and safety concerns.

The proposed haul road will alleviate traffic and safety concerns at this intersection, and will also optimise haul distances at the Mine by reducing the 17.3 km distance between the WRD and Swartberg shaft by 1.2 km.

Ultimately, the new haul road will optimise operations at the Mine by improving hauling efficiency.

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

BMM considered four haul road alignment alternatives (see Figure 4).

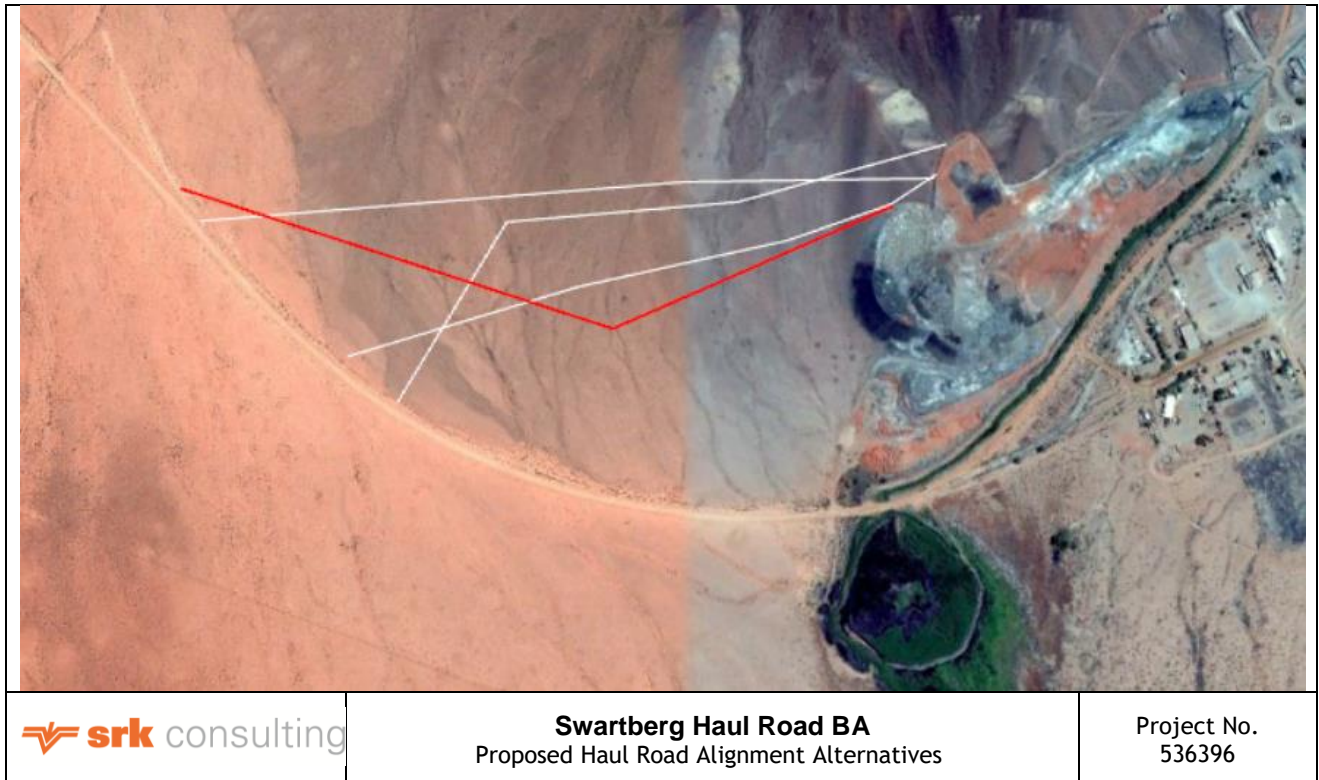


Figure 4: Proposed haul road alignment alternatives

The selected route alternative (in red in Figure 4) was determined based on biological, safety and design (e.g. slopes, fill material requirements, etc.) considerations. The terrain along the selected route is less undulating and less rocky for most of the route, especially in the western section. Consequently, the drainage lines do not form such deep incisions (which is a benefit from an ecological perspective). Furthermore, the site investigation undertaken by the ecology specialist revealed the presence of one ToPS (quiver tree) to the north of the WRD. Two of the screened-out alignment alternatives would have traversed this ToPS which is located at least 50 m north of the selected route.

BMM does not consider the other route alternatives to be feasible based on the financial and technical requirements to address the safety and design considerations for the other route alternatives.

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

NB!! – This section is about the determination of the specific site layout and the location of infrastructure and activities on site, having taken into consideration the issues raised by interested and affected parties, and the consideration of alternatives to the initially proposed site layout.

i. Details of the development footprint alternatives considered.

With reference to the site plan provided as Appendix 4 and the location of the individual activities on site, provide details of the alternatives considered with respect to:

- (a) the property on which or location where it is proposed to undertake the activity;
- (b) the type of activity to be undertaken;
- (c) the design or layout of the activity;
- (d) the technology to be used in the activity;
- (e) the operational aspects of the activity; and
- (f) the option of not implementing the activity.

Appendix 1, Section 3 (h)(i) of the EIA Regulations, 2014, requires that all BA processes must identify and describe alternatives to the proposed activity that are feasible and reasonable. Different types or categories of alternatives can be identified, e.g. location alternatives, type of activity, design or layout alternatives, technology alternatives and operational alternatives. The “No-Go” or “no development” alternative must also be considered.

Not all categories of alternatives are applicable to this project, as discussed in Table 4.

Table 4: Alternatives considered for the development of the haul road

Type / category of alternative	Description of alternatives considered
(a) the property on which or location where it is proposed to undertake the activity;	BMM owns Portion 4, Farm Zuurwater No 62, the property on which the Mine and proposed haul road is located. BMM considered four road alignment (route) alternatives (see Figure 4). The motivation for the selected alternative, and the reasons why the other alternatives were screened out are discussed above in Section 3(g). Furthermore, the ecology specialist considered environmental opportunities and constraints of all four alternatives and, although the selected alternative crosses more watercourses than the other alternatives, no fatal flaws were identified for this alternative.
(b) the type of activity to be undertaken;	The purpose of the project is to alleviate traffic and safety concerns at the intersection near the WRD, and to optimise haul distances between the WRD and Swartberg shaft. No other activity alternatives (other than the No-Go alternative) are considered acceptable or viable by the proponent, and activity alternatives (other than the No-Go alternative) are not considered further in the BA process.
(c) the design or layout of the activity;	See (a) above.
(d) the technology to be used in the activity;	Conveyers were also considered but were deemed unviable as they cannot accommodate the current volumes of ore and waste rock from the Mine.
(e) the operational aspects of the activity; and	Operational activity alternatives do not apply to the haul road, which is intended to address operational constraints, e.g. traffic and safety.
(f) the option of not implementing the activity.	The No-Go alternative implies that the haul road will not be constructed and the road safety at the mine will not be improved, and haul distances not optimised. This will inhibit future development at the Mine, and indirectly, in the region. In other words, the benefit of increased road safety and haul distance optimisation will be forgone.

	As a number of protected plant species and drainage lines occur on the site, biophysical impacts associated with the project would not materialise if the project does not proceed.
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ii. Details of the Public Participation Process Followed

Describe the process undertaken to consult interested and affected parties including public meetings and one on one consultation. NB the affected parties must be specifically consulted regardless of whether or not they attended public meetings. (Information to be provided to affected parties must include sufficient detail of the intended operation to enable them to assess what impact the activities will have on them or on the use of their land.

Public participation is currently being undertaken to raise public and authority awareness of the proposed project.

The key activities are described in further detail below.

- Placement of notice boards (size A2, in English and Afrikaans) at the entrance to the Mine;
- Placement of an advertisement (in English and Afrikaans) in one local newspaper (23 November 2018);
- Notification of stakeholders in terms of Section 41 (2) (b) of GN R982 of 2014; and
- Stakeholders and the public were invited to register on the stakeholder database for the project on or before 26 November 2018.

Comments received on the BAR will be collated into an Issues and Responses Summary which will be included with the Final BAR to be submitted to the DMR for decision making.

Proof of the notification of stakeholders will be provided in the Final BAR.

Newspaper Advertisements and Posters

A newspaper advertisement (in English and Afrikaans) announcing the commencement of the BA process, the availability of the BAR and inviting IAPs to register on the project database was placed in Die Plattelander on 23 November 2018.

In addition to the advertisement, a set of A2 posters (in English and Afrikaans) were placed at the entrance to the Mine. These posters contained brief details of the proposed project and process and the contact details of the consultant.

Identification of Key Stakeholders and IAPs

Relevant IAPs from local, provincial and national authorities, conservation bodies, Non-Governmental Organisations groups, local businesses and forums and surrounding land owners and occupants were considered for inclusion in the initial notification of the project and BA process. Relevant authorities were automatically registered as IAPs. Owners of properties neighbouring the site were notified but not automatically registered as IAPs.

As specified in GN R 982, authorities and all persons who submit written comments, or request in writing to be placed on the register will be registered as IAPs.

The stakeholder database is attached as Appendix C. The database of registered stakeholders will be updated throughout the process.

Notification of BAR for Public Comment

The release of the BAR for public review was communicated to all identified IAPs by post, email or fax on or by 26 November 2018. Hard copies of the full report have been placed at the following venues:

- Aggeneys Public Library;
- BMM security offices at the Mine; and

- SRK's office in Rondebosch, Cape Town.

An electronic version of the report is also available on SRK's website www.srk.co.za.

Hard copies of the BAR were sent to the following Organs of State on 26 November 2018 for comment:

- DMR;
- DWS;
- NCDENC;
- Namakwa District Municipality; and
- Khai-Ma Local Municipality.

DMR was notified that the reports were sent to the organs of state listed above to request their comment. Proof of notifications will be provided to DMR in the Final BAR.

Stakeholders will be afforded a 30 day comment period, ending on 18 January 2019.

Submission and Acceptance of Final BAR

Following initial review of the BAR, issues raised by authorities and the public will be summarised and responded to in an Issues and Responses Summary, which will be appended to the Final BAR. The BAR will be updated (if necessary) taking stakeholder input into account. The Final BAR will then be submitted to the DMR for decision making. IAPs will be informed of the submission of the Final BAR to the DMR, including the Issues and Responses Summary.

iii. Summary of issues raised by I&As

(Complete the table summarising comments and issues raised, and reaction to those responses)

A public comment period is currently underway and will end on 18 January 2019. Comments received on the BAR will be collated into an Issues and Responses Summary which will be appended to the Final BAR to be submitted to the DMR for decision making.

iv. The Environmental attributes associated with the alternatives

(The environmental attributes described must include socio-economic, social, heritage, cultural, geographical, physical and biological aspects)

1) Baseline Environment

a) Type of environment affected by the proposed activity

(its current geographical, physical, biological, socio-economic, and cultural character).

Topography

The topography of the NDM is characterised by mountainous areas, ridges, steep slopes, undulating hills and plateaus, floodplains and coastal dunes. The Kamiesberg mountain range forms an escarpment from Garies in the southeast to Springbok in the northeast. The Kamiesberg mountain range is characterised by granite and gneiss rock formations and steep rocky slopes that are separated by sandy plains and lowland areas. The mountain range functions as an important rain catchment area (Chidley et al., 2011).

The lowest lying areas of the NDM are situated along the coastal plain belt to the west of the N7.

The area surrounding the site is characterised by rocky slopes (north of the site) and sandy plains (south and southwest of the site) (Ekotrust, 2018) (see Figure 5). The site is located

on the southern slopes and plains of Noeniepoort se kop inselberg at approximately 810 m - 840 m metres above sea level.

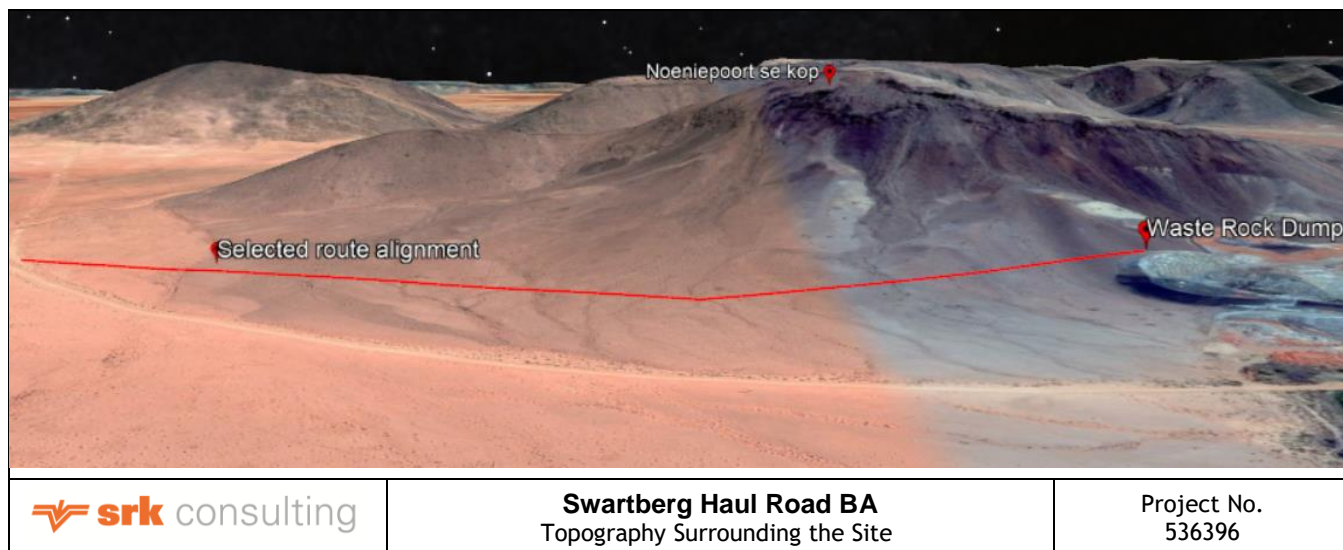


Figure 5: Topography surrounding the site

Geology

The prominent inselbergs and ranges of hills which characterise the arid landscape of the area are formed by the metavolcanic-metasedimentary units of the Bushmanland Group that usually occur as major, often overturned, synformal infolds in the associated granitic gneisses (Paleo Field Services, 2007).

The rocky slopes of the mountain on site consist of medium- to thick-bedded, white quartzite and pelitic schist, with interbedded sillimanite bodies (Kwr - Wortel Formation of the Aggeneys Subgroup, Bushmanland Group (Geological Series, 2007). The sandy plains to the east and west (Qs2) are covered by quaternary sand, scree, rubble and sandy soils.

Climate

Regional Climate

The NDM has a typical arid to semi- arid climate. Rainfall is low and unreliable. Summers have characteristically high temperatures and winters have mild to cold temperatures. The northern areas of the NDM experience the highest mean annual temperatures, while the cooler areas have the highest rainfall. The cold Benguela Current influences the climatic conditions by producing coastal fog and dew during the winter months (Chidley et al, 2011).

Rainfall

Rainfall in the NDM is among the lowest in the country. The western parts of the NDM (the Succulent Karoo, including the Garies area) are characterised by winter rainfall while the Nama Karoo is characterised by late summer rainfall. The south eastern areas of the NDM, (a band along the escarpment from Sutherland to Nieuwoudtville) receive most rainfall (between 400 mm and 600 mm per annum). The majority of the NDM receives rainfall less than 200 mm per annum.

The mean annual rainfall for Aggeneys (recorded from 1986 to 2017) was 100.9 mm, ranging from a minimum of 27.6 mm in 2015 to a maximum of 219.5 mm in 2006 (see Table 5).

Most rain is recorded between January and April, with least rainfall occurring between May and September (see Table 5) (BMM, 2018).

Table 5: Rainfall recorded at Aggeneys weather station from 1986 - 2018

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1986	2.0	2.0	20.0	31.0	1.0	34.0				16.0			106.0
1987		3.0	27.0	8.0				1.3	32.0	1.0	2.8		75.1
1988		26.0	88.0		6.0	2.0	1.0	10.0	3.5		10.0	42.0	188.5
1989	3.0	18.0		31.0		2.0	6.0						60.0
1990		13.0	6.5	40.0	5.0	13.0	2.0					12.0	91.5
1991	35.0		29.0	7.0	2.0				20.0	45.5		1.0	139.5
1992						4.5	5.0	1.5					11.0
1993	35.0		9.5	33.5	13.5	6.0	2.0			1.0	12.5	1.5	114.5
1994	20.5	21.5	6.0	12.0		6.0	10.0						76.0
1995	42.5	1.5	13.5		6.5		2.0	7.5	15.5	28.0	9.5	34.0	160.5
1996	10.0	16.0			3.5	2.0	65.0	9.0	8.5	15.5	39.0	3.0	171.5
1997		9.0	22.0	1.0	18.5	0.5	6.0		1.0	0.5	0.5	3.0	62.0
1998	1.0	1.0	20.5		5.5			33.0	19.0	3.5	1.0	17.0	101.5
1999		14.0	22.5	24.0	10.0			1.5	12.0	29.0	12.0	35.0	160.0
2000	7.5	90.0	6.0	5.0	0.5	0.5	7.5		2.0				119.0
2001	0.5	7.0	7.0	109.0	1.0		20.0	7.0	2.0	0.5	38.5		192.5
2002	0.5	15.5	18.5	35.0	10.5	3.5	1.0	35.0	4.0	7.0	3.5	3.0	137.0
2003		5.0	0.5					18.0		2.5	11.0	5.0	42.0
2004	7.5	6.0	5.0	8.0	6.0				3.0	17.0	1.0		53.5
2005	45.0	2.0	8.5	31.0	15.0			2.5		57.0	2.0	1.5	164.5
2006	47.0	45.0		75.0	14.0	1.5	2.0	35.0					219.5
2007	13.0		8.0	1.0	2.0	10.5	1.5	2.5		5.0	8.5	19.0	71.0
2008	4.0	11.0	23.0	0.5	23.0	33.0	15.0	2.0		3.5	11.0	2.0	128.0
2009		77.5	2.0		1.5	13.0	8.0	4.0			6.0		112.0
2010	24.0	20.0	4.0		3.5							20.0	71.5
2011	2.0	10.5	48.5	4.0	22.0	6.0		7.0			3.0		103.0
2012		20.5	7.5	3.0		6.3				2.0		9.0	48.3
2013	4.8			26.0				6.0				6.5	43.3
2014	28.0	15.5	17.5	6.0		6.0					29.0	3.0	105.0
2015	8.0			7.6	0.2	7.6	0.6	2.8	0.4			0.4	27.6
2016	27.4		0.4	2.2	2.2		0.6			3.4			36.2
2017	16.4	10.2	3.6			2.8			1.6		3.4	0.2	38.2
2018	0.4	4.6	18.8	5.0									
Month	16.0	17.9	16.4	21.1	7.5	8.0	8.6	10.3	8.9	13.2	10.7	10.9	
Mean	12.0	14.4	13.3	15.7	5.4	5.0	4.9	5.8	3.9	7.4	6.4	6.8	100.9

Source: BMM, 2018

Ambient Temperature

The NDM can be divided into a number of climatic regions. The NDM has an average annual temperature of less than 18°C.

The nearest town for which temperature data was available at the time of this study was Pofadder, approximately 50 km east of the site.

The mean annual temperature for Pofadder is 18.6°C (see Table 6), with maximum and minimum temperatures measured as 40.6°C and -1.4°C.

The highest mean daily maximum (33.0°C) is recorded in January and lowest mean daily minimum (5.1°C) is recorded in June.

Table 6: Temperature data (°C) for Pofadder weather station over a 29 year period

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Mean daily max.	33.0	32.4	30.1	25.4	21.4	17.8	18.0	20.0	23.6	26.5	30.0	32.1	25.8
Monthly max.	40.6	39.6	39.2	35.7	31.3	26.0	27.6	31.0	35.2	37.9	39.4	40.5	40.6
Mean daily min.	16.6	17.2	16.0	12.4	8.6	5.7	5.1	6.0	8.6	10.9	14.0	15.5	11.4
Monthly min.	6.4	5.6	4.4	0.5	-0.4	-2.7	-3.0	-2.7	-1.2	1.6	4.0	5.0	-3.0
Mean monthly temperature	24.8	24.8	23.0	18.9	15.0	11.8	11.6	13.0	16.1	18.7	22.0	23.8	18.6

Source: Ekotrust, 2018

Hydrology and Surface Water

This section is based on the Ecological Impact Assessment (2018) undertaken by Ekotrust (see Appendix D).

Catchment

The study area falls within the D82C quaternary catchment in the Lower Orange Water Management Area (Vedanta, 2017).

The general drainage direction is from north to south, with small to medium watercourses that are nonperennial. There are three very large sub-catchments that drain from the mountain range in the north towards the town of Aggeneys, Deeps and towards Swartberg respectively. These sub-catchments can contribute major volumes of run-off because of the size of these catchments. Mitigation measures, in the form of cut-off berms, have already been put in place to protect the Deeps area and the town of Aggeneys from the run-off from these catchments during big storm events (Vedanta, 2017).

Drainage Features

The proposed haul road will traverse 11 ephemeral drainage lines (see Figure 6).

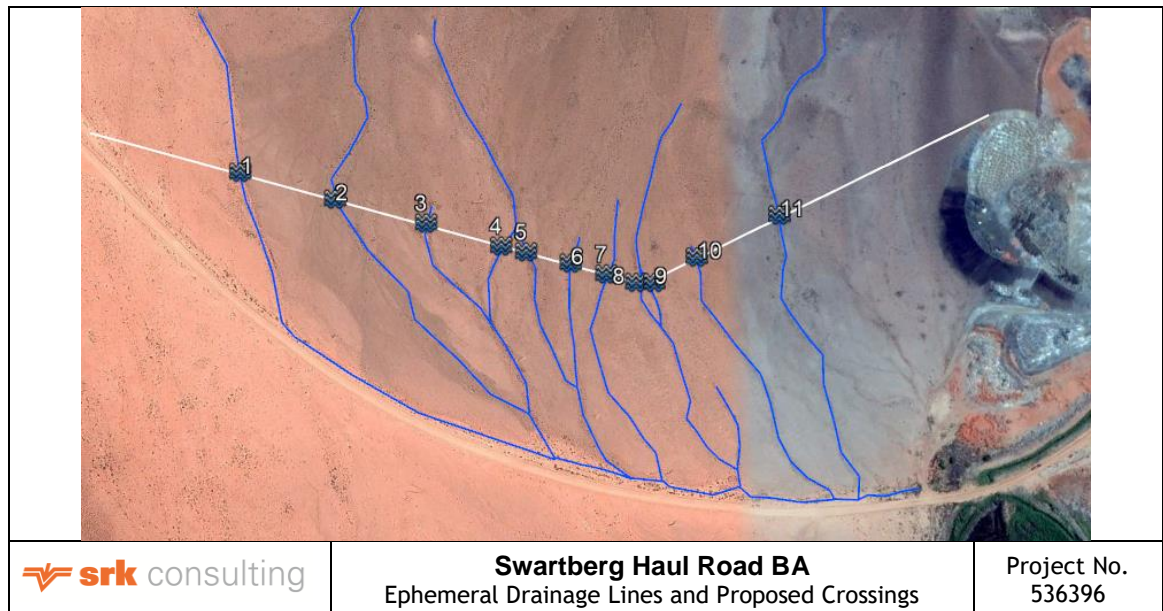


Figure 6: Ephemeral drainage lines and proposed crossings

The site is drained by a number of poorly defined ephemeral drainage lines (hereafter referred to as “drainage lines”) that run southwards from Noeniepoort se kop to the existing haul road in the south. Storm water that reaches the existing haul road diverts eastwards (naturally).

The drainage lines that occur on site are likely to convey water flow during rare, heavy thunderstorms in the rainy season and may not flow at all during droughts. As such, the drainage lines are neither riparian habitats nor wetlands (Ekotrust, 2018).

Ecological Condition of Drainage Lines

Present Ecological Status (PES) and Ecological Importance and Sensitivity (EIS) were calculated for the drainage lines.

PES refers to the degree to which ecological conditions of an area have been modified from natural conditions (Ekotrust, 2018). The results of the PES analysis show that the drainage lines are considered to be **Category A: unmodified or approximated natural condition**.

The ecological importance of a watercourse or river is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales. Ecological sensitivity (or fragility) refers to the system’s ability to resist disturbance and its capability to recover from disturbance once it has occurred (resilience).

A median score of <1.0 was obtained which means that the drainage lines fall in the **Category D: Marginal/Low** category, i.e. drainage lines that are not ecologically important and sensitive (unique) at any scale. The biodiversity of these drainage lines is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers.

Terrestrial Vegetation and Habitats

This section is based on the Ecological Impact Assessment (2018) undertaken by Ekotrust (see Appendix D).

Vegetation Types

The site falls within the Nama-Karoo Biome and the Bushmanland Bioregion (Mucina & Rutherford 2006).

The site is identified to fall within one vegetation type [Bushmanland Sandy Grassland (NKb 4)] as identified by Mucina and Rutherford (2006) (see Figure 7).

Based on fieldwork undertaken by Ekotrust in October 2018, it was determined that the western and southern portions of the site fall in the Bushmanland Sandy Grassland (NKb 4) vegetation type, and that the northern and eastern portions of the site fall within the Aggeneys Gravel Vygieveld (SKr 19) vegetation type.

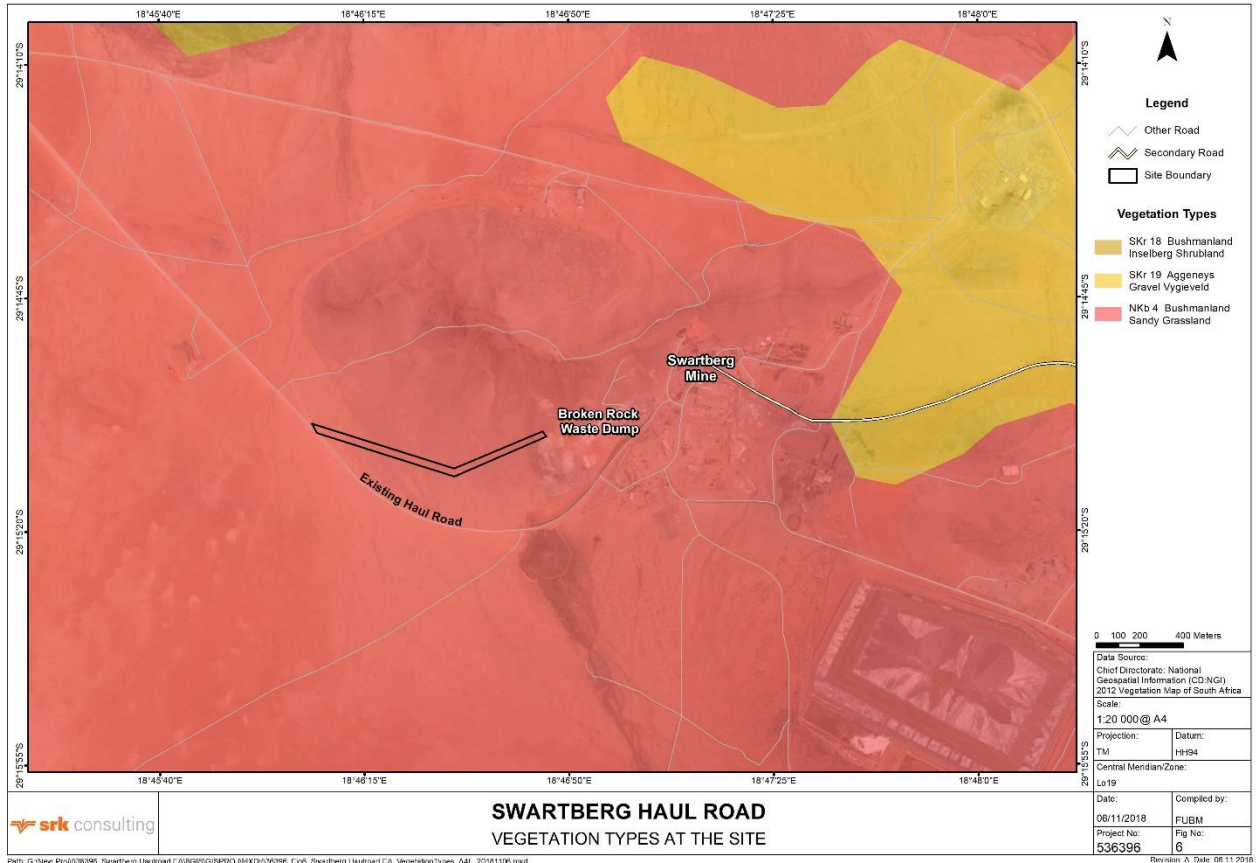


Figure 7: Vegetation types at the site
 Source: Ekotrust, 2018

Bushmanland Sandy Grassland (NKb 4)

This vegetation type is typical in northern Bushmanland in the surrounds of Aggeneys and a few isolated patches in eastern Bushmanland. Its distribution follows the course of the Koa River, a palaeoriverine system of the Orange River. The landscape consists of sandy grassland dominated by *Stipagrostis* species (e.g. *S. brevifolia*, *S. ciliata*, *S. obtusa* and *S. anomala*), *Schmidtia kalahariensis* and many drought-resistant shrubs such as *Rhigozum trichotomum* and *Sisyndite spartea*. Other grass species include *Aristida adscensionis*, *Centropodia glauca* and *Enneapogon desvauxii*. The forb layer is represented by *Gazania lichtensteinii*, *Grielum humifusum*, *Tribulus zeyheri*, *Dicoma capensis* and *Sesamum capense*. Prominent dwarf shrubs include *Eriocephalus microphyllus*, *Tetraena microphyllum*, *Hermannia spinosa* and *Monechma incanum*.

The conservation status of the Bushmanland Sandy Grassland is "least threatened" (NEM:BA, 2011) and is not conserved in any statutory conservation areas.

Aggeneys Gravel Vygieveld (SKr 19)

This vegetation type occurs at the foothills or on peneplains of inselbergs in northern Bushmanland from Pofadder westwards towards Namaqualand. The terrain is flat to slightly sloping with quartz layers alternating with red sandy soils, supporting a sparse layer of dwarf shrubs and dwarf leaf-succulents of the families Aizoaceae, Crassulaceae, Euphorbiaceae, Portulacaceae and Zygophyllaceae. Prominent shrubs and dwarf shrubs include *Ruschia divaricata*, *Euphorbia gariiepina*, *Kleinia longiflora*, *Lycium cinereum*, *Monsonia crassicaule*, *Aptosimum spinescens* and *Pegolettia retrofracta*. Succulent herbs include *Crassula corallina*, *C. deltoidea*, *Dinteranthus* species, *Avonia* species and *Conophytum* species.

The conservation status of the Bushmanland Sandy Grassland is "least threatened" (NEM:BA 2011) and is not conserved in any statutory conservation areas.

Plant Communities

Four plant communities occur within the site (Ekotrust, 2018) (see Figure 8).

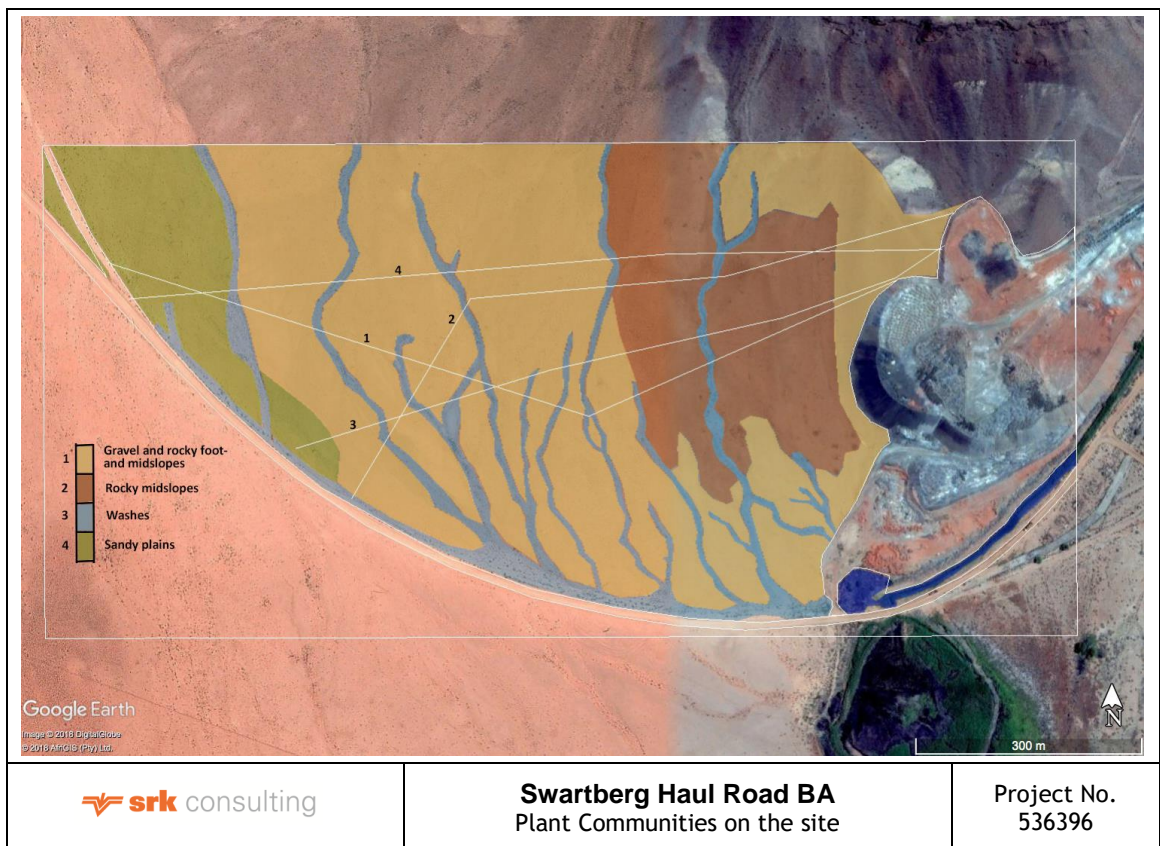


Figure 8: Plant communities, selected alternative (1) and alternatives screened out (2-4)

Source: Ekotrust, 2018

Gravel and Rocky foot- and midslopes

This dwarf shrubland is found on the footslopes and plains within the central and eastern portions of the site (see Photo 1, Figure 9). In these areas, the shallow soils are covered by gravel as well as large rocks.

The plant community is characterised by *Larryleachia marlothii*, *Avonia albissima* and *Mesembryanthemum arenosus*. No trees or shrubs were recorded. The open dwarf shrub layer includes species such as *Zygophyllum decumbens*, *Euphorbia gariiepina*, *Salsola tuberculata*, *Mesembryanthemum arenosus*, *Pteronia* sp. and *Portulacaria fruticulosa*. The most prominent forbs are *Sesamum capense*, *Ursinia nana*, *Didelta carnosa*, *Gazania lichtensteinii*, *Heliophila* species and *Kewa salsoloides*. The grass layer is poorly developed

with *Enneapogon desvauxii* (d), *Enneapogon scaber* and *Stipagrostis uniplumis* the prominent species.

Protected species include *Larryleachia marlothii*, *Euphorbia gariiepina*, *Avonia albissima*, *Avonia papyracea*, *Trianthema parvifolia* and *Mesembryanthemum arenosus*.

Rocky Midslopes

This dwarf shrubland is found on the mid- and footslopes in the north eastern parts of the site (see Photo 2, Figure 9), where shallow soils are covered by large rocks.

The plant community is characterised by *Aloidendron dichotomum*, *Boscia foetida*, *Mesembryanthemum schenkii*, *Mesembryanthemum noctiflorum*, *Anacampseros baeseckii*, *Ruschia centrocapsula* and *Tylecodon rubrovenosus*. The sparse tree and shrub layer include some individuals of *Aloidendron dichotomum* and *Boscia foetida*. The open dwarf shrub layer includes species such as *Mesembryanthemum schenkii*, *Mesembryanthemum noctiflorum*, *Euphorbia gariiepina*, *Portulacaria fruticulosa* and *Hermannia spinosa*. The most prominent forbs are *Ursinia nana*, *Sericocoma avolans*, *Acanthopsis hoffmannseggiana*, *Heliophila* species, *Didelta carnosus* and *Gazania lichtensteinii*. The grass layer is poorly developed with *Enneapogon desvauxii* (d), *Enneapogon scaber* and *Eragrostis obtusa* the prominent species.

Protected species include *Aloidendron dichotomum*, *Boscia foetida*, *Hoodia gordonii*, *Euphorbia gariiepina*, *Avonia papyracea*, *Mesembryanthemum schenkii*, *Mesembryanthemum noctiflorum*, *Anacampseros baeseckii*, *Tylecodon rubrovenosus*, *Tylecodon reduplicata*, *Drosanthemum* sp., *Trianthema parvifolia* and *Ruschia centrocapsula*.

Drainage Lines

This diverse dwarf shrubland is found along the small and narrow drainage lines flowing from the mountain in the north southwards through the site (see Photo 3, Figure 9). The drainage lines on the footslopes and plains are covered by sandy to sandy loam soils, while higher up it becomes rockier.

The drainage lines are diverse in floristic composition depending on the location on site. The plant community is characterised by species such as *Parkinsonia africana*, *Lycium oxycarpum*, *Lycium cinereum*, *Microloma incanum*, *Osteospermum sinuatum*, *Eriocephalus scariosus* and *Aptosimum spinescens*. The sparse tree and shrub layer include some individuals of *Parkinsonia africana*, *Lycium oxycarpum* and *Lycium cinereum*. The open dwarf shrub layer includes species such as *Rhigozum trichotomum* (d), *Euphorbia gariiepina*, *Salsola tuberculata*, *Monechma incanum*, *Kleinia longiflora*, *Microloma incanum*, *Osteospermum sinuatum*, *Melolobium microphyllum*, *Eriocephalus scariosus* and *Aptosimum spinescens*. The most prominent forbs are *Trianthema parvifolia*, *Blepharis macra*, *Chascanum gariiepense*, *Heliophila* spp., *Gazania lichtensteinii* and *Didelta carnosus*. The grass layer is poorly developed with various *Stipagrostis* species, *Aristida engleri*, *Enneapogon desvauxii*, *Enneapogon scaber* and *Eragrostis obtusa* the prominent species.

Protected species include *Larryleachia marlothii*, *Hoodia gordonii*, *Euphorbia gariiepina*, *Mesembryanthemum arenosus*, *Mesembryanthemum crystallinum*, *Mesembryanthemum* sp., *Microloma incanum*, *Tetragonia arbuscula*, *Tetragonia reduplicata* and *Trianthema parvifolia*.

Sandy Plains

This open dwarf shrubland is found on the sandy plains to the west and southwest of the site (see Photo 4, Figure 9). The sandy soils are medium to deep with little gravel and rock cover.

The plant community is characterised by *Stipagrostis uniplumis*, *Hermannia stricta*, *Sisyndite spartea*, *Augea capensis* and *Monsonia parvifolia*. The shrub layer is represented by *Sisyndite spartea*, *Diospyros austro-africana*, *Phaeoptilum spinosum*, *Lycium oxycarpum* and *Lycium cinereum*. The open dwarf shrub layer includes species such as *Monechma incanum*, *Kleinia longiflora*, *Hermannia stricta*, *Tetragonia arbuscula*, *Salsola tuberculata*, *Limeum aethiopicum* and *Mesembryanthemum tetragonum*. The most prominent forbs are *Monsonia parvifolia*, *Foveolina dichotoma*, *Blepharis mitrata*, *Heliophila species*, *Didelta carnosa* and *Gazania lichtensteinii*. The grass layer is poorly developed with *Stipagrostis uniplumis*, *Stipagrostis ciliata*, *Stipagrostis obtusa* and *Enneapogon desvauxii* the prominent species.

Protected species include *Euphorbia gariiepina*, *Euphorbia rhombifolia*, *Mesembryanthemum crystallinum*, *Tetragonia arbuscula* and *Mesembryanthemum tetragonum*.

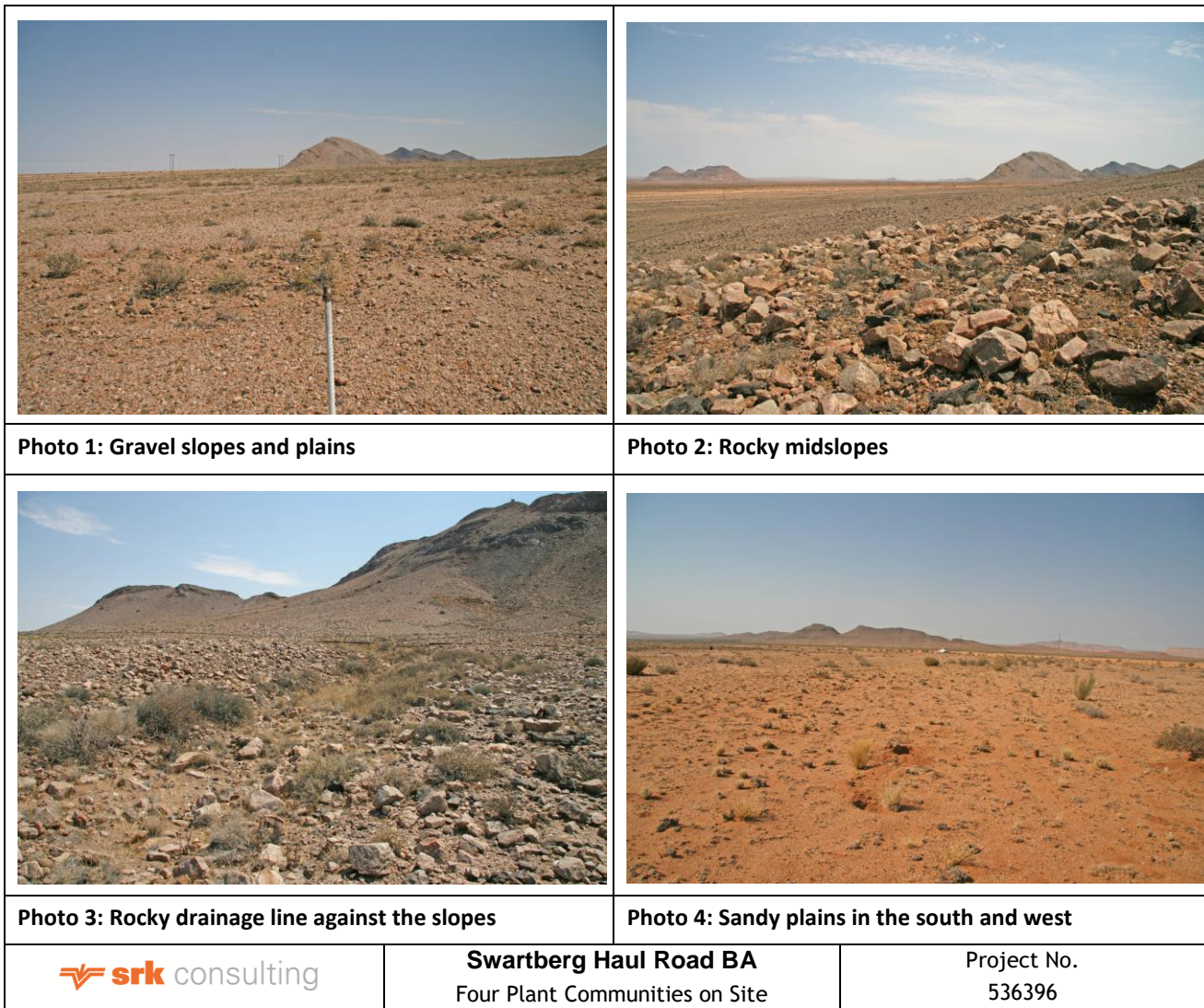
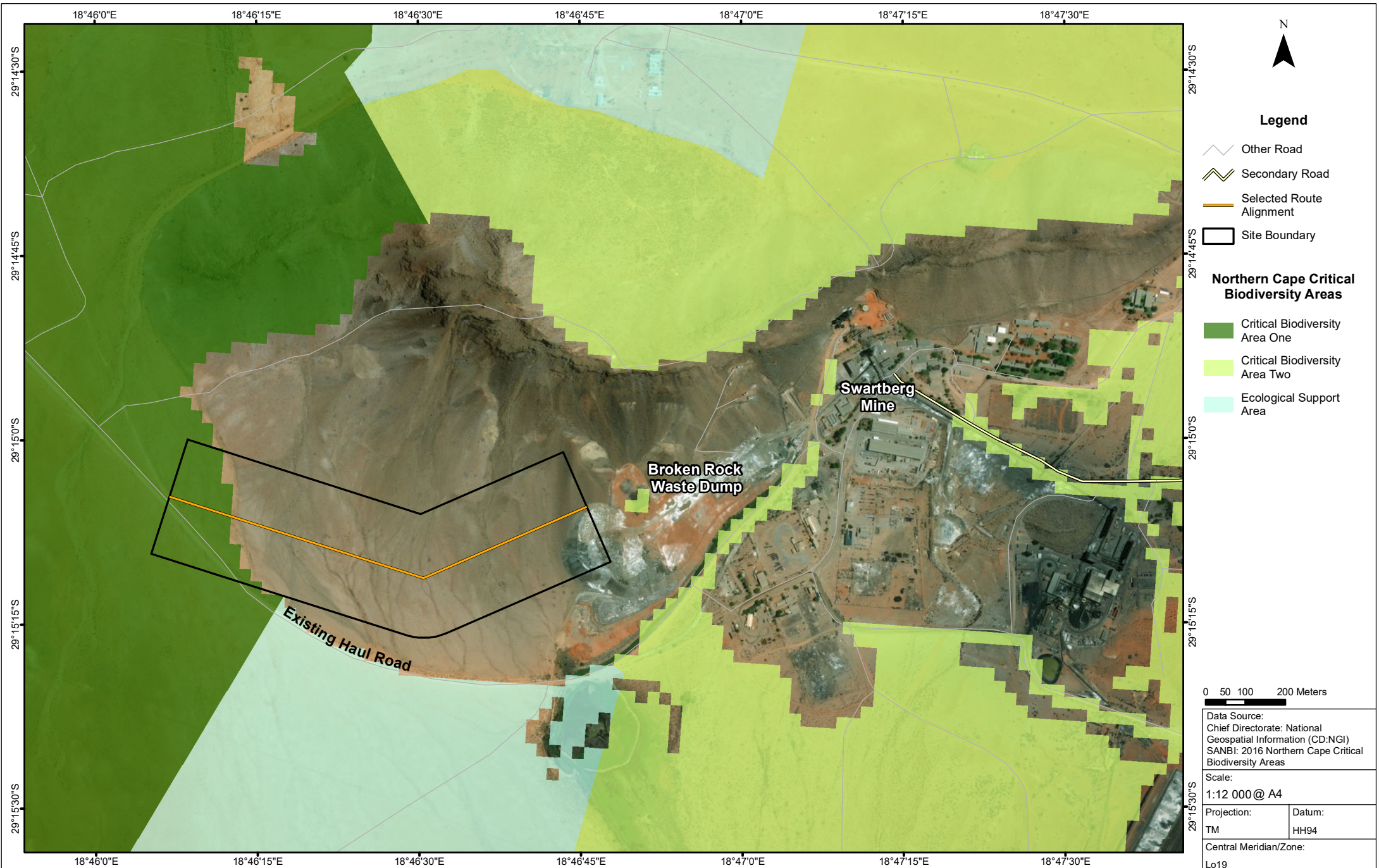


Figure 9: Plant communities on site
Source: Ekotrust, 2018

A total of 92 plant species was recorded on the site during a vegetation survey in October 2018. The mean species richness for the site is 36 species per habitat, with the highest species richness associated with the drainage lines.

Conservation

CBAs are areas required to meet biodiversity targets for ecosystems, species or ecological processes. CBAs should be kept in a natural or near-natural state, with no further loss of habitat or land-use change permitted. A small portion of the haul road (~1 280 m²) will occur within an area identified as CBA 1 in terms of the 2016 Northern Cape Critical Biodiversity Area Map (SANBI) (see Figure 10)



SWARTBERG HAUL ROAD ENVIRONMENTAL SENSITIVITY

Legend	
	Other Road
	Secondary Road
	Selected Route Alignment
	Site Boundary
Northern Cape Critical Biodiversity Areas	
	Critical Biodiversity Area One
	Critical Biodiversity Area Two
	Ecological Support Area
0 50 100 200 Meters	
Data Source: Chief Directorate: National Geospatial Information (CD:NGI) SANBI: 2016 Northern Cape Critical Biodiversity Areas	
Scale: 1:12 000 @ A4	
Projection: TM	Datum: HH94
Central Meridian/Zone: Lo19	
Date: 06/11/2018	Compiled by: FUBM
Project No: 536396	Fig No: 11

The site does not fall within any formally protected areas and no nationally protected trees were noted on site.

In terms of the NCNCA (2009), two '*specially protected*' and 21 '*protected plant*' species were recorded on site (a list of protected plant species is available in the Ecology Impact Assessment – see Appendix D).

None of the plant species recorded on site are listed as '*critically endangered*' or '*endangered*' species in terms of the NEM:BA (2013). Only one species, *Aloidendron dichotomum*, is classified as '*vulnerable*', however, this is located at least 50 m north of the selected route alternative and will not be displaced on account of construction, operation or closure activities.

The site is located along the southern boundary of the Gariep Centre of Endemism (Van Wyk & Smith 2001). Six endemic plant species were recorded on site and are listed in the Ecology Impact assessment (see Appendix D).

Ecological Sensitivity

Sensitivity is the vulnerability of a habitat to any impact. In this region, a dune, wetland or ridge system would be more vulnerable to development than a sandy plain would. The following indicators were used to evaluate the sensitivity of the vegetation on site:

- Threatened status of the regional vegetation type wherein the proposed site is situated;
- Percentage of red list plant species per community or site;
- Number of protected tree species per community or site;
- Percentage of provincially protected plant species;
- Percentage of endemic plant species per community or site (endemic to vegetation type);
- Conservation value of community (habitat) or site;
- Species richness per plant community or per sample plot (number of plant species);
- Degree of connectivity and/or fragmentation of the habitat, i.e. high connectivity and low fragmentation infers a low rating;
- Soil erosion potential; and
- Resilience (this is a measure of the ability of a particular habitat/plant community to recover after an impact, i.e. high resilience infers low rating).

Overall, the sensitivity of vegetation on the site is rated as low (i.e. the sensitivity is not significant enough and should not have an influence on the decision about the project) to very low (usually applicable to habitats in poor condition or that have been transformed, especially by human activities) (see Figure 11).

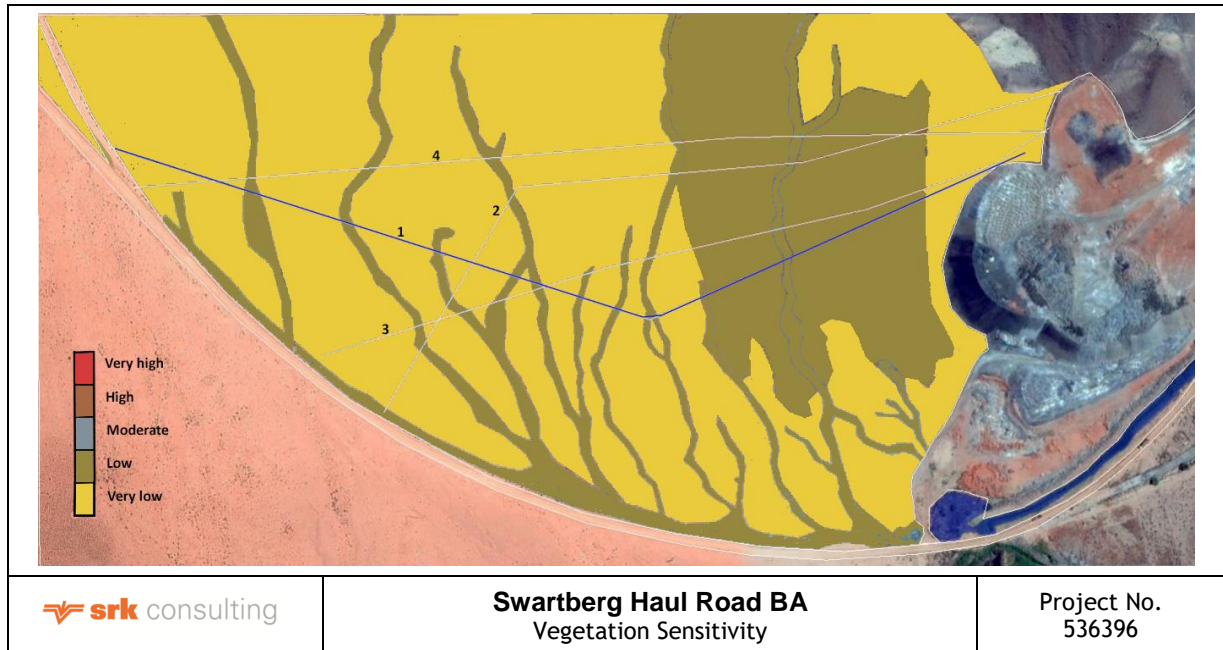


Figure 11: Vegetation sensitivity, selected alternative (1) and alternatives screened out (2-4)

Source: Ekotrust, 2018

Fauna

The site is located within the Mining Right Area with no farming activities and limited free roaming wildlife utilising the area. Considering the aridity of the area, fauna populations are relatively low, but with heterogeneity and diversity adapted to the harsh environments (Endemic Vision, 2017).

Lists of mammals, reptiles and amphibians which are likely to occur at the site were derived based on distribution records from literature and various spatial databases.

While detailed lists of faunal species are available in the Ecology Impact Assessment (see Appendix D), the below focusses on species of conservation concern that may occur in the site.

Mammals

The site falls within the distribution range of approximately 50 terrestrial mammal species, of which two are classified as '*vulnerable*' in terms of the International Union for Conservation of Nature (IUCN) red list of threatened species: Black-footed cat and Leopard. All others are categorised as either '*Near threatened*', '*Least concern*' or '*Data deficient*'.

Avifauna

Approximately 174 bird species are expected to occur in the region according to the bird distribution data obtained between 2007 and 2017 on the South African Bird Atlas 1 and 2 (SABAP1 & 2) (2017) (Ekotrust, 2018), of which three species are classified as '*vulnerable*' in terms of the IUCN red list of threatened species: Kori Bustard, White-backed Vulture and Ludwig's Bustard.

Reptiles

The site falls within / near the distribution range of at least 49 reptile species, which is indicative of a fairly high species diversity. One tortoise, 19 snake, 19 lizard and skink, one

chameleon and nine gecko species are likely to occur in the region (Todd, 2012). However, snakes are expected to be very rare in the exposed habitat of the site.

Amphibians

No amphibians are expected to occur on site due to the aridity of the area.

Invertebrates

Approximately nine scorpion species are expected to occur in the region.

Historical and Cultural Environment

A Phase 1 Heritage Impact Assessment was undertaken by Paleo Field Services in 2017 (see Appendix E) to inform a BA process for a new gravel road and associated infrastructure near Swartberg Shaft. The findings of Paleo Field Service's study were used in this BA to infer information on heritage resources at the proposed haul road.

A foot survey by Paleo Field Service in 2017 of a targeted area near the site indicated that any impact on potential palaeontological heritage resources within the superficial sediments (overlying Quaternary sediments) is unlikely and that no above-ground evidence was found of intact Stone Age archaeological assemblages or sites. The pedestrian survey also revealed no evidence of prehistoric structures, marked graves or rock art sites within the confines of the development footprint of the (then) proposed gravel road near Swartberg Shaft.

Although the EAP (for this BA process) did not undertake a survey of the alignment, the EAP did not identify any structures or marked graves, etc. during the site visit.

Socio-Economic Environment

Regional Context

The study area is located within the NDM, which includes the Local Municipalities (LMs) of Richtersveld, Nama Khoi, Kamiesberg, Hantam, Karoo Hoogland and Khâi-Ma (KLM). The NDM has the smallest population in the Northern Cape and the overall population density in the NDM is estimated at one person per square kilometre (NDM, 2012).

According to Census 2011 data available from Statistics South Africa (StatsSA), the NDM had a population of 115 842, more than 10 000 below the 2007 estimate (NDM, 2012), but more than in 2001. This indicates that the population has not grown as rapidly as anticipated, or declined between 2007 and 2011. Some 8.8% of the population reside in the KLM, 10.3% in the Richtersveld LM, 40.6% in the Nama Khoi LM, 18.6% in the Hantam LM, 10.8% in the Karoo Hoogland LM, and 10.7% in the Khâi-Ma LM (Census, 2011).

The NDM has an economic growth rate of 2.03% per annum, which is lower than the Northern Cape Province growth rate (2.4%) and is less than half of the national growth rate (5%) measured from 1996 to 2007. The NDM has an undiversified economy, heavily reliant on mining. Mining contributes approximately 52% to the Gross Geographic Product (GGP) (CNdV, 2012). In 2007, the Nama Khoi LM made the largest contribution to the GGP (41.7%), followed by the Richtersveld LM (17.3%) (NDM, 2012).

Mining and agriculture are the biggest employers in the NDM. Trade, catering and accommodation contribute 13% to the GGP, while the remaining sectors in total contribute less than 10%. The mining growth rate declined by 0.3% between 2001 and 2007, while trade, catering and accommodation (mainly tourism activities) have significantly increased their contribution to both GGP and employment in the NDM. The economy of NDM has diversified from a vulnerable economy with an over reliance on mining in 1995 to a more

diversified economy with reliance on mining, community services and trade in 2007 (CNdV, 2012). However, the increase in the community services sector indicates increased dependence on social assistance within the NDM (NDM, 2012).

In 2001, 29 279 persons were employed and 11 663 were unemployed in the NDM, with a total (formal) labour force of 40 942 and an unemployment rate of 28% (CNdV, 2012). According to StatsSA (2011), the unemployment rate in the NDM decreased to 20.1% in 2011. However, the NDM economy remains unable to absorb and employ the full complement of job market entrants and participants (CNdV, 2012).

The highest unemployment rate in 2011 was recorded for the Kamiesberg LM (30.8%) and the lowest was for the Hantam LM (11.8%). Unemployment declined most markedly in the Richtersveld LM, from 35.5% in 2001 to 18.6% in 2011, while in the Khâi-Ma LM unemployment increased from 15.3% in 2001 to 22.1% in 2011 (Census, 2011).

In 2011, 6.6% of the population in the NDM had no education, while the highest level of education for 18.8% of the population was matric, with 7.4% of the population having a tertiary education (StatsSA 2011). Indications are that qualified persons leave the NDM to seek work elsewhere due to the lack of suitable education facilities and employment opportunities in the NDM (NDM, 2012).

The IDP identifies economic development and job creation as one of the urgent developmental issues in the NDM (NDM, 2012).

The NDM is characterised by unique flora and several nature reserves are located in the area, including the Namaqua National Park. The unspoilt and sparsely inhabited environment make the NDM highly suitable for adventure tourism and outdoor recreational activities, including camping, fishing, hiking, mountain biking and star gazing. The area is also unique in terms of its historical and cultural heritage (Chidley et al., 2012). The potential for energy production, diamond mining and beneficiation, scientific research and development, mainly in the fields of astronomy and biodiversity, tourism and conservation initiatives has also been identified. Development in the agricultural sector is challenging due to the scarcity of suitable land, poor transport networks and linkages to markets (CNdV, 2012).

Local Context

The population of the KLM is estimated to be ~12 465 people in 2011 (approximately 10.7% of the total population of the NDM). The municipality is sparsely populated (+/- 1 person/km²) and most people are settled in its five (5) towns: Aggeneys, Onseepkans, Pella, Pofadder and Witbank.

Key socio-economic statistics for the municipality are shown in Table 7.

Table 7: Key socio-economic statistics

Key Statistics	
Total population	12,465
Young (0-14)	25,9%
Working Age (15-64)	68,6%
Elderly (65+)	5,5%
Dependency ratio	45,7
Gender (female: male) ratio	111,1
Growth rate	0,83% (2001-2011)
Population density	1 persons/km ²

Key Statistics	
Unemployment rate	22,1%
Youth unemployment rate	23,6%
No schooling aged 20+	3,9%
Higher education aged 20+	5,8%
Matric aged 20+	18,1%
Number of households	3,796
Number of Agricultural households	810
Average household size	3,2
Female headed households	34%
Formal dwellings	86,1%
Housing owned/paying off	46,6%
Flush toilet connected to sewerage	69%
Weekly refuse removal	75,6%
Piped water inside dwelling	45,5%
Electricity for lighting	89,6%

Source: StatsSA, 2011

The KLM contributes 8.8% towards the NDM's economy and 1.3% towards the province's economy (Urban Econ, 2016). The primary sector (predominantly mining and quarrying) contribute 67% towards the municipal Regional Gross Domestic Product (GDPR).

Mining and quarrying are the prominent industries within the primary sector and contribute 51%, whilst the agriculture industry contributes 15% to the overall economy.

The average household annual income in the KLM was R 99 144.00 in 2016. The Mine is the main source of income in KLM (Urban Econ, 2016).

b) Description of the current land uses

The site is located within the BMM Mining Right Area between the Swartberg shaft and the processing area. Beyond the Mining Right Area, the land use is predominantly grazing (sheep, cattle and goats), with evidence of historic bulk sampling and prospecting activities on some of the neighbouring farms (Endemic Vision, 2017).

c) Description of specific environmental features and infrastructure on the site

The key environmental features of the site are the dry drainage lines (see Photo1, Figure 12) that the new haul road will cross and Noeniepoort se kop north of the new haul road (see Photo 2, Figure 12).

Significant infrastructure includes the existing haul road south of the proposed new haul road (see Photo3, Figure 12), a powerline and water pipeline (see Photo4, Figure 12).






			
<p>Photo 1: Rocky drainage line</p>	<p>Photo 2: Noeniepoort se kop</p>		
			
<p>Photo 3: Existing haul road and weighbridge</p>	<p>Photo 4: Water pipeline and powerline</p>		
	<p align="center">Swartberg Haul Road BA Specific Environmental Features and Infrastructure</p>		<p align="right">Project No. 536396</p>

Figure 12: Specific environmental features and infrastructure on the site

d) Environmental and current land use map

(Show all environmental, and current land use features)

Figure 10 illustrates environmental sensitivity and Figure 13 illustrates land cover.

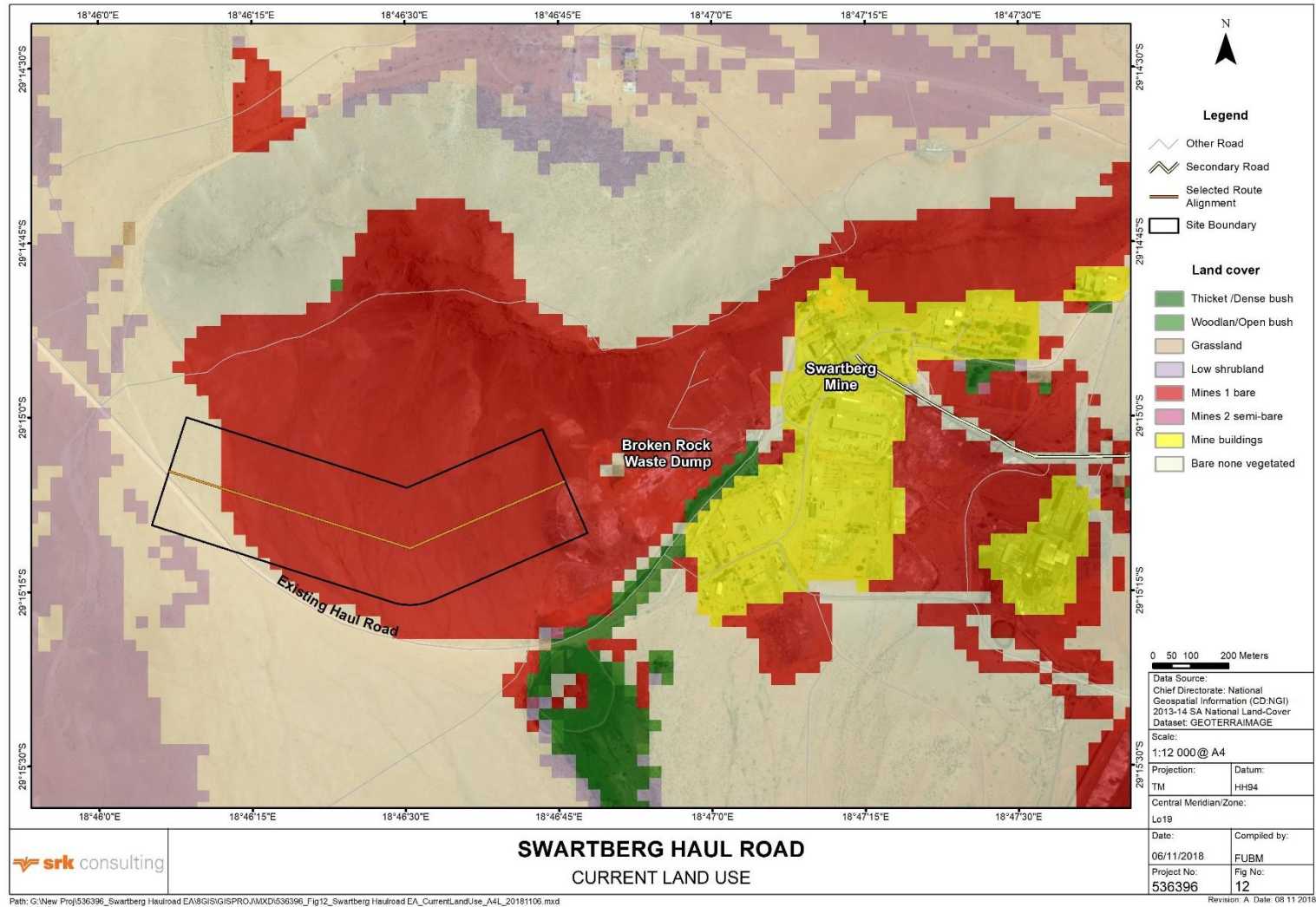


Figure 13: Current land use

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

(Provide a list of the potential impacts identified of the activities described in the initial site layout that will be undertaken, as informed by both the typical known impacts of such activities, and as informed by the consultations with affected parties together with the significance, probability, and duration of the impacts. Please indicate the extent to which they can be reversed, the extent to which they may cause irreplaceable loss of resources, and can be avoided, managed or mitigated).

Based on the professional experience of the EAPs, legal requirements, the nature of the proposed activity, the nature of the receiving environment and issues raised in the stakeholder engagement process, the following key environmental issues – potential negative impacts and potential benefits – were identified:

- Soil and land capability – disturbance to the soil profiles and loss of land use and land capability;
- Air quality – impaired air quality from suspended particulates affecting receptors;
- Terrestrial ecology – potential loss of vegetation and protected plant species, and the potential loss of or disturbance to fauna and faunal habitats;
- Freshwater ecology – potential degradation of ephemeral drainage lines; and
- Heritage – potential loss of palaeontological resources during road construction.

Direct impacts associated with the Construction, Operational and Closure Phases of the project have been quantitatively assessed both with and without recommended mitigation measures. This was undertaken to assess significance according to the methodology laid out in Section 3(h)(vi).

Potential Soil and Land Capability Impacts

Assessment of Impacts: Construction Phase

The following potential direct Construction Phase impacts on the soil and land capability were identified:

- LC1: Soil Compaction caused by Construction Traffic; and
- LC2: Loss of Land Capability.

Potential Impact LC1: Soil Compaction caused by Construction Traffic

Repetitive movement of construction vehicles and machinery over exposed surfaces will compact the soil in the project footprint areas (i.e. the haul road and laydown areas), disturbing soil structure. Physical disturbance may increase the risk of erosion (by wind and stormwater) and may damage soil structure, reduce water infiltration rates and water retention capacity.

Soil compaction will be a long-term impact, but will be restricted to the proposed construction footprint areas.

The impact is assessed to be of **very low** significance with and without the implementation of mitigation (Table 8).

Table 8: Significance of soil compaction caused by construction traffic

	<i>Extent</i>	<i>Intensity</i>	<i>Duration</i>	<i>Consequence</i>	<i>Probability</i>	<i>Significance</i>	<i>Status</i>	<i>Confidence</i>
Without mitigation	Local	Low	Short-term	Very low	Definite	VERY LOW	-ve	High
	1	1	1	5				
Essential mitigation measures:								
<ul style="list-style-type: none"> ▪ Restrict construction activities to the project footprint areas. ▪ Restrict vehicle movements to haul roads and laydown areas and prohibit vehicle parking or storage of construction materials outside these areas. 								
With mitigation	Local	Low	Short-term	Very low	Probable	VERY LOW	-ve	High
	1	1	1	5				

This impact can be managed to a *moderate* degree, and is *reversible*.

Potential Impact LC2: Loss of Land Capability

The construction of the haul road will cause physical disturbance to the soil and compromise land capability.

Although the loss of land capability due to construction will convert to a long-term impact in the Operational Phase, the site is already in poor condition due to previous mining-related activities and heavy grazing, resulting in a very sparse vegetation cover. As such, the site has a low grazing capacity land capability and the change in land use will not cause any loss to agricultural production in the area.

The impact is assessed to be of **low** significance with and without the implementation of mitigation (Table 9).

Table 9: Significance of loss of land capability during construction

	<i>Extent</i>	<i>Intensity</i>	<i>Duration</i>	<i>Consequence</i>	<i>Probability</i>	<i>Significance</i>	<i>Status</i>	<i>Confidence</i>
Without mitigation	Local	Low	Long-term	Low	Definite	LOW	-ve	High
	1	1	3	5				
Essential mitigation measures:								
<ul style="list-style-type: none"> ▪ Restrict construction activities to the project footprint areas. ▪ Rehabilitate disturbed areas incrementally and as soon as possible, not necessarily waiting until completion of the Construction Phase. 								
With mitigation	Local	Low	Long-term	Low	Probable	LOW	-ve	High
	1	1	3	5				

This impact can be managed to a *moderate* degree, and is *reversible*.

Assessment of Impacts: Operational Phase

The following potential direct Operational Phase impacts on soil and land capability were identified:

- LC3: Soil Erosion caused by Operational Activities;
- LC4: Soil Compaction caused by Hauling; and
- LC5: Loss of Land Capability.

Potential Impact LC3: Soil Erosion caused by Operational Activities

Soil erosion (by wind and stormwater) in areas cleared of natural vegetation reduces soil quality because of the loss of nutrient-rich topsoil and the reduced water-holding capacity of severely eroded soils.

Soil erosion can only be prevented as soil particles transported away by wind and water energy cannot be recovered.

The impact is assessed to be of **low** significance and with the implementation of mitigation is reduced to **very low** (Table 10).

Table 10: Significance of soil erosion caused by Operational activities

	<i>Extent</i>	<i>Intensity</i>	<i>Duration</i>	<i>Consequence</i>	<i>Probability</i>	<i>Significance</i>	<i>Status</i>	<i>Confidence</i>
Without mitigation	Local	Low	Long-term ¹	Low	Probable	LOW	-ve	High
	1	1	3	5				
Essential mitigation measures:								
<ul style="list-style-type: none"> Implement drainage control measures and install culverts or drifts to manage the natural flow of surface runoff from the haul road. 								
With mitigation	Local	Low	Long-term	Low	Possible	VERY LOW	-ve	High
	1	1	3	5				

This impact can be managed to a *moderate* degree, and is *reversible*.

Potential Impact LC4: Soil Compaction caused by Hauling

Heavy vehicles continuously moving over the soil surface (e.g. hauling waste from Swartberg shaft to the WRD) will cover and damage / compact the soil.

The impact is assessed to be of **low** significance with and without the implementation of mitigation (Table 11).

Table 11: Significance of soil compaction caused by hauling during Operational activities

	<i>Extent</i>	<i>Intensity</i>	<i>Duration</i>	<i>Consequence</i>	<i>Probability</i>	<i>Significance</i>	<i>Status</i>	<i>Confidence</i>
Without mitigation	Local	Low	Long-term	Low	Definite	LOW	-ve	High
	1	1	3	5				
Essential mitigation measures:								
<ul style="list-style-type: none"> Restrict hauling to designated haul roads and no additional roads or turn-around areas should be created. 								
With mitigation	Local	Low	Long-term	Low	Probable	LOW	-ve	High
	1	1	3	5				

This impact can be managed to a *moderate* degree, and is *reversible*.

Potential Impact LC5: Loss of Land Capability

Transport activities along the haul road will cause physical disturbance to the soil and compromise land capability.

The areas' very low grazing capacity / wilderness land capability and the change in land use will not cause any loss to agricultural production in the area. Land capability will be temporarily lost, but this impact is reversible with appropriate rehabilitation.

The impact is assessed to be of **low** significance with and without the implementation of mitigation measures (Table 12).

¹ BMM have confirmed that the current life of mine is 2022, but that projects are currently underway to extend this by 15 to 20 years. As such, SRK have assumed the worst-case scenario ("long-term") for the duration of Operational activities.

Table 12: Significance of loss of land capability during Operational activities

	<i>Extent</i>	<i>Intensity</i>	<i>Duration</i>	<i>Consequence</i>	<i>Probability</i>	<i>Significance</i>	<i>Status</i>	<i>Confidence</i>
Without mitigation	Local	Low	Long-term	Low	Definite	LOW	-ve	High
	1	1	3	5				
Essential mitigation measures:								
<ul style="list-style-type: none"> Restrict activities to the project footprint areas. 								
With mitigation	Local	Low	Long-term	Low	Probable	LOW	-ve	High
	1	1	3	5				

This impact can be managed to a *high* degree, and is *reversible*.

Assessment of Impacts: Closure Phase

Impacts on soil and land capability are expected to occur primarily during the Construction and Operational Phases. No additional impacts are anticipated during the Closure Phase.

Potential Air Quality Impacts

Assessment of Impacts: Construction Phase

The following potential direct Construction Phase impact on air quality was identified:

- A1: Impaired air quality from suspended particulates affecting receptors.

Potential Impact A1: Impaired air quality from suspended particulates affecting receptors

Construction activities, particularly vegetation clearing and earthworks, are expected to generate dust in the construction area, temporarily affecting air quality in the area immediately surrounding the site. Emissions are also anticipated from vehicles and other equipment.

These activities are not expected to cause health impacts as emissions from vehicles and other equipment (including nitrogen oxides (NO_x), carbon dioxide (CO₂), carbon monoxide (CO) and volatile organic compounds (VOC)) are likely to be very low, and will be limited in extent and duration.

Increased dust deposition could potentially harm physiological processes of plants and a reduction in the photosynthetic capacity of plants. However, the dust levels are not likely to exceed normal dust levels associated with construction activities and will be limited in extent and duration.

The increase in dust from construction activities is unlikely to be noticeable to off-site receptors.

The impact is assessed to be of **Very Low** significance without mitigation and **insignificant** with the implementation of mitigation measures (see Table 13).

Table 13: Significance of impaired air quality from suspended particulates affecting receptors during construction

	<i>Extent</i>	<i>Intensity</i>	<i>Duration</i>	<i>Consequence</i>	<i>Probability</i>	<i>Significance</i>	<i>Status</i>	<i>Confidence</i>
Without mitigation	Local	Low	Short-term	Very Low	Definite	VERY LOW	-ve	High
	1	1	1	3				
Essential Mitigation Measures:								
<ul style="list-style-type: none"> Implement existing dust suppression measures at the Mine on access roads. 								
With mitigation	Local	Low	Short-term	Very Low	Possible	INSIGNIFICANT	-ve	High
	1	1	1	3				

This impact can be managed to a *high* degree, and is *reversible*.

Assessment of Impacts: Operational Phase

The following potential direct Operational Phase impact on air quality was identified:

- A2: Increased Dustfall Associated with Hauling Activities

Potential Impact A2: Increased Dustfall Associated with Hauling Activities

Particulate emissions (e.g. dust) entrained from exposed soils (sparse vegetation) by the movement of vehicles over unpaved areas contribute to elevated dust levels.

The area is rural, the site is remote, and no sensitive air quality receptors are located in close proximity to the site.

The impact is assessed to be of **very low** significance with and without the implementation of mitigation (Table 14).

Table 14: Significance of increased dustfall associated with hauling activities

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Low	Medium-term	Very Low	Probable	VERY LOW	-ve	High
	1	1	2	4				
Essential mitigation measures:								
<ul style="list-style-type: none"> ▪ Implement existing dust suppression measures at the Mine on access roads. 								
With mitigation	Local	Low	Medium-term	Very Low	Probable	VERY LOW	-ve	High
	1	1	2	5				

This impact can be managed to a *high* degree, and is *reversible*.

Assessment of Impacts: Closure Phase

Impacts on air quality during the Closure Phase are anticipated to be the same as the Construction Phase impacts.

Potential Terrestrial Ecology Impacts

Assessment of Impacts: Construction Phase

The following potential direct Construction Phase impacts on terrestrial ecology were identified:

- T1: Loss of Vegetation;
- T2: Loss of Threatened Floral Species; and
- T3: Disturbance to Terrestrial Fauna and Loss of Habitat.

This section is largely informed by the Ecology Impact Assessment (see Appendix D). It should, be noted, however, that SRK has rated some impacts slightly lower than the ecology specialist. This is largely due to different impact rating methodologies and a different interpretation of the spatial extent of the impact. SRK believes that the specialist over emphasises the impact at the project footprint extent rather than considering the impact in the context of the overall site, thereby increasing the probability rating.

Potential Impact T1: Loss of Vegetation

The proposed haul road will traverse two vegetation types: Bushmanland Sandy Grassland and Aggeneys Gravel Vygieveld. Both vegetation types are listed as '*Least Threatened*' since habitats of both vegetation types are intact, i.e. more than 80% of the vegetation type is adequately conserved in parks and reserves. Furthermore, overall sensitivity of all plant communities on site are assessed to be *low* to *very low*.

Construction activities anticipated to lead to a loss of indigenous vegetation include the construction / clearing of the new haul road.

The clearing required for the new haul road will affect vegetation that are well conserved and with '*Least Threatened*' conservation status. Therefore, and provided that the site has low to very low sensitivity, clearing required for the project will be easily sustainable on a regional scale. The loss of the vegetation may, however, cause a loss of protected and endemic species and potentially result in the proliferation of alien species (Ekotrust, 2018).

The impact is assessed to be of **low** significance without mitigation and **very low** significance with the implementation of mitigation measures (see Table 15).

Table 15: Significance of loss of vegetation

	<i>Extent</i>	<i>Intensity</i>	<i>Duration</i>	<i>Consequence</i>	<i>Probability</i>	<i>Significance</i>	<i>Status</i>	<i>Confidence</i>
Without mitigation	Local	Low	Long-term	Low	Probable	LOW	-ve	High
	1	1	3	5				
Essential Mitigation Measures:								
<ul style="list-style-type: none"> ▪ Limit vegetation clearance and the footprint of construction activities to what is absolutely essential. ▪ Define all areas outside of the planned project and construction footprint as no-go areas. 								
With mitigation	Local	Low	Long-term	Low	Possible	VERY LOW	-ve	High
	1	1	3	5				

This impact can be managed to a *moderate* degree, and is *reversible*.

Potential Impact T2: Loss of Threatened Floral Species

The site survey undertaken by the ecologist revealed the presence of one ToPS, *Aloidendron dichotomum*, which is listed as "*vulnerable*" in terms of the IUCN Red List, however, this is located at least 50 m north of the selected route and will not be displaced on account of construction activities.

Although no threatened floral species were observed within the project footprint during the site inspection by the ecologist, this may be strongly influenced by the season in which the survey was carried out, i.e. the survey was conducted during the dry season (October 2018) and most bulbous and summer annual plant species were not present. Consequently, the number of these plant species encountered is probably an underestimate of the number of species which could potentially occur on site.

Despite the above, many protected and endemic species were recorded and some individuals of these species will be destroyed by the proposed road.

The impact is assessed to be of **low** significance without mitigation and **very low** significance with the implementation of mitigation measures (Table 16).

Table 16: Significance of loss of threatened floral species during construction

	<i>Extent</i>	<i>Intensity</i>	<i>Duration</i>	<i>Consequence</i>	<i>Probability</i>	<i>Significance</i>	<i>Status</i>	<i>Confidence</i>
Without mitigation	Local	Low	Long-term	Low	Probable	LOW	-ve	Medium
	1	1	3	5				
Essential Mitigation Measures:								
<ul style="list-style-type: none"> ▪ Limit vegetation clearance and the footprint of construction activities to what is absolutely essential. ▪ Define all areas outside of the planned project and construction footprint as no-go areas. 								
With mitigation	Local	Low	Long-term	Low	Possible	VERY LOW	-ve	Medium
	1	1	3	5				

This impact can be managed to a *moderate* degree, and is *irreversible*.

Potential Impact T3: Disturbance to Terrestrial Fauna and Loss of Habitat

The sandy to sandy loam soils on site are suitable in places for burrowing animals such as aardvarks and ground squirrels. The prominent mountains, rocky outcrops and ridges surrounding the site are suitable for many wildlife species of rocky habitats.

It is typical that faunal species will be disturbed due to habitat (vegetation) loss. This may also alter behavioural patterns of some animals.

Aspects of the construction of project that are anticipated to lead to disturbance to terrestrial fauna and loss of habitat are as follows:

- Disturbance and removal of vegetation (habitats);
- Increased noise levels due to increased human presence and / or construction activities;
- Compaction of soils that may alter behavioural patterns; and
- Increased vehicle traffic that could pose an increased collision risk for slow-moving fauna (snakes and tortoises).

The habitat on site is fairly homogeneous with little variation. The project footprint (~0.96 ha) is a relatively small area in relation to the wider study area and available habitat and the construction of the haul road is unlikely to have a significant impact on the broader faunal species richness in the area (Ekotrust, 2018).

The impact is assessed to be of **low** significance without mitigation and **very low** significance with the implementation of mitigation measures (Table 17).

Table 17: Significance of disturbance to terrestrial fauna and loss of habitat during construction

	<i>Extent</i>	<i>Intensity</i>	<i>Duration</i>	<i>Consequence</i>	<i>Probability</i>	<i>Significance</i>	<i>Status</i>	<i>Confidence</i>
Without mitigation	Local	Low	Long-term	Low	Probable	LOW	-ve	High
	1	1	3	5				
Essential mitigation measures:								
<ul style="list-style-type: none"> ▪ Limit vegetation clearance and the footprint of construction activities to the minimum required. ▪ Confine construction vehicles and staff to designated roadways and construction areas and strictly prohibit the indiscriminate movement of construction vehicles and staff through vegetation outside of the construction footprint. ▪ Limit vehicle speeds on internal and haul roads to 40 km/hr during construction. ▪ Conduct environmental induction for all construction staff to increase awareness in fauna protection. ▪ Prohibit trapping, collecting and hunting of fauna. ▪ Usher any faunal species within the construction footprint towards more suitable habitat within the surrounding areas. Threatened fauna should be relocated by a suitably qualified environmental officer. ▪ Prohibit construction activities and driving at night. ▪ Limit soil compaction to the minimum required. ▪ Immediately clean up spills and dispose of contaminated soil at a licensed waste disposal facility. ▪ Do not leave trenches open for extended periods. 								
With mitigation	Local	Low	Long-term	Low	Possible	VERY LOW	-ve	High
	1	1	3	5				

This impact can be managed to a *high* degree, and is *irreversible*.

Assessment of Impacts: Operational Phase

The following potential direct operational phase impacts on terrestrial ecology were identified:

- T4: Increased faunal mortalities.

Potential Impact T4: Increased faunal mortalities

Faunal mortalities may be caused by collisions with heavy and maintenance vehicles, increased human activity and litter. Slow-moving species such as tortoises may be particularly prone to vehicle collision mortalities.

The raised powerline may marginally increase the probability of avifaunal collisions and mortalities associated with the powerline. Species most heavily affected are heavy-bodied birds with limited manoeuvrability such as bustards, storks, cranes and various species of waterbirds (CvR, 2017).

The impact is assessed to be of **very low** significance with and without the implementation of mitigation measures (Table 18).

Table 18: Significance of increased terrestrial mortalities during Operational activities

	<i>Extent</i>	<i>Intensity</i>	<i>Duration</i>	<i>Consequence</i>	<i>Probability</i>	<i>Significance</i>	<i>Status</i>	<i>Confidence</i>
Without mitigation	Local	Low	Long-term	Low	Possible	VERY LOW	-ve	Medium
	1	1	3	5				
Essential Mitigation Measures:								
<ul style="list-style-type: none"> ▪ Train staff to increase awareness of environmental concerns. ▪ Limit night driving as far as possible to minimize negative effects on nocturnal animals. ▪ Enforce speed limits on site. 								
With mitigation	Local	Low	Long-term	Low	Improbable	VERY LOW	-ve	Medium
	1	1	3	5				

This impact can be managed to a *high* degree, and is *irreversible*.

Assessment of Impacts: Closure Phase

Impacts on terrestrial ecology during the Closure Phase are anticipated to be the same as the Construction Phase impacts.

Freshwater Ecology Impacts

Assessment of Impacts: Construction Phase

The following potential direct Construction Phase impact on freshwater ecology was identified:

- FE1: Degradation of Ephemeral Drainage Lines

This section is largely informed by the Ecology Impact Assessment (see Appendix D). It should, be noted, however, that SRK has rated the impact slightly lower than the ecology specialist. This is largely due to different impact rating methodologies and a different interpretation of the spatial extent of the impact. SRK believes that the specialist over emphasises the impact at the project footprint extent rather than considering the impact in the context of the overall site, thereby increasing the probability rating.

Potential Impact FE1: Degradation of Ephemeral Drainage Lines

Eleven ephemeral drainage lines were identified traversing the proposed haul road route. The project would entail the installation of eleven (pre-cast) cement culverts and / or construction of low-level drift crossings across the beds of the affected drainage lines and increased vehicle movement over these culverts during construction activities.

Construction activities are anticipated to lead to the following disturbances to drainage lines:

- Physical disturbance from construction such as:
 - Infilling of drainage line margins;
 - Clearing of vegetation (discussed above);
 - Compaction from trampling and vehicles;
 - Creation of tracks and scour holes; and
 - Loss and removal of topsoil;

- Temporary diversion of flows from the creation of tracks and scour holes, vegetation clearing and compaction; and
- Contamination (from e.g. cement and hydrocarbons).

Although the condition of all the affected drainage lines is assessed to be of a mostly natural, unmodified condition the drainage lines are not ecologically important and sensitive (unique) at any scale.

The drainage lines are considered to be of *low* to *very low* ecological sensitivity, indicating low to very low sensitivity changes in flows and physical disturbance.

The impact is assessed to be of **very low** significance with and without the implementation of mitigation measures (Table 19).

Table 19: Significance of degradation of drainage lines during construction

	<i>Extent</i>	<i>Intensity</i>	<i>Duration</i>	<i>Consequence</i>	<i>Probability</i>	<i>Significance</i>	<i>Status</i>	<i>Confidence</i>
Without mitigation	Local	Low	Long-term	Low	Possible	VERY LOW	-ve	High
	1	1	3	5				
Essential Mitigation Measures:								
<ul style="list-style-type: none"> ▪ Construct new watercourse crossings during dry conditions only, and when no rainfall is forecast. ▪ Appoint a suitably qualified engineer to design and supervise the correct installation of all culverts and drifts. ▪ Limit the footprint area of the construction activity to what is absolutely essential. ▪ Define all areas outside of the planned project and construction footprint (including roads and walking routes) as no-go areas. ▪ Close and rehabilitate erosion gullies as they form. 								
With mitigation	Local	Low	Long-term	Low	Improbable	VERY LOW	-ve	High
	1	1	3	5				

This impact can be managed to a *high* degree, and is *reversible*.

Assessment of Impacts: Closure Phase

Impacts on freshwater ecology during the Closure Phase are anticipated to be the same as the Construction Phase impacts.

Potential Heritage Impacts

Assessment of Impacts: Construction Phase

One potential Construction Phase impact on the archaeology resources of the area was identified:

- H1: Loss of palaeontological resources during road construction.

Potential Impact H1: Loss of palaeontological resources during road construction

Building the new haul road may disturb buried archaeological resources. It is not possible to predict the condition or quantity of material that may be found (if any).

A foot survey by Paleo Field Service in 2017 of a targeted area near the site indicated that any impact on potential palaeontological heritage resources within the superficial sediments (overlying Quaternary sediments) is unlikely and that no above-ground evidence was found of intact Stone Age archaeological assemblages or sites. The pedestrian survey also revealed no evidence of prehistoric structures, marked graves or rock art sites within the confines of the development footprint of the (then) proposed gravel road near Swartberg Shaft.

The impact is assessed to be of **low** significance without mitigation and **very low** significance with the implementation of mitigation measures (Table 20).

Table 20: Significance of loss of palaeontological resources during road construction

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local	Low	Long-term	Low	Possible	LOW	- ve	Medium
	1	1	3	5				
Essential mitigation measures:								
<ul style="list-style-type: none"> Limit clearance and the footprint of construction activities to what is absolutely essential. Alert personnel to possibility of finding historical resources and follow "Chance Finds Procedure". 								
With mitigation	Local	Low	Long-term	Low	Improbable	VERY LOW	- ve	Medium
	1	1	3	5				

This impact can be managed to a *high* degree, and is *irreversible*.

Assessment of Impacts: Closure Phase

Impacts on palaeontological resources during the Closure Phase are anticipated to be the same as the Construction Phase impacts.

The No-Go Alternative

The No-Go alternative implies that the haul road will not be constructed and the road safety at the mine will not be improved, and haul distances not optimised. This will inhibit future development at the Mine. In other words, the benefit of increased road safety and haul distance optimisation will be forgone.

As a number of protected plant species and drainage lines occur on the site, biophysical impacts associated with the project would not materialise if the project does not proceed.

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

(Describe how the significance, probability, and duration of the aforesaid identified impacts that were identified through the consultation process was determined in order to decide the extent to which the initial site layout needs revision).

The assessment of impacts was based on specialists' expertise, SRK's professional judgement, field observations and desk-top analysis.

The significance of potential impacts that may result from the proposed project was determined in order to assist decision-makers (typically by a designated competent authority or state agency, but in some instances, the applicant).

The **significance** of an impact is defined as a combination of the **consequence** of the impact occurring and the **probability** that the impact will occur.

The criteria used to determine impact consequence are presented in the table below.

Table 21: Criteria used to determine the consequence of the impact

Rating	Definition of Rating	Score
A. Extent – the area over which the impact will be experienced		
Local	The site (i.e. 300 m corridor on either side of the selected route) and immediate surrounds	1
Regional	The region (Municipality or catchment)	2
(Inter) national	Nationally or beyond	3
B. Intensity – the magnitude of the impact in relation to the sensitivity of the receiving environment, taking into account the degree to which the impact may cause irreplaceable loss of resources		
Low	Site-specific and wider natural and/or social functions and processes are negligibly altered	1
Medium	Site-specific and wider natural and/or social functions and processes continue albeit in a modified way	2

High	Site-specific and wider natural and/or social functions or processes are severely altered	3
C. Duration – the timeframe over which the impact will be experienced and its reversibility		
Short-term	Up to 2 years and reversible	1
Medium-term	2 to 15 years and reversible	2
Long-term	More than 15 years and irreversible	3

The combined score of these three criteria corresponds to a **Consequence Rating**, as follows:

Table 22: Method used to determine the consequence score

Combined Score (A+B+C)	3 – 4	5	6	7	8 – 9
Consequence Rating	Very low	Low	Medium	High	Very high

Once the consequence was derived, the probability of the impact occurring was considered, using the probability classifications presented in the table below.

Table 23: Probability classification

Probability – the likelihood of the impact occurring	
Improbable	< 40% chance of occurring
Possible	40% - 70% chance of occurring
Probable	> 70% - 90% chance of occurring
Definite	> 90% chance of occurring

The overall **significance** of impacts was determined by considering consequence and probability using the rating system prescribed in the table below.

Table 24: Impact significance ratings

		Probability			
		Improbable	Possible	Probable	Definite
Consequence	Very Low	INSIGNIFICANT	INSIGNIFICANT	VERY LOW	VERY LOW
	Low	VERY LOW	VERY LOW	LOW	LOW
	Medium	LOW	LOW	MEDIUM	MEDIUM
	High	MEDIUM	MEDIUM	HIGH	HIGH
	Very High	HIGH	HIGH	VERY HIGH	VERY HIGH

Finally the impacts were also considered in terms of their status (positive or negative impact) and the confidence in the ascribed impact significance rating. The prescribed system for considering impacts status and confidence (in assessment) is laid out in the table below.

Table 25: Impact status and confidence classification

Status of impact	
Indication whether the impact is adverse (negative) or beneficial (positive).	+ ve (positive – a 'benefit')
	– ve (negative – a 'cost')
Confidence of assessment	
The degree of confidence in predictions based on available information, SRK's judgment and/or specialist knowledge.	Low
	Medium
	High

The impact significance rating should be considered by authorities in their decision-making process based on the implications of ratings ascribed below:

- **INSIGNIFICANT:** the potential impact is negligible and **will not** have an influence on the decision regarding the proposed activity/development.
- **VERY LOW:** the potential impact is very small and **should not** have any meaningful influence on the decision regarding the proposed activity/development.
- **LOW:** the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.
- **MEDIUM:** the potential impact **should** influence the decision regarding the proposed activity/development.
- **HIGH:** the potential impact **will** affect the decision regarding the proposed activity/development.
- **VERY HIGH:** The proposed activity should only be approved under special circumstances.

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.

(Provide a discussion in terms of advantages and disadvantages of the initial site layout compared to alternative layout options to accommodate concerns raised by affected parties)

BMM owns Portion 4, Farm Zuurwater No 62, the property on which the Mine and proposed haul road is located. The new haul road will be located within the Mining Right Area.

The locations of the Swartberg shaft and the WRD are fixed, which dictates the possible haul road route (between the two) (and therefore location / layouts). The motivation for the new haul road is two-fold: it will improve road safety at the Mine and reduce haul distances, thus maximising operational efficiency.

BMM proposed four route alternatives for the haul road. The selected route alternative (in red in Figure 4) was determined based on safety and design (e.g. steep slopes, fill material requirements, etc.) considerations. The terrain along the selected route is less undulating and rocky for most of the route, especially in the western section. BMM does not consider the other route alternatives to be feasible based on the financial and engineering input that will be required to address the safety and design considerations for the other route alternatives.

Upon assessment of the four layout alternatives, the ecology specialist confirmed that the selected alternative was acceptable from an ecological perspective. This layout was selected for assessment and no other layout alternatives were assessed.

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

(With regard to the issues and concerns raised by affected parties provide a list of the issues raised and an assessment/discussion of the mitigations or site layout alternatives available to accommodate or address their concerns, together with an assessment of the impacts or risks associated with the mitigation or alternatives considered).

A public comment period is currently underway and will end on 18 January 2019. Comments received on the BAR will be collated into an Issues and Responses Summary which will be appended to the Final BAR to be submitted to the DMR for decision making.

Refer to Section 3(h)(v) for the identified impacts, the key mitigation / optimisation measures and the significance rating without and with mitigation.

ix. Motivation where no alternative sites were considered

Refer to Section 3(h)(vii)i.

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

(Provide a statement motivating the final site layout that is proposed)

The existing location of Swartberg mine relative to the RWD limits the ore and rock waste movement to a long, narrow corridor. The steep slopes to the north of the site, and reedbeds to the southeast of the site further restricts the area that can be considered.

BMM proposed four route alternatives for the haul road. The selected route alternative (in red in Figure 4) was determined based on safety and design (e.g. steep slopes, fill material requirements, etc.) considerations. The terrain along the selected route is less undulating and rocky for most of the route, especially in the western section. BMM does not consider the other route alternatives to be feasible based on the financial and engineering input that will be required to address the safety and design considerations for the other route alternatives.

Upon assessment of the four layout alternatives, the ecology specialist confirmed that the selected alternative was acceptable from an ecological perspective. This layout was selected for assessment and no other layout alternatives were assessed.

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

(Including (i) a description of all environmental issues and risks that were identified during the environmental impact assessment process and (ii) an assessment of the significance of each issue and risk and an indication of the extent to which the issue and risk could be avoided or addressed by the adoption of mitigation measures.)

An Ecology Impact Assessment was undertaken as part of the BA process to investigate the key potential ecology issues and impacts identified. These key issues and impacts have been identified based on:

- The legal requirements;
- The nature of the proposed activity;
- The nature of the receiving environment; and
- The professional experience of the EIA team.

The Ecology Impact Assessment is attached as Appendices D to this report. Soil and land capability, air quality and socio-economic impacts were assessed by experienced EAPs and SRK specialists, and stand-alone specialist studies were not considered necessary.

The significance of the identified impacts is assessed using SRK's proven impact rating methodology [see Section 3(h)(vi)]. Practicable mitigation and optimisation measures are recommended and impacts are rated in the prescribed way both without and with the assumed effective implementation of mitigation and optimisation measures.

j) Assessment of each identified potentially significant impact and risk

(This section of the report must consider 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).

Table 26 below summarises the potentially significant impacts and their significance ratings before and after application of mitigation and/or optimisation measures. The supporting impact assessment conducted by the ecology specialist is included in Section 3(h)(v).

Table 26: Summary of potential impacts

Potential negative impacts are shaded in reds, benefits are shaded in greens. Insignificant impacts have not been shaded. Only key (non-standard essential) mitigation / optimisation measures are presented.

ID #	Impact	Significance rating		Key mitigation/optimisation measures
		Before mitigation/optimisation	After mitigation/optimisation	
CONSTRUCTION PHASE IMPACTS				
LC	Impacts on Soil and Land Capability			
LC1	Soil compaction caused by construction traffic	Very Low	Very Low	<ul style="list-style-type: none"> Restrict construction activities to the project footprint areas. Restrict vehicle movements to haul roads and laydown areas and prohibit vehicle parking or storage of construction materials outside these areas.
LC2	Loss of land capability	Low	Low	<ul style="list-style-type: none"> Restrict construction activities to the project footprint areas. Rehabilitate disturbed areas incrementally and as soon as possible, not necessarily waiting until completion of the Construction Phase.
A	Impacts on Air Quality			
A1	Impaired air quality from suspended particulates affecting receptors	Very Low	Insignificant	<ul style="list-style-type: none"> Implement dust suppression measures on access roads.
T	Impacts on Terrestrial Ecology			
T1	Loss of vegetation	Low	Very Low	<ul style="list-style-type: none"> Limit vegetation clearance and the footprint of construction activities to what is absolutely essential. Define all areas outside of the planned project and construction footprint as no-go areas. Demarcate construction footprints and restrict access beyond these areas.
T2	Loss of threatened floral species	Low	Very Low	<ul style="list-style-type: none"> Limit vegetation clearance and the footprint of construction activities to what is absolutely essential. Define all areas outside of the planned project and construction footprint as no-go areas. Demarcate construction footprints and restrict access beyond these areas.

ID #	Impact	Significance rating		Key mitigation/optimisation measures
		Before mitigation/optimisation	After mitigation/optimisation	
T3	Disturbance to terrestrial fauna and loss of habitat during construction	Low	Very Low	<ul style="list-style-type: none"> Limit vegetation clearance and the footprint of construction activities to the minimum required. Confine construction vehicles and staff to designated roadways and construction areas and strictly prohibit the indiscriminate movement of construction vehicles and staff through vegetation outside of the construction footprint. Limit vehicle speeds on internal and haul roads to 40 km/hr during construction. Conduct environmental induction for all construction staff to increase awareness in fauna protection. Prohibit trapping, collecting and hunting of fauna. Usher any faunal species within the construction footprint towards more suitable habitat within the surrounding areas. Threatened fauna should be relocated by a suitably qualified environmental officer. Prohibit construction activities and driving at night. Limit soil compaction to the minimum required. Immediately clean up spills and dispose of contaminated soil at a licensed waste disposal facility. Do not leave trenches open for extended periods.
FE	Impacts on Freshwater Ecology			
FE1	Degradation of ephemeral drainage lines	Very Low	Very Low	<ul style="list-style-type: none"> Construct new watercourse crossings / culverts during dry conditions only, and when no rainfall is forecast.. Appoint a suitably qualified engineer to design and supervise the correct installation of all culverts. Limit the footprint area of the construction activity to what is absolutely essential. Define all areas outside of the planned project and construction footprint (including roads and walking routes) as no-go areas. Close and rehabilitate erosion gullies as they form. Ensure that construction-associated waste (e.g. plastic, rubble) is disposed of appropriately on a frequent and ongoing basis. Ensure that vehicle and machinery refuelling is managed to minimise pollution opportunities.
OPERATIONAL PHASE IMPACTS				
LC	Impacts on Soil and Land Capability			
LC3	Soil erosion caused by operational activities	Low	Very Low	<ul style="list-style-type: none"> Undertake vegetation clearance and soil stripping immediately prior to construction activities. Implement drainage control measures and install culverts to manage the natural flow of surface runoff from the haul road.
LC4	Soil compaction caused by hauling	Low	Low	<ul style="list-style-type: none"> Restrict hauling to designated haul roads and no additional roads or turn-around areas should be created.
LC5	Loss of land capability	Low	Low	<ul style="list-style-type: none"> Restrict activities to the project footprint areas.
A	Impacts on Air Quality			
A2	Increased Dustfall Associated with Hauling Activities	Very Low	Very Low	<ul style="list-style-type: none"> Implement existing dust suppression measures at the Mine on access roads.
FE	Impacts on Freshwater Ecology			

ID #	Impact	Significance rating		Key mitigation/optimisation measures
		Before mitigation/optimisation	After mitigation/optimisation	
FE2	Degradation of ephemeral drainage lines	Very Low	Very Low	<ul style="list-style-type: none"> Inspect watercourses annually during routine maintenance and report on evidence of erosion at crossings. Respond to reports of erosion by closing gullies and reshaping and revegetating river.
T	Impacts on Terrestrial Ecology			
T4	Loss of vegetation	Very Low	Very Low	<ul style="list-style-type: none"> Limit vegetation clearance, pruning and the footprint of maintenance activities to what is absolutely essential; Restrict driving to the disturbance footprint of the haul road; Appoint a suitably qualified engineer to design and supervise the correct installation of all culverts.
T5	Increased faunal mortalities	Very Low	Very Low	<ul style="list-style-type: none"> Train staff to increase awareness of environmental concerns. Limit night driving as far as possible to minimize negative effects on nocturnal animals. Enforce speed limits on site.
H	Impacts on Heritage			
H1	Loss of palaeontological resources during road construction	Low	Very Low	<ul style="list-style-type: none"> Limit clearance and the footprint of construction activities to what is absolutely essential. Alert personnel to possibility of finding historical resources and follow "Finds Procedure".
CLOSURE PHASE IMPACTS				
A	Impacts on Air Quality			
	Same as Construction Phase impacts			
T	Impacts on Terrestrial Ecology			
	Same as Construction Phase impacts			
FE	Impacts on Freshwater Ecology			
	Same as Construction Phase impacts			
H	Impacts on Heritage			
	Same as Construction Phase impacts			

k) Summary of specialist reports.

(This summary must be completed if any specialist reports informed the impact assessment and final site layout process and must be in the following tabular form):

LIST OF STUDIES UNDERTAKEN	RECOMMENDATIONS OF SPECIALIST REPORTS	SPECIALIST RECOMMENDATIONS THAT HAVE BEEN INCLUDED IN THE EIA REPORT (Mark with an X where applicable)	REFERENCE TO APPLICABLE SECTION OF REPORT WHERE SPECIALIST RECOMMENDATIONS HAVE BEEN INCLUDED.
Ecology Impact Assessment	Construction Phase	X	Chapter 9 of the Ecology Impact Assessment
	<ul style="list-style-type: none"> • Confine vegetation clearance to the footprint of the proposed haul road and avoid unnecessary clearance. 		
	<ul style="list-style-type: none"> • Install culverts or pipe at all drainage line crossings to allow the natural functioning of the watercourses. 		
	<ul style="list-style-type: none"> • Appoint a suitably qualified person to plan, design and supervise the correct construction of the road and culverts to minimize the impact on the environment. 		
	<ul style="list-style-type: none"> • Confine soil compaction and levelling to the footprint of the proposed haul road. 		
	<ul style="list-style-type: none"> • Design roads to reduce the risk of erosion. 		
	<ul style="list-style-type: none"> • Wet roads regularly to control dust generation. Other suitable dust control mitigation measures can also be considered. 		
	<ul style="list-style-type: none"> • Adhere to SANS noise standards. 		
	<ul style="list-style-type: none"> • Prohibit construction at night. 		
	<ul style="list-style-type: none"> • Staff must undergo environmental awareness training to increase their awareness of environmental concerns. All construction contractors and crew should attend and pass an induction course. Although road kills cannot be avoided, the increased awareness of drivers should be able to reduce the number of fatalities. 		
	<ul style="list-style-type: none"> • Limit night driving. 		
	<ul style="list-style-type: none"> • Enforce speed limits on all roads on site. 		
	<ul style="list-style-type: none"> • Implement a monitoring program for the early detection of alien invasive plant species and a control program to combat declared alien invasive plant species should be employed. 		
	<ul style="list-style-type: none"> • No alien species should be used in rehabilitation. 		
Operational Phase			

	<ul style="list-style-type: none"> • Avoid vegetation clearance wherever possible and avoid new areas. • Restrict driving to designated roads. • Staff must undergo environmental awareness training to increase their awareness of environmental concerns. All construction contractors and crew should attend and pass an induction course. Although road kills cannot be avoided, the increased awareness of drivers should be able to reduce the number of fatalities. • Limit night driving. • Enforce speed limits on all roads on site. • Maintain the haul road. • Implement a monitoring program for the early detection of alien invasive plant species and a control program to combat declared alien invasive plant species should be employed. • No alien species should be used in rehabilitation. 	X	Section 3(h)(v)
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Attach copies of Specialist Reports as appendices

I) Environmental impact statement

i. Summary of the key findings of the environmental impact assessment;

The proposed haul road will entail so-called triple bottom line costs, i.e. social, environmental and economic costs. The triple bottom line concerns itself with environmental (taken to mean biophysical) sustainability, social equity and economic efficiency and is typically employed by companies seeking to report on their performance. The concept serves as a useful construct to frame the evaluation of environmental impacts of the project.

The challenge for DMR is to take a decision which is sustainable in the long term and which will probably entail trade-offs between social, environmental and economic costs and benefits. The trade-offs are documented in the report, which assesses environmental impacts and benefits and compares these to the No-Go alternative. SRK believes it will be instructive to reduce the decision factors to the key points which the authorities should consider. These points constitute the principal findings of the BA:

- BMM owns and operates the Black Mountain Mine near the town of Aggeneys in the Northern Cape. The mine holds a Mining Licence (ML2/99), covering an extent of 9,505.7 ha, and an approved EMPr to conduct mining activities at the Mine.
- BMM proposes to construct a new haul road from the top of the WRD to an area near the weighbridge (adjacent to onthe existing haul road). The new haul road will be 8 m wide to allow for 2-way truck traffic and ~ 1.2 km long.
- The new haul road will be located within the Mining Right Area between the Swartberg shaft and processing area, north of an existing haul road.
- The purpose of the project is to alleviate traffic and safety concerns at the existing haul road intersection at the processing area, and to optimise haul distances between the Swartberg shaft and the WRD.
- Key aspects of the project include the construction of a new haul road, establishment of laydown areas within the existing disturbed footprint of the weighbridge area and WRD, installation of 11 cement culverts and / or drifts, and the raising of an existing powerline to ensure heavy vehicles can pass safely beneath.
- BMM considered four haul road route alignments for the proposed haul road. The selected route alternative was determined based on safety and design (e.g. steep slopes, fill material requirements, etc.) considerations. Only the selected route has been presented as feasible to BMM.
- The haul road will cross 11 ephemeral drainage lines. The condition of all the affected drainage lines is assessed to be of a mostly natural, unmodified condition, but the drainage lines are not ecologically important or sensitive (unique) at any scale.
- An ecology specialist and the EAP undertook detailed screening of the study area to assess baseline conditions.
- Potential environmental aspects considered include soil and land capability, air quality, terrestrial ecology and freshwater.
- Key ecological impacts are associated with a loss in vegetation and the degradation of ephemeral drainage lines. These impacts are mitigated to acceptable levels through the strict implementation of the EMPr.
- The No-Go alternative implies that the haul road will not be constructed and the road safety at the mine will not be improved, and haul distances not optimised. This will inhibit future

development at the Mine. In other words, the benefit of increased road safety and haul distance optimisation will be forgone.

- A number of mitigation and monitoring measures have been identified to avoid, minimise and manage potential environmental impacts associated with the proposed development. These are further laid out in the EMPr.

ii. Final Site Map

*Provide a map at an appropriate scale which superimposes the proposed overall activity and its associated structures and infrastructure on the environmental sensitivities of the preferred site indicating any areas that should be avoided, including buffers. Attach as **Appendix***

The specialists did not identify any specific areas of high sensitivity within the proposed haul footprint that should be designated as “exclusion zones” (see **Error! Reference source not found.**).

iii. Summary of the positive and negative impacts and risks of the proposed activity and identified alternatives

Refer to Section 3(J) for a summary of the positive and negative impacts of the proposed activity.

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

Based on the assessment and where applicable the recommendations from specialist reports, the recording of proposed impact management objectives, and the impact management outcomes for the development for inclusion in the EMPr as well as for inclusion as conditions of authorisation.

The purpose of the EMPr is to demonstrate how environmental management and mitigation measures will be implemented to ensure that potential environmental pollution and degradation can be minimised, if not prevented. The EMPr guides construction and operational activities and provides a framework for the ongoing assessment of environmental performance.

The objectives of the EMPr are to:

- Ensure compliance with regulatory authority stipulations and guidelines;
- Ensure sufficient allocation of resources;
- Verify environmental performance;
- Respond to changes in project implementation not considered in the EIA;
- Respond to unforeseen events; and
- Provide feedback for continual improvement in environmental performance.

n) Aspects for inclusion as conditions of Authorisation.

Any aspects which must be made conditions of the Environmental Authorisation

All identified management and mitigation measures included in the EMPr.

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

(Which relate to the assessment and mitigation measures proposed)

As is standard practice, the report is based on several assumptions and is subject to certain limitations. These are as follows:

- Information provided by BMM, other consultants and specialists is assumed to be accurate and correct;

- SRK's assessment of the significance of impacts of the proposed development on the affected environment has been based on the assumption that the activities will be confined to those described in Section 3 (d);
- Where detailed design information is not available, the precautionary principle, i.e. a conservative approach that overstates negative impacts and understates benefits, has been adopted; and
- A once-off ecology survey was conducted during the dry season (October 2018) and most bulbous and summer annual plant species are unlikely to occur during this time of year. Consequently, the number of these plant species encountered and reported on in the Ecology Impact Assessment is likely to be an underestimate of the number of species which could potentially occur on site.

Notwithstanding the above, SRK is confident that these assumptions and limitations do not compromise the overall findings of the report.

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

i. Reasons why the activity should be authorized or not.

This draft BAR has identified and assessed the potential biophysical and socio-economic impacts associated with the new haul road at the Mine.

In terms of Section 31 (n) of NEMA, the EAP is required to provide an opinion as to whether the activity should or should not be authorised. In this section, a qualified opinion is ventured, and in this regard SRK believes that sufficient information is available for DMR to take a decision.

The Swartberg haul road project will result in unavoidable, minor adverse environmental impacts. None of these adverse impacts are considered unacceptably significant and all can be managed to tolerable levels through the effective implementation of the recommended mitigation measures. In addition, the project will directly and indirectly benefit the workers at the Mine, as well as the regional economy.

Working on the assumption that BMM is committed to ensuring that the proposed activities are undertaken to high standards, achieved through implementation of the recommended mitigation measures and ongoing monitoring of performance, SRK believes and the BAR demonstrates that through effective implementation of the stipulated mitigation measures, the adverse impacts of this project can be reduced to levels compliant with national (and international) standards or guidelines.

The fundamental decision is whether to allow the development, which is generally consistent with development policies for the area, but which may have limited biophysical impacts.

SRK believes that the BAR and the Ecology Impact Assessment (Appendix D) have clearly shown that the project is generally acceptable. The BAR has also assisted in the identification of essential mitigation measures that will mitigate the impacts associated with these components to within tolerable limits.

In conclusion SRK is of the opinion that on purely 'environmental' grounds (i.e. the project's potential socio-economic and biophysical implications) the application as it is currently articulated should be approved, provided the essential mitigation measures are implemented. Ultimately, however, the DMR will need to consider whether the project benefits outweigh the potential impacts.

ii. Conditions that must be included in the authorisation

Key recommendations, which are considered essential, are:

1. Implement the EMPr to guide construction, operation and maintenance activities and to provide a framework for the ongoing assessment of environmental performance;
2. Designate the Environmental Manager / Officer at BMM to oversee the implementation of the EMPr and supervise any construction activities (particularly within the drainage lines);
3. Minimise the physical footprint of the development and areas disturbed by construction activities to the smallest extent possible;
4. Rehabilitate all areas disturbed by construction activities (outside of the project footprint);
5. Obtain other permits and authorisations as may be required, including, but not limited to:
 - a) Water Use Authorisations;
 - b) Heritage Approval; and
 - c) Permits for the removal of protected plant species.

q) Period for which the Environmental Authorisation is required.

All non-operational activities (i.e. construction activities) will be completed within five (5) years.

r) Undertaking

Confirm that the undertaking required to meet the requirements of this section is provided at the end of the EMPr and is applicable to both the Basic assessment report and the Environmental Management Programme report.

Refer to the EAP Affirmation.

s) Financial Provision

State the amount that is required to both manage and rehabilitate the environment in respect of rehabilitation.

BMM has calculated the liability to achieve the total quantum for rehabilitation and remediation of environmental impacts related to the new haul road. The quantum for financial provision is estimated to be R 751 838.31.

BMM has indicated that the new haul road, and the rehabilitation thereof, can be incorporated into the current closure cost. Adjustments to the quantum of financial provision for the amendments are, therefore, not required.

t) Explain how the aforesaid amount was derived.

BMM has indicated that the new haul road, and the rehabilitation thereof, can be incorporated into the current closure cost. Adjustments to the quantum of financial provision for the amendments are, therefore, not required.

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

(Confirm that the amount, is anticipated to be an operating cost and is provided for as such in the Mining work programme, Financial and Technical Competence Report or Prospecting Work Programme as the case may be).

BMM has indicated that the new haul road, and the rehabilitation thereof, can be incorporated into the current closure cost. Adjustments to the quantum of financial provision for the amendments are, therefore, not required.

u) 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). the EIA report must include the:-

1) Impact on the socio-economic conditions of any directly affected person.

*(Provide the results of Investigation, assessment, and evaluation of the impact of the mining, bulk sampling or alluvial diamond prospecting on any directly affected person including the landowner, lawful occupier, or, where applicable, potential beneficiaries of any land restitution claim, attach the investigation report as an **Appendix***

All potential socio-economic impacts are assessed in Section 3(h)(v).

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

(Provide the results of Investigation, assessment, and evaluation of the impact of the mining, bulk sampling or alluvial diamond prospecting on any national estate referred to in section 3(2) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) with the exception of the national estate contemplated in section 3(2)(i)(vi) and (vii) of that Act, attach the investigation report as Appendix 2.19.2 and confirm that the applicable mitigation is reflected in 2.5.3; 2.11.6.and 2.12.herein).

A field assessment conducted near the Swartberg shaft for a previous BA process for the Mine provided no above-ground evidence of prehistoric structures, buildings older than 60 years, or material of cultural significance or in situ archaeological sites within the proposed development footprint.

Based on the above, it was inferred that heritage impacts were unlikely and as such, have not been assessed. However, mitigation / management measures have been included in the EMPr, should any heritage resources be identified during excavations.

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

*(the EAP managing the application must provide the competent authority with detailed, written proof of an investigation as required by section 24(4)(b)(i) of the Act and motivation if no reasonable or feasible alternatives, as contemplated in sub-regulation 22(2)(h), exist. The EAP must attach such motivation as **Appendix 4**).*

Refer to Section 3(h)(ix)

PART B

ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT

4. DRAFT ENVIRONMENTAL MANAGEMENT PROGRAMME

a) Details of the EAP

(Confirm that the requirement for the provision of the details and expertise of the EAP are already included in PART A, section 1(a) herein as required).

The details and expertise of the EAP are provided in Part A, Section 3 (a).

b) Description of the Aspects of the Activity

(Confirm that the requirement to describe the aspects of the activity that are covered by the draft environmental management programme is already included in PART A, section (1)(h) herein as required).

The activities covered by the EMPr are provided in Part A, Section 3 (d).

c) Composite Map

*(Provide a map (**Attached as an Appendix**) at an appropriate scale which superimposes the proposed activity, its associated structures, and infrastructure on the environmental sensitivities of the preferred site, indicating any areas that any areas that should be avoided, including buffers)*

The specialist did not identify any specific areas of high sensitivity within the proposed project footprint that should be designated as "exclusion zones" (refer to **Error! Reference source not found.**).

d) Description of Impact management objectives including management statements

ii. Determination of closure objectives.

(ensure that the closure objectives are informed by the type of environment described)

The haul road forms part of the BMM operation and as such, will not deviate from the closure objectives already committed to by the Mine.

BMM has a main integrated Closure Management Plan (2010); a Concept Closure Plan to integrate the Gamsberg project (2013) and a Closure Quantum External Review and Amendment (2016) (Endemic Vision, 2017).

The aim of the BMM Closure Management Plan is to ensure that the area transformed by mining, processing and other operational activities is either returned to as natural a state as possible or facilities remaining at the end of Life-of-Mine (LoM) are utilised for other economically viable and sustainable activities.

The BMM Closure Management Plan states that the closure objectives should be achieved in as cost effective a manner as possible, and the closure solution should be sustainable in the long term.

The following key objectives of the Closure Management Plan were identified through environmental, social and physical assessment and public workshops held from 2008 to 2010:

- To secure the effective and sustainable transfer of the municipal services of the town, Aggeneys, and the Pella-drift Water Board to the KLM;
- To ensure that the biodiversity and environment on the site is protected; and

- To make sure that the following commitments will be achieved as a minimum:
 - The site will be made safe for both humans and animals;
 - The site will be rehabilitated to be physically, chemically and biologically stable;
 - The residual impacts will be managed to acceptable levels and will not deteriorate over time; and
 - Closure will be achieved with minimal socio-economic upheaval.

BMM commits to provide sufficient funds at the end of LoM, to properly implement the closure plan, and also to make provision for possible premature closure, and post closure monitoring requirements.

iii. **Volumes and rate of water use required for the operation**

During the Construction Phase of the project, water will be used for typical construction activities and to suppress dust (if required). Water will not be required for the Operational Phase. Volumes cannot be estimated but are likely to be insignificant. BMM purchase water from the Sedibeng-owned Pelladrif Water Board. The additional (negligible) water use will be within BMM's approved allocation.

iv. **Has a water use licence has been applied for**

Section 21 of the NWA specifies a number of water uses that require WUA in terms of Section 22(1) of the Act. A WUA process must be conducted to obtain authorisation for any of these activities, unless the specific use is listed in Schedule 1 of the NWA or is an existing lawful use.

WUA may be granted by means of a WUL or General Authorisation (GA) (issued in terms of Section 39 of the NWA). The competent authority for WUAs is the DWS.

The project activities trigger the following water use activities in terms of Section 21 of the NWA:

- c) impeding or diverting the flow of water in a watercourse; and
- i) altering the bed, banks, course or characteristics of a watercourse;

Government Notice (GN) 509 of 2016, promulgated in terms of Section 39 of NWA, specifies the requirements for GA in terms of Sections 21 (c) and (i) of NWA. Some project activities will be undertaken within below ephemeral drainage lines. As such, the project would take place within the regulated area of a watercourse as defined in GN 509 and may impede and/or alter watercourses in the catchment.

GA in terms of GN 509 replaces the need for a water user to apply for a license for Section 21 (c) and (i) water uses that are to take place within the regulated area of a watercourse, provided that these water uses are carried out within the limits and conditions of the GA. Furthermore, the GA does not apply to Section 21 (c) and (i) water uses where the risk class of these uses is medium or high as determined by a suitably qualified specialist during the completion of the prescribed risk matrix (see Appendix D).

Based on the outcomes of the risk matrix for the site, the risk is considered to be *low*, and GA applies to the Section 21 (c) and (i) water uses associated with the project (Ekotrust, 2018).

An application has been submitted to DWS.

e) Impacts to be mitigated in their respective phases

Measures to rehabilitate the environment affected by the undertaking of any listed activity

The environmental management and mitigation measures that must be implemented for the project during the **Design Phase**, as well as responsibilities and timelines for the implementation of these measures, are laid out in Table 27 below. Design activities include the technical design of the haul road, drainage crossings and stormwater abatement infrastructure.

Table 27: Environmental management and mitigation measures that must be implemented during the *Design Phase*

Design Phase Measures						
Aspect	ID	Mitigation measure / Procedure	Responsible	Implementation Timeframe	Monitoring Methods ²	Performance Indicators
Environmental Compliance	1.	Ensure that all required licences and permits have been obtained before the start of construction including WUA and heritage approval.	• BMM	• Before construction activities commence	• Check updated EMPr • BMM to check tender documents and contract	• Required licences/permits on file • Water Use Authorisation obtained • Updated EMPr on file • Incorporated in tender documents
	2.	Finalise the EMPr (if required) to include all conditions of authorisation imposed by DMR and DWS.		• Before construction activities commence		
Planning and Design – Line Crossings	3.	Allow for culverts and/or low-level drift crossings at line crossing points for the uninterrupted flow of water across the road.	• Design engineer	• During detailed design	• Review final designs and project implementation	• Final design and implementation incorporates design mitigation
	4.	Design all drainage line crossings perpendicular to watercourses (where feasible).				
	5.	Design terrace walls using materials that blend in with the surroundings (e.g. sandstone stone-packing, riverstone gabions) where necessary.				
	6.	Get written sign-off of final designs of all watercourse crossings from the Environmental Manager.	• BMM		• Review Environmental Manager approval	• Approval of final design
Planning and Design - Specific to Culverts	7.	Include design measures at all crossings that allow for surface and subsurface flow across the full width of the drainage line.	• Design engineer	• During detailed design	• Review final designs and project implementation	• Final design and implementation incorporates design mitigation
Planning and Design – Specific to Low-level Crossings	8.	Design low-level crossings through lines that allow overtopping even during small floods	• Design engineer	• During detailed design	• Review final designs and project implementation	• Final design and implementation incorporates design mitigation
Planning and Design – Haul Road	9.	Ensure that the haul road is constructed within the project footprint as assessed in the BAR.	• Design engineer	• During detailed design	• Review final designs and project implementation	• Final design and implementation

² Unless otherwise indicated, monitoring will be undertaken by the Environmental Manager and / or Environmental Officers, supported by the authorities where the requirement is specifically stipulated in a licence or permit.

	10.	Include appropriate measures in design (including signage) to ensure vehicles do not exceed the speed limit (40 km/hr at sharp turns and 70 km/hr on straights) and remain on the construction footprint.				incorporates design mitigation
Stormwater Management	11.	Include the erosion control and abatement structures in final designs of the road.	<ul style="list-style-type: none"> • Design engineer 	<ul style="list-style-type: none"> • During detailed design 	<ul style="list-style-type: none"> • Review final designs and project implementation 	<ul style="list-style-type: none"> • Final design and implementation incorporates design mitigation

The environmental management and mitigation measures that must be implemented for the project during the **Construction Phase**, as well as responsibilities and timelines for the implementation of these measures and monitoring thereof, are laid out in Table 28 below. Activities in the Construction Phase include:

- Establishment of site camp and lay-down areas;
- Vegetation clearance;
- Construction of the haul road and low-level crossings;
- Installation of pre-cast culverts (where low-level crossings are not constructed); and
- Raising the existing powerline.

Table 28: Environmental management and mitigation measures that must be implemented during the *Construction Phase*

Construction Phase Measures						
Aspect	ID	Mitigation measure / Procedure	Responsible	Implementation Timeframe	Monitoring Methods ³	Performance Indicators
Environmental Compliance	1.	Compile monthly inspection reports for submission to BMM management and authorities on request.	• Environmental manager / officer (BMM)	• Throughout construction	• Environmental manager / officer to submit reports to BMM management and authorities on request	• Monthly site inspections and reports
Site Establishment	2.	Submit a Method Statement for Site Camp establishment for approval by the Environmental manager / officer at BMM at least two weeks prior to the start of construction activities.	• Contractors	• Start of construction	• Visual inspections • Method Statement	• Approved Method Statement • Site boundaries demarcated • Signage in place
	3.	Establish a suitably fenced Site Camp at the start of the contract, which will allow for site offices, vehicle, equipment, material and waste storage areas to be consolidated as much as possible. Locate the Site Camp within the existing disturbed footprint of the weighbridge area and/or WRD.				
	4.	Designate the area beyond the boundary of the site camp as “No Go” areas for all personnel on site. No vehicles, machinery, materials or people shall be permitted in the “No Go” area at any time without the express permission of the Environmental Manager / Officer.				
	5.	Locate laydown areas or other temporary use areas within the site camp.				

³ Unless otherwise indicated, monitoring will be undertaken by the Environmental Manager and / or Environmental Officers, supported by the authorities where the requirement is specifically stipulated in a licence or permit.

Construction Phase Measures						
Aspect	ID	Mitigation measure / Procedure	Responsible	Implementation Timeframe	Monitoring Methods ³	Performance Indicators
Environmental Awareness Training	6.	Provide environmental awareness training to all personnel on site at the start of their employment. Training should include discussion of: <ul style="list-style-type: none"> Potential impact of construction waste and activities on the environment; Suitable disposal of construction waste and litter; Key measures in the EMPr relevant to worker's activities; and How incidents and suggestions for improvement can be reported. Ensure that all attendees remain for the duration of the training and on completion sign an attendance register that clearly indicates participants' names.	<ul style="list-style-type: none"> Contractors 	<ul style="list-style-type: none"> Before workers start working on-site Before new activities are undertaken 	<ul style="list-style-type: none"> Check training attendance register Observe whether activities are executed in line with EMPr requirements 	<ul style="list-style-type: none"> Proportion of workers that completed environmental training Compliance of workers with EMPr
Ablution Facilities	7.	Utilise existing ablation facilities	<ul style="list-style-type: none"> BMM 	<ul style="list-style-type: none"> Throughout construction 	<ul style="list-style-type: none"> Visual inspections of ablutions 	<ul style="list-style-type: none"> Number of incidents of staff not using facilities
Fire Management	8.	Ensure that no fires are permitted on or adjacent to site except in areas designated for this purpose. Any such designated areas should be situated as far as possible from vegetated areas and/or flammable material stores. Suitable firefighting equipment must be readily available in this area.	<ul style="list-style-type: none"> Contractors 	<ul style="list-style-type: none"> Throughout construction 	<ul style="list-style-type: none"> Inspect fire extinguishers and certificates 	<ul style="list-style-type: none"> Number of fire incidents Certified extinguishers in appropriate locations
	9.	Ensure that no smoking is permitted on the site except for within a designated area in the Site Camp (to be included in the Site Camp Method Statement). Suitable firefighting equipment must be readily available in this area.				
	10.	Ensure that sufficient fire-fighting equipment is available on site.				
	11.	Equip all waste storage areas with fire extinguishers.				
	12.	Ensure that all personnel on site are aware of the location of firefighting equipment on the site and how the equipment is operated.				
	13.	Suitably maintain firefighting equipment.				
Hazardous Materials	14.	Utilise existing facilities in the processing area	<ul style="list-style-type: none"> Contractors 	<ul style="list-style-type: none"> Throughout construction 	<ul style="list-style-type: none"> Visual inspection of hazardous materials handling and storage areas 	<ul style="list-style-type: none"> Number of incidents of non-compliance with safety procedures concerning hazardous materials, including waste materials Number of spills of hazardous materials,
	15.	Ensure that contaminants (including cement) are not placed directly on the ground (e.g. mix cement on plastic sheeting).				
	16.	Develop (or adapt and implement) procedures for the safe transport, handling and storage of potential pollutants.				

Construction Phase Measures							
Aspect	ID	Mitigation measure / Procedure	Responsible	Implementation Timeframe	Monitoring Methods ³	Performance Indicators	
	17.	Avoid unnecessary use and transport of hazardous substances.				including waste materials	
	18.	Keep Material Safety Data Sheets for all hazardous materials on site and ensure that they are available for reference by staff responsible for handling and storage of materials.				<ul style="list-style-type: none"> Evidence of contamination and leaks 	
Transportation and Refuelling	19.	Undertake regular maintenance of vehicles and machinery to identify and repair minor leaks and prevent equipment failures.	<ul style="list-style-type: none"> Contractors 	<ul style="list-style-type: none"> Throughout construction 	<ul style="list-style-type: none"> Inspect vehicles, machinery and refuelling/maintenance areas 	<ul style="list-style-type: none"> Number of incidents of non-compliance Number of leaks and spills 	
	20.	Undertake any refuelling and maintenance of vehicles/machinery in existing approved maintenance / refuelling areas in the processing area.					
	21.	Clean up any spills immediately, through containment and removal of free product and appropriate disposal of contaminated soils.					
Response to Environmental Pollution	22.	Compile a Method Statement for response to environmental pollution for approval by the Environmental Manager / Officer.	<ul style="list-style-type: none"> Contractors 	<ul style="list-style-type: none"> Before construction commences 	<ul style="list-style-type: none"> Review Method Statement Maintain register of pollution events and response Inspect repaired equipment to ensure proper functioning 	<ul style="list-style-type: none"> Method Statement Number of incidents Time activities stopped Number of recurring incidents Availability and completeness of register 	
	23.	In the event of environmental pollution, e.g. through spillages, immediately stop the activity causing the problem.		<ul style="list-style-type: none"> Throughout construction 			
	24.	Only resume activity once the problem has been stopped.					
	25.	Repair faulty equipment as soon as possible.					
	26.	Install additional bunding / containment structures around the equipment that was the source of the leak / spillage.					
Waste Management	27.	Submit a Method Statement for waste management (including hazardous waste) for approval by the Environmental Manager / Officer.	<ul style="list-style-type: none"> Contractors 	<ul style="list-style-type: none"> Before start of activities on site Throughout construction 	<ul style="list-style-type: none"> Method Statement Visual inspection of waste collection and disposal areas Visual inspection of construction areas (litter) Check waste disposal slips 	<ul style="list-style-type: none"> Presence of litter Availability of rubbish bins and skips Degree to which rubbish bins and skips are filled Total volume of general and hazardous waste storage capacity Degree to which different waste is separated 	
	28.	Aim to minimise waste through reducing and re-using material.					
	29.	Collect recyclables separately and deliver these to suitable facilities or arrange for collection.					
	30.	Collect all waste in bins and/or skips at the construction site.					
	31.	Prevent littering by construction staff at work sites by providing bins or waste bags in sufficient locations.					

Construction Phase Measures						
Aspect	ID	Mitigation measure / Procedure	Responsible	Implementation Timeframe	Monitoring Methods ³	Performance Indicators
	32.	Provide separate bins for hazardous / polluting materials and mark these clearly. Store hazardous / polluting materials on impermeable ground until it is disposed of / collected.				<ul style="list-style-type: none"> • Frequency of waste collection
	33.	Dispose of waste appropriately to prevent pollution of soil and groundwater.				
	34.	Do not allow any burning or burying of waste on site.				
	35.	Do not dispose of any waste in the drainage lines.				
	36.	Display and explain waste handling and disposal protocols.				
Concrete/Cement Work	37.	Use Ready-Mix concrete rather than batching where possible.	<ul style="list-style-type: none"> • Contractors 	<ul style="list-style-type: none"> • Throughout construction 	<ul style="list-style-type: none"> • Visual inspection and approval by Environmental Manager / Officer. 	<ul style="list-style-type: none"> • Number of incidents of batching outside works footprint • Contamination of water and soil
	38.	Ensure that no cement truck delivery chutes are cleaned on site. Cleaning operations are to take place where wastewater can be disposed of in the correct manner.				
	39.	Batch cement in a bunded area within the boundaries of the development footprint only (where unavoidable).				
	40.	Ensure that cement is mixed on mortar boards and not directly on the ground (where unavoidable).				
	41.	Physically remove any remains of concrete, either solid, or liquid, immediately and dispose of as waste.				
	42.	Place cement bags in bins and dispose of bags as waste to a licensed waste disposal facility.				
	43.	Sweep / rake / stack excess aggregate / stone chip / gravel / pavers into piles and dispose at a licensed waste disposal facility.				
Contaminated Water/Run-off management	44.	Prevent discharge of any pollutants, such as cements, concrete, lime, chemicals, and other contaminated waste water and fuels into any water sources and/or the environment.	<ul style="list-style-type: none"> • Contractors 	<ul style="list-style-type: none"> • Throughout construction 	<ul style="list-style-type: none"> • Visual inspection of fuel/workshop areas and concrete swills 	<ul style="list-style-type: none"> • Implementation of preventative actions • Visibility of water pollution
	45.	Collect and strictly control runoff from the concrete batching areas.				
Erosion Control	46.	Stabilize exposed slopes within 30 m of any watercourse as soon as these are created (e.g. at stockpiles and cut and fill areas) to prevent sedimentation.	<ul style="list-style-type: none"> • Contractor 	<ul style="list-style-type: none"> • Throughout construction 	<ul style="list-style-type: none"> • Check that exposed slopes within 30m of any watercourse are stabilized • Check for evidence of erosion gullies 	<ul style="list-style-type: none"> • Evidence of erosion
	47.	Close and rehabilitate erosion gullies as they form.				

Construction Phase Measures						
Aspect	ID	Mitigation measure / Procedure	Responsible	Implementation Timeframe	Monitoring Methods ³	Performance Indicators
	48.	Install silt fences and erosion prevention measures in areas sensitive to erosion.			<ul style="list-style-type: none"> Check silt fences and erosion prevention measures are installed in areas sensitive to erosion Check areas are not cleared prematurely 	
	49.	Avoid clearing of vegetation until absolutely necessary.				
Stormwater Management	50.	Collect stormwater from bunded areas in a suitable container and remove from the site for appropriate disposal.	<ul style="list-style-type: none"> Contractors 	<ul style="list-style-type: none"> Throughout construction 	<ul style="list-style-type: none"> Inspect bunded areas and roads Inspect stormwater channels and high erosion potential areas 	<ul style="list-style-type: none"> Incidents of stormwater contamination Visible leaks/ water wastage Visible surface erosion
	51.	Use berms and stormwater drainage systems to prevent surface run-off from entering construction areas.				
	52.	Plan for the management of water runoff during infrequent but potentially destructive storms.				
	53.	Implement measures to maximise the infiltration of stormwater on site.				
	54.	Allow for the dissipation of runoff into the surrounding veld from multiple side drains, rather than for the concentration of flows along or off the road in major drainage lines.				
	55.	Regularly maintain stormwater outlets / dissipation drainage lines.				
Water Conservation	56.	Minimise the use of potable water as far as practically possible.	<ul style="list-style-type: none"> Contractor 	<ul style="list-style-type: none"> Throughout construction 	<ul style="list-style-type: none"> Check for evidence of water wastage Check that water is recycled and reused where possible 	<ul style="list-style-type: none"> Water Conservation
	57.	Reuse and recycle water wherever possible.				
Topsoil Stockpiling	58.	Limit construction and lay down areas to areas within the project footprint.	<ul style="list-style-type: none"> Contractors 	<ul style="list-style-type: none"> Before construction commences 	<ul style="list-style-type: none"> Visual inspection Regular monitoring of stockpile areas 	<ul style="list-style-type: none"> Incidents of erosion Incidents of incorrect storage and harvesting of topsoil
	59.	Designate areas outside the development footprint as "No Go" areas.				
	60.	Designate and demarcate areas to be used for topsoil stockpiling.		<ul style="list-style-type: none"> During vegetation clearing 		
	61.	Remove topsoil prior to the commencement of construction activities and stockpile topsoil in a designated area for rehabilitation.				
	62.	Locate topsoil stockpiles in an area protected from the wind, and agreed to with the Environmental Manager / Officer and in an area where the topsoil will not have to be relocated prior to replacement for final rehabilitation.				

Construction Phase Measures						
Aspect	ID	Mitigation measure / Procedure	Responsible	Implementation Timeframe	Monitoring Methods ³	Performance Indicators
	63.	Do not stockpile topsoil higher than 4 m or for longer than 6 months to ensure that the nutrient cycles are maintained over a large surface to volume ratio.				
	64.	Ensure suitable control of run-off during the Construction Phase to prevent erosion of topsoil on adjacent land and undeveloped portions of the site.		• During construction		
	65.	Replace harvested topsoil in areas that are to be rehabilitated as soon as sections of the works are completed (i.e. not only following the completion of all works) to maintain soil nutrient cycles.				
Noise Management	66.	Comply with the applicable municipal and/or industry noise regulations.	• Contractors	• Throughout construction	<ul style="list-style-type: none"> • Visual inspections • Random noise tests 	<ul style="list-style-type: none"> • Results of noise measurements • Number of registered complaints
	67.	Maintain all generators, vehicles and other equipment in good working order to minimise exhaust fumes and excess noise.				
	68.	Enclose diesel generators used for power supply on site to reduce unnecessary noise.				
Air Quality Management	69.	Avoid vegetation clearing until absolutely necessary (i.e. just before excavations).	• Contractors	• Throughout construction	<ul style="list-style-type: none"> • Visual assessment of dust plumes • Visual assessment of dust control measures 	<ul style="list-style-type: none"> • Visibility of dust coming off construction site • Dust mitigation measures in place • Number of days that dust plumes are visible
	70.	Stabilise exposed surfaces as soon as is practically possible.				
	71.	Avoid excavation and handling and transport of materials which may generate dust under high wind conditions or when a visible dust plume is present.				
	72.	Minimise dust generated off stockpiles: <ul style="list-style-type: none"> • Locate stockpiles in sheltered areas where possible; • Place the stockpile lengthwise into the wind; • Minimise the slope of the stockpile (maximum slope of 2:1); • Limit stockpile sizes; and • Use the last in – first out system of stockpile management. 				
	73.	Limit vehicle speeds to 40 km/hr on unconsolidated and non-vegetated areas.				
	74.	Ensure that any material spilled from trucks during transport to or from the site is cleaned up immediately.				
	75.	Limit the number of vehicles allowed on-site and restrict the movement of these vehicles over unsurfaced or unvegetated areas once they are on site to reduce dust problems.				

Construction Phase Measures						
Aspect	ID	Mitigation measure / Procedure	Responsible	Implementation Timeframe	Monitoring Methods ³	Performance Indicators
	76.	Reduce airborne dust at construction sites through: <ul style="list-style-type: none"> Dampening dust-generating areas with water; and Utilising screens in high dust-generating areas. 				
	77.	Use high quality (low sulphur) diesel for construction vehicles / equipment.				
	78.	Maintain all generators, vehicles, vessels and other equipment in good working order to minimise exhaust fumes.				
Floral Management	79.	Obtain a permit from NCDENC for the removal of all protected plant species.	• BMM	• Prior to vegetation clearance	• Visual inspection • Permits for removal of protected plant species obtained	• Size of area cleared relative to development footprint • Size of area disturbed outside of construction site boundary • Permits on file
	80.	Restrict construction activities to the project footprint areas and minimise vegetation clearance to what is essential.	• Contractors	• Throughout construction		
	81.	Designate areas outside the construction site boundary as "No Go" areas.				
	82.	Ensure that no vegetation is removed or disturbed outside the delineated construction site boundary.			• Check for evidence of offsite disturbances / vegetation clearing • Check stockpiles located in disturbed areas • Review early detection of alien species monitoring programme	• Protection of Flora
	83.	Limit the project footprint to what is absolutely essential.		• Prior to clearing vegetation		
	84.	Confine soil compaction and levelling to the footprint of the proposed haul road.				
	85.	Ensure that no vegetation is removed or disturbed beyond the approved construction and access footprint.				
	86.	Stockpile all materials in disturbed areas or in areas approved by the Environmental Manager / Officer.				
	87.	Implement a monitoring program for the early detection of alien invasive plant species and a control program to combat declared alien invasive plant species should be employed.		• Prior to construction		
88.	Get Environmental Manager / Officer approval of laydown areas.		• Prior to construction activities			
Fauna Management	89.	Flush any faunal species within the construction footprint towards more suitable habitat within the surrounding areas. Threatened fauna should be relocated by a suitably qualified environmental officer.	• Contractors	• Throughout construction	• Visual inspection	• Number of animals harmed • Number of incidents of animals mortalities
	90.	Check for nests within the construction footprint prior to construction activities.				

Construction Phase Measures						
Aspect	ID	Mitigation measure / Procedure	Responsible	Implementation Timeframe	Monitoring Methods ³	Performance Indicators
	91.	Do not harm, catch or kill birds or animals by any means, including poisoning, trapping, shooting or setting of snares.				<ul style="list-style-type: none"> Number of avifaunal collisions with powerlines
	92.	Safely remove and relocate any fauna that may be physically harmed by construction activities.				
	93.	Keep the construction site clear of litter and especially plastic, twine and string.				
	94.	Limit vehicle speeds to 40 km/hr on unconsolidated and non-vegetated areas.				
	95.	Prohibit construction at night.				
Protection of Watercourses	96.	Limit the project footprint to what is absolutely essential.	<ul style="list-style-type: none"> Contractor 	<ul style="list-style-type: none"> Throughout construction 	<ul style="list-style-type: none"> Check for evidence of offsite disturbances 	<ul style="list-style-type: none"> Protection of drainage lines
	97.	Designate areas outside the development footprint as no-go areas.				
	98.	Restrict access to no-go areas by construction personal.				
	99.	Restrict the movement of vehicles to new and existing access roads only.				
	100.	Construct new watercourse crossings during dry conditions only, and when no rainfall is forecast.				
Protection of Heritage Resources	101.	Inform employees and contractors that archaeological or paleontological artefacts might be exposed during construction activities.	<ul style="list-style-type: none"> BMM Contractors 	<ul style="list-style-type: none"> Throughout construction 	<ul style="list-style-type: none"> Visual inspection Keep records of finds 	<ul style="list-style-type: none"> Records of heritage finds Number of incidences of loss/damage to heritage resources
	102.	Empower staff to stop works on (chance) discovery of heritage resources at the site.				
	103.	On discovery of fossil bones / shells, send information and photographs to a palaeontologist for assessment and to determine preservation, collection and record keeping procedures.				
Site Rehabilitation	104.	Ensure that slopes are immediately stabilized to prevent erosion, using geofabric or other appropriate erosion stabilisation techniques.	<ul style="list-style-type: none"> Contractors 	<ul style="list-style-type: none"> Once construction is complete; or Throughout construction if it takes place in phases / different areas sequentially 	<ul style="list-style-type: none"> Visual inspection of site Keep record of rehabilitation measures 	<ul style="list-style-type: none"> Rehabilitation forms an integral part of construction
	105.	Remove all construction equipment, vehicles, equipment, waste and surplus materials, including site offices, temporary fencing and other facilities, from the site.				
	106.	Clean up and remove any spills and contaminated soil in the appropriate manner.				

Construction Phase Measures						
Aspect	ID	Mitigation measure / Procedure	Responsible	Implementation Timeframe	Monitoring Methods ³	Performance Indicators
	107.	Ensure that no discarded materials are buried on site or on any other land not designated for this purpose.				
	108.	Ensure that affected areas are rehabilitated following construction.				
	109.	Rehabilitate areas adjacent to the site (if disturbance is unavoidable) to at least the same condition as was present prior to construction.				
	110.	Use harvested topsoil for rehabilitation following construction.				
	111.	Rehabilitate all project areas as soon as possible after completion of activities in each area, including removing and/or remediating any contaminated soils.				
	112.	Forbid the planting of alien species during rehabilitation.				

The environmental management and mitigation measures that must be implemented for the project during the **Operational Phase**, as well as responsibilities and timelines for the implementation of these measures and monitoring thereof, are laid out in Table 29 below. Activities in the Operational Phase include hauling activities between the Swartberg shaft and WRD.

Table 29: Environmental management and mitigation measures that must be implemented during the Operational Phase

Operational Phase Measures						
Aspect	ID	Mitigation measure / Procedure	Responsible	Implementation Timeframe	Monitoring Methods ⁴	Performance Indicators
Environmental Compliance	1.	Ensure that all required licences and permits have been obtained before the start of operations.	• BMM	• Throughout operations	<ul style="list-style-type: none"> • Keep record of all permits, licences and authorisations • BMM to check contracts • Keep record of all incidents 	<ul style="list-style-type: none"> • Required licences/permits on file • Environmental management measures in contract documents • Environmental incidents register
	2.	Include applicable environmental management measures in contracts for external service providers.				
	3.	Maintain an environmental incidents register.				
	4.	Update the Operational Phase EMPr with lessons learnt during construction in consultation with the DMR (if better practices are identified during this phase).	• BMM	• Following construction	• Check updated EMPr	• Updated EMPr on file
Vegetation Management	5.	Restrict hauling to the designated haul road and no additional roads or turn-around areas should be created.	• BMM	• Throughout operations	• Visual inspection	<ul style="list-style-type: none"> • Size of area cleared relative to development footprint • Size of area disturbed outside of construction site boundary • Extent of alien vegetation
	6.	Designate areas outside the project footprint boundary as "No Go" areas and ensure that no vegetation is removed or disturbed outside the delineated boundary.				
	7.	Undertake regular monitoring for alien plants within the project footprint.				
	8.	Conduct regular alien clearing using the best-practice methods for the species concerned. Avoid using herbicides as far as possible				
Stormwater Management	9.	Implement measures (adjusting the routing of flows, dissipating runoff and/or establishing vegetation) to address erosion nick-points along the roads.	• BMM	• Throughout operations	• Visual inspection	• Visible surface erosion
Air Quality Management	10.	Avoid handling and transport of materials which may generate dust under high wind conditions or when a visible dust plume is present.	• BMM	• Throughout operations	<ul style="list-style-type: none"> • Visual assessment of dust plumes • Visual assessment of dust control measures 	<ul style="list-style-type: none"> • Visibility of dust plumes • Dust mitigation measures in place
	11.	Limit vehicle speeds to 40 km/hr at sharp turns and 70 km/hr on straights.				

⁴ Unless otherwise indicated, monitoring will be undertaken by the Environmental Manager / Officer at BMM, supported by the authorities where the requirement is specifically stipulated in a licence or permit.

Operational Phase Measures						
Aspect	ID	Mitigation measure / Procedure	Responsible	Implementation Timeframe	Monitoring Methods ⁴	Performance Indicators
	12.	Ensure that any material spilled from trucks during transport to or from the shaft and WRD is cleaned up immediately.				<ul style="list-style-type: none"> Number of days that dust plumes are visible Size of disturbed areas
Fire Management	13.	Ensure that sufficient fire-fighting equipment is available in all vehicles travelling along the haul road.	<ul style="list-style-type: none"> BMM 	<ul style="list-style-type: none"> Throughout operations 	<ul style="list-style-type: none"> Visual inspections Inspect fire extinguishers and certificates. 	<ul style="list-style-type: none"> Number of fire incidents Certified extinguishers in appropriate locations
Transportation and Refuelling	14.	Undertake regular maintenance of vehicles and machinery to identify and repair minor leaks and prevent equipment failures.	<ul style="list-style-type: none"> BMM 	<ul style="list-style-type: none"> Throughout operations 	<ul style="list-style-type: none"> Visual inspection of vehicles, machinery and refuelling/maintenance areas Keep record of incidents and complaints 	<ul style="list-style-type: none"> Number of incidents of non-compliance Number of leaks and spills
	15.	Inspect mining vehicles and equipment for oil / fuel leaks frequently.				
	16.	Clean up any spills immediately, through containment and removal of free product and appropriate disposal of contaminated soils.				
	17.	Restrict hauling to the designated haul road and no additional roads or turn-around areas should be created. No vehicles should be allowed to turn in or pull over into areas abutting the road, other than where formally designated turning or pullover areas have been created and managed.				
	18.	Undertake any refuelling and maintenance of vehicles/machinery in existing approved maintenance / refuelling areas in the processing area.				
	19.	Ensure that vehicle axle loads do not exceed the technical design capacity of the road.				
	20.	Ensure contractors use the designated haul roads for hauling product between the shaft and WRD.				
Faunal Management	21.	Do not harm, catch or kill animals by any means, including poisoning, trapping, shooting, setting of snares and egg collecting.	<ul style="list-style-type: none"> BMM 	<ul style="list-style-type: none"> Throughout operations 	<ul style="list-style-type: none"> Visual inspection Inspect powerline 	<ul style="list-style-type: none"> Number of animals harmed Number of incidents of animals found in trenches Monitoring reports
	22.	Keep the operational areas clear of litter and especially plastic, twine and string.				
	23.	Limit vehicle speeds to 40 km/hr at sharp turns and 70 km/hr on straights.				
	24.	Prohibit unnecessary driving at night.				

The environmental management and mitigation measures that must be implemented for the project during the **Maintenance Phase**, as well as responsibilities and timelines for the implementation of these measures and monitoring thereof, are laid out in Table 29 below. Activities in the Maintenance Phase include general road and drainage crossing maintenance.

These measures essentially constitute the Maintenance Management Plan (MMP) for the project.

Table 30: Environmental management and mitigation measures that must be implemented during the *Maintenance Phase*

Operational Phase Measures						
Aspect	ID	Mitigation measure / Procedure	Responsible	Implementation Timeframe	Monitoring Methods ⁵	Performance Indicators
Environmental Awareness Training	25.	Provide environmental awareness training to all personnel on site at the start of their employment. Training should include discussion of: <ul style="list-style-type: none"> • Potential impact of waste and activities on the environment; • Suitable disposal of waste and litter; • Fauna and avifauna protection; • Key measures in the EMPr relevant to worker's activities; and • How incidents and suggestions for improvement can be reported. Ensure that all attendees remain for the duration of the training and on completion sign an attendance register that clearly indicates participants' names.	<ul style="list-style-type: none"> • BMM 	<ul style="list-style-type: none"> • Before workers start working on-site • Before new activities are undertaken 	<ul style="list-style-type: none"> • Check training attendance register • Observe whether activities are executed in line with EMPr requirements 	<ul style="list-style-type: none"> • Proportion of workers that completed environmental training • Compliance of workers with EMPr
Vegetation Management	26.	Designate areas outside the project footprint boundary as "No Go" areas and ensure that no vegetation is removed or disturbed outside the delineated boundary.	<ul style="list-style-type: none"> • BMM 	<ul style="list-style-type: none"> • Throughout maintenance 	<ul style="list-style-type: none"> • Visual inspection 	<ul style="list-style-type: none"> • Size of area cleared relative to development footprint
Waste Management	27.	Do not dispose of any waste in the drainage lines.	<ul style="list-style-type: none"> • BMM 	<ul style="list-style-type: none"> • Throughout maintenance 	<ul style="list-style-type: none"> • Visual inspection of waste collection and disposal areas • Visual inspection operational areas (litter) 	<ul style="list-style-type: none"> • Presence of litter • Availability of rubbish bins and skips
	28.	Prevent littering by staff at work sites by providing bins or waste bags in sufficient locations.				
Stormwater Management	29.	Undertake ongoing maintenance of culverts and drifts by removing sand and debris and dispose material outside of the affected watercourse so that it does not create additional blockages.	<ul style="list-style-type: none"> • BMM 	<ul style="list-style-type: none"> • Throughout operations 	<ul style="list-style-type: none"> • Visual inspection 	<ul style="list-style-type: none"> • Visible surface erosion • Culverts in place and well maintained
	30.	Undertake bi-annual auditing of the road to assess erosion with photographic records.				

⁵ Unless otherwise indicated, monitoring will be undertaken by the Environmental Manager / Officer at BMM, supported by the authorities where the requirement is specifically stipulated in a licence or permit.

Operational Phase Measures						
Aspect	ID	Mitigation measure / Procedure	Responsible	Implementation Timeframe	Monitoring Methods ⁵	Performance Indicators
Fire Management	31.	Ensure that no fires are permitted on or adjacent to site.	• BMM	• Throughout maintenance	<ul style="list-style-type: none"> • Visual inspections • Inspect fire extinguishers and certificates. 	<ul style="list-style-type: none"> • Number of fire incidents • Certified extinguishers in appropriate locations
	32.	Ensure that all personnel on site are aware of the location of firefighting equipment in vehicles operated on the haul road.				
	33.	Suitably maintain firefighting equipment.				
Ablution Facilities	34.	Ensure there are sufficient ablution facilities for all site staff at BMM site offices, Brokenhill change house or at the Swartberg surface crusher.	• BMM	• Throughout maintenance	• Visual inspections of ablutions	• Number of incidents of staff not using facilities
Response to Environmental Pollution	35.	In the event of environmental pollution, e.g. through spillages, immediately stop the activity causing the problem.	• BMM	• Throughout maintenance	<ul style="list-style-type: none"> • Maintain register of pollution events and response • Inspect repaired equipment to ensure proper functioning 	<ul style="list-style-type: none"> • Number of incidents • Time activities stopped • Number of recurring incidents
	36.	Only resume activity once the source has been contained.				
	37.	Repair faulty equipment as soon as possible.				

Closure Plan

The overall closure vision for BMM is to ensure operations are safe, stable and non-polluting over the long-term to integrate with the current agricultural, eco-tourism and economic activities of the area in which the mine is located.

The vision is underpinned by the closure objectives:

- Secure the effective and sustainable transfer of the municipal services of the town, Aggeneys, and the Pella-drift Water Board to the Khai Ma municipality;
- Ensure that the biodiversity and environment on the site is protected; and
- Ensure that the following commitments will be achieved as a minimum:
 - The site will be made safe for both humans and animals;
 - The site will be rehabilitated to be physically, chemically and biologically stable;
 - The residual impacts will be managed to acceptable levels and will not deteriorate over time; and
 - Closure will be achieved with minimal socio-economic upheaval.

The objective of this section is to provide recommendations for the decommissioning, closure and rehabilitation of the road at the end of LoM (assuming the haul road is to be decommissioned), to achieve sustainable land use conditions and avoid or minimise costs and long-term liabilities to BMM.

In order to achieve this, it is essential that the closure plan applied for the Mine is applied to the closure / decommissioning of the haul road.

f) Impact Management Outcomes

(A description of impact management outcomes, identifying the standard of impact management required for the aspects contemplated in paragraph ());

The impact management outcomes are included in Table 27 to Table 30 as “Performance Indicators”.

g) Impact Management Actions

(A description of impact management actions, identifying the manner in which the impact management objectives and outcomes contemplated in paragraphs (c) and (d) will be achieved).

The impact management actions are included in Table 27 to Table 30.

h) Financial Provision

i. Determination of the amount of Financial Provision.

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

Refer to Section 1(d)(ii) for closure objections. The closure plan for the haul road is based on the closure objectives for the Mine.

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

The BAR and EMPr will be released for public review and comment during the stakeholder engagement process. Stakeholders will have the opportunity to review the project scope; the affected environment description; the findings of the specialist study and impact assessment; the recommended management/mitigation measures developed to address the potential impacts; and the closure objectives, plan and financial provision.

3) 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.

Environmental management and mitigation measures that must be implemented for rehabilitation during the construction, operational and decommissioning / Closure Phases have been included in the EMPr, including the requirement to review and update the Rehabilitation Plan, if required, to ensure that responsibilities and sufficient resources are allocated to rehabilitation.

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

The Rehabilitation Plan has been accepted by the authorities for previous authorisations and the same closure objectives and RP will be implemented for this project.

j) Calculate and state the quantum of the financial provision required to manage and rehabilitate the environment in accordance with the applicable guideline.

BMM has confirmed that the financial provision required to manage and rehabilitate the environment for the haul road project can be accommodated within the existing financial provision for the Mine.

k) Confirm that the financial provision will be provided as determined.

BMM has confirmed that the financial provision for the haul road project can be accommodated within the existing financial provision for the Mine.

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

- a) Monitoring of Impact Management Actions
- b) Monitoring and reporting frequency
- c) Responsible persons
- d) Time period for implementing impact management actions
- e) Mechanism for monitoring compliance

SOURCE ACTIVITY	IMPACTS REQUIRING MONITORING PROGRAMMES	FUNCTIONAL REQUIREMENTS FOR MONITORING	ROLES AND RESPONSIBILITIES (FOR THE EXECUTION OF THE MONITORING PROGRAMMES)	MONITORING AND REPORTING FREQUENCY and TIME PERIODS FOR IMPLEMENTING IMPACT MANAGEMENT ACTIONS
<ul style="list-style-type: none"> • Hauling 	<ul style="list-style-type: none"> • Degradation of Ephemeral Drainage Lines 	<ul style="list-style-type: none"> • Audit crossings to assess erosion. • Implement a monitoring program for the early detection of alien invasive plant species. 	<ul style="list-style-type: none"> • Environmental Manager / Officer • Suitably qualified Contractor's Designated Environmental Officer 	<ul style="list-style-type: none"> • Bi-annually with photographic records
<ul style="list-style-type: none"> • Powerline 	<ul style="list-style-type: none"> • Disturbance to terrestrial fauna and loss of habitat 	<ul style="list-style-type: none"> • Undertake avifaunal monitoring of the powerline. 	<ul style="list-style-type: none"> • Environmental Manager / Officer 	<ul style="list-style-type: none"> • Quarterly throughout the operational phase
<ul style="list-style-type: none"> • Hauling 	<ul style="list-style-type: none"> • EMPr performance 	<ul style="list-style-type: none"> • Audit the performance of BMM against environmental commitments. 	<ul style="list-style-type: none"> • Environmental Manager / Officer 	<ul style="list-style-type: none"> • Monthly during the Construction Phase • Annually throughout the operational phase
<ul style="list-style-type: none"> • Hauling 	<ul style="list-style-type: none"> • Rehabilitation progress 	<ul style="list-style-type: none"> • Monitor the success of rehabilitation in terms of the Rehabilitation Plan. 	<ul style="list-style-type: none"> • Environmental Manager 	<ul style="list-style-type: none"> • Annually throughout the operational phase

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

The new haul road and the relevant EMPr will be incorporated into the existing Performance Assessment reports undertaken at BMM.

n) Environmental Awareness Plan

ii. Manner in which the applicant intends to inform his or her employees of any environmental risk which may result from their work.

BMM and contractors employed at the Mine will be required to provide environmental awareness training to all employees on site during the construction, operational and closure phases (refer to Table 28 to Table 30). Training will include discussion of:

- Potential impact of waste and activities on the environment;
- Suitable disposal of waste and litter;
- Protection of flora;
- Protection of drainage lines;
- Protection of fauna and avifauna;
- Key measures in the EMPr relevant to worker's activities; and
- How incidents and suggestions for improvement can be reported.

Employees will be required to attend environmental awareness training before work commences on site and before any new activities are undertaken. Employees will be required to sign an attendance register.

iii. Manner in which risks will be dealt with in order to avoid pollution or the degradation of the environment.

The management measures provided in the EMPr are recommended to avoid pollution or the degradation of the environment as far as possible.

Prior to the commencement of construction, maintenance and/or closure activities, Contractors will be required to submit a Method Statement for response to environmental pollution for approval by the Environmental Manager / Officer (refer to Table 28 and Table 30).

BMM has existing procedures in place to prevent and respond to environmental incidents at the Mine (e.g. oil spill clean-up, protection of archaeological resources, protection of no-go areas). BMM will update and apply these procedures in the management of operations for the project.

o) Specific information required by the Competent Authority

(Among others, confirm that the financial provision will be reviewed annually).

In terms of Section 41, Regulations 53 and 54 of the MPRDA, BMM is required to make financial provision for the interim and final rehabilitation activities on the site. The existing financial provision will be reviewed annually for adequacy and amended to compensate for new activities (i.e. the new haul road) and/or inflation.

5. 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; and
- d) that the information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested and affected. parties are correctly reflected herein.

Prepared by

SRK Consulting - Certified Electronic Signature

 536396/43423/Report
 8491-5418-8602-MASS-21/11/2018
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Scott Masson
 Senior Environmental Consultant

Reviewed by

SRK Consulting - Certified Electronic Signature

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Chris Dalgliesh
 Partner

Signature of the environmental assessment practitioner:

SRK Consulting (South Africa) (Pty) Ltd.

Name of company:

November 2018

Date:

-END-

Appendices

Appendix A: Curriculum Vitae of the EAP

Scott Masson

Senior Consultant



Profession	Environmental Consultant
Education	MLA, L. Arch, Cape Town, 2008 BSc (Hons), Environmental Management, Cape Town, 2004 BSc, Environmental Management, Cape Town, 2003
Registrations/ Affiliations	Certified Environmental Assessment Practitioner (South Africa) Professionally Registered Landscape Architect Member of National Association for Clean Air

Specialisation Visual impact assessment, environmental impact assessment, environmental planning and site sensitivity studies

Expertise Scott has been involved in the environmental and landscape architecture field for the past 9 years. His expertise includes:

- Visual impact assessment;
- environmental impact assessment;
- environmental management programmes;
- integrated water and waste management plans;
- environmental audits and due diligence; and
- environmental planning and sensitivity studies.

Employment

2011 – present	SRK Consulting (Pty) Ltd, Environmental Consultant, Cape Town
2009 – 2011	Megan Anderson Landscape Architects, Candidate Landscape Architect

Publications I have been interviewed and quoted in numerous environmental and sustainability articles published in the press and sector specific journals including *Civil Engineering Contractor*, *Position IT*, *Cape Business News* and *To Build*.

Languages English – read, write, speak (Excellent)
Afrikaans – read, write, speak (Fair)

Scott Masson

Environmental Consultant

Environmental (and Social) Impact Assessment (EIA or ESIA)

- Chevron South Africa (Pty) Ltd, Basic Assessment for Propane and Oxygen storage tanks at the Chevron Refinery, Cape Town, Western Cape, 2018-ongoing, R180 000
- Impact Africa Limited, EIA for offshore seismic survey/s in the Orange Basin Deep Block, West Coast, South Africa, 2017-ongoing, R500 000
- Easigas (Pty) Ltd, EIA for the proposed LPG import and storage facility in Mossel Bay, Western Cape, 2017-ongoing, R580 000
- Mineral Sands Resources (Pty) Ltd, EIA for the proposed extension of Tormin Mine, Western Cape, 2016-ongoing, R2.5 million
- Eskom, EIA for the proposed Transient Interim Storage Facility at Koeberg, Western Cape, 2015-2017, R1.5 million
- Matzikama Municipality, EIA for proposed abalone farms at Doringbaai, West Coast, 2014-2017, R1.2 million
- PetroSA, EIA for offshore drilling, Mossel Bay, Western Cape, 2016-2017, R450 000
- Airports Company of South Africa, EIA for proposed re-alignment of runway at Cape Town International Airport, Cape Town, Western Cape, 2012-2017, R1.3 million
- Eskom, Basic Assessment for the Double Circuit 132kV Powerline and Denova 132/11kV Substation, Kraaifontein, Western Cape, 2014-2015, R300 000
- UWP Consulting Engineers, Basic Assessment and borrow pit application for the rehabilitation of the N7 between Okiep and Steinkopf, Northern Cape, 2014-2015, R400 000
- Department of Environmental Affairs, Basic Assessments in support of Waste Management Licences for 21 Waste Disposal Sites in the Western Cape, 2014-2015, R2 million
- Hatch on behalf of Grindrod Terminals, ESIA for the Phase 4 development of TCM, Matola Port, Maputo, Mozambique, 2012, US\$400 000
- Rare Metals Industry, Scoping Study for a rare metals specialty complex, Saldanha, Western Cape, 2012, R250 000
- Langeberg Municipality, Basic Assessment in support of a WML for the proposed municipal landfill at Stockwell, Bonnievale, 2012, R350 000
- WSP SA Civil and Structural Engineers (Pty) Ltd, Basic Assessment, Stakeholder Engagement and Water Use Licence Application, Stellenbosch, Western Cape, 2012, R140 000
- Exxaro TSA Sands (Pty) Ltd, Basic Assessments for a new warehouse storage shed at Namakwa Sands Smelter Plant in Saldanha and for a dryer unit in the UMM Plant at the Namakwa Sands Mine in Brand-se-Baai, West Coast, 2011-2013, R400 000

Environmental Planning and Management

- Tiger Brands, Tomato Paste Plant Integrated Water and Waste Management Plan, Lutzville, Western Cape, 2016-2017, R110 000
- Black Mountain Mining (Pty) Ltd, Gamsberg Mine Environmental Management Programme (EMPr) Amendment, Aggeneys, Northern Cape, 2016-2017, R120 000
- African Inter-Continental Enterprises (Pty) Ltd, EA Amendment and EMP for the Velddrif Desalination Plant, Western Cape, 2015-2016, R230 000
- Chevron South Africa (Pty) Ltd, Application for Coastal Waters Discharge Permit Application for the upgrade of Tank 25-D1 at Cape Town Harbour, 2015, R120 000

Scott Masson

Environmental Consultant

- Nadeson Consulting, Application for Water Use Authorisation for Botterlary Primary School, 2015, R70 000
- De Beers Kimberley Mines, EMPr Addendum, Kimberley, Northern Cape, 2015, R260 000
- SAOTA, Application for Ad Hoc Development Setback Line Adoption/Delineation, Sunset Beach, West Coast, 2014, R12 000
- Lucky Star, Public Participation for the St Helena Fish processing Plant Coastal Waters Discharge Permit Application, 2014-2015, R50 000
- De Beers Consolidated Mines, EMPr Addendum for the Raising of the CTP FRD Wall, Calcrete Borrow Pit, TMR Live Stockpile and Emergency Tailings Facility at Kimberley Mines, Northern Cape, 2013-2014, R250 000
- Tronox Mineral Sands (Pty) Ltd, Integrated Water and Waste Management Plan for the Namakwa Sands Northern Operations, Western Cape, 2013-2014, R100 000
- Tronox Mineral Sands (Pty) Ltd, Integrated Water and Waste Management Plan for the Namakwa Sands Smelter Plant, Saldanha, Western Cape, 2013, R100 000
- West Coast District Municipality, Development of a coastal management programme for the West Coast District, West Coast, 2011-2013, R450 000
- Search Ahead Invest (Pty) Ltd, EMPr for a Prospecting Right Application of five Portions of Farm Macarthy 559, Northern Cape, Tsantsabane Municipality, Northern Cape, 2013, R100 000

Environmental Auditing and Due Diligence

- Angola Environmental Services, Environmental Operations Licence audit of Soyo Landfill, 2017, € 10 000
- Angola Environmental Services, Environmental Operations Licence audit of Total Waste Management Facility, 2017, € 12 000
- Tronox Mineral Sands (Pty) Ltd, Environmental Management Programme Performance Assessment Audit, West Coast, 2014, R180 000
- Tronox Mineral Sands (Pty) Ltd, Assessment of Namakwa Sands' performance against commitments in Water Use Licences for the Mine, MSP and Smelter, West Coast, 2014-2015, R160 000 per year

Air Quality

- Tronox Mineral Sands (Pty) Ltd, Renewal and variation of the Atmospheric Emissions Licence for the Namakwa Sands Smelter Plant, Saldanha, Western Cape, 2018-ongoing, R300 000
- Tronox Mineral Sands (Pty) Ltd, Application for Atmospheric Emission Licence for the MSP, Koekenaap, Western Cape, 2014-2015, R112,000
- Tronox Mineral Sands (Pty) Ltd, Application for Postponement of Timeframes relating to Minimum Emission Standards for the MSP, Koekenaap, Western Cape, 2014-2015, R250 000
- Chevron, Application for Postponement of Timeframes relating to Minimum Emission Standards for the Chevron Refinery, Cape Town, Western Cape, 2014, R750 000
- Lucky Star, Public Participation for the Renewal of the Atmospheric Emission Licence for the Lucky Star Fish processing Plant in St Helena, Western Cape, 2013, R300 000
- Tronox Mineral Sands (Pty) Ltd, Renewal of the Atmospheric Emissions Licence for the Namakwa Sands Smelter Plant, Saldanha, Western Cape, 2012, R150 000

Scott Masson

Environmental Consultant

Visual Impact Assessment (VIA)

- CSIR, Expert review of the Visual Resources Chapter of the Strategic Environmental Assessment for Aquaculture in South Africa, 2017
- Eskom, VIA for the proposed 66/132 kV Romansrivier – Ceres powerline, 2017, R70 000
- CSIR, VIA for two wind energy facilities in the Greater Accra District, Ghana, 2016-2017, R100 000
- Mineral Sands Resources (Pty) Ltd, VIA for the extension of Tormin Mine, Western Cape, 2016-ongoing, R100 000
- Tronox Mineral Sands (Pty) Ltd, VIA for the Slimes Dam 6 at Tronox Namakwa Sands Mine, Western Cape, 2016, R30 000
- Department of Forestry, Fisheries and Agriculture, VIA for a proposed Aquaculture Development Zone in Saldanha Bay, Western Cape, 2016, R50 000
- Matzikama Municipality, VIA for the proposed construction of four abalone farms in Doringbaai, Western Cape, 2015 - 2016
- Eskom, VIA for the proposed Merino substation and Bon-Chretien-Merino powerline in Ceres, Western Cape, 2016-ongoing
- Transnet Capital Projects, VIA for the construction of additional substations, transmission infrastructures and area lighting masts near the Port of Saldanha, Western Cape, 2015-2017, R40 000
- EFG Engineers, VIA for a the proposed bypass road in Hermanus, Western Cape, 2015-2016, R49 000
- Liesbeek Leisure Club (Pty) Ltd, VIA for a the proposed redevelopment of the River Club, Western Cape, 2015-2017, R55 000
- Eskom, VIA for the proposed TISF at Koeberg, Western Cape, 2015-2016, R42 000
- Tronox Mineral Sands (Pty) Ltd, VIA for a the proposed expansion of the Namakwa Sands Mine, Brandse-Baai, Western Cape, 2012-2013, R46 000
- Vale, VIA for a proposed phosphate mine in Mozambique, 2011-2012, R100 000
- Courtrai Developments, VIA for a proposed retirement village in Paarl, 2011, R35 000
- CSIR Environmental, VIA for an EIA proposal for four wind energy facilities, Swellendam, Mossel Bay, Heidelberg and Albertinia, Western Cape, 2010, R100 000
- CSIR Environmental, VIA for a proposed eco-residential estate and nature reserve, Jacobsbaai, Western Cape, 2010, R25 000
- Vodacom, VIA for a proposed cell phone mast at Hermanus golf course, on Graymead farm near Villiersdorp and on a farm in Klipdale, 2009, R30 000

Environmental Control Officer Services (ECO)

- Project Assignment and Water and Wastewater Engineering, ECO for upgrades at various wastewater treatment works for City of Cape Town, Cape Town, 2014-ongoing
- Worcester Land Trust, ECO for Worcester Island Development and Worcester Hills Development Ph2, Worcester, 2014, R75 000
- Worcester Land Trust, ECO for construction of internal roads and services for a commercial development, Worcester, 2011, R70 000



we certify that

Scott Maclean Masson

was admitted to the degree of

Master of Landscape Architecture

on 8 December 2008

A handwritten signature in black ink, appearing to read "Alan Price".

Vice-Chancellor

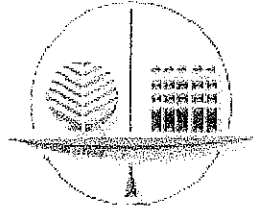


A handwritten signature in black ink, appearing to read "Hugh Amoore".

Registrar

IT IS HEREBY CERTIFIED THAT THIS IS A TRUE COPY OF THE ORIGINAL DOCUMENT AND THAT THERE IS NO INDICATION THAT ALTERATIONS HAVE BEEN MADE THERE TO BY AN UNAUTHORISED PERSON

Name: *Leon Beales*
Rank: *Manager*
Signature: *[Signature]* Date: *[Date]*



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RONDEBOSCH 7701
20 MAY 2015
COUNTER 1

The Interim Certification Board
for
Environmental Assessment Practitioners
of
South Africa

Scott Maclean Masson

was certified as an

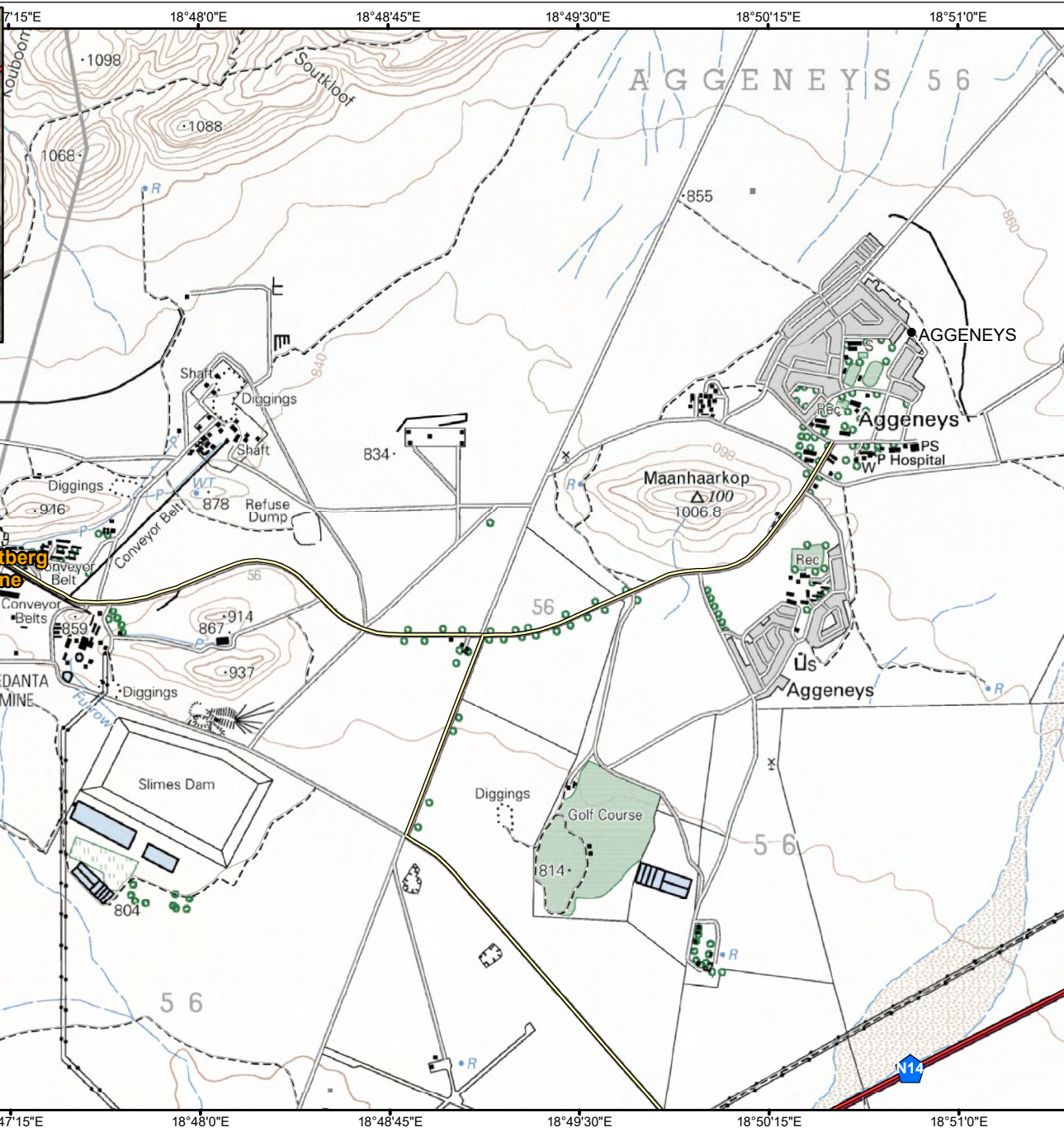
**ENVIRONMENTAL ASSESSMENT
PRACTITIONER**

on this 16th day of March 2015

[Signature]
.....
Chairperson

[Signature]
.....
Secretary

Appendix B: Site Map



N

Legend

- Towns
- Other Road
- Secondary Road
- National Road
- Site Boundary

0 250 500 1 000 Meters

Data Source:
Chief Directorate: National Geospatial Information (CD:NGI)

Scale:
1:40 000 @ A4

Projection: TM	Datum: HH94
Central Meridian/Zone: Lo19	
Date: 06/11/2018	Compiled by: FUBM
Project No: 536396	Fig No: 1



SWARTBERG HAUL ROAD LOCALITY MAP

Appendix C: Stakeholder Database

536396 Swartberg Haul Road BA

Name	Capacity	Organization
Organs of State		
Karsten, Deidre	Environmental Officer	Department of Mineral Resources
Nxantsiya, Luzuko	SAMRAD Officer	Department of Mineral Resources
Abrahams, Abe	Chief Director:Northern Cape	Department of Water and Sanitation: Kimberley
Cloete, Shaun	Environmental Officer	Department of Water and Sanitation: Upington
October, Leon	District Manager	Department of Agriculture
Mans, Jacoline	Chief Forester:NFA Regulation	Department of Agriculture, Forestry & Fisheries
Julius, Eddie	Manager LED	Department of Economic Development and Tourism (DEDAT)
Ndzumo, Onwabile	Environmental Officer	Department of Environment & Nature Conservation
van der Poll, Ralph	Biodiversity Officer	Department of Environment & Nature Conservation
Ntombela, Lindi	PA to HOD	Department of Transportation
Ratha, Timothy	Manager	Ngwao Boswa Ya Kapa Bokone (NBKB)
Municipality and councillors		
Municipal manager		Khai Ma Municipality
Secretary		Khai Ma Municipality
van Heerden, Pasqueline	Councillor	Khai Ma Municipality
Fortuin, Chris	Municipal Manager	Namakwa District Municipality
Smith, Denver	Environmental Health Manager	Namakwa District Municipality
Adjacent Landowners (other than BMM)		
Mosterd, Jasper	Landowner	Witputs
Surrounding Landowners		
Deon Pietersen,	Farmer - Rental	Gamsberg portion 4 /no.60
Dixon, HAC	Landowner	Kaitop
Gerber, Danie	Landowner	Aroams
Jacobs, Danie	Landowner	Organised Agriculture Union - Bushmanland
Kennedy, Nols	Landowner	Brabees Portion 2
Louw, Sakkie	Chairperson	Boesmanland Farmers union
Luttig, Danie	Landowner	Rozybosch
Maasdorp, Deon	Landowner	Zuurwater
Maasdorp, Hester		Farming Community
Roux, Albertus	Landowner	Bloemhoek - Gamsberg
Strauss, Phillip	Landowner	Brabees Portion 1
Titus, Gert	Landowner	Koerus
Van Niekerk, Abri	Landowner	Dabbiepoort Aroams
Visser, Gerhard	Landowner	Vogelstruishoek; Pofadder Farmers Union
VD Heever, Pieter-Jan	Landowner	Koups Leegte 56 (Witstand)
Visser, Tertius	Landowner	Kykgat 87 portion 1
Institutions / Organisations		
Booth, Jonathan	Advocacy Officer	BirdLife South Africa
Rabaney, Zaitoon	Director of Operation	Botanical Society
Bourne, Amanda	Climate Adaptation Coordinator	Conservation South Africa
Newman, Ronnie		Conservation South Africa (CSA)
Davies-Mostert, Harriet	Head of Conservation	Endangered Wildlife Trust (EWT)
Law, Stephen	Executive Director	Environmental Monitoring Group
Weideman, Henk	Senior Supervisor	ESKOM
Ettelt, Jörg	President	German society for "other"succulents
Matete, Mampiti	Deputy Regional Director	International Union for Conservation of Nature (IUCN)
Retief, Kotie	Kambroo	Botanical Society of South Africa
Mcgregor Museum		Mcgregor Museum
Pienaar, Andy		Namakwaland Action Group/Nago
Koopman, Abe		NAVO Institution
van Rooyen, Frans	Manager	SA National Parks - Augrabies
Isaks, Angela	Manager	SA National Parks - Namaqua
Rossouw, Adele	Organiser	Solidarity
Davids, Shaheeda	SKEP Communications Officer	Succulent Karoo Ecosystem Programme (SKEP) SANBI
Erasmus, Suzanne	Regional Chairperson	WESSA
Brown, J.	Land Programme	WWF
Libraries		
Librarian		Aggeneys Library
Applicant		
Cloete, Anne-marie	BMM Environmental Officer	Black Mountain Mining
Venter, Pieter	BMM Environmental Manager	Black Mountain Mining

Appendix D: Ecology Impact Assessment

ECOLOGICAL IMPACT
ASSESSMENT AND
RISK ASSESSMENT:
BLACK MOUNTAIN MINING
HAUL ROAD, AGGENEYS



CONTENTS

EXECUTIVE SUMMARY	i
TERMS OF REFERENCE	v
LIMITATIONS, ASSUMPTIONS & UNCERTAINTIES	vi
REGULATIONS GOVERNING THIS REPORT	vii
GENERAL INFORMATION	ix
CHAPTER 1: INTRODUCTION	1
CHAPTER 2: METHODOLOGY	5
CHAPTER 3: ENVIRONMENTAL DESCRIPTION	9
CHAPTER 4: REGULATORY FRAMEWORK.....	16
CHAPTER 5: VEGETATION TYPES.....	24
CHAPTER 6: FLORA.....	32
CHAPTER 7: FAUNA.....	38
CHAPTER 8: ECOLOGICAL SENSITIVITY ANALYSIS	40
CHAPTER 9: ASSESSMENT OF SIGNIFICANCE OF ENVIRONMENTAL IMPACTS.....	45
CHAPTER 10: PRESENT ECOLOGICAL STATUS	55
CHAPTER 11: ECOLOGICAL IMPORTANCE AND SENSITIVITY	60
CHAPTER 12: ECOLOGICAL RISK ASSESSMENT	65
CHAPTER 13: CONCLUSIONS AND RECOMMENDATIONS.....	68
REFERENCES AND BIBLIOGRAPHY.....	70
APPENDIX A: ECOLOGICAL RISK ASSESSMENT.....	74
APPENDIX B: PLANT SPECIES LIST	75
APPENDIX C: PLANT SPECIES LIST (NEWPOSA, SANBI)	78
APPENDIX D: GPS: PROTECTED PLANT SPECIES (PERMIT).....	80
APPENDIX E: DIFFERENTIAL TABLE OF PLANT COMMUNITIES	83
APPENDIX F: LISTS OF ANIMAL SPECIES.....	85
APPENDIX G: PHOTO-SERIES OF THE PROPOSED HAUL ROAD	95
APPENDIX H: <i>Curriculum Vitae</i> : N VAN ROOYEN	101
APPENDIX I: <i>Curriculum Vitae</i> : MW VAN ROOYEN	105

EXECUTIVE SUMMARY

Ekotruster cc was commissioned by SRK (South Africa) to provide an ecological impact assessment and ecological risk assessment (ERA) (on the prescribed Risk Assessment Matrix (RAM) of the Department of Water and Sanitation) regarding the impact that the proposed new haul road at BMM, in the Northern Cape province might have on the ephemeral drainage lines on site. The study includes a sensitivity assessment, impact assessment, present ecological status assessment (PES), ecological importance and sensitivity assessment (EIS) and an Ecological Risk Assessment (ERA) of the ephemeral drainage lines.

The study site is situated on the farm Zuurwater 62 near Aggeneys in the Northern Cape and is part of Black Mountain Mining (Pty) Ltd. The proposed haul road is located between approximately 29 15 3.44 S; 18 46' 48.6"E at the Brokenhill rock waste dump in the east, and 29 15' 3.94" S; 18 46' 4.9" E in the west. The topocadastral grid references are 2918 BB and 2918 BD.

This report considers the Environmental Impact Assessment (EIA) Regulations 2014, with amendments in 2017, under the National Environmental Management Act, (Act No. 107 of 1998) (NEMA 1998, 2014, 2017). According to the Regulations (2017) under Listing Notice 1 (GRN No. 327) and Listing Notice 3 (GRN No 324), some activities listed are identified as activities that may require Environmental Authorisation prior to commencement of that activity and to identify competent authorities in terms of sections 24(2) and 24D of the Act.

The proposed haul road will involve minor ephemeral drainage lines that are poorly developed and some drainage lines are difficult to distinguish by the untrained eye. These drainage lines are often dry for years and flow only during high rainfall events. Sections 21(c) and 21(i) of the National Water Act (1998) are identified as activities that may require General Authorisation.

The results and conclusions of the ecological assessment are as follows:

- **Sensitivity**

The sensitivity of the four plant communities (habitats) ranged from **very low** to **low**. Consequently, from an ecological perspective there were no 'no-go' areas that had to be avoided when constructing the proposed haul road.

- **Significance of impacts**

The significance of the impacts on the vegetation after mitigation (residual), i.e. the loss of indigenous vegetation **within the footprint of the haul road was rated as high. However, beyond the footprint, environmental functions and processes should however, not be altered and the impact for the site as a whole could be rated as low.**

All other impacts, i.e. loss of species, water flow, erosion, run-off, dust, noise and fauna were considered to be **very low to low**.

- **IUCN Threatened Species**

The only species with a threatened IUCN Red List status on site, is *Aloidendron dichotomum* which is classified as Vulnerable (VU).

- **Present Ecological Status (PES)**

PES refers to the degree to which ecological conditions of an area have been modified from natural (reference) conditions. The results of this PES analysis showed that the ephemeral drainage lines were currently considered to be **Category A: unmodified or approximated natural condition**.

- **Ecological Importance and Sensitivity (EIS)**

The ecological importance of a watercourse, river or drainage line is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales. Ecological sensitivity (or fragility) refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (resilience).

A median score of <1.0 was obtained which means that the delineation falls in the **Category D: Low/Marginal category**, i.e. delineations that are not ecologically important and sensitive (unique) at any scale. The biodiversity of these ephemeral drainage lines is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers.

- **Ecological Risk Assessment (ERA) and Risk Assessment Matrix (RAM)**

The risk assessment was based on the assumption that culverts and low level concrete crossings would be laid at each of the ephemeral drainage lines that would be crossed by the proposed haul road. ERA defines the probability or likelihood of any undesired (negative) effect of the proposed haul road on the drainage lines, expressed in relation to the effect or consequence of impacts, with and without mitigation (probabilistic analyses).

Overall, the ecosystem structure and function of the drainage lines should not be adversely affected by the development. The probability or likelihood of the development having significant impacts on the drainage lines is also fairly low.

The **risk** is rated as **Low** and described as "acceptable as is or requirement for mitigation should be considered". The impact on the drainage lines and resource quality was evaluated as low and could be easily mitigated.

- **Legislation**

1. *NWA (1998)*

Provided that the water use is within the limits and conditions of the General Authorisation (GA), Government Gazette 40229 prescribes that a water user is not required to apply for a Water Use Licence (WUL) in terms of the NWA, but that these water uses can be authorised generally by the

regional office of the DWS. Portions of the project will take place within ephemeral drainage lines and may impede waterflow and/or alter the channels. As defined by the DWS risk assessment matrix (see Appendix A), the construction of the haul road and culverts/low level drift crossings within the drainage channels will be of a **low risk**. As such, it is anticipated that Government Gazette 40229 will apply to the project, and that a GA will be required.

2. *NEM:PA 2003 - Protected areas*

The site is not part of a formally protected area. For the most part, the site is located in a "developed" zone.

3. *National Environmental Management: Biodiversity Act (NEM:BA 2011, 2013)*

The site is not situated in any threatened ecosystem as both the Aggeneys Gravel Vygieveld and the Bushmanland Sandy Grassland vegetation type on site have a "least threatened" status.

Aloidendron dichotomum is the Threatened or Protected Species (ToPS) on site.

4. *National Environmental Management Act (NEMA 2014, 2017)*

The following **listings and activities** may be triggered by the building of the haul road:

4.1 *Listing Notices 1 GNR 327*

Portions of the project will take place within ephemeral drainage lines and consequently Activities 12 and 14 are applicable.

4.2 *Listing Notices 3 GRN 324:*

A small portion of the proposed haul road project is located in a Critical Biodiversity Area 1 (CBA1) mentioned for the Northern Cape in Listing Notices 3 and Activities 4, 12 and 14 are therefore applicable and an Environmental Authorisation will be required for these activities.

5. *National Forest Act (NFA 2017) - Protected trees*

No nationally protected tree species were noted on site.

6. *Conservation of Agricultural Resources Act (1983, 2001)*

The activities related to the proposed haul road are (*inter alia*):

- the prevention or control of waterlogging or salinisation of land;
- the utilisation and protection of vleis, marshes, water sponges, watercourses and water sources;
- the regulation of the flow pattern of run-off water;
- **the control of weeds and invader plants;**
- the construction, maintenance, alteration or removal of soil conservation works or other structures on land.

In addition, lists of alien invasive plant species are provided with associated categories indicating the appropriate management and mitigation of these declared alien invasive species.

8. Northern Cape Nature Conservation Act (2009) - provincial 'specially protected' and 'protected' plant species

One of the provisions in the Northern Cape Nature Conservation Act is that no person may without a permit, pick, import, export, transport, possess, cultivate or trade in a specimen of a specially protected plant or a protected plant species. Two specially protected and 21 protected plant species were recorded on site. **Permits will have to be obtained for the removal of all protected plant species** from the Northern Cape Department of Nature Conservation (NCDENC).

9. Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)

Seven CITES listed indigenous plant species were noted on site. Permits are required to trade in any of these protected species.

TERMS OF REFERENCE

The project includes the following components:

- An eight-metre-wide, two lane haul road (one lane for each direction) to connect the top of the Brokenhill rock waste dump in the east (approximate coordinates: 29°15'3.44"S; 18°46'48.67"E) to an existing haul road in the west (approximate coordinates: 29°15'3.94"S; 18°46'4.92"E), a distance of approximately 1.2 km;
- No laydown area is required as (already disturbed) areas at the weighbridge and at the return water dam are available;
- Cement culverts and low level drift crossing will be used to cross the ephemeral drainage lines; and
- Fill material will be sourced from the existing pit (location attached).

Project study:

- Conduct a site survey of the terrestrial and aquatic baseline characteristics of the area;
- Describe and map the vegetation (habitats);
- Identify rare species and other sensitive features;
- Describe drainage lines (ephemeral streams) in the project footprint, including and present ecological state (PES) and the ecological importance and sensitivity (EIS) of the drainage lines;
- Assess the direct, indirect and cumulative impacts of the project on terrestrial and freshwater habitats, and recommend mitigation measures;
- Complete a National Water Act, (Act No 36 of 1998) prescribed Risk Assessment Matrix (RAM) for the project (Department of Water and Sanitation, DWS);
- Update the biodiversity register for the mine; and
- Identify National Environmental Management: Biodiversity Act, (Act No 10 of 2004) permitting requirements for vegetation removal.

Deliverable: Baseline and impact assessment report.

LIMITATIONS, ASSUMPTIONS AND UNCERTAINTIES

The following assumptions, limitations or uncertainties are listed regarding the field survey and ecological impact and risk assessment of the proposed road haul project for BMM at Aggeneys:

- The survey was conducted during the dry season (October 2018) and most bulbous and summer annual plant species were not present. Consequently, the number of these plant species encountered is probably an underestimate of the number of species which could potentially occur on site.
- Rare and threatened plant and animal species are generally uncommon and/or localised and the once-off survey may fail to locate such species.

REGULATIONS GOVERNING THIS REPORT

This report has been prepared in terms of the National Water Act (Act No 36 of 1998) and the EIA Regulations (2014) under the National Environmental Management Act (Act No. 107 of 1998) (NEMA 2014).

It is important to note that the assessment of impacts required for Environmental Authorisation (as authorised by DMR) differs from that required for the Water Use Authorisation process (as authorised by the DWS) and as such two separate assessments (impact and risk) have been applied. The Impact Assessment, providing larger ecological impacts of the construction and operation of the road on ecological features, is provided in Chapter 9, while the DWS Risk Assessment, which considers the risks of each individual activity on the relevant freshwater features, is provided in Chapter 12 of this report.

Appointment of specialist

Ekotrust cc was commissioned by SRK (South Africa) to provide an ecological impact assessment and ecological risk assessment (ERA) (based on the prescribed Risk Assessment Matrix of the Department of Water and Sanitation) regarding the potential impact and risk of the proposed new haul road on affected drainage lines at Black Mountain Mining (BMM), Aggeneys, in the Northern Cape province (the site). The study includes a habitat assessment, sensitivity analysis, assessment of impacts and their significance, determination of the present ecological status (PES), ecological importance and sensitivity (EIS) and completion of a Risk Assessment Matrix (RAM) of the drainage lines.

Company profile:

Name of Company: Ekotrust cc
(Registration number: CK90/05465/23)
Sole Member: Dr Noel van Rooyen
Founding date: 1990

Ekotrust cc specializes in habitat evaluation, vegetation classification and mapping, floristic diversity assessments, rare species assessments, alien plant assessments and management, veld condition assessment, bush encroachment, fire management, carrying capacity, wildlife management and wildlife production.

Declaration of independence

I, Noel van Rooyen, declare that:

- I am a member of Ekotrust cc: (CK90/05465/23);
- I act as an independent specialist consultant in the fields of ecology and botany;
- I regard the information contained in the report to be objective, true and correct within the framework of assumptions and limitations;
- I undertake to disclose to the applicant and the competent authority all information in my possession that reasonably has or may have the potential of influencing any decision to be taken by the competent authority; and

- I do not have any business, financial, personal or other interest in the activity or application other than fair remuneration for work performed in connection with the activity or application.

Indemnity and conditions relating to this report

The observations, findings, recommendations and conclusions provided in the current report are based on the compiler's best scientific and professional knowledge and other available information. If new information should become available Ekotrust cc reserves the right to modify aspects of the report. This report (hard copy and/or electronic) must not be amended or extended without the prior written consent of the author. Furthermore, any recommendations, statements or conclusions drawn from or based on this report must make reference to the report. If these recommendations, statements or conclusions form part of a main report relating to the current investigation, this report must be included in its entirety (as an Appendix).

Although Ekotrust cc has exercised due care in preparing this report, it accepts no liability, and by receiving this document, the client indemnifies Ekotrust cc against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, and by the use of the information contained in this document.

Scope and purpose of report

The scope and purpose of the report are summarised in the "Terms of Reference" section of this report.



Dr Noel van Rooyen

Date: 13 November 2018

GENERAL INFORMATION

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CHAPTER 1

INTRODUCTION

Black Mountain Mining (Pty) Ltd (BMM) mines and processes copper, lead and zinc at the Black Mountain and Gamsberg Mines near the town of Aggeneys in the Northern Cape. The Black Mountain Mining complex ('the Mine') has been in operation since 1980 and comprises a processing area (including waste management and ancillary facilities) and two underground shafts:

- Deeps shaft which produces copper, lead and zinc with silver as a by-product; and
- Swartberg shaft which produces primarily copper and lead with silver as a by-product.

Currently, trucks transport ore and waste rock from the Swartberg shaft using the existing haul road to the processing area. The haul road intersects numerous ancillary roads in the processing area (Figure 1). Access to the Brokenhill Waste Rock Dump (WRD) at this intersection requires heavy vehicles to turn a haul road alternatives which presents traffic logistical issues and raises safety concerns.

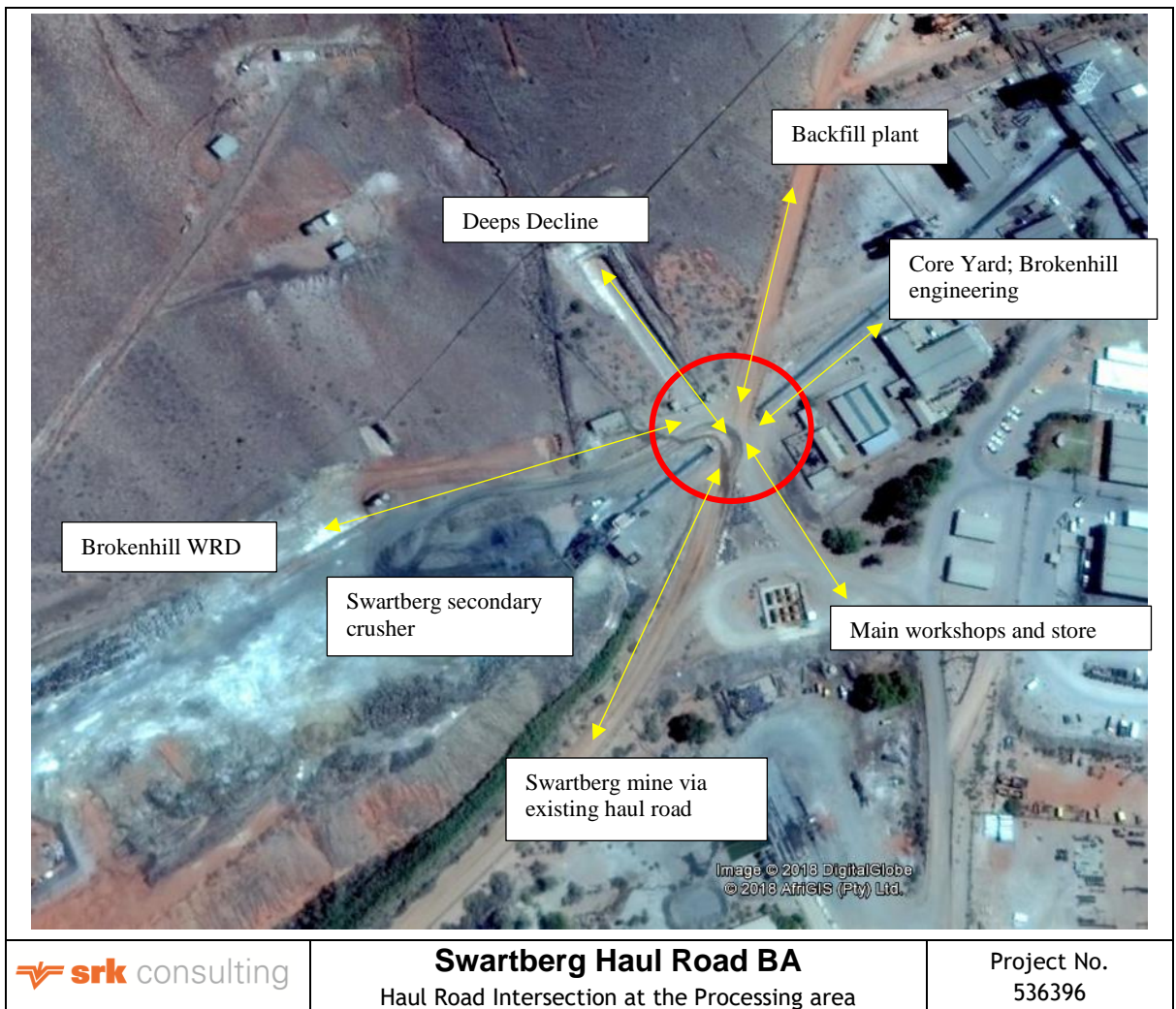


Figure 1. Haul road intersection at the processing area (Source BMM 2018).

To alleviate traffic and safety concerns and to optimise haul distances at the Mine, BMM proposes to construct a new haul road (~ 1.2 km long) from the top of the Brokenhill WRD to the weighbridge area located adjacent to the haul road in the west (the project). BMM considered four haul road route alignments for the proposed haul road (Figure 2). The selected route alignment was determined based on safety and design considerations such as steep slopes and fill material requirements. Only the selected route has been presented as feasible by BMM.

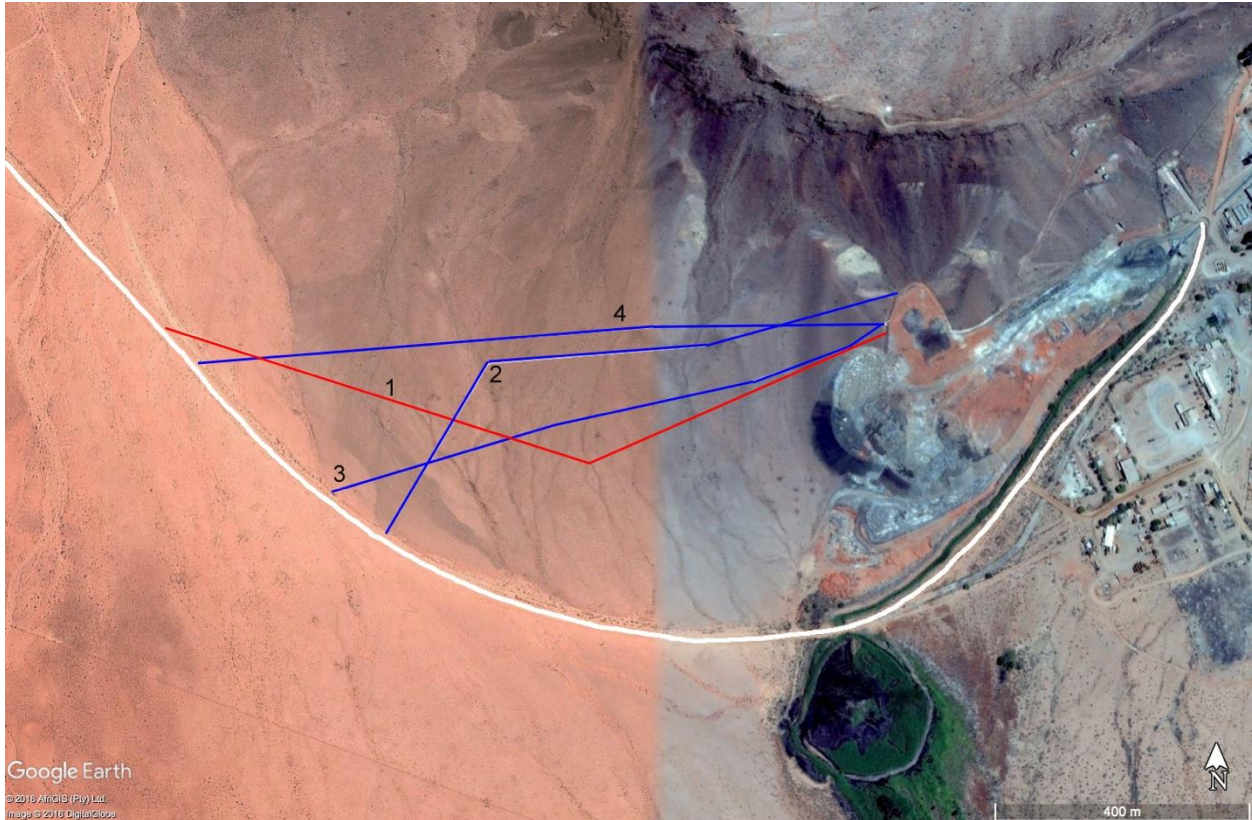


Figure 2. Alignments of selected new (red), alternatives (blue) and existing (white) haul road.

The project will include the installation of cement culverts and low-level concrete drift crossings (Figure 3) at drainage line crossings, as well as laydown areas within the existing disturbed footprints of the weighbridge area and WRD.

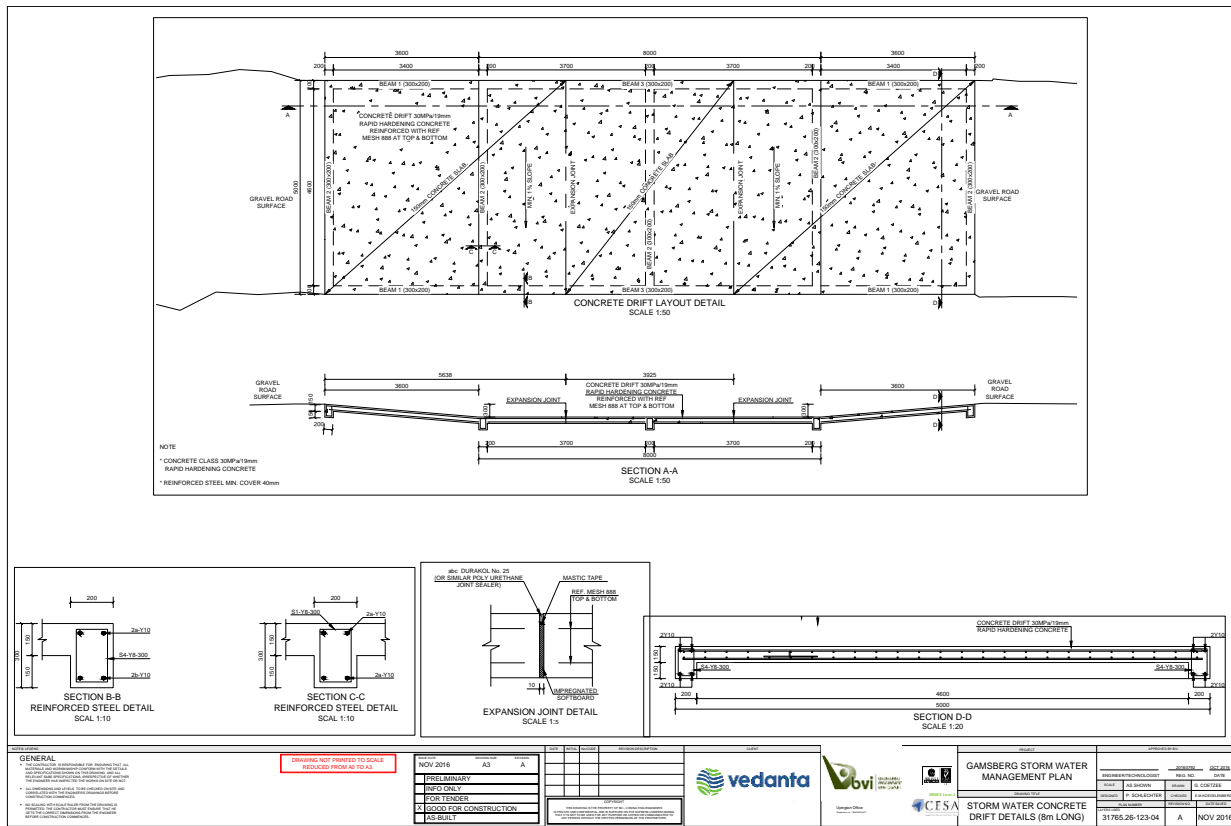


Figure 3. Details of the proposed storm water concrete drift crossings.

The new haul road will be 8 m wide to allow for 2-way truck traffic and additional fill, if required, will be sourced from BMM’s approved pit. A 66 kV powerline will be raised to ensure vehicles can pass safely beneath the powerline.

The project will occur entirely within the Mine’s approved Mining Right Area.

As with all land-uses, there are environmental impacts associated with road and bridge building, including:

- **Impedance of stream flow:** Uninterrupted streamflow is crucial for the maintenance of riparian habitats and wetlands. Streamflow of drainage lines may be impeded if erosion and siltation occur due to vegetation clearing and physical disturbance, and may lead to changes in habitat.
- **Increased sedimentation load:** Roads may potentially increase sediment loads and disrupt water flow patterns.
- **Disturbance related erosion and alien invasion:** Physical disturbance of soils and natural vegetation, result in erosion and in many instances invasion by alien plant species.
- **Reduction in ecological connectivity:** Roads cause a reduction in the connectivity that individual drainage lines have with other natural areas in the landscape.

Drainage lines, or watercourses/ivers in general, are considered to be of high conservation value for the following reasons:

- The indigenous vegetation of riverine areas is often in danger of being replaced by alien invasive species. Conditions in these areas are often conducive to alien invasion due to the high level of disturbance and the fact that seeds of invasive species are easily dispersed to these areas. All areas with indigenous vegetation in these habitats must therefore be regarded as of conservation importance.
- The riparian and wetland vegetation often shows large variation in species composition and vegetation structure across short distances and is therefore usually very diverse. The large variation in the vegetation can

be ascribed to the wetness gradient, habitat differences and the effect of flood disturbance.

- Rivers are longitudinal ecosystems and their condition at any point is a reflection of not only the immediate upstream activities, but also those in the entire upstream catchment. Any impact on a riparian habitat is therefore likely to impact on downstream water quality and water flow, e.g. increase in silt load.

In this instance at BMM, the drainage lines in the study area are ephemeral drainage lines and may flow only during rare, heavy thunderstorms in the rainy season. During droughts they may not flow at all for several years. It is therefore clear that the ephemeral drainage lines on BMM are neither true riparian habitats nor wetlands.

Because the proposed haul road will cross ephemeral drainage lines, the project will require authorisation in terms of the National Environmental Management Act 107 of 1998 and in terms of the National Water Act 36 of 1998 (NWA) (SRK (South Africa)).

The aim of this study was to provide an (1) ecological impact assessment, (2) ecological risk assessment (ERA), (3) present ecological status assessment (PES) and (4) ecological importance and sensitivity assessment (EIS) of the drainage lines (watercourses) at the site of the proposed new haul road at BMM.

CHAPTER 2

METHODOLOGY

2.1 Approach

The objective of the study was to assess the vegetation, flora and fauna of the study area in order to identify any rare plant species and sensitive areas that should be avoided during development and to gather the necessary onsite information to compile the impact and risk assessment, PES and EIS.

The study commenced as a desktop study, followed by field-based surveys and verification in October 2018. Hard copy and digital information from spatial databases such as DAFFarcgis, topocadastral maps (Aggeneys 2918BB and Brabees 2918BD), geological and land type maps and vegetation types (Mucina & Rutherford 2006) were sourced to provide information on topography, geology, land types and broad vegetation types of the study area. Information on the climate was sourced from the Weather Bureau (1988, 1998) and data supplied by BMM.

The study site was stratified into relatively homogeneous vegetation/terrain units on Google Earth satellite images based on physiography and vegetation cover. This stratification was used to determine the position and number of sample plots, and was the basis for identifying habitat types and to produce a vegetation map.

The vegetation survey consisted of visiting the mapping units and systematically recording all identifiable woody species, grasses, forbs and alien (exotic) plant species within each of the stratified units on site, and estimating their cover-abundance. Physical habitat features, e.g. geology, topography, soil colour and texture, and rock cover, were noted. A checklist of the plant species recorded on site was compiled (Appendix B). During the site visit, digital photographs of the sample plots and some individual plant species were taken and representative photographs of the different plant communities (Chapter 5), plant species (Chapter 6) and haul road route alignment (Appendix G) are included in the report.

2.2 Data analyses

A classification of the vegetation data was done with the TURBOVEG and JUICE computer programmes (Hennekens & Schaminee 2001, Tichy *et al.* 2011). A table was compiled (Appendix E) and the different plant communities were described and mapped.

2.3 Plant species checklists

All plant species recorded in the sample plots are listed in the plant species checklist (Appendix B) and in the differential table for the plant communities (Appendix E). The NEWPOSA plant species list for the 29.20° - 29.30° and 18.7° - 18.9° area is provided in Appendix C.

2.4 Fauna

The faunal survey involved a field survey and consulting of available databases and/or relevant literature to determine the diversity, conservation status and distribution of relevant faunal species. Species presence was mainly attained by means of direct or indirect sighting methods (animal, spoor, burrows, scats) whilst traversing the area on foot.

2.5 Sensitivity assessment

A sensitivity assessment of each plant community/habitat was done and a rating awarded. A sensitivity map was drawn based on a number of criteria discussed in Chapter 8.

2.6 Impact assessment

The significance of the impacts of the haul road on the terrestrial and aquatic systems and flora and fauna of the site, is discussed and mitigation measures recommended where appropriate.

2.7 Rare and protected plant species

The site was systematically surveyed for rare, threatened and/or endemic plant species during a site visit in October 2018 (Appendix B). The Red Data status, conservation and protected status of plant species recorded on site were determined from the Red lists of South African plants (redlist.sanbi.org), the protected trees according to the National Forests Act (Act No 84 of 1998)(NFA 2017), the threatened and protected species list (ToPS list) of the National Environmental Management: Biodiversity Act, (Act No 10 of 2004) (NEM:BA 2013), CITES appendices (2017), and the Northern Cape Nature Conservation Act (Act No 9 of 2009).

For the IUCN classification, the following definitions were applied (Figure 4).

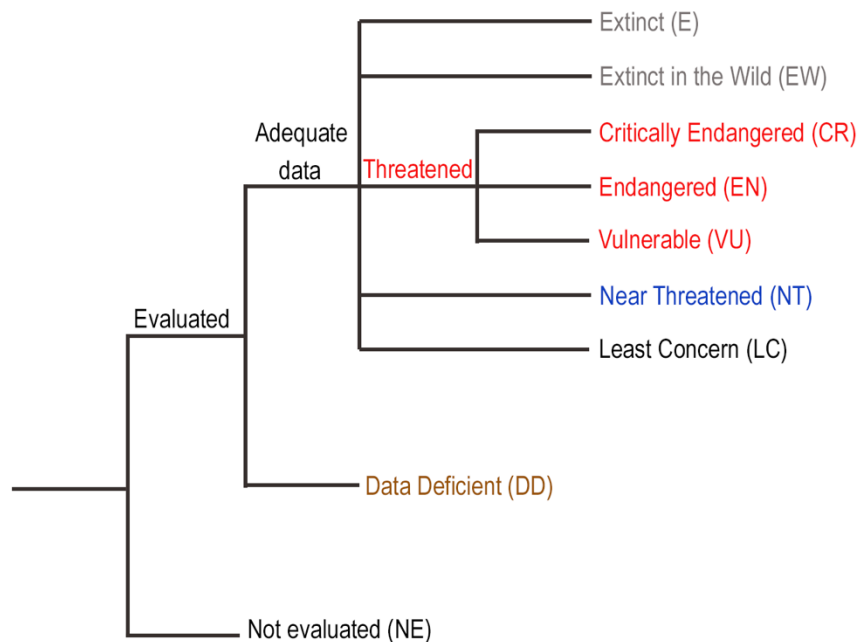


Figure 4: Schematic representation of the relationship between the various IUCN Red List Categories.

2.7.1 Threatened Species and Species of Conservation Concern (SCC)

Extinct Categories:

- **Extinct (E):** A species is Extinct when there is no reasonable doubt that the last individual has died. Species should be classified as Extinct only once exhaustive surveys throughout the species' known range have failed to record an individual.
- **Extinct in the Wild (EW):** A species is Extinct in the Wild when it is known to survive only in cultivation or

as a naturalized population (or populations) well outside the past range.

Threatened Categories:

- **Critically Endangered (CR):** A species is Critically Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Critically Endangered, indicating that the species is facing an extremely high risk of extinction.
- **Endangered (EN):** A species is Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Endangered, indicating that it is facing a very high risk of extinction.
- **Vulnerable (VU):** A species is Vulnerable when the best available evidence indicates that it meets at least one of the five IUCN criteria for Vulnerable, indicating that it is facing a high risk of extinction.

2.7.2 Not Threatened Categories but of conservation concern:

- **Near Threatened (NT):** A species is Near Threatened when available evidence indicates that it nearly meets any of the IUCN criteria for Vulnerable, and is therefore likely to become at risk of extinction in the near future.
- **Data Deficient (DD):** A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking.

2.7.3 Not Threatened Categories:

- **Least Concern (LC):** A species is Least Concern when it has been evaluated against the IUCN criteria and does not qualify for any of the above categories. Species classified as Least Concern are considered at low risk of extinction. Widespread and abundant species are typically classified in this category.
- **Not Evaluated (NE):** A taxon is Not Evaluated when it has not yet been evaluated against the five IUCN criteria. This category often applies to alien species.

2.7.4 Additional Categories identified by the Threatened Species Programme in South Africa

- **Critically Rare:** A species is Critically Rare when it is known to occur at a single site, but is not exposed to any direct or plausible potential threat and does not otherwise qualify for a category of threat according to one of the five IUCN criteria.
- **Rare:** A species is Rare when it meets at least one of four South African criteria for rarity, but is not exposed to any direct or plausible potential threat and does not qualify for a category of threat according to one of the five IUCN criteria. The four criteria are as follows:
 - Restricted range: Extent of Occurrence (EoO) <500 km², OR
 - Habitat specialist: Species is restricted to a specialized microhabitat so that it has a very small Area of Occupancy (AoO), typically smaller than 20 km², OR
 - Low densities of individuals: Species always occurs as single individuals or very small subpopulations (typically fewer than 50 mature individuals) scattered over a wide area, OR
 - Small global population: Less than 10 000 mature individuals.

2.8 Present Ecological Status (PES) and Ecological Importance and Sensitivity (EIS)

The PES and EIS of the drainage lines that will be crossed by the haul road were assessed.

2.9 Risk Assessment

An Ecological Risk Assessment (ERA) was completed according to the prescribed Risk Assessment Matrix (RAM) of the Department of Water and Sanitation (DWS).

A summary of relevant environmental legislation regarding the current development was incorporated in the report (see Chapter 4).

CHAPTER 3

ENVIRONMENTAL DESCRIPTION

3.1 Location

The site is situated at Black Mountain Mine near Aggeneys in the Northern Cape on portion 4 of farm Zuurwater 62 (see Figure 5). The site that was evaluated comprises the project footprint (including all the alternatives) as well as the immediate surroundings (approximately 150 m on either side of the footprint). The project area falls within the Namakwa District Municipality and the Khâi-Ma Local Municipality. The proposed haul road will run from the top of the Brokenhill Waste Rock Dump (WRD) in the east to the weighbridge area located adjacent to the existing haul road (Figure 2).

The topocadastral grid references for the site are 2918 BB and 2918 BD.

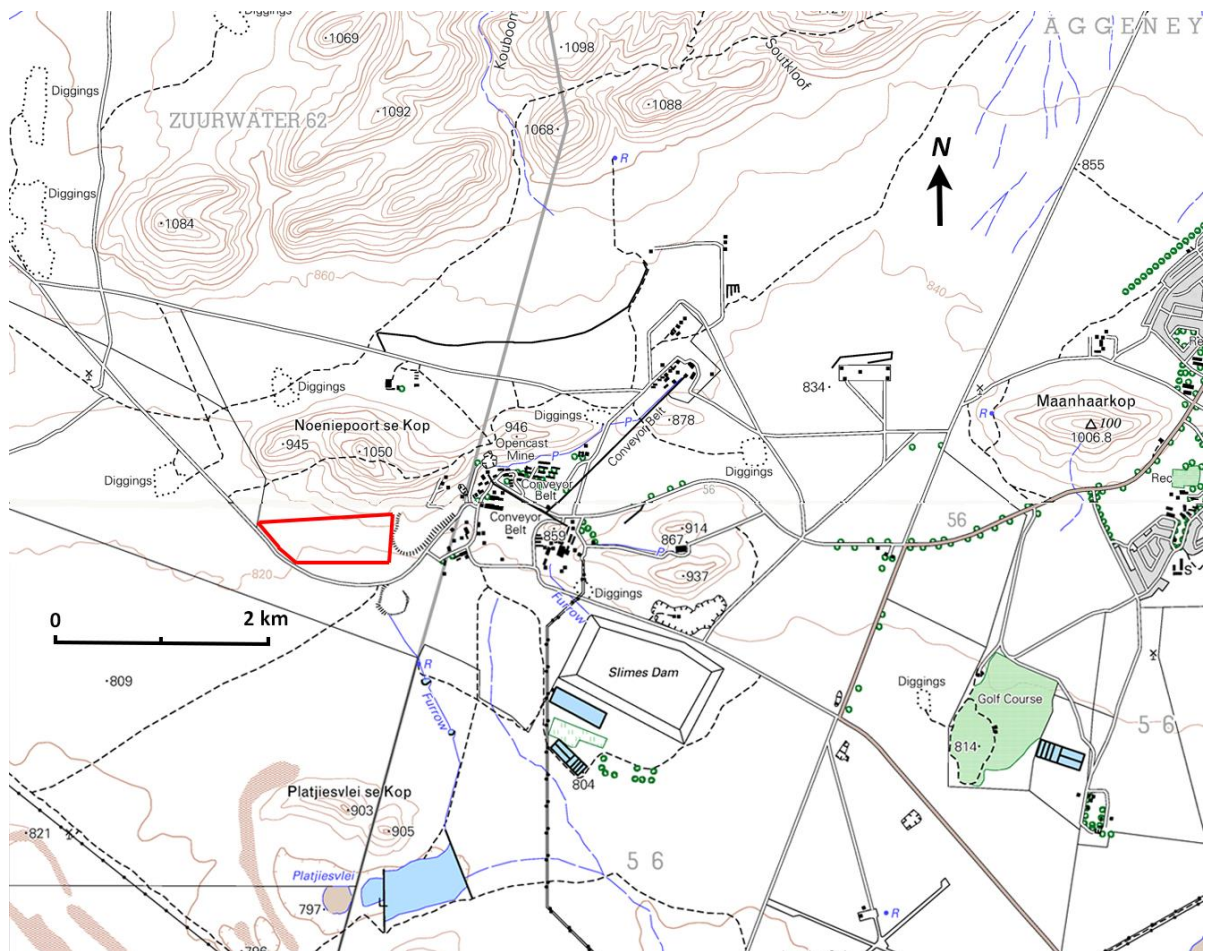


Figure 5. Topocadastral map of the Black Mountain Mine, Aggeneys, indicating the location of the site for the proposed haul road (red quadrilateral).

3.2 Topography and drainage

The site covers the southern slopes of Noeniepoort se Kop, an inselberg, and the plains surrounding it. Although Noeniepoort se kop is 1050 m above sea level (masl), the site is situated on the lower slopes of the kop, between 810 m and 840 masl. The terrain is rocky against the slopes but levels out on the sandy plains south and west of the site.

Aggeneys is located in the Lower Orange Water Management Area (WMA 14) and within the Primary Catchment Boundary D; Secondary Catchment Boundary D8 and Quarternary Catchment Boundary D82C. The site is drained by a number of poorly defined ephemeral drainage lines (Figure 13), running southwards from Noeniepoort se kop in the north to the current haul road in the south. The flow of the drainage lines was blocked by the current haul road and their flow was diverted towards the east along the haul road. They now flow into the large artificial pond where mine water is gathered (Figure 2).

3.3 Climate

3.3.1 Regional climate

The regional climate for the Aggeneys Gravel Vygieveld and Bushmanland Sandy Grassland are very similar. Rainfall can be described as erratic with a mean annual rainfall of less than 100 mm (range 70 - 120 mm), occurring mainly in the form of thunderstorms in late summer from February to April (Mucina & Rutherford 2006). The mean annual precipitation coefficient of variation is about 40%. The mean annual temperature is about 17°C, while the mean monthly maximum and minimum temperatures are 38.0°C and -3°C. The incidence of frost may be up to 30 days per year. The mean annual potential evaporation is 2720 mm and far exceeds the annual precipitation.

3.3.2 Rainfall

The mean annual rainfall for Aggeneys recorded over a 32 year period from 1986 to 2017 was 100.9 mm, ranging from 27.6 mm in 2015 to 219.5 mm in 2006 (Table 1). The rainfall is highest from January to April when from 16.0 to 21.1 mm per month is recorded (Table 1, Figures 6, 7 & 8). The driest months are from May to July when less than 10 mm per month is recorded.

Table 1. Rainfall for Aggeneys weather station from 1986 to 2018 (supplied by BMM)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
1986	2.0	2.0	20.0	31.0	1.0	34.0				16.0			106.0
1987		3.0	27.0	8.0				1.3	32.0	1.0	2.8		75.1
1988		26.0	88.0		6.0	2.0	1.0	10.0	3.5		10.0	42.0	188.5
1989	3.0	18.0		31.0		2.0	6.0						60.0
1990		13.0	6.5	40.0	5.0	13.0	2.0					12.0	91.5
1991	35.0		29.0	7.0	2.0				20.0	45.5		1.0	139.5
1992						4.5	5.0	1.5					11.0
1993	35.0		9.5	33.5	13.5	6.0	2.0			1.0	12.5	1.5	114.5
1994	20.5	21.5	6.0	12.0		6.0	10.0						76.0
1995	42.5	1.5	13.5		6.5		2.0	7.5	15.5	28.0	9.5	34.0	160.5
1996	10.0	16.0			3.5	2.0	65.0	9.0	8.5	15.5	39.0	3.0	171.5
1997		9.0	22.0	1.0	18.5	0.5	6.0		1.0	0.5	0.5	3.0	62.0
1998	1.0	1.0	20.5		5.5			33.0	19.0	3.5	1.0	17.0	101.5
1999		14.0	22.5	24.0	10.0			1.5	12.0	29.0	12.0	35.0	160.0

2000	7.5	90.0	6.0	5.0	0.5	0.5	7.5		2.0				119.0
2001	0.5	7.0	7.0	109.0	1.0		20.0	7.0	2.0	0.5	38.5		192.5
2002	0.5	15.5	18.5	35.0	10.5	3.5	1.0	35.0	4.0	7.0	3.5	3.0	137.0
2003		5.0	0.5					18.0		2.5	11.0	5.0	42.0
2004	7.5	6.0	5.0	8.0	6.0				3.0	17.0	1.0		53.5
2005	45.0	2.0	8.5	31.0	15.0			2.5		57.0	2.0	1.5	164.5
2006	47.0	45.0		75.0	14.0	1.5	2.0	35.0					219.5
2007	13.0		8.0	1.0	2.0	10.5	1.5	2.5		5.0	8.5	19.0	71.0
2008	4.0	11.0	23.0	0.5	23.0	33.0	15.0	2.0		3.5	11.0	2.0	128.0
2009		77.5	2.0		1.5	13.0	8.0	4.0			6.0		112.0
2010	24.0	20.0	4.0		3.5							20.0	71.5
2011	2.0	10.5	48.5	4.0	22.0	6.0		7.0			3.0		103.0
2012		20.5	7.5	3.0		6.3				2.0		9.0	48.3
2013	4.8			26.0				6.0				6.5	43.3
2014	28.0	15.5	17.5	6.0		6.0					29.0	3.0	105.0
2015	8.0			7.6	0.2	7.6	0.6	2.8	0.4			0.4	27.6
2016	27.4		0.4	2.2	2.2		0.6			3.4			36.2
2017	16.4	10.2	3.6			2.8			1.6		3.4	0.2	38.2
2018	0.4	4.6	18.8	5.0									
Month	16.0	17.9	16.4	21.1	7.5	8.0	8.6	10.3	8.9	13.2	10.7	10.9	
Mean													100.9

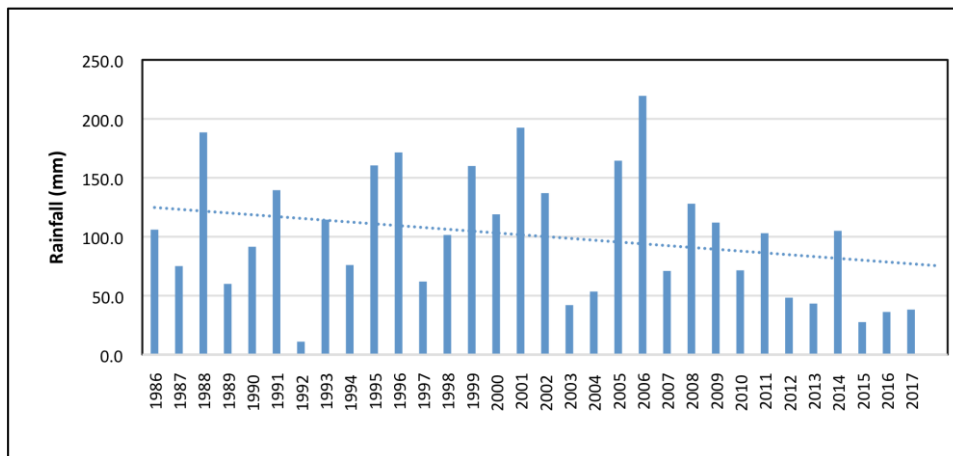


Figure 6. Total rainfall per annum for Aggeneys from 1986 to 2017 (BMM data, Aggeneys).

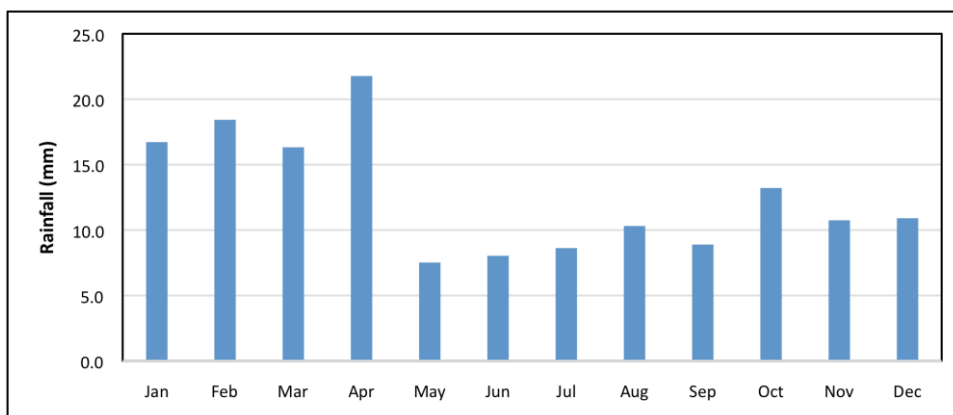


Figure 7. Mean rainfall per month for Aggeneys from 1986 to 2017 (BMM data, Aggeneys).

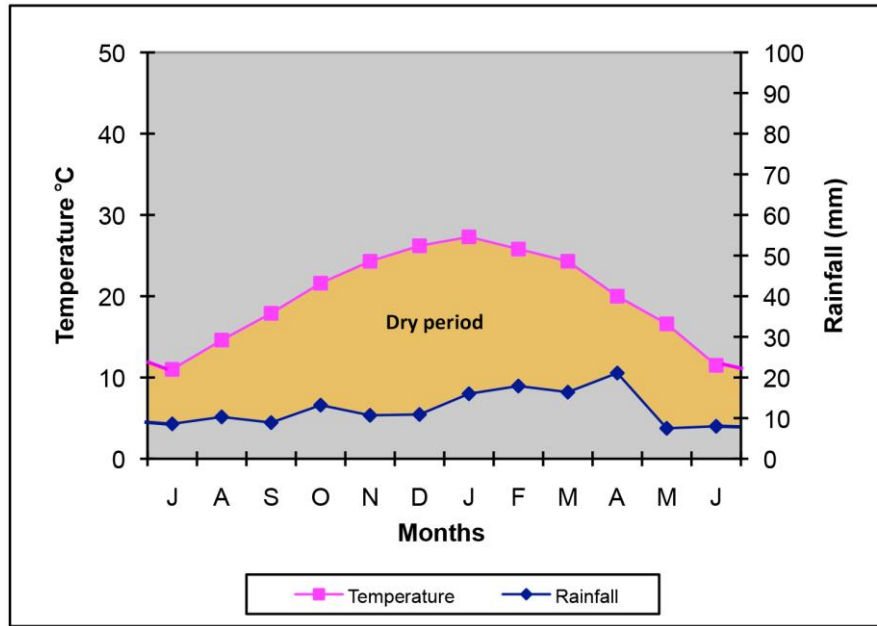


Figure 8. Climate diagram for Aggeneys region. Rainfall data for Aggeneys and temperature data from nearby Pofadder. Because the rainfall curve is the entire year below the temperature curve, there is no wet or very wet period.

3.3.3 Temperature

The mean annual temperature for Pofadder is 18.6°C (Table 2) and the extreme maximum and minimum temperatures measured at Pofadder are 40.6°C and -1.4°C (Table 2). The mean daily maximum at Pofadder for the hottest month, January, is 33.0°C and for the coldest month, June, it is 17.8°C (Table 2). The mean daily minimum for January is 16.6°C and for June it is 5.7°C. Frost may potentially occur from May to September, a period of approximately 150 days.

Table 2. Temperature data (°C) for Pofadder weather station 0247668 A4; 29 08' S; 19 23' E; 989 m; 29 year period.

Month	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Max	33.0	32.4	30.1	25.4	21.4	17.8	18.0	20.0	23.6	26.5	30.0	32.1	25.8
*Ext. Max	40.6	39.6	39.2	35.7	31.3	26.0	27.6	31.0	35.2	37.9	39.4	40.5	40.6
Min	16.6	17.2	16.0	12.4	8.6	5.7	5.1	6.0	8.6	10.9	14.0	15.5	11.4
*Ext. Min	6.4	5.6	4.4	0.5	-0.4	-2.7	-3.0	-2.7	-1.2	1.6	4.0	5.0	-3.0
Mean	24.8	24.8	23.0	18.9	15.0	11.8	11.6	13.0	16.1	18.7	22.0	23.8	18.6

Max = mean daily maximum temperature for the month
 *Ext. Max = extreme maximum temperature recorded per month
 Min = mean daily minimum temperature for the month
 *Ext. Min = extreme minimum temperature recorded per month
 Mean = mean monthly temperature for each month and for the year

3.4. Geology

The rocky slopes of the mountain on site consist of medium- to thick-bedded, white quartzite and pelitic schist, with interbedded sillimanite bodies (Kwr - Wortel Formation of the Aggeneys Subgroup, Bushmanland Group (Figure 9,

Geological Series 2007). The sandy plains to the east and west (Qs2) are covered by quaternary sand, scree, rubble and sandy soils.

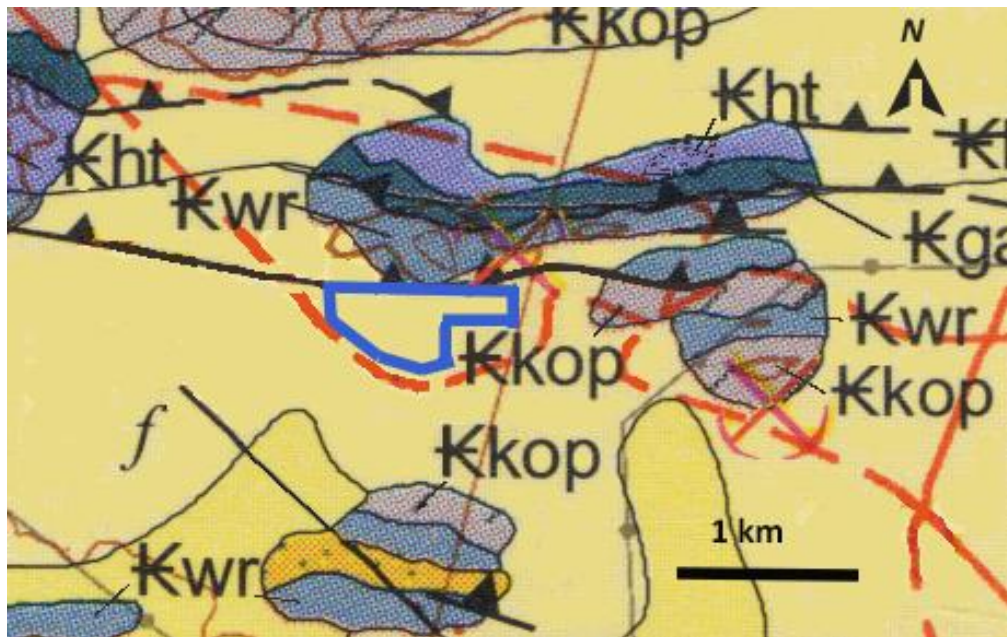


Figure 9. Geological map of the region with the location of the site indicated in blue.

Legend:

Qs2 - Sand, scree, rubble, sandy soil

Kht - Rhythmically layered quartzite, quartz-feldspar-biotite gneiss, quartz-biotite-sillimanite schist

Kga - Sulphide-bearing magnetite-grunerite-garnet-pyroxene rocks, cordierite fels, sillimanite schist and quartzite

Kwr - Layered sequence of mainly medium- to thick-bedded, white quartzite and pelitic schist with interbedded sillimanite bodies

Kkop - Red-brown-weathering, medium- to coarse-grained leuco-gneiss, in places biotite-rich with abundant augen.

3.5. Land Types

Land Types denote areas that display a marked degree of uniformity with respect to terrain form, soil pattern and climate.

The site falls in the Af26 Land Type (Figure 10). This land type comprises the sandy plains where the soils are described as red-yellow apedal, freely-drained soils; red, high base status; >300 mm deep, with dunes.

The inselbergs/mountains of the region falls in the Ic151 Land Type, which indicates miscellaneous land classes that are very rocky with little soils. Although the land types have not been mapped at this scale, Noenieput se Kop falls within the Ic151 Land Type.

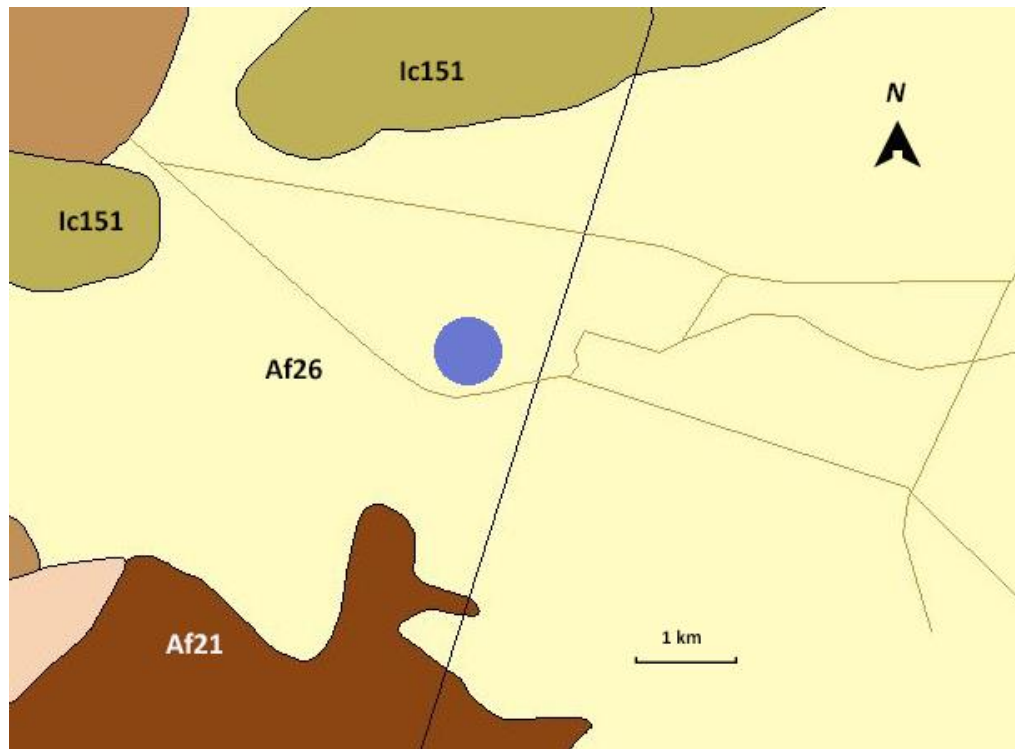


Figure 10. Land types in the project area. The approximate location of the site is indicated in blue.

3.6 Critical Biodiversity Areas (CBA), Ecological Support Areas (ESA) and the National Protected Areas Expansion Strategy (NPAES)

A small section of the haul road (approximately 1247 m²) will fall within a CBA1 (Namakwa Biodiversity Sector Plan 2016, Figure 11). CBAs are areas required to meet biodiversity targets for ecosystems, species or ecological processes. CBAs should be kept in a natural or near-natural state, with no further loss of habitat or land-use change permitted. An ESA is not essential for meeting biodiversity targets but plays an important role in supporting the ecological functioning in a CBA. Although this section of the road falls within a CBA1, it is important to note that the particular section is already highly disturbed, due to the presence (or proximity) of the weighbridge and the existing haul road. Furthermore, the sensitivity analysis revealed that the sensitivity of this particular plant community was 'Very Low' (Chapter 8).

The development does not fall in any ESA or NPAES areas.

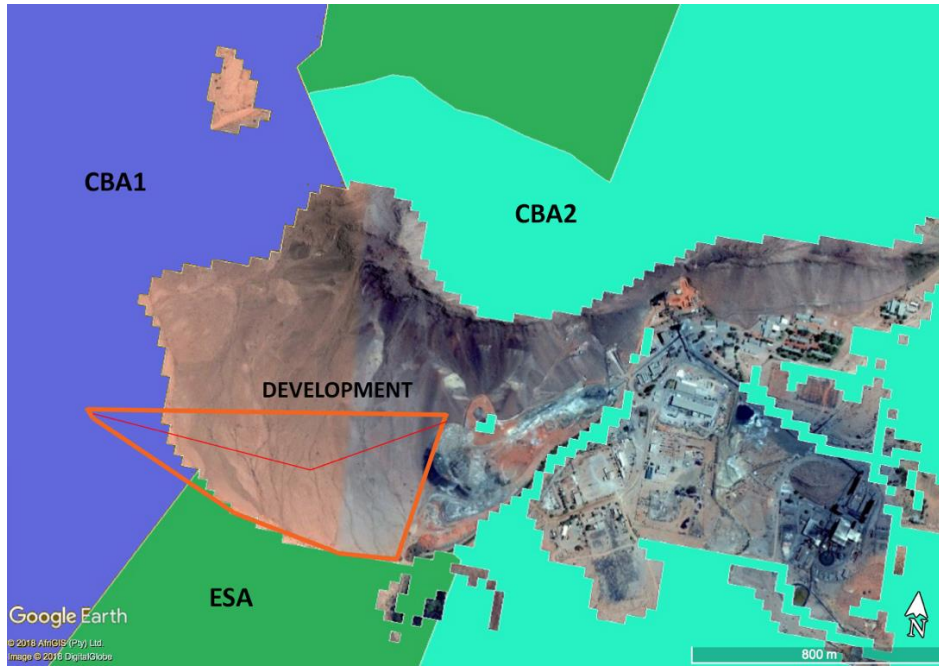


Figure 11. Critical Biodiversity Areas (CBA) map of the region indicating the site (orange boundary) and the selected haul road (red line).

CHAPTER 4

REGULATORY FRAMEWORK

4.1 Introduction

The White Paper on the conservation and sustainable use of South Africa's biodiversity and the National Environmental Management Act (Act No. 107 of 1998) specify that due care must be taken to conserve and avoid negative impacts on biodiversity and that the sustainable, equitable and efficient use of biological resources must be promoted. Various acts provide control over natural resources in terms of their conservation, the use of biological resources and avoidance of negative impacts on biodiversity. Some international conventions are also relevant to sustainable development.

4.2 National Environmental Management Act (Act No. 107 of 1998) (NEMA)

NEMA is the framework environmental management legislation, enacted as part of the government's mandate to ensure every person's constitutional right to an environment that is not harmful to his or her health or well-being. It is administered by DEA but several functions have been delegated to the provincial environment departments. One of the purposes of NEMA is to provide for co-operative environmental governance by establishing principles for decision-making on matters affecting the environment. The Act further aims to provide for institutions that will promote cooperative governance and procedures for coordinating environmental functions exercised by organs of state and to provide for the administration and enforcement of other environmental management laws.

NEMA requires that measures are taken that "prevent pollution and ecological degradation; promote conservation; and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development." In addition: (1) NEMA requires that the disturbance of ecosystems and loss of biological diversity are avoided, or where they cannot be altogether avoided, are minimised and remedied, (2) a risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions, and (3) 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.

This report considers the Environmental Impact Assessment (EIA) Regulations 2014, with amendments in 2017, under the National Environmental Management Act, (Act No. 107 of 1998) (NEMA 1998, 2014, 2017). According to the Regulations (2017) under Listing Notice 1 (GRN No. 327), Listing Notice 2 (GRN No 325) and Listing Notice 3 (GRN No 324), the activities listed are identified as activities that may require Environmental Authorisation prior to commencement of that activity and to identify competent authorities in terms of sections 24(2) and 24D of the Act.

Definitions:

“indigenous vegetation” refers to vegetation consisting of indigenous plant species occurring naturally in an area, regardless of the level of alien infestation and where the topsoil has not been lawfully disturbed during the preceding 10 years (NEMA 1998).

"Watercourse" and "wetland" are similarly defined in the NWA (1998) and NEMA (2014) Acts.

“watercourse” means –

- a river or spring;
- **a natural channel in which water flows regularly or intermittently;**
- a wetland, pan, lake or dam into which, or from which, water flows; and
- any collection of water which the Minister may, by notice in the *Gazette*, declare to be a watercourse as defined in the National Water Act, 1998 (Act No. 36 of 1998); and a reference to a watercourse includes, where relevant, its bed and banks

“Wetland” means land that is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.

The activities listed below are identified as activities that may require Environmental Authorisation prior to commencement of that activity. The following activities may be applicable to the haul road project:

4.2.1 Listing Notice 1 (GNR 327)

Activity 12: *The development of (inter alia)-*

(xii) infrastructure or structures with a physical footprint of 10 m² or more;

where such development occurs -

(a) within a watercourse;

(b) in front of a development setback; or

(c) if no development setback has been adopted, within 32 metres of a watercourse, measured from the edge of a watercourse.

Activity 19: *The infilling or depositing of any material of more than [5] 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than [5] 10 cubic metres from*

(i) a watercourse; -

Activity 27: *The clearance of an area of 1 hectares or more, but less than 20 hectares of indigenous vegetation, except where such clearance of indigenous vegetation is required for -*

(i) the undertaking of a linear activity; or

(ii) maintenance purposes undertaken in accordance with a maintenance management plan.

The proposed haul road project is classified as a 'linear activity' and an EA should therefore not be required.

4.2.2 Listing Notice 3 (GRN 324)

The purpose of this Notice is to list activities and identify competent authorities under sections 24(2), 24(5) and 24D of the Act, where environmental authorisation is required prior to commencement of that activity in specific identified geographical areas only, i.e. provinces.

Activity 4 - *The development of a road wider than 4 metres with a reserve less than 13.5 metres*

Applicability of Activity 4 In the Northern Cape:

Outside urban areas:

- A protected area identified in terms of NEM:PAA, excluding disturbed areas;
- National Protected Area Expansion Strategy Focus areas (NPAES);
- Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority;
- Sites or areas identified in terms of an international convention;
- Critical biodiversity areas as identified in systematic biodiversity plans as adopted by the competent authority or in bioregional plans;
- Core areas in biosphere reserves;
- Areas within 10 kilometers from national parks or world heritage sites or 5 kilometers from any other protected area identified in terms of NEMPAA or from the core areas of a biosphere reserve, excluding disturbed areas, or
- Areas seawards of the development setback line or within 1 kilometer from the high-water mark of the sea if no such development setback line is determined.

A portion of the proposed haul road project falls within a CBA1 in terms of the Namakwa Biodiversity Sector Plan 2016, see Figure 11) and EA is therefore required.

Activity 12 - *The clearance of an area of 300 m² or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan.*

Applicability of **Activity 12** In the Northern Cape:

- Within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEM:BA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004;
- Within critical biodiversity areas identified in bioregional plans;
- Within the littoral active zone or 100 metres inland from the high water mark of the sea or an estuary, whichever distance is the greater, excluding where such removal will occur behind the development setback line on erven in urban areas; or
- On land, where, at the time of the coming into effect of this Notice or thereafter such land was zoned open space, conservation or had an equivalent zoning.

A portion of the proposed haul road project falls within a CBA1 in terms of the Namakwa Biodiversity Sector Plan 2016, see Figure 11) and EA is therefore required.

Activity 14: *The development of (inter alia) -*

(xii) infrastructure or structures with a physical footprint of 10 m² or more;

where such development occurs -

(a) within a watercourse

(b) in front of a development setback; or

(c) if no development setback has been adopted, within 32 metres of a watercourse, measured from the edge of a watercourse.

Applicability of **Activity 14** In the Northern Cape (outside urban areas):

- A protected area identified in terms of NEM:PAA, excluding conservancies;
- National Protected Area Expansion Strategy Focus areas (NPAES);
- World Heritage Sites;
- Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority;
- Sites or areas identified in terms of an international convention;
- Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans as adopted by the competent authority or in bioregional plans;
- Core areas in biosphere reserves;
- Areas within 10 kilometers from national parks or world heritage sites or 5 kilometers from any protected area identified in terms of NEMPAA or from the core area of a biosphere reserve;
- Areas seawards of the development setback line or within 1 kilometer from the high-water mark of the sea if no such development setback line is determined.

The proposed haul road project does not occur in any of the abovementioned conservation or sensitive areas and an EA should therefore not be required.

4.3 National Environmental Management: Biodiversity Act (Act No. 10 of 2004) (NEM:BA)

As the principal national act regulating biodiversity protection, NEM:BA, which is administered by DEA, is concerned with the management and conservation of biological diversity, as well as the use of indigenous biological resources in a sustainable manner. The term biodiversity according to the Convention on Biodiversity (CBD) refers to the variability among living organisms from all sources including, *inter alia* terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity in genes, species and ecosystems.

4.3.1 Threatened ecosystems

Section 53 of NEM:BA lists the threatened status of ecosystems, i.e. critically endangered ecosystems, endangered ecosystems, and vulnerable ecosystems. The list of threatened ecosystems was published in 2011 (NEM:BA, 2011). Both the Bushmanland Sandy Grassland (Nkb 4) and the Aggeneys Gravel Vygieveld (SKr 19) where-in the proposed project is situated, have a "**least threatened**" status.

4.3.2 Threatened or Protected Species (ToPS) Regulations

Section 56 of NEM:BA makes provision for the declaration of species which are of such high conservation value, national importance or are considered threatened that they need protection, i.e. critically endangered species, endangered species and vulnerable species. Lists of species that are threatened or protected, and associated activities that are prohibited and/or exempted from restriction have been published in the Government Gazette Vol 574, No 36375 of 16 April 2013 (NEM:BA 2013). Any proposed removal of threatened or protected species and/or prohibited/restricted activities will require a permit in term of these Threatened or Protected Species (ToPS) Regulations of 2013, as read with NEM:BA.

***Aloidendron dichotomum* is the threatened species that were identified on the site (single young individual).**

4.3.3 Alien and Invasive Species (AIS) Regulations

Chapter 5 of NEM:BA provides for the protection of biodiversity from alien and invasive species. The act defines alien species and contemplates the listing of invasive species in regulations. As for ToPS, the act defines certain

activities that are restricted in connection with declared listed alien or invasive species which include, among others, importing, exporting, growing, breeding, transporting and selling those species, and would therefore require Environmental Authorisation.

The Alien and Invasive Species (AIS) Regulations, in terms of Section 97(1) of NEM:BA, was published in Government Notice R598 in Government Gazette 37885 dated 1 August 2014. The Alien and Invasive Species (AIS) lists in terms of sections 66(1), 67(1), 70(1)(a), 71(3) and 71A of NEM:BA was subsequently published in Government Notice R 864 of 29 July 2016.

4.4 The National Environmental Management: Protected Areas Act (Act No. 57 of 2003) (NEM:PAA)

NEM:PAA provides for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes; for the establishment of a national register of all national, provincial and local protected areas; for the management of those areas in accordance with national norms and standards; for intergovernmental co-operation and public consultation in matters concerning protected areas; and for matters in connection therewith.

The site does not fall within any formally protected area.

4.5 National Forests Act (Act No. 84 of 1998)(NFA)

The National Forest Act makes provision for the declaration of for example specially protected areas, forest nature reserves, forest wilderness areas and protected woodlands. A list of tree species declared protected in terms of the NFA, was published in 2017. In terms of section 15(1) of this act, no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree or any product derived from a protected tree, except under a licence or exemption granted by the Minister to an applicant and subject to such period and conditions as may be stipulated. The competent authority responsible for considering and issuing the licence will be the national Department of Agriculture, Forestry and Fisheries (DAFF).

No nationally protected trees were noted on site.

4.6 National Water Act (Act No. 36 of 1998)

4.6.1 Introduction

The National Water Act places strong emphasis on sustainable use of water resources, and its purpose as per Subsection 2(g) of the NWA includes protecting aquatic and associated ecosystems and their biological diversity.

Wetlands, riparian zones and watercourses are defined as water resources by the Water Act and any contemplated activities that could affect these areas require authorisation.

One of the objectives to control the quality of water resources relates to the regulation or prohibition of instream or land-based activities which may affect the quantity or quality of the water resource. Any activity, e.g. roads, bridges, building construction and crop cultivation, is considered to be a streamflow reduction activity if that activity is likely to significantly reduce the availability and quality of water in a watercourse and may lead to the degradation of the water resource.

The key mechanism through which NEMA (2014, 2017) attempts to mitigate the impacts of development on streamflows and wetlands is by specifying a buffer zone of some 32 m from the edge of the watercourse and wetland

areas NEMA (2014, 2017) that should not be developed without authorisation. It is therefore necessary to delineate all watercourses and wetlands and their associated buffer zones in areas to be developed.

The haul road will cross numerous ephemeral drainage lines and will require authorisation in terms of the NWA.

4.6.2 General Authorisations (GA)

The GA in Government Gazette 40229 of 26 August 2016 specifies the requirements for GA in terms of:

- Impeding or diverting the flow of water in a watercourse Section 21 (c); or
- Altering the bed, banks or characteristics of a watercourse (Section 21 (i) of the National Water Act (Act No. 36 of 1998).

Provided that the water use is within the limits and conditions of the GA, Government Gazette 40229 prescribes that a water user is not required to apply for a Water Use Licence (WUL) in terms of the NWA, but that these water uses can be authorised generally by the regional office of the DWS. The GA does not apply to the use of water within a regulated area of a watercourse where the risk class is medium or high as determined by a risk matrix.

Portions of the project will take place within ephemeral drainage lines and may impede waterflow and /or alter the channels. As defined by the DWS risk assessment matrix (see Appendix A), the construction of the haul road and culverts and low level concrete drift crossings within the drainage channels will be of a **low risk**. As such, it is anticipated that Government Gazette 40229 will apply to the project, and that a GA does apply.

4.6.3 Water Use Licence

Any person wishing to exercise a water use other than those defined in Schedule 1 of the NWA, or an existing lawful use, or a use promulgated by a GA, requires a water use licence (WUL). A water use licence may be issued to a natural person or legal entity and is attached to the property/ies on which the water is used. It includes descriptions of the licence holder, the property/ies on which the water may be used, the nature of the water uses, the period for which the licence will be valid, and licence conditions.

As defined by the DWS risk assessment matrix (see Appendix A), the construction of the haul road and culverts/low level drift crossings within the drainage channels will be of a **low risk**. As such, it is anticipated that Government Gazette 40229 will apply to the project, and that a GA does apply.

4.6.4 Activities

Conditions for impeding or diverting the flow or altering the bed, banks, course or characteristics of a watercourse in terms of the National Water Act, Government Notice 1199 of 2010 (Sections 21 (c) and 21 (i)). Form on water use information (DWS) to be completed by the EAP.

Sections 21 (c) and 21(i) of the National Water Act of 1998 (NWA) could potentially trigger the need for an authorisation.

Section 21(c): *“Impeding or diverting the flow of water in a watercourse”*

The terms “diverting or impeding the flow” is defined as follows in Government Notice 1199 of 2010 (NWA amendment):

“diverting the flow” means a temporary or permanent structure causing the flow of water to be rerouted in a watercourse for any purpose.

“impeding the flow” means the temporary or permanent obstruction or hindrance to the flow of water in a watercourse by a structure built either fully or partially in or across a watercourse.

Section 21(i): *“Altering the bed, banks, course or characteristics of a water course”*

“altering the bed, banks, course or characteristics of a watercourse” is defined as any change affecting the resource quality within the riparian habitat or 1:100 year flood line.

4.7 Conservation of Agricultural Resources Act (Act No. 43 of 1983) (CARA)

The objectives of CARA (1983, 2001) are to provide for the conservation of the natural agricultural resources by the maintenance of the production potential of the land, by combating and preventing erosion and weakening or destruction of the water resources, and by protecting the vegetation and combating weeds and invader plants. In order to achieve the objectives, certain control measures are prescribed which shall be complied with by land users to whom they apply. The activities which are mentioned relate to (*inter alia*):

- the cultivation of virgin soil;
- the utilization and protection of land which is cultivated;
- the irrigation of land;
- the prevention or control of waterlogging or salinisation of land;
- the utilisation and protection of vleis, marshes, water sponges, watercourses and water sources;
- the regulation of the flow pattern of run-off water;
- the control of weeds and invader plants;
- the restoration or reclamation of eroded land or land which is otherwise disturbed or denuded;
- the protection of water sources against pollution on account of farming practices; and
- the construction, maintenance, alteration or removal of soil conservation works or other structures on land.

In addition, lists of alien invasive plant species are provided with associated categories indicating the appropriate management and mitigation of these declared alien invasive species.

4.8 Northern Cape Nature Conservation Act (Act No. 9 of 2009)(NCNCA)

The Northern Cape Nature Conservation Act (Act No. 9 of 2009) restricts activities involving specially protected, protected and indigenous plant species.

Section 50 deals with the restricted activities involving protected plants and states that no person may, without a permit, pick, import, export, transport, cultivate or trade in a specimen of a protected plant.

Section 51 involves the picking, receipt, possession, acquisition or handling of indigenous plants and states that no person may, without a permit, pick an indigenous plant – (a) on a public road; (b) on land next to a public road within a distance of 100 meters measured from the centre of the road; or (c) within an area bordering a natural water course, whether wet or dry, up to and within a distance of 100 meters from the middle of a river on either side of the natural water course.

The Act lists different categories of flora and fauna, i.e. Schedules 1, 2, 3 and 6 for flora and Schedules 1, 2, 3, 4, 5 and 6 for fauna. The lists of flora in the Act were consulted and compared with lists of plant species recorded during the vegetation surveys of the sites.

Permit applications pertaining to selected plant species in terms of the Northern Cape Nature Conservation Act (Act No. 9 of 2009) (see Appendix D) for purposes of the proposed haul road will have to be lodged with the Northern Cape Department of Environment and Nature Conservation.

4.9 Convention on Biodiversity (CBD)

South Africa became a signatory to the United Nations Convention on Biological Diversity (CBD) in 1993, which was ratified in 1995. The CBD requires signatory states to implement objectives of the Convention, which are the conservation of biodiversity; the sustainable use of biological resources; and the fair and equitable sharing of benefits arising from the use of genetic resources. According to Article 14 (a) of the CBD, each Contracting Party, as far as possible and as appropriate, must introduce appropriate procedures, such as environmental impact assessments of its proposed projects that are likely to have significant adverse effects on biological diversity, to avoid or minimize these effects and, where appropriate, to allow for public participation in such procedures.

4.10 Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES)

CITES is an international agreement to which countries adhere voluntarily. The aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. The species covered by CITES (2017) are listed in three appendices reflecting the degree of protection that the species needs. Appendix I includes species which are threatened with extinction and trade in these species is permitted only in exceptional circumstances. Appendix II lists species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled. Appendix III lists species that are protected in at least one country that has asked other CITES parties for assistance in controlling the trade (Website: www.cites.org).

CHAPTER 5

VEGETATION

5.1 Introduction

BMM falls in the Karoo-Namib phytogeographic zone of White (1983), an extensive region stretching from Namibia into the western interior of South Africa. The site falls in the Nama-Karoo Biome and the Bushmanland Bioregion (Mucina & Rutherford 2006). In terms of vegetation types, the western and southern part of the site falls in the Bushmanland Sandy Grassland (NKb 4) and the northern and eastern part of the site in the Aggeneys Gravel Vygiveld (SKr 19) (Figure 12).

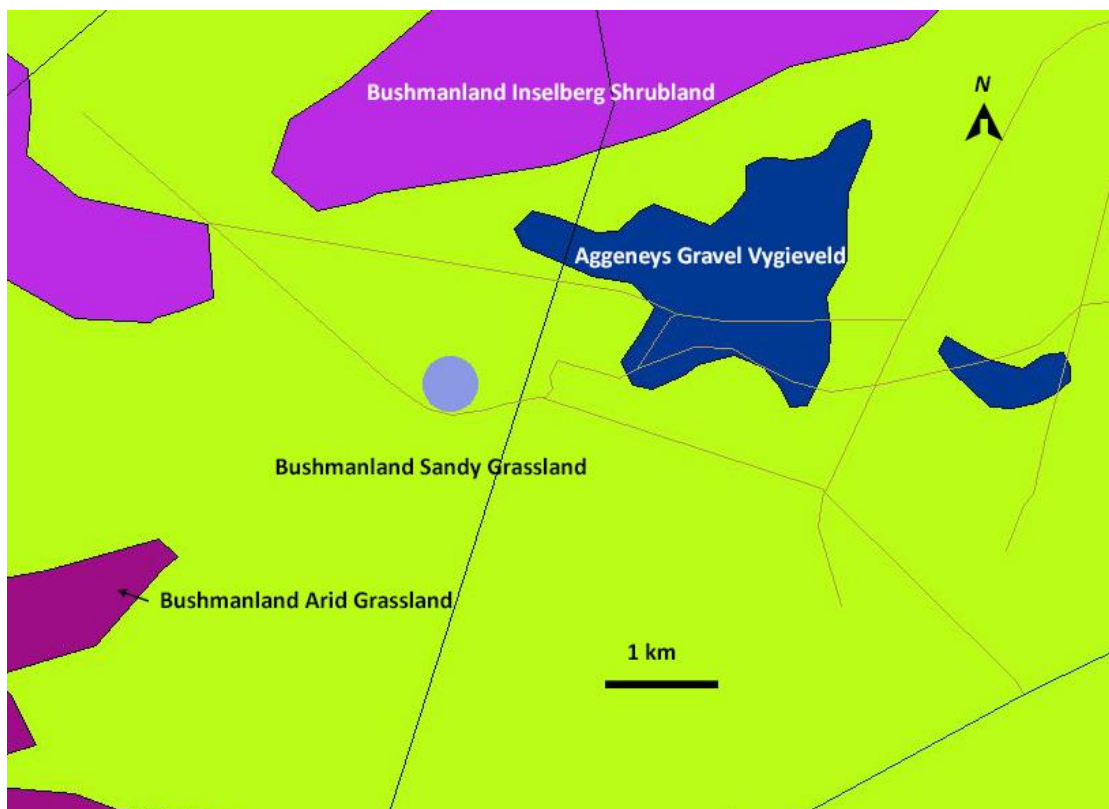


Figure 12. Vegetation types of the BMM haul road site. Note that the mapping of the Aggeneys Gravel Vygiveld is not accurate and should include Noeniepoort se Kop.

Bushmanland Sandy Grassland (NKb 4)

This vegetation type is typical in northern Bushmanland in the surrounds of Aggeneys and a few isolated patches in eastern Bushmanland. Its distribution follows the course of the Koa River, a paleoriverine system of the Orange

River. The landscape consists of sandy grassland dominated by *Stipagrostis* species (e.g. *S. brevifolia*, *S. ciliata*, *S. obtusa* and *S. anomala*), *Schmidtia kalahariensis* and many drought-resistant shrubs such as *Rhigozum trichotomum* and *Sisyndite sparteae*. Other grass species include *Aristida adscensionis*, *Centropodia glauca* and *Enneapogon desvauxii*. The forb layer is represented by *Gazania lichtensteinii*, *Grielum humifusum*, *Tribulus zeyheri*, *Dicoma capensis* and *Sesamum capense*. Prominent dwarf shrubs include *Eriocephalus microphyllum*, *Tetraena microphyllum*, *Hermannia spinosa* and *Monechma incanum*.

Aggeneys Gravel Vygieveld (SKr 19)

This vegetation type occurs on the foothills or penepains of inselbergs¹ in northern Bushmanland from Pofadder westwards towards Namaqualand. However, this vegetation type has not been mapped for the site, because Noenieput se kop is too small for the scale of the national vegetation map. The terrain in this vegetation type is flat to slightly sloping with quartz layers alternating with red sandy soils, supporting a sparse layer of dwarf shrubs and dwarf leaf-succulents of the families Aizoaceae, Crassulaceae, Euphorbiaceae, Portulacaceae and Zygophyllaceae. Prominent shrubs and dwarf shrubs include *Ruschia divaricata*, *Euphorbia gariepina*, *Kleinia longiflora*, *Lycium cinereum*, *Monsonia crassicaule*, *Aptosimum spinescens* and *Pegolettia retrofracta*. Succulent herbs include *Crassula corallina*, *C. deltoidea*, *Dinteranthus* species, *Avonia* species and *Conophytum* species.

5.2 Plant communities

The vegetation survey of the site resulted in the identification, classification and mapping of four plant communities (Figure 13).



Figure 13. Vegetation map of the study site indicating communities 1 - 4. The selected route of the haul road (1) and the other screened-out alternatives (2, 3 & 4) are indicated with white lines.

¹An inselberg is defined as an isolated hill or mountain rising abruptly from a plain

Vegetation description:

1. *Enneapogon desvauxii* - *Avonia albissima* gravel and rocky foot- and midslopes

This dwarf shrubland is found on the footslopes and plains in the central and eastern parts of the site (Figures 13 & 14). The shallow soils are covered by gravel as well as large rocks.



Figure 14. Community 1: Gravel slopes and plains.

The plant community is characterised by *Larrieachia* cf. *marlothii*, *Avonia albissima* and *Mesembryanthemum arenosus* (species group 1, Appendix E). No trees or shrubs were recorded. The open dwarf shrub layer includes species such as *Zygophyllum decumbens*, *Euphorbia gariepina*, *Salsola tuberculata*, *Mesembryanthemum arenosus*, *Pteronia* sp. and *Portulacaria fruticulosa*. The most prominent forbs are *Sesamum capense*, *Ursinia nana*, *Didelta carnosus*, *Gazania lichtensteinii*, *Heliophila* species and *Kewia salsoloides*. The grass layer is poorly developed with *Enneapogon desvauxii* (d), *Enneapogon scaber* and *Stipagrostis uniplumis* the prominent species.

Protected species (for which a permit for removal will be required) include *Larrieachia* cf. *marlothii*, *Euphorbia gariepina*, *Avonia albissima*, *Avonia papyracea*, *Trianthema parvifolia* and *Mesembryanthemum arenosus*.

2. *Boscia foetida* - *Tylecodon rubrovenosus* rocky midslopes

This dwarf shrubland is found on the mid- and footslopes in the northeastern parts of the site (Figures 13 & 15). The shallow soils are covered by large rocks.



Figure 15. Community 2: Rocky midslopes.

The plant community is characterised by *Aloidendron dichotomum*, *Boscia foetida*, *Mesembryanthemum schenkii*, *Mesembryanthemum noctiflorum*, *Anacampseros baeseckii*, *Ruschia centrocapsula* and *Tylecodon rubrovenosus* (species groups 2 & 3, Appendix E). The sparse tree and shrub layer include some individuals of *Aloidendron dichotomum* and *Boscia foetida*. The open dwarf shrub layer includes species such as *Mesembryanthemum schenkii*, *Mesembryanthemum noctiflorum*, *Euphorbia gariepina*, *Portulacaria fruticulosa* and *Hermannia spinosa*. The most prominent forbs are *Ursinia nana*, *Sericocoma avolans*, *Acanthopsis hoffmannseggiana*, *Heliophila species*, *Didelta carnosus* and *Gazania lichtensteinii*. The grass layer is poorly developed with *Enneapogon desvauxii* (d), *Enneapogon scaber* and *Eragrostis obtusa* the prominent species.

Protected species (for which a permit for removal will be required) include *Aloidendron dichotomum*, *Boscia foetida*, *Hoodia gordonii*, *Euphorbia gariepina*, *Avonia papyracea*, *Mesembryanthemum schenkii*, *Mesembryanthemum noctiflorum*, *Anacampseros baeseckii*, *Tylecodon rubrovenosus*, *Tylecodon reduplicata*, *Drosanthemum sp.*, *Trianthema parvifolia* and *Ruschia centrocapsula*.

3. *Rhigozum trichotomum* - *Stipagrostis ciliata* ephemeral drainage lines

This diverse dwarf shrubland is found along the small and narrow ephemeral drainage lines flowing from the mountain in the north southwards through the site (Figures 13, 16 & 17). The drainage lines on the footslopes and plains are covered by sandy to sandy loam soils, while higher up it becomes more rocky.



Figure 16. Community 3: Sandy ephemeral drainage line on the plains.



Figure 17. Community 3: Rocky drainage line on the midslopes.

The ephemeral drainage lines are diverse in floristic composition with separate species groups characteristic for certain areas depending on the location on site. The plant community is characterised by species such as *Parkinsonia africana*, *Lycium oxycarpum*, *Lycium cinereum*, *Microloma incanum*, *Osteospermum sinuatum*, *Eriocephalus scariosus* and *Aptosimum spinescens* (species groups 5 to 10, Appendix E). The sparse tree and shrub layer include some individuals of *Parkinsonia africana*, *Lycium oxycarpum* and *Lycium cinereum*. The open dwarf shrub layer includes species such as *Rhigozum trichotomum* (d), *Euphorbia gariepina*, *Salsola tuberculata*, *Monechma incanum*, *Kleinia longiflora*, *Microloma incanum*, *Osteospermum sinuatum*, *Melolobium microphyllum*, *Eriocephalus scariosus*

and *Aptosimum spinescens*. The most prominent forbs are *Trianthema parvifolia*, *Blepharis macra*, *Chascanum gariepense*, *Heliophila* spp., *Gazania lichtensteinii* and *Didelta carnosa*. The grass layer is poorly developed with various *Stipagrostis* species, *Aristida engleri*, *Enneapogon desvauxii*, *Enneapogon scaber* and *Eragrostis obtusa* the prominent species.

Protected species (for which a permit for removal will be required) include *Larryleachia marlothii*, *Hoodia gordonii*, *Euphorbia gariepina*, *Mesembryanthemum arenosus*, *Mesembryanthemum crystallinum*, *Mesembryanthemum* sp., *Microlooma incanum*, *Tetragonia arbuscula*, *Tetragonia reduplicata* and *Trianthema parvifolia*.

4. *Sisyndite spartea* - *Stipagrostis uniplumis* sandy plains

This open dwarf shrubland is found on the sandy plains in the west and southwest of the site (Figures 13 & 18). The sandy soils are medium to deep with little gravel and rock cover.



Figure 18. Community 4: Sandy plains in the south and west.

The plant community is characterised by *Stipagrostis uniplumis*, *Hermannia stricta*, *Sisyndite spartea*, *Augea capensis* and *Monsonia parvifolia* (species group 12, Appendix E). The shrub layer is represented by *Sisyndite spartea*, *Diospyros austro-africana*, *Phaeoptilum spinosum*, *Lycium oxycarpum* and *Lycium cinereum*. The open dwarf shrub layer includes species such as *Monechma incanum*, *Kleinia longiflora*, *Hermannia stricta*, *Tetragonia arbuscula*, *Salsola tuberculata*, *Limeum aethiopicum* and *Mesembryanthemum tetragonum*. The most prominent forbs are *Monsonia parvifolia*, *Foveolina dichotoma*, *Blepharis mitrata*, *Heliophila* species, *Didelta carnosa* and *Gazania lichtensteinii*. The grass layer is poorly developed with *Stipagrostis uniplumis*, *Stipagrostis ciliata*, *Stipagrostis obtusa* and *Enneapogon desvauxii* the prominent species.

Protected species (for which a permit for removal will be required) include *Euphorbia gariepina*, *Euphorbia rhombifolia*, *Mesembryanthemum crystallinum*, *Tetragonia arbuscula* and *Mesembryanthemum tetragonum*.

5.3 Wetland delineation

5.3.1 Introduction

According to the National Water Act, 36 of 1998, any activity is considered to be a streamflow reduction activity if that activity is likely to significantly reduce the availability of water in a water course and may lead to the degradation of the water resource. According to NWA (1998) the regulated area of a watercourse for section 21(c) or (i) of the Act water uses in terms of this Notice means:

- The outer edge of the 1 in 100 year flood line and /or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam;
- In the absence of a determined 1 in 100 year flood line or riparian area, the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench (subject to compliance to section 144 of the Act); or
- A 500 m radius from the delineated boundary (extent) of any wetland or pan.

NEMA (2014, 2017) specifies that a buffer zone of at least 32 m from the edge of the watercourses should not be developed without authorisation.

5.3.2 Definitions

"Watercourse" and "wetland" are similarly defined in the Acts.

"Watercourse" means (NWA 1998, NEMA 2014) –

- a river or spring;
- **a natural channel in which water flows regularly or intermittently;**
- a wetland, pan, lake or dam into which, or from which, water flows; and
- any collection of water which the Minister may, by notice in the *Gazette*, declare to be a watercourse as defined in the National Water Act, 1998 (Act No. 36 of 1998); and a reference to a watercourse includes, where relevant, its bed and banks

"Wetland" means –

- land that is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or
- the land is periodically covered with shallow water, and
- land that in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.

"Wetland" is a family name given to a variety of ecosystems, e.g. springs, seeps, mires, marshes, pans, lakes, swamps and estuaries. Wetlands must have one or more of the following attributes:

- Topography associated with the watercourse or channel, e.g. outer edge of the macro-channel bank;
- Wetland soils (hydromorphic or gleyed soils) that display characteristics resulting from prolonged saturation, alluvial soils and/or deposited material;
- Soil wetness, i.e. high water tables that result in saturation at or near the surface.
- The presence hydrophytic or aquatic plant species.

"Instream habitat" means –

- the physical structure of a watercourse and the associated vegetation in relation to the bed of the watercourse.

“Riparian habitat” means –

- the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation with a composition and physical structure distinct from those of adjacent land areas.
- are associated with bottomlands and a watercourse (channel and banks);
- contain distinctively different plant species than adjacent terrestrial areas;
- may contain species similar to adjacent areas but exhibiting more vigorous or robust growth forms; and
- usually occur on alluvial soils.

Although the vegetation along the drainage lines on the site differs somewhat from the surrounding landscape, most of the species are terrestrial in habit (Appendix E). The ephemeral drainage lines on site are therefore not regarded as "wetlands" and the "riparian habitat", if any, extremely weakly developed.

5.3.3 *Wetland delineation*

To delineate a wetland, an approach is commonly followed where direct and indirect indicators of prolonged saturation by water are identified (DWAF 2005). However, the methodology described for wetland delineation is not always applicable when studying arid ephemeral drainage lines (DWAF 2005). By using satellite images and ground-truthing, the boundaries of the ephemeral drainage lines (community 3, Figure 13), could be clearly distinguished.

CHAPTER 6

FLORA

6.1 Threats

Loss of habitat is regarded as the foremost cause of loss of biodiversity. Development (or change in land use) usually contributes to habitat loss and degradation in many biodiversity important areas. Much of the impact can be minimized through careful planning and avoidance of sensitive areas.

6.2 Vegetation types

The conservation status of both vegetation types (ecosystems) occurring on the site, i.e. the Aggeneys Gravel Vygieveld and the Bushmanland Sandy Grassland are "**least threatened**" (NEMA 2011). None of these vegetation types is conserved in statutory conservation areas.

6.3 Species richness (number of species per plant community)

A total of 92 plant species (the term species is used here in a general sense to denote species, subspecies and varieties) was recorded on the site during the vegetation survey undertaken during October 2018. The species richness per plant community was as follows:

Community 1	-	26 species
Community 2	-	30 species
Community 3	-	52 species
Community 4	-	36 species

The mean species richness for the site is **36** species per community. Because of the dry conditions during the vegetation survey in October 2018, the species list (Appendix B) is unlikely to be indicative of the full species richness potential. Especially the annual and geophytic species were under-represented at the time of the survey. However, according to the NewPosa species list for the area (Appendix C) no annual or geophytic species have a IUCN Red List threatened status.

6.4 NEWPOSA (SANBI) species list

According to the NEWPOSA plant species list (Appendix C) for the immediate region of the site (for the 29.20° - 29.30° and 18.7° - 18.9° area) 169 plant taxa are listed. If the quarter degrees 2918 BB & BD are used, then 437 plant taxa have been recorded, but the quarter degrees include the well-collected Gamsberg as well as the inselbergs to the north of Aggeneys.

6.5 Threatened, protected and endemic plant species (Table 3)

Red Data Lists are a source of information for decision-makers and improve monitoring of the rate of loss of biodiversity, and should include an assessment of the cause of a species' conservation status. Species threatened by habitat destruction need to be conserved through mechanisms that conserve the entire ecosystem, where possible.

The IUCN Red List classification of species (NewPosa SANBI; Threatened Species Programme SANBI) of South African plants, the National Forests Act (Act No 84 of 1998)(NFA 2017), the National Environmental Management: Biodiversity Act, (Act No 10 of 2004), CITES (2017) lists, and the lists of protected species of the Northern Cape Nature Conservation Act 2009 (Act No 9 of 2009), were consulted.

Threatened, protected and endemic plant species found on site are shown in (Table 3).

Table 3 Threatened, protected and endemic plant species on the site

Species	Endemic*	NCNCA*			NFA*	CITES*	NEM:BA ToPS*	IUCN Red list*
		Sch 1*	Sch 2*	Sch 6*				
<i>Acanthopsis hoffmannseggiana</i>								DDT
<i>Aloidendron dichotomum</i>		x				x	x	VU
<i>Anacampseros baeseckii</i>	x		x			x		LC
<i>Avonia albissima</i>			x			x		LC
<i>Avonia papyracea</i>	x		x			x		LC
<i>Boscia foetida</i> subsp. <i>foetida</i>			x					LC
<i>Drosanthemum</i> sp.			x					
<i>Euphorbia gariepina</i>			x			x		LC
<i>Euphorbia rhombifolia</i>			x			x		LC
<i>Hoodia gordonii</i>	x	x				x		DDD
<i>Galenia fruticosa</i>			x					LC
<i>Larryleachia</i> cf. <i>marlothii</i>			x					LC
<i>Mesembryanthemum arenosus</i>			x					LC
<i>Mesembryanthemum crystalinum</i>			x					LC
<i>Mesembryanthemum noctiflorum</i>			x					LC
<i>Mesembryanthemum schenkii</i>			x					LC
<i>Mesembryanthemum tetragonum</i>			x					LC
<i>Mesembryanthemum</i> sp.			x					-
<i>Microlooma incanum</i>			x					LC
<i>Plinthus karoocicus</i>			x					LC
<i>Ruschia centrocapsula</i>	x		x					LC
<i>Sisyndite sparteae</i>	x							LC
<i>Tetragonia arbuscula</i>			x					LC
<i>Tetragonia reduplicata</i>			x					LC
<i>Trianthea parvifolia</i>			x					LC
<i>Tylecodon rubrovenosus</i>	x							LC
<i>Prosopis glandulosa</i>				x				NE

*Endemic: Gariep Centre of Endemism (Van Wyk & Smith 2001; Mucina & Rutherford 2006)

*NCNCA: Northern Cape Nature Conservation Act 2009 (No. 9 of 2009)

*Schedule 1: Specially protected species

*Schedule 2: Protected species

*Schedule 6: Alien invasive plant species

*NFA (2017): Protected trees: National Forest Act, (Act 84 of 1998).

*CITES: Convention on the Trade in Endangered Species of Wild Fauna and Flora (2017)

*NEM:BA (2013)- ToPS Threatened or Protected Species list

*IUCN Red List of South African plants (NEWPOSA, SANBI)

*DDD = Data Deficient

*DDT = Data Deficient (Taxonomically problematic)

*LC = least concern

*VU = Vulnerable

*NE = Not Evaluated

- The only species with a threatened IUCN Red List status on site, is *Aloidendron dichotomum* which is classified as Vulnerable (VU).
- Two Data Deficient (not threatened according to the IUCN classification) species were also recorded, viz. *Hoodia gordonii* and *Acanthopsis hoffmannseggiana*.

According to the NewPosa species list for the immediate environs of the site (Appendix C), a number of additional Species of Special Concern (SCC) could potentially occur on site:

SCC with a IUCN threatened status:

- *Crotalaria pearsonii* (VU)

SCC with a IUCN non-threatened status:

- *Adromischus diabolicus* (DDT)
- *Crotalaria meyeriana* (NT)
- *Drosanthemum breve* (DDT)
- *Lachenalia polypodantha* (DDT)

SCC without a IUCN classification, but classified as RARE or CRITICALLY RARE according to SANBI's Treated Species Programme:

- *Trichodiadema obliquum* (RARE)

6.6 Northern Cape Nature Conservation Act 2009 (Act No 9 of 2009)

As shown in Table 3, the following NCNCA Schedules 1 – 6 species occur on site:

- Schedule 1 - Specially protected species:

Aloidendron dichotomum
Hoodia gordonii

- Schedule 2 - Protected species:

Twenty-one protected species were recorded on site.

- Schedule 3: Common indigenous plant species:

These are all indigenous species, except those listed as Schedule 1 and 2 species.

- Schedule 6 - Invasive plant species:

Prosopis glandulosa is a declared alien invasive plant species recorded near the site.



Figure 19. *Hoodia gordonii*, an endemic, specially protected species (NCNCA 2009) and Cites (2017) listed species.



Figure 20. *Anacampseros baeseckii*, an endemic, protected species (NCNCA 2009) and Cites (2017) listed species.



Figure 21. *Anacampteros albissima*, a protected species (NCNCA 2009) and Cites (2017) listed species.



Figure 22. *Anacampteros papyracea*, a protected species (NCNCA 2009) and Cites (2017) listed species.



Figure 23. *Laryleachia* cf. *marlothii*, a protected species (NCNCA 2009)

6.7 National Environmental Management: Biodiversity Act, (Act 10 of 2004) (ToPS lists)

Aloidendron dichotomum is listed in the NEM:BA (2013) lists of critically endangered, endangered or vulnerable flora.

6.8 CITES classification (2016 lists)

CITES comprises three Appendices: Appendix I, Appendix II and Appendix III.

Appendix I lists species that are threatened with extinction. CITES prohibits international trade in specimens of these species except when the purpose of the import is not commercial, for instance for scientific research. Appendix II lists species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled. Appendix III is a list of species included at the request of a Party that already regulates trade in the species and that needs the cooperation of other countries to prevent unsustainable or illegal exploitation. Seven CITES Appendix II species were recorded on site (Table 3).

6.9 Gariep Centre of Endemism (Van Wyk & Smith 2001)

The term endemic refers to a taxon that is limited in its range to a specified geographical area. A Centre of Endemism is a localised area which has a high occurrence of endemics (Van Wyk & Smith 2001).

The site at Aggeneys is located on the southern boundary of the Gariep Centre of Endemism (Van Wyk & Smith 2001). Six endemic plant species were recorded on site (Table 3).

6.10 Protected trees (National Forest Act, Act 84 of 1998) (NFA 2017)

No nationally protected tree species was recorded on site.

6.11 Alien plant species

Invasive alien plant species listed in terms of the Conservation of Agricultural Resources Act (Act No. 43 of 1983 - Regulation 15, 30 March 2001), and the National Environmental Management Act: Biodiversity Act (Act No. 10 of 2004), should be controlled and eradicated with an emphasis on urgent action in biodiversity priority areas. In addition to habitat loss due to development pressures, transformation of habitats due to the uncontrolled spread of invasive alien species is a serious concern in all biomes and ecosystems.

Prosopis glandulosa is declared an alien invasive plant species which occurs in the surrounds of the site.

CHAPTER 7

FAUNA

7.1 Introduction

Lists of animals that could occur or possibly occur on site were sourced from the Animal Demography Unit, University of Cape Town (adu.uct.ac.za) and supplemented by literature such as Mills and Hes (1997), Friedmann and Daly (2004), Skinner and Chimimba (2005) and Bates *et al.* (2014). Animal lists for the 2918B grid were generated.

No indigenous large mammal species, except for porcupine (*Hystrix africaeaustralis*) and Cape hare (*Lepus capensis*), was recorded on the site during the survey in October 2018. The habitat is in poor condition due to previous mining-related activities and heavy grazing by livestock, resulting in a very sparse vegetation cover on the sites. The higher woody cover along the drainage lines may provide some fodder for browser species and cover for faunal species. The sandy to sandy loam soils are suitable in places for burrowing animals such as the aardvark and ground squirrels. The prominent mountains, rocky outcrops and ridges surrounding the study sites are suitable for many wildlife species of rocky habitats.

7.2 Mammals

Based on Du Plessis (1969), Mills & Hess (1997), Friedmann & Daly (2004), Skinner & Chimimba (2005), Red data book of mammals (2012), and Todd (2012), the types of habitat on site, the habitat requirements of the species and personal observations during the field survey, the following 52 mammal species (the term species is used here in a general sense to denote species, subspecies and varieties) may occur on site or move occasionally through the area (see Appendix F for full list and red list status):

Artiodactyla/Perissodactyla/Proboscidea	5 species
Hyracoidea	1 species
Carnivora	15 species
Chiroptera	7 species
Insectivora	2 species
Lagomorpha	2 species
Primata	2 species
Rodentia	14 species
Macroscelidea/Pholidota/Tubulidentata	4 species

Since the 2918B grid contains a more diverse array of habitats, not all species are likely to occur in the study area. Among the listed mammal species only two have a threatened status.

- The leopard *Panthera pardus* is Vulnerable; and
- The black-footed cat *Felis nigripes* is Vulnerable.

7.3 Avifauna

According to the SABAP 1 & 2 data sets, 173 bird species (Appendix F) are known from the environs of the study area (Todd 2012). This includes the following 11 IUCN listed species:

<i>Ardeotis kori</i>	VU
<i>Charadrius pallidus</i>	NT
<i>Ciconia nigra</i>	NT
<i>Circus maurus</i>	NT
<i>Falco biarmicus</i>	NT
<i>Gyps africanus</i>	VU
<i>Neotis ludwigii</i>	VU
<i>Phoenicopterus ruber</i>	NT
<i>Polemaetus bellicosus</i>	VU
<i>Sagittarius serpentarius</i>	NT
<i>Spizocorys sclateri</i>	NT

7.4 Reptiles

Fifty reptile species could possibly occur on or near the site (Appendix F) (Todd 2012, Bates *et al.* 2014). These include:

- 1 chelonian;
- 30 lizards (comprising):
 - 3 agamas;
 - 1 chameleon;
 - 2 cordylids;
 - 10 gekkos;
 - 8 typical lizards;
 - 6 skinks; and
- 19 snakes

Snakes are expected to be very rare in the exposed habitat of the study area.

7.5 Amphibians

The site falls within the distribution range of four frog species. However, due to the aridity of the site, the likelihood of occurrence of the frogs is regarded as low.

7.6 Fishes

No fishes occur on site due to the absence of suitable habitat.

7.7 Invertebrates

Fourteen scorpion species could potentially occur in the region. The scorpions have not yet been evaluated for IUCN Red List status. The genera *Hadogenes* and *Opisthophthalmus* are protected in the Northern Cape.

Summary:

The habitat on site is fairly homogeneous with little variation and the loss of a relatively small area to the haul road would not have a high impact on the broader faunal species richness in the area. Collisions and electrocution from power-line infrastructure are significant causes of mortality for bustards, flamingos, eagles and vultures.

CHAPTER 8

ECOLOGICAL SENSITIVITY ANALYSIS

8.1 Introduction

Sensitivity is the vulnerability of a habitat to any impact, for example a dune, wetland or ridge system would be more vulnerable to development than would a sandy plain. Several features of a site can be identified and assessed to derive a sensitivity score, e.g.:

- threatened status of the regional vegetation type wherein the proposed site is situated;
- percentage of red list plant species per community or site;
- number of protected tree species per community or site;
- percentage of provincially protected plant species;
- percentage of endemic plant species per community or site (endemic to vegetation type);
- conservation value of community (habitat) or site;
- species richness per plant community or per sample plot (number of plant species);
- degree of connectivity and/or fragmentation of the habitat, i.e. high connectivity and low fragmentation infers a low rating;
- soil erosion potential; and
- resilience (this is a measure of the ability of a particular habitat/plant community to recover after an impact, i.e. high resilience infers low rating).

An **overall sensitivity model** (Table 4) is developed for each plant community on site. This is achieved by weighting each criterion and calculating the sum for the community, which reflects the sensitivity and sensitivity ranking

The parameters that were used to allocate the different categories of sensitivity (very low, low, moderate, high and very high) were the following:

1. Threatened status of the ecosystem (depends on the percentage area intact, or degree of transformation) (Driver *et al.* 2005, Mucina & Rutherford 2006, NEM:BA 2011).

The ecosystems are classified into the following categories:

Low sensitivity: If “Least Threatened”, the vegetation type has most of its habitat intact, i.e. more than 80%; or the vegetation type is adequately statutory or formally conserved in parks and reserves.

Moderate sensitivity: If “Vulnerable”, the vegetation type has from 60% to 80% of the ecosystem intact; less than 40% has been transformed which could result in some ecosystem functioning being altered, and/or the ecosystem is statutory poorly conserved. For example, the vegetation type is rich in plant species but is not a pristine example of a vegetation type, therefore some transformation or disturbance occurred, such as human structures and degraded veld due to overgrazing and/or bush encroachment.

High sensitivity: If “Endangered”, the vegetation type has from 40% to 60% of the ecosystem intact; or 40% to 60% transformed due to disturbance, cultivation or alien species; or the ecosystem is statutory poorly conserved e.g. less than about 3% conserved.

Very high sensitivity: If “Critically Endangered”, the vegetation type has only 16% to 36% of the ecosystem intact. The richer the ecosystem is in terms of species, the higher the percentage threshold.

Category rating:

Low	(LT)	= 1
Moderate	(VU)	= 2
High	(EN)	= 3
Very high	(CE)	= 4

2. Percentage of IUCN red list plant species (listed higher than ‘least concern’, LC).

The sensitivity scale ranges from low, moderate to high and the rating is determined by the presence of rare flora in a plant community (calculated as percentage of the mean number of species per community).

Category rating:

None	(0%)	= 0
Low	(>0 – 2%)	= 1
Moderate	(>2 – 5%)	= 2
High	(>5%)	= 3

3. Presence of protected tree species (National Forests Act, Act No. 84 of 1998; NFA 2015)

The presence of protected tree species in a vegetation type is rated as low, moderate or high. This rating depends on the availability of habitat in the community and the protection and management guidelines for these species and guidelines for biodiversity offsets of the Department of Agriculture, Forestry and Fisheries, DAFF).

Category rating:

None	(0 species)	= 0
Low	(1 or 2 species)	= 1
Moderate	(3 – 4 species)	= 2
High	(>4 species)	= 3

4. Presence of Northern Cape protected plant species (Northern Cape Nature Conservation Act, Act No. 9 of 2009):

The presence of 'specially protected species' and 'protected species' in a vegetation type is rated as low, moderate or high depending on the number of protected species in relation to the total plant species per community. Weedy species such as *Mesembryanthemum coriarium* were excluded in this assessment.

Category rating:

None	(0%)	= 0
Low	(>0 - 5%)	= 1
Moderate	(>5 – 10%)	= 2
High	(>10%)	= 3

5. Percentage of plant species endemic to the regional vegetation type (Van Wyk & Smith 2001; Mucina & Rutherford 2006).

The scale ranges from none, low, moderate to high, and depends on the availability of habitat in the community. The number of species is expressed as a percentage of the number of species per community.

Category rating:

None	(0%)	= 0
Low	(>0 - 2%)	= 1
Moderate	(>2–5%)	= 2
High	(>5%)	= 3

6. Conservation value of the terrain type and/or habitat.

The criteria are low, moderate and high. The presence of e.g. quartzitic outcrops, ridges, wetlands and dunes should be considered to have a moderate to high conservation value. However, this should be seen in the context of the presence of representative habitat in the broader region or in conservation areas.

Category rating:

Low		= 1
Moderate		= 2
High		= 3

7. Community species richness

The species-richness (number of species per community) will depend on the region, climate, topography, ecosystem and degree of transformation. The scale ranges from low, moderate to high.

Category rating:

Low	(<30)	= 1
Moderate	(30 – 50)	= 2
High	(>50)	= 3

8. Degree of connectivity and/or fragmentation of the ecosystem

The degree of connectivity with surrounding or adjacent natural areas and/or fragmentation of plant communities, is indicated as low, moderate or high, e.g. high connectivity with surrounding similar habitat, or low fragmentation of habitat is considered as having a low rating.

Category rating (note reverse order):

Low		= 3
Moderate		= 2
High		= 1

9. Erosion potential of the soil

The erosion potential of the soil is indicated as low, moderate or high, e.g. coarse sandy soils on plains have a low erosion potential.

Category rating:

Low	= 1
Moderate	= 2
High	= 3

10. Resilience is a measure of the ability of a particular habitat/plant community to recover after an impact, i.e. high resilience infers low rating.

Category rating (note reverse order):

Low	= 3
Moderate	= 2
High	= 1

8.2 Weighting of sensitivity criteria

Threatened status of the vegetation type	= x5
Percentage of red list plant species	= x4
Number of NFA protected tree species	= x3
Percentage of NCNCA protected species	= x4
Percentage of endemic species	= x2
Conservation value (habitat)	= x4
Plant community species richness	= x2
Degree of connectivity/fragmentation of habitat	= x2
Erosion	= x2
Resilience	= x3

8.3 Sensitivity rating

≤30	= very low	(VL)	(rating scale = 1)
31 – 40	= low	(L)	(rating scale = 2)
41 – 50	= moderate	(M)	(rating scale = 3)
51 – 65	= high	(H)	(rating scale = 4)
>65	= very high	(VH)	(rating scale = 5)

Table 4. Sensitivity of the plant communities of the Aggeneys site (see Figures 13 & 24).

Plant communities	1	2	3	4
Threatened status (x5)	5	5	5	5
% Red data species (x4)	0	4	0	0
Number protected trees (x3)	0	0	0	0
% NCNCA species (x4)	4	4	4	4
% Endemic species (x2)	4	6	2	4
Conservation value (x4)	4	4	4	4
Species richness (x2)	2	4	6	4
Connectivity (x2)	2	2	2	2
Erosion (x2)	2	2	2	2
Resilience (x3)	6	9	6	3
Sum:	29	40	31	28
Sensitivity rating:	VL	L	L	VL

Overall, the sensitivity rating of the communities on site was low (L) to very low (VL).

Explanation of sensitivity ratings:

- **Very low (1)** sensitivity means that a minimum score is allocated to almost all the sensitivity criteria used. It is usually applicable to habitats in poor condition or that have been transformed, especially by human activities.
- **Low (2)** sensitivity means the sensitivity is not significant enough and should not have an influence on the decision about the project. However, any protected species may not be removed/destroyed without a permit.
- **Moderate (3)** means a sensitivity rating that is real and sufficiently important to require management, e.g. mitigation measures, management or protection of the rare/threatened fauna and flora, protection of the specific habitat on the property and/or rehabilitation.
- **High (4)** means a sensitivity rating where the habitat should be excluded from any development.
- **Very high (5)** means a sensitivity rating that should influence the decision whether or not to proceed with the project.

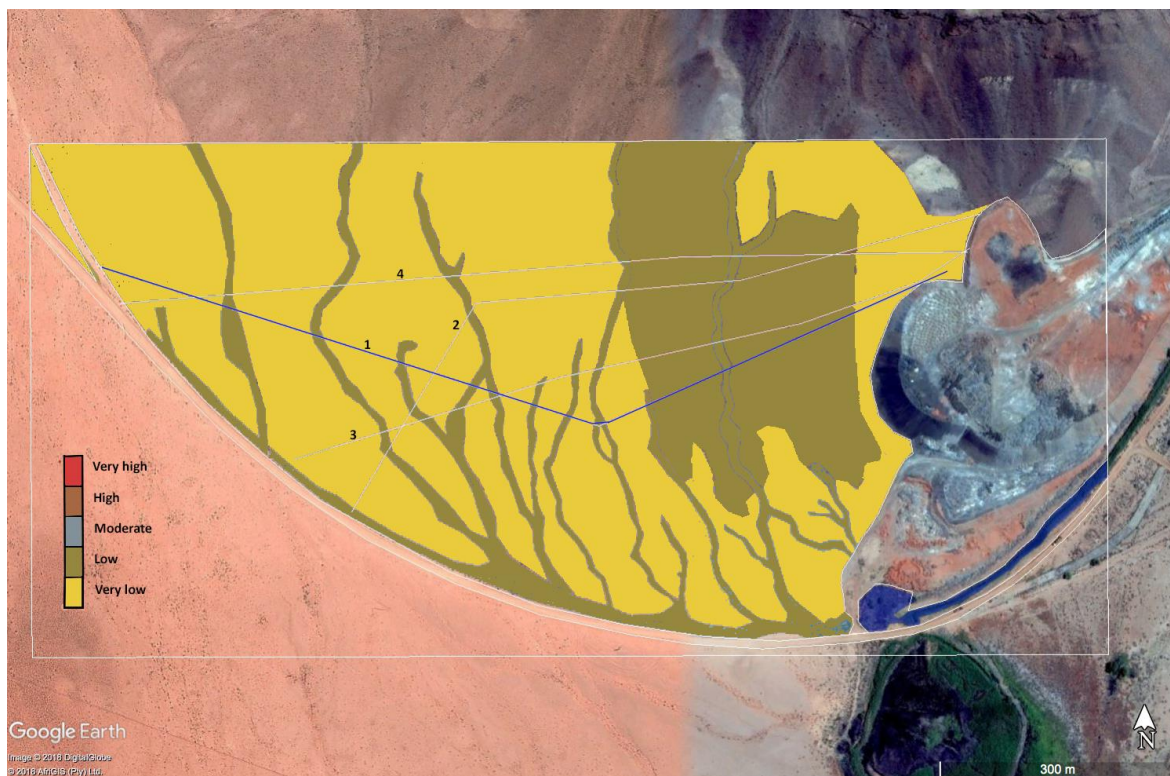


Figure 24. Sensitivity map of the haul road site, Aggeneys. Preferred route 1 - blue line.

CHAPTER 9

ASSESSMENT OF SIGNIFICANCE OF ENVIRONMENTAL IMPACTS

9.1 Introduction

The identification of potential impacts includes impacts that may occur during the construction or operational phases of the proposed development. The assessment of impacts includes direct, indirect as well as cumulative impacts.

- **Direct impacts** are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.
- **Indirect impacts** of an activity are indirect or induced changes that may occur as a result of the activity. These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken or which occur at a different place as a result of the activity.
- **Cumulative impacts** are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities. Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts.
- **Nature of impact** - this reviews the type of effect that a proposed activity will have on the environment and includes what will be affected and how?
- **Spatial extent** – The size of the area that will be affected by the risk/impact:
 - o Site specific (within boundaries of site and immediately adjacent to project site)
 - o Local (<10 km from site)
 - o Regional (<100 km of site)
 - o National
 - o International (e.g. Greenhouse Gas emissions or migrant birds).
- **Duration** – The timeframe during which the risk/impact will be experienced:
 - o Very short term (instantaneous; less than 6 months)
 - o Short term (less than 1 year)
 - o Medium term (1 to 10 years)
 - o Long term (the impact will cease after the operational life of the activity (i.e. the impact or risk will occur for the project duration))
 - o Permanent (mitigation will not occur in such a way or in such a time span that the impact can be considered transient (i.e. the impact will occur beyond the project decommissioning)).
- **Probability** – The probability of the impact occurring:
 - o Extremely unlikely (little to no chance of occurring)
 - o Very unlikely (<30% chance of occurring)
 - o Unlikely (30-50% chance of occurring)
 - o Likely (51 – 90% chance of occurring)

- o Very Likely (>90% chance of occurring regardless of prevention measures).
- **Severity** – The anticipated severity of the impact:
 - o Extreme (extreme alteration of natural systems, patterns or processes, i.e. where environmental functions and processes are altered such that they permanently cease)
 - o Severe (severe alteration of natural systems, patterns or processes, i.e. where environmental functions and processes are altered such that they temporarily or permanently cease);
 - o Substantial (substantial alteration of natural systems, patterns or processes, i.e. where environmental functions and processes are altered such that they temporarily or permanently cease)
 - o Moderate (notable alteration of natural systems, patterns or processes, i.e. where the environment continues to function but in a modified manner)
 - o Slight (negligible alteration of natural systems, patterns or processes, i.e. where no natural systems/environmental functions, patterns, or processes are affected).
- **Significance** – To determine the significance of an identified impact/risk, the consequence is "multiplied" by probability (qualitatively as shown in Figure 25 below).
- **Significance** – Will the impact cause a notable alteration of the environment?
 - o Very low (the risk/impact may result in very minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making)
 - o Low (the risk/impact may result in minor alterations of the environment and can be easily avoided by implementing appropriate mitigation measures, and will not have an influence on decision-making)
 - o Moderate (the risk/impact will result in moderate alteration of the environment and can be reduced or avoided by implementing the appropriate mitigation measures, and will only have an influence on the decision-making if not mitigated)
 - o High (the risk/impacts will result in a major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making)
 - o Very high (the risk/impacts will result in very major alteration to the environment even with the implementation on the appropriate mitigation measures and will have an influence on decision-making (i.e. the project cannot be authorised unless major changes to the engineering design are carried out to reduce the significance rating)).
- **Confidence** – The degree of confidence in predictions based on available information and specialist knowledge:
 - o Low
 - o Medium
 - o High

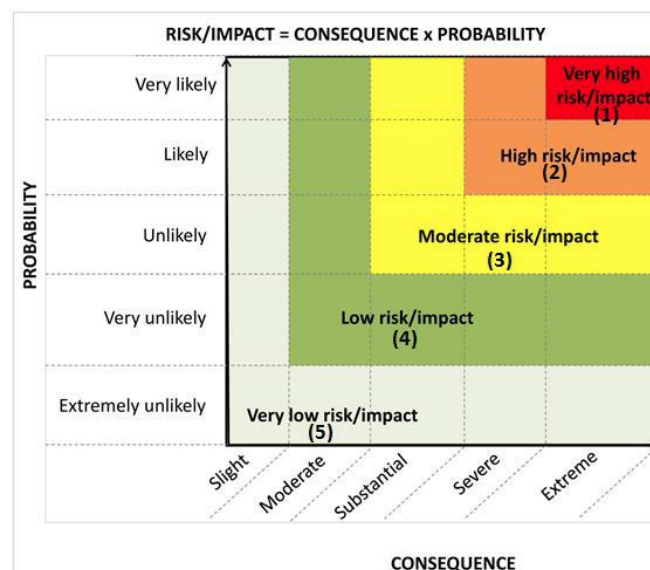


Figure 25. Guide to assessing impact significance as a result of severity (consequence) and probability.**9.2 Haul road alternatives**

BMM considered four haul road route alignments for the proposed haul road::

- Alternative 1 is the selected and preferred route. Although the road crosses more drainage lines, the terrain is less undulating and rocky than most of the alternatives and consequently the drainage lines do not form such deep incisions.
- Alternative 2 will encounter some relatively deep and rocky incisions before connecting with the present haul road.
- Alternative 3 could be a suitable alternative route from an ecological point of view.
- Alternative 4 is the more direct route but the terrain is very undulating with rocky ridges and relatively deep incisions (drainage lines).

In consultation with BMM, alternatives 2 – 4 were screened out. The selected route alternative (1) was determined based on safety and design considerations (e.g. lack of steep slopes, minimum fill material requirements). Only the selected route was presented as feasible by BMM.

9.3. Impacts during the construction phase, proposed mitigation measures and their significance**9.3.1 Direct impacts during the construction phase****Loss of indigenous vegetation**

Nature: Indigenous vegetation will be cleared for the proposed haul road. The removal of natural vegetation will result in negative effects. The loss of the vegetation may cause a loss of individuals of threatened, protected and endemic species, it will also be accompanied by a loss of faunal habitat. Overall, this may lead to a loss of biodiversity. Vegetation loss is also invariably associated with increased water run-off and erosion, both water and wind erosion.

The loss of vegetation along the route will be permanent with no mitigation possible. **At the footprint of the road, the severity of the impact is therefore severe to extreme. Beyond the footprint, environmental functions and processes should however, not be altered and the severity for the site as a whole could be rated as moderate.** Unnecessary clearing of vegetation beyond the footprint of the development can largely be avoided.

Proposed mitigation measure:

- Vegetation clearance should be confined to the footprint of the proposed haul road and unnecessary clearance should be avoided.
- The use of arboricides for the clearing of vegetation is not recommended.

Significance without and with mitigation (residual) measures (assessment refers to the footprint):

Parameter	Without mitigation	Residual
Extent	Site specific	Site specific
Duration	Long-term to permanent	Long-term to permanent
Severity	Severe to extreme at footprint Moderate for the site as a whole	Severe at footprint Moderate for the site as a whole
Probability	Very likely	Likely
Significance	High to very high at footprint Low for the site as a whole	High at footprint Low for the site as a whole

Confidence level	High	High
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The loss of individuals of Species of Conservation Concern (SCC)

Nature: The loss of the vegetation along the proposed route of the haul road may cause a loss of individuals of SCC. The site visit revealed the presence of only one individual with an IUCN threatened status, *Aloidendron dichotomum*. This individuals would however not be affected by the selected haul road alignment. Many protected and endemic species were however, recorded and some individuals of these species will be destroyed by the proposed road.

Comment: In the NCNCA (2009), a number of families and genera, for example the family Aizoaceae, (formerly Mesembryanthemaceae) and genus such as *Euphorbia* are listed as Protected. This blank classification may be because of the presence of one or two species with a threatened status in the family or genus. Unfortunately, this then includes many species that are either common, or even weedy, e.g. *Galenia fruticosa* or *Euphorbia gariiepina* that do not need to be awarded special conservation status. Nevertheless, permit applications should be done as required by the DENC for all listed species.

Proposed mitigation measures:

- Vegetation clearance should be confined to the footprint of the proposed haul road and unnecessary clearance should be avoided.

Significance without and with mitigation measures (assessment refers to the footprint):

Parameter	Without mitigation	Residual
Extent	Site specific	Site specific
Duration	Long-term to permanent	Long-term to permanent
Severity	Moderate	Moderate
Probability	Likely	Likely
Significance	Low	Low
Confidence level	Medium	Medium

Water flow may be impeded and/or diverted at crossings of drainage lines

Nature: The preferred route will cross a number of ephemeral drainage lines and a raised road would cause impediment and/or diversion of water flowing down the slopes and along the drainage lines. BMM have, however, confirmed that these crossings will either be equipped with culverts or low level drift crossings will be built (or a mixture thereof).

Significance without and with mitigation measures:

Parameter	Without mitigation	Residual
Extent	Site specific	Site specific
Duration	Long-term	Long-term
Severity	Moderate	Moderate
Probability	Unlikely	Unlikely
Significance	Low	Low
Confidence level	Medium	Medium

Proposed mitigation measures:

- Construct new watercourse crossings during dry conditions only, and when no rainfall is forecast.
- Limit the footprint area of the construction activity to what is absolutely essential.

- A suitably qualified person should plan, design and supervise the proper construction of the road to minimize the impact on the environment.

Increased erosion and water run-off

Nature: Increased erosion (water and wind) and water run-off will be caused by the clearing of the indigenous vegetation and compaction of soil. Compaction of the road surface will furthermore contribute to additional run-off and erosion.

Proposed mitigation measures:

- Clearing of vegetation, compaction and levelling should be restricted to the footprint of the proposed development.
- A suitably qualified person should plan, design and supervise the proper construction of the road to minimize the impact on the environment.
- Roads should be designed to reduce the risk of erosion.

Significance without and with mitigation measures:

Parameter	Without mitigation	Residual
Extent	Site specific	Site specific
Duration	Long-term	Long-term
Severity	Moderate	Moderate
Probability	Likely	Likely
Significance	Low	Low
Confidence level	Medium	Medium

Increased dust deposition

Nature: Increased dust deposition may harm physiological processes of plants and a reduction in the photosynthetic capacity of the plants may occur.

Proposed mitigation measures:

- Excessive dust can be reduced by spraying water regularly to control dust generation. Other suitable dust control mitigation measures can also be considered.
- Increased dust levels are largely temporary and primarily applicable to the construction phase.

Significance without and with mitigation measures:

Parameter	Without mitigation	Residual
Extent	Site specific	Site specific
Duration	Short-term	Short-term
Severity	Moderate	Slight
Probability	Likely	Unlikely
Significance	Low	Very low
Confidence level	High	Medium

Increased noise levels

Nature: Construction activities will increase noise levels at the site. The elevated noise levels may alter the behavioural patterns of some animals.

Proposed mitigation measures:

- The SANS noise standards should be adhered to.
- No construction should be done at night.

Significance without and with mitigation measures:

Parameter	Without mitigation	Residual
Extent	Site specific	Site specific
Duration	Short-term	Short-term
Severity	Moderate	Moderate
Probability	Likely	Likely
Significance	Low	Low
Confidence level	High	Medium

The loss of faunal habitat

Nature: The loss of the vegetation for the proposed haul road will also be accompanied by a loss of faunal habitat. **Although the impact at the footprint is rated as moderate, the impact for the site as a whole, is slight.**

Proposed mitigation measures:

- Vegetation clearance should be confined to the footprint of the development and unnecessary clearance should be avoided. However, at the footprint vegetation clearance is inevitable and cannot be mitigated.

Significance without and with mitigation measures:

Parameter	Without mitigation	Residual
Extent	Site specific	Site specific
Duration	Long-term to permanent	Medium term
Severity	Moderate	Moderate
Probability	Very likely	Unlikely
Significance	Low	Low
Confidence level	High	High

Direct faunal mortalities

Nature: Faunal mortalities may be caused by road construction and construction vehicles. In particular slow-moving species such as tortoises, might be prone to these mortalities.

Proposed mitigation measures:

- Construction crew, in particular the drivers, should undergo environmental training to increase their awareness of environmental concerns. All construction contractors and crew should attend and pass an induction course.

Although all road kills cannot be avoided, the increased awareness of drivers should be able to reduce the number of fatalities.

- Night driving should be limited.
- Existing speed limits enforced at the mine should be adhered to.

Significance without and with mitigation measures:

Parameter	Without mitigation	Residual
Extent	Site specific	Site specific
Duration	Short term	Short term
Severity	Moderate	Moderate
Probability	Likely	Likely
Significance	Low	Low
Confidence level	High	Medium

9.3.2 Indirect impacts during the construction phase

Establishment of alien vegetation

Nature: As a result of the loss of indigenous vegetation and resulting degradation, alien species might invade the area. Alien invasive species are currently not common in the area, with only *Prosopis glandulosa* occurring in the vicinity of the site. Increased vehicle traffic, and import of soil may however facilitate the introduction of seeds of other alien species. Infestation by invasive alien species may cause changes to the structure and functioning of the ecosystem and often exacerbates the further loss of indigenous vegetation.

Proposed mitigation measures:

- Implement a monitoring program for the early detection of alien invasive plant species and a control program to combat declared alien invasive plant species should be employed.
- No alien species should be used in rehabilitation.

Significance without and with mitigation measures:

Parameter	Without mitigation	Residual
Extent	Local	Local
Duration	Long-term	Long-term
Severity	Moderate	Slight
Probability	Likely	Unlikely
Significance	Low	Very low
Confidence level	Medium	Medium

Changes in animal behaviour

Nature: The increased human presence and/or construction operations will increase noise levels. The increased human presence, elevated noise, loss of animal habitat and compaction of soils may alter the behavioural patterns of some animals. Some of these changes may favour certain species and negatively affect others and consequently change the composition of the animal communities. Species that live or move in the soil may be negatively affected as well. The impact is largely temporary and animals may return after the construction phase has been completed.

Proposed mitigation measures:

- Construction crew should undergo environmental training, by way of an induction course, to increase their awareness of environmental concerns.
- Soil compaction should be kept to a minimum by restricting driving to the designated roads.
- No construction should be done at night, as far as possible.
- Increased noise due to construction are temporary and should normalize once all construction has ceased.

Significance without and with mitigation measures:

Parameter	Without mitigation	Residual
Extent	Site specific	Site specific
Duration	Long-term	Short- to Long-term
Severity	Moderate	Moderate
Probability	Likely	Unlikely
Significance	Low	Low
Confidence level	Medium	Medium

9.4 Impacts during the operational phase and their significance

9.4.1 Direct impacts during the operational phase

Loss and / or disturbance of indigenous vegetation

Nature: Clearing or disturbance of natural vegetation should be limited during the operational phase, although some removal might still arise due to maintenance activities.

Proposed mitigation measures:

- Vegetation clearance should be avoided wherever possible and new areas should not be denuded.
- Driving should be restricted to the designated road.

Significance without and with mitigation measures:

Parameter	Without mitigation	Residual
Extent	Site specific	Site specific
Duration	Long-term	Short-term
Severity	Slight	Slight
Probability	Likely	Likely
Significance	Very low	Very low
Confidence level	Medium	Medium

Increased faunal mortalities

Nature: Faunal mortalities may be caused by heavy vehicles, maintenance vehicles or other maintenance activities and litter. In particular slow-moving species such as tortoises, might be prone to road mortalities.

Proposed mitigation measures:

- Drivers should undergo environmental training, by way of an induction course, to increase their awareness of environmental concerns.
- Night driving should be limited as far as possible to minimize negative effects on nocturnal animals.
- Speed limits should apply on site.

Significance without and with mitigation measures:

Parameter	Without mitigation	Residual
Extent	Site specific	Site specific
Duration	Long-term	Long-term
Severity	Moderate	Slight
Probability	Likely	Likely
Significance	Low	Very low
Confidence level	Medium	Medium

9.4.2 Indirect impacts during the operational phase**Alteration to hydrological processes**

Nature: Increased erosion and water run-off will be caused by the clearing of the indigenous vegetation and soil disturbance during the construction phase. Increased run-off and erosion could affect hydrological processes in the area and could change water discharge into the streams and increase silt load. Impacts due to increased erosion and water run-off during the operational stage will largely be the residual impacts that could not be mitigated.

Proposed mitigation measures:

- Proper road maintenance procedures should be in place.

Significance without and with mitigation measures:

Parameter	Without mitigation	Residual
Extent	Site specific	Site specific
Duration	Long-term	Long-term
Severity	Moderate	Moderate
Probability	Likely	Unlikely
Significance	Low	Low
Confidence level	High	Medium

Establishment of alien vegetation

Nature: As a result of the loss of indigenous vegetation and resulting degradation, alien species might invade the area. Increased vehicle traffic and import of soils may facilitate the introduction of seeds of alien species. Infestation by invasive alien species may eventually cause changes to the structure and functioning of the ecosystem and often exacerbates the further loss of indigenous vegetation.

Proposed mitigation measures:

- Implement a monitoring program for the early detection of alien invasive plant species.
- A control program to combat declared alien invasive plant species should be employed.
- No alien species should be used in rehabilitation.

Significance without and with mitigation measures:

Parameter	Without mitigation	Residual
Extent	Local	Site specific
Duration	Long-term	Long-term
Severity	Slight	Slight
Probability	Likely	Likely
Significance	Very low	Very low
Confidence level	Medium	Medium

Changes in animal behaviour

Nature: The loss of vegetation cover, compacting of soils and the increased human activities will alter animal behavioural patterns by making roads difficult to traverse and increasing levels of predation. Some animal species will be more severely affected than others. See “Changes in animal behavior” under construction phase impacts. However, no new vegetation loss is anticipated during the operational phase and impacts on animal behaviour that are relevant during the operational stage are the residual impacts that could not be mitigated during the construction phase.

Proposed mitigation measures:

- Soil compaction should be kept to a minimum by restricting driving to the designated road.
- Drivers should undergo environmental training, by way of an induction course, to increase their awareness of environmental concerns.
- Night driving should be limited as far as possible to minimize negative effects on nocturnal animals.

Significance without and with mitigation measures:

Parameter	Without mitigation	Residual
Extent	Site specific	Site specific
Duration	Long-term	Short- to Long-term
Severity	Moderate	Moderate
Probability	Likely	Unlikely
Significance	Low	Low
Confidence level	Medium	Medium

CHAPTER 10

PRESENT ECOLOGICAL STATUS OF THE DRAINAGE LINES

10.1 Introduction

The proposed haul road will traverse four plant communities and eleven ephemeral drainage lines. These drainage lines are dry for most of the year and flow only during high rainfall events.

10.2 Activities

The activities listed below are identified as activities related to the crossing of a watercourse that may require Environmental Authorisation prior to commencement of that activity.

10.2.1 National Environmental Management Act (Act No. 107 of 1998) (NEMA 2014, 2017)

Listing Notice 1 GRN 327 (NEMA)

- Activity 12: *The development of (inter alia)-
(xii) infrastructure or structures with a physical footprint of 10 m² or more;
where such development occurs -
(a) within a watercourse;
(b) in front of a development setback; or
(c) if no development setback has been adopted, within 32 metres of a watercourse, measured from the edge of a watercourse.*
- Activity 19: *The infilling or depositing of any material of more than [5] 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than [5] 10 cubic metres from*
 - *(i) a watercourse; -*

10.2.2 National Water Act (Act No. 36 of 1998) (NWA 1998)

The following activities listed in the NWA 1998 may be applicable to the proposed development and could potentially trigger the need for authorisation:

- Section 21 (c): *"impeding or diverting the flow of water in a watercourse"; and*
- Section 21 (i): *"altering the beds, banks, course or characteristics of a watercourse".*

Section 21(c): "Impeding or diverting the flow of water in a watercourse"

The terms "impeding or diverting the flow" is defined as follows in Government Notice 1199 of 2010 (NWA amendment):

"diverting the flow" means a temporary or permanent structure causing the flow of water to be rerouted in a watercourse for any purpose.

"impeding the flow" means the temporary or permanent obstruction or hindrance to the flow of water in a watercourse by a structure built either fully or partially in or across a watercourse.

Section 21(i): "Altering the bed, banks, course or characteristics of a watercourse"

"altering the bed, banks, course or characteristics of a watercourse" is defined as any change affecting the resource quality within the watercourse or 1:100 year flood line.

10.3 Determination of the Present Ecological Status (PES) of the drainage lines

Present Ecological Status (PES) refers to the degree to which ecological conditions of an area have been modified from natural (reference) conditions. The measure is based on a number of attributes and results are classified on a 6-point scale, from Category A (*Largely Natural*) to Category F (*Critically Modified*) (Tables 5 & 6).

A PES analysis was conducted for the drainage lines identified and delineated within the study area (Figure 13). For the purpose of this study, the scoring system as described in DWAF (1999) was applied for the determination of the PES. Factors that may influence the PES of the drainage lines on site are:

- road crossings;
- impeding or diverting the flow of water in a drainage line;
- altering the beds, banks, course or characteristics of a drainage line;
- erosion and incision of the drainage lines; and
- encroachment of alien invasive species.

Table 5. Attributes to be assessed for determination of Present Ecological Status (PES) (see Table 6)(DWAF 1999)

Assessment Attributes	Considerations for Assessment of Attributes
Flow	Relative deviation from the expected natural - modification/deterioration of habitat due to abstraction and/or flow regulation.
Inundation	Relative degree of inundation by weirs (or similar structures) and impoundments - loss of instream habitat and the riparian zone as well as the possible fragmentation effect on biological populations and communities.
Water quality	Water quality (relative degree of modification from the expected natural, and its perceived biological impact and significance).
Stream bed condition	Stream bed condition (relative degree of modification as caused by disturbances such as sedimentation, covering by excessive algal growth related to eutrophication, etc.).
Introduced instream biota	Species involved, their characteristics and severity of impact on native biota - i.e., impact on physical habitat and competition, predation.
Riparian or stream bank condition	Riparian or stream bank condition (relative deviation from the expected natural situation as indicated by disturbances such as removal of vegetation, invasive vegetation, erosion, road crossings, etc.).

Table 6. Scoring and rating guidelines for PES estimation (Kleynhans 1996, DWAF 1999)

Mean	Category	Explanation
Within generally acceptable range		
>4	A	Unmodified, or approximates natural condition
>3 and ≤4	B	Largely natural with a few modifications, but with some loss of natural habitats
>2.5 and ≤3	C	Moderately modified, and with some loss of natural habitats
≤2.5 and >1.5	D	Largely modified. A large loss of natural habitat and basic ecosystem function has occurred.
Outside generally acceptable range		
>0 and ≤1.5	E	Seriously modified. The losses of natural habitat and ecosystem functions are extensive
0	F	Critically modified. Modification has reached a critical level and the system has been modified completely with almost complete loss of natural habitat.

10.4 Assessment

The selected haul road route alignment will cover the sandy plains and gravelly and rocky foot- and midslopes of the site and will cross 11 drainage lines. The characteristics of the drainage lines should be retained. The results of the PES analysis are indicated in Table 7.

10.4.1 Impeding or diverting the flow of water in a watercourse

At present the water flow is not impeded or diverted at the site where the proposed haul road will be built. Water is however impeded and diverted by the current haul road to the south of the site.

For the proposed road, culverts and low level concrete crossings will be used at the crossings of the drainage lines and the impeding or diversion of flow would be of minor concern.

10.4.2 Inundation

There is currently no inundation at the site where the proposed haul road will be built.

For the proposed road, no obstructions are envisaged that will lead to any inundation of the drainage lines and their habitats on site.

10.4.3 Water quality

Water is only temporarily present in the ephemeral drainage lines. There was no water present at the time of the site visit. It is assumed that water quality is currently unmodified.

It is not anticipated that the proposed road will alter the water quality of the drainage lines, especially since they only flow during high rainfall events. However, erosion because of disturbance caused by the road building may

contribute to siltation and some minor alteration of the water quality.

10.4.4 Streambed condition (altering the beds, banks, course or characteristics of a watercourse)

At present the streambed conditions have not been altered. The beds, banks, course or characteristics of the ephemeral drainage lines will not be altered by the road except where the drainage lines are crossed. However, culverts or low level concrete crossings will be used at the crossings of the drainage lines. It is important that culverts or low level crossing should be used for **all** drainage lines to limit any impeding or diversion of the flow regime. Erosion and incision of the drainage lines will then not be enhanced higher than naturally occurring processes.

10.4.5 Introduced instream biota

There are no wetlands on site and riparian vegetation along the mostly dry ephemeral drainage lines is basically absent. The only introduced biota in the area is the alien *Prosopis cf. glandulosa*, which may alter the vegetation along the drainage lines if not controlled according to legislation.

The proposed haul road should not affect instream biota if mitigation measures are applied.

10.4.6 Riparian or stream bank condition

There is no riparian zone characterised by riparian plant species along the dry ephemeral drainage lines, especially if compared to the riparian zone along the perennial Orange River. The current condition of the ephemeral drainage lines approximates natural conditions.

10.4.7 Road crossings of ephemeral drainage lines

The proposed road will cross the ephemeral drainage lines, and provided culverts or low level concrete drift crossings are used to allow flow of water, there are no other structures envisaged that will impede the flow of water nor will the beds, banks, course or characteristics of the drainage lines be altered in any significant way.

10.4.8 Encroachment of alien invasive species

The only alien invasive plant species in the drainage lines in the general area is mesquite (*Prosopis glandulosa*), especially some distance downstream from the site.

10.5 Result of assessment

The results of this analysis show that the drainage lines are basically unmodified, or that they approximate natural condition (PES Category A) (Table 7).

In summary therefore the PES currently is Category A: Unmodified, or approximates natural condition.

Table 7. Present Ecological Status analysis (PES) of the ephemeral drainage lines on site in the area that will be traversed by the proposed haul road (shaded areas indicate the result of each analysis)

	Category	Mean		Category	Mean
1. Flow			2. Inundation		
Acceptable:	A	>4	Acceptable:	A	>4
	B	>3 and ≤4		B	>3 and ≤4
	C	>2.5 and ≤3		C	>2.5 and ≤3
	D	≤2.5 and >1.5		D	≤2.5 and >1.5
Unacceptable:	E	>0 and ≤1.5	Unacceptable:	E	>0 and ≤1.5
	F	0		F	0

	Category	Mean		Category	Mean
3. Water quality			4. Stream bed condition		
Acceptable:	A	>4	Acceptable:	A	>4
	B	>3 and ≤4		B	>3 and ≤4
	C	>2.5 and ≤3		C	>2.5 and ≤3
	D	≤2.5 and >1.5		D	≤2.5 and >1.5
Unacceptable:	E	>0 and ≤1.5	Unacceptable:	E	>0 and ≤1.5
	F	0		F	0

	Category	Mean		Category	Mean
5. Introduced instream biota			6. Riparian or stream bank condition		
Acceptable:	A	>4	Acceptable:	A	>4
	B	>3 and ≤4		B	>3 and ≤4
	C	>2.5 and ≤3		C	>2.5 and ≤3
	D	≤2.5 and >1.5		D	≤2.5 and >1.5
Unacceptable:	E	>0 and ≤1.5	Unacceptable:	E	>0 and ≤1.5
	F	0		F	0

CHAPTER 11

ECOLOGICAL IMPORTANCE AND SENSITIVITY

11.1 Assessment of ecological importance and sensitivity categories (EIS)

The ecological importance of a watercourse (stream or river) is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales. Ecological sensitivity (or fragility) refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (resilience). Although the scoring guidelines of DWAF (1999) are aimed at riparian and instream biota, they were used for the ephemeral drainage lines of the site at the Mine to determine ratings for determinants (Tables 8, 9 & 10). Both abiotic and biotic components of the system were taken into consideration in the assessment of the ecological importance and sensitivity.

a. *Biotic determinants (instream and riparian) for assessment of ecological importance and sensitivity.*

Rare and endangered biota:	Marginal/low rating	= 1
Unique biota:	Marginal/low rating	= 1
Intolerant biota:	Marginal/low rating	= 1
Species/taxon richness:	Marginal/low rating	= 1

b. *Habitat (instream and riparian) determinants for assessment of ecological importance and sensitivity.*

Diversity of aquatic habitat types or features:	Marginal/low rating	= 1
Refuge value of habitat types:	Marginal/low rating	= 1
Sensitivity of habitat to flow changes:	Marginal/low rating	= 1
Sensitivity to flow related water quality changes:	Marginal/low rating	= 1
Migration route/corridor for instream and riparian biota:	None	= 0
National Parks, wilderness areas, nature reserves, heritage sites, natural areas:	Very low rating	= 0

11.2 Ecological importance and sensitivity score

The median score for the biotic and habitat determinants is interpreted as indicated in Table 10 (DWAF 1999). A median score of <1.0 was obtained which means that the delineations falls in the **Marginal/Low** category (**Category D**): Delineations that are not ecologically important and sensitive (unique) at any scale. The biodiversity of these rivers is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers.

Table 8 Biotic determinants (instream and riparian) for assessment of ecological importance and sensitivity

Determinant*	Guidelines and Description	Scoring Guidelines
Rare and [@] endangered biota	Biota can be rare or endangered on a local, Provincial and National scale. Useful sources for this information include the South African Red Data Books that are suitable for assessment on a National scale. However, species (or taxa in the case of invertebrates) can be rare or endangered on a Provincial or local scale but not on a National scale. Professional judgement needs to be utilised in such cases.	Very High - rating=4; One or more species/taxon judged as rare or endangered on a National scale (i.e. SA Red Data Books). High - rating=3; One or more species/taxon judged to be rare or endangered on a Provincial/regional scale. Moderate - rating=2; More than one species/taxon judged to be rare or endangered on a local scale. Marginal - rating=1; One species/taxon judged as rare or endangered at a local scale. None - rating=0; No rare or endangered species/taxon at any scale
Unique biota [@]	Endemic or uniquely isolated species populations (or taxa, i.e. in the case of invertebrates) that are not rare or endangered should be included here. This assessment should also consider local, Provincial and National scales and should be treated separately from rare and endangered species (i.e. the same species should not be considered). The assessment should be based on professional knowledge. Fynbos biome: Within this biome all the biota would be unique. The rivers were therefore assessed within the context of the biome for the Western Cape (Luger 1999a).	Very High - rating=4; One or more population (or taxon) unique on a National scale. For the Western Cape – rated on a biome scale. High - rating=3; One or more population (or taxon) judged to be unique on a Provincial/regional scale. For the Western Cape - rated on a sub-regional scale (i.e. northern, western, southern and karroid). Moderate – rating=2; More than one population (or taxon) judged to be unique on a local scale. Marginal - rating=1; One population (or taxon) judged to be unique at a local scale. None - rating=0; No population (or taxon) judged to be unique at any scale.
Intolerant biota	Intolerant biota includes those species (or taxa in the case of invertebrates) that are known (or derived or suspected) to be intolerant to decreased or increased flow conditions as well as changed physical habitat and altered water quality conditions related to decreased or increased flows. As little experimental information is available on the intolerance of indigenous biota, assessment should be based on professional judgement. Kwazulu/Natal: There is no quaternary without flow and everywhere that there is flow an invertebrate community dependent on flow develops. This would mean that every quaternary should be rated highly with respect to this criterion. The solution to the problem was to use only fish (Chutter 1999).	Very High - rating=4; A very high proportion of the biota is expected to be dependent on permanently flowing water during all phases of their life cycle. High - rating=3; A high proportion of the biota is expected to be dependent on permanently flowing water during all phases of their life cycle. Moderate - rating=2; A small proportion of the biota is expected to be dependent on permanently flowing water during some phases of their life cycle. Marginal - rating=1; A very low proportion of the biota is expected to be only temporarily dependent on flowing water for the completion of their life cycle. Sporadic and seasonal flow events expected to be sufficient. None - rating=0; Rarely if any biota expected with any dependence on flowing water.
Species/taxon richness	Species/taxon richness can be assessed on a comparative basis according to a local, Provincial or National scale. Strictly, this kind of assessment should be based on the grouping of ecologically similar rivers. However, such a system is still under development and assessment will again	Very High - rating=4; Rated on a National scale. For the Western Cape - rated on a biome scale. High - rating=3; Rated on a Provincial/regional scale. For the Western Cape - rated on a sub-regional scale (i.e. northern, western, southern and karroid).

	to have to be based on professional judgement.	Moderate - rating=2; Rated on a local scale. Marginal/low - rating=1; Not significant at any scale. A rating of none is not appropriate in this context.
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*: The current guidelines will mostly be applicable to vertebrates and vascular plants for which information is more readily available than for other groups. In cases where expert knowledge allows for the assessment of biota other than vertebrates and vascular plants, such information should be included. The taxonomic groups on which the assessment is based should be indicated. In cases where invertebrates (in particular) and other plants are used as indicators, the relevant scoring system may have to be adapted by the relevant ecological experts.

@: In the case of rare and endangered and unique biota: the highest of the possible scores should be provided, i.e.: If a species is rare and endangered on a national scale, it should be scored as very high for this determinant. If a species is rare and endangered on a regional scale but it is very unique on a national scale, it should be scored as very high for this determinant.

Table 9. Habitat (instream and riparian) determinants for assessment of ecological importance and sensitivity

Determinant*	Guidelines And Description	Scoring Guidelines
Diversity of aquatic habitat types or features	Diversity of habitat types in a river delineation should be assessed according to local, Provincial and National scales (riffles, rapids, runs, pools and backwaters and the associated marginal areas and substrate types, lotic wetlands (source sponges, floodplain habitat types) and the riparian zone). Assessment should again be based on professional judgement.	Very High - rating=4; Rated on a National scale. High - rating=3; Rated on a Provincial/regional scale. Moderate - rating=2; Rated on a local scale Marginal/low – rating=1; Not significant at any scale. (a rating of none is not appropriate in this context)
Refuge value of habitat types	The functionality of the habitat types present should be assessed in terms of their ability to provide refugia to biota during periods of environmental stress on a local, Provincial and National scale. Assessment is based on available information and expert judgement.	Very High – rating=4; Rated on a National scale. High - rating=3; Rated on a Provincial/regional scale. Moderate - rating=2; Rated on a local scale Marginal/low - rating=1; Not significant at any scale. (a rating of none is not appropriate in this context)
Sensitivity of habitat to flow changes	This assessment should essentially take into account the size of the stream as well as the habitat types available. The presumption is that only a limited decrease or increase in the flow (and the related depth and width) of certain rivers (often "smaller" streams) will result in particular physical habitat types (i.e. riffles), becoming unsuitable for biota as compared to "larger" streams. Assessment is based on available information and expert judgement.	Very High - rating=4; Streams of a particular size and with abundant habitat types highly sensitive to flow decreases or increases at all times High - rating=3; Streams of a particular size and with some habitat types being highly sensitive to flow decreases or decreases at all times. Moderate - rating=2; Streams of a particular size and with some habitat types being susceptible to flow decreases or increases during certain seasons. Marginal/low - rating=1; Streams of a particular size and with habitat types rarely sensitive to flow decreases or increases. (a rating of none is not appropriate in this context)
Sensitivity to flow related water quality changes	This assessment should also consider the size and flow of the stream in terms of its sensitivity to water quality changes. A decrease in the natural flow volume may, for example, result in a diminished assimilative capacity (in the situation where effluent forms part of the total flow volume) or may cause natural water quality variables (i.e. water temperature and oxygen) to reach levels detrimental for biota (also applicable to increases in flow). The assumption regarding the sensitivity of "smaller" streams is also applicable here. In terms of organic pollution load, it has been pointed out that slow flowing deep rivers would be impacted over greater distances than fast flowing shallow rivers where re-aeration rates would be high	Very High - rating=4; Streams of a particular size (usually "small") and with abundant habitat types highly sensitive to water quality changes related to flow decreases or increases at all times. High - rating=3; Streams of a particular size (usually "small") and with some habitat types being highly sensitive to water quality related changes related to flow decreases or increases at all times. Moderate - rating=2; Streams of a particular size (often "larger") and with some habitat types being sensitive to water quality related flow decreases or increases during certain seasons. Marginal/low - rating=1; Streams of a particular size (often "larger") and with habitat types rarely sensitive to water quality change related to flow decreases or increases.

Determinant*	Guidelines And Description	Scoring Guidelines
	(Chutter 1999). Assessment is based on available information and expert judgement.	(a rating of none is not appropriate in this context)
Migration route/corridor for instream and riparian biota	<p>The importance of a specific stream delineation in terms of the link it provides for the upstream and downstream biological functioning of other sections of the stream, is indicated here (i.e. connectivity). In essence the biological connectivity provided by a particular stream delineation can influence its ecological importance and result in an adapted (i.e. higher) rating than it would have had if was assessed only on its own. Assessments should be based on the results of ratings for individual stream network delineations, professional judgement and available information. The sensitivity of the migration route/corridor to modifications and disruptions form part of the assessment.</p> <p>Within this context, headwater quaternaries/delineations could have a low importance as a migration route /corridor (at a sub-quaternary or other smaller delineation, migration route/corridor may be more important)</p>	<p>Very high - rating=4; The stream delineation is a critical link in terms of connectivity for the survival of biota upstream and downstream and is very sensitive to modification.</p> <p>High - rating=3; The stream delineation is an important link in terms of connectivity for the survival of biota upstream and downstream and is sensitive to modification.</p> <p>Moderate - rating=2; The stream delineation is a moderately important link in terms of connectivity for the survival of biota upstream and downstream and is moderately sensitive to modification.</p> <p>Marginal/Low - rating=1; The stream delineation is a marginally/low important link in terms of connectivity for the survival of biota upstream and downstream and has a marginal sensitivity to modification</p> <p>None – rating=0; The stream delineation is not of any importance in terms of connectivity for the survival of biota upstream and downstream.</p>
National parks, Wilderness areas, Nature reserves, Natural Heritage sites, Natural areas	<p>The presence of conservation (i.e. National Parks, Wilderness areas and Nature Reserves) and natural areas (i.e. unproclaimed, relatively unmodified/undisturbed areas) within a stream delineation will logically place an additional emphasis on the ecological importance and sensitivity of a stream. The importance of such areas for the conservation of the aquatic ecological diversity on different scales must be judged, i.e. the presence of a quaternary or other delineation in a conservation or natural area does not automatically indicate a high score.</p>	<p>Very high - score=4; The stream delineation is present within an area very important for the conservation of ecological diversity on a National and even international scale.</p> <p>High - score=3; The stream delineation is present within an area important for the conservation of ecological diversity on a National scale.</p> <p>Moderate - score=2; The stream delineation is present within an area important for the conservation of ecological diversity on a provincial /regional scale.</p> <p>Marginal/Low - score=1; The stream delineation is present within an area important for the conservation of ecological diversity on a local scale.</p> <p>Very low - score=0; The stream delineation is not present within an area important for the conservation of ecological diversity on any scale.</p>

*: The scoring system indicated here is mainly applicable to vertebrates. In cases where invertebrates (in particular) and plants are used as indicators, the relevant scoring system may have to be adapted by the relevant ecological experts.

Table 10. Ecological importance and sensitivity categories

Ecological Importance and Sensitivity categories	Range of Median	Recommended Ecological Management Class
Very high	>3 and ≤4	A
Delineations that are considered ecologically important and sensitive (unique) on a national or even international level based on unique biodiversity. The biodiversity of these rivers is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers.		
High	>2 and ≤3	B
Delineations that are considered to be ecologically important and sensitive (unique) on a national scale due to biodiversity. The biodiversity of these rivers may be sensitive to flow and habitat modifications but may have a substantial capacity for use. They play a role in moderating the quantity and quality of water of major rivers.		
Moderate	>1 and ≤2	C
Delineations that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these rivers is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers.		
Low/marginal	>0 and ≤1	D
Delineations that are not ecologically important and sensitive (unique) at any scale. The biodiversity of these rivers is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers.		

CHAPTER 12

ECOLOGICAL RISK ASSESSMENT

12.1 Introduction

Ecological risk assessment (ERA) defines the probability or likelihood of any undesired (negative) effect of the proposed development on the ephemeral drainage lines, expressed in relation to the effect or consequence of impacts, with and without mitigation (probabilistic analyses) (U.S. Environmental Protection Agency (US EPA) 1992; DEAT 2002; Kellerman & Snyman-Van der Walt 2017).

The consequence of an impact depends on: (1) exposure to the impact, e.g. species or ecosystems; (2) the nature of the impact, i.e. a physical event that may cause damage or loss to ecosystems and environmental resources; (3) the vulnerability of the receiving environment, e.g. sensitivity of the ecosystem (Kellerman & Snyman-Van der Walt 2017).

Ecological risk assessment includes three primary phases: problem formulation, analysis, and risk characterization. Ecological risk assessment is therefore a process that “evaluates the likelihood that adverse ecological effects will occur (or have occurred or are occurring) as a result of exposure to one or more stressors from various human activities” (U.S. EPA, 1998; DEAT 2002). Stressors can be chemical, physical, biological, or radiological in nature, with the major portion of interest related to the use and/or current or previous disposal of industrial chemicals or pesticides.

The process is used to systematically evaluate and organize data, information, assumptions, and uncertainties in order to help understand and predict the relationships between stressors and the likelihood of adverse ecological effects that is useful for environmental decision-making. Ecological risk assessment provides risk managers an approach for considering available scientific information along with the other factors they need to consider (e.g., social, legal, political, or economic) in selecting a course of action (U.S. EPA 1998).

The use of ERA as part of Environmental Impact Assessment (EIA) processes provides a number of benefits, particularly in relation to systematic identification of hazards, scoping of technical investigations, setting impact assessment priorities and managing uncertainty.

12.2 Objectives of risk assessment

The risk assessment is intended to evaluate the cause and effect of a risk.

12.2.1 *The hazard/problem and why? (drainage lines affected by what?)*

- Construction and maintenance of the proposed haul road.
- Clearing of virgin land (indigenous vegetation) for the proposed haul road.
- Road crossings of the ephemeral drainage lines.

- Possible impediments or diversions of water flow.

12.2.2 *The object (target) to be affected? (the effect on what?)*

The ephemeral drainage lines are the targets that could be affected.

12.2.3 *What is the type, magnitude and characteristics of the effect being assessed? (the response of the streams/habitat)*

- The total area to be cleared for the road building is approximately 1.5 ha.
- The proposed haul road will cross several ephemeral or seasonal drainage lines. However, the site is situated in an area with a mean annual rainfall of about 100 mm per annum and the ephemeral drainage lines are dry for most years and flow only during rare heavy downpours.
- The drainage lines on the terrain have remained fairly undisturbed in spite of some vehicle tracks occurring on site. The water supply pipelines to Swartberg also traverse the site.
- The road footprint will be mechanically cleared of indigenous vegetation and the vegetation in an additional area of approximately 2 m on either side of the road will also be affected. The use of arboricides for the clearing of vegetation is not recommended.
- The road construction may contribute to soil erosion, water run-off and siltation of the drainage lines, which may affect the flow regime and water quality. The stream bank condition (habitat and/or geomorphology) will be affected where roads cross the drainage lines.
- Road crossings of drainage lines will involve culverts and low level drift crossing to lessen the impacts on the flow regime. No other structures will be built in the drainage lines, e.g. weirs.
- The haul road will have some effect on loss of natural habitat on site and on the indigenous biota.
- Alien biota such as the invasive alien *Prosopis glandulosa* are localised at the southern part of the site and should be controlled according to legislation. Other alien plant species that may proliferate as a result of the disturbance of the site should be monitored and controlled according to an alien plant management plan.

Overall, the ecosystem structure and function of the ephemeral drainage lines should not be adversely affected by the development.

12.2.4 *Probability or likelihood of effect*

The probability or likelihood of the development having significant impacts on the ephemeral drainage lines is fairly **low**.

12.3 Risk Assessment Matrix

The prescribed Risk Assessment Matrix of the Department of Water Affairs and Sanitation (DWS) was completed with the focus on the effect that the proposed development may have on the ephemeral drainage lines (Appendix A). **The risk is rated as Low (L)** and described as "acceptable as is or consider requirement for mitigation". The impact to the drainage lines and resource quality is small and easily mitigated.

12.4 Mitigation

12.4.1 *Ephemeral drainage lines*

The drainage lines are for most of the year dry and flow only for short periods after relatively rare heavy downpours. The upper reaches of these ephemeral drainage lines are not considered to be riparian or wetlands in the strict sense of the word.

The proposed haul road will cross a number of ephemeral drainage lines, however, watercourses and a buffer of at least 32 m are usually excluded from any development. It is planned to use culverts and low level drift crossings when crossing the drainage lines to limit the impact on the flow of water, e.g. impeding the flow, diversion of the flow or altering of the banks and beds. Care will have to be taken not to negatively impact on the drainage system by limiting soil erosion and silt transport, thereby affecting the hydrological processes in the environment. Flow of water along these drainage lines should not be impeded, and where necessary, erosion control measures should be taken, e.g. by using gabions.

The target is to minimise loss or disturbance of natural vegetation/habitat in order to limit influence on water flow, water quality and soil properties, and disturbed areas should be rehabilitated and re-vegetated as soon as possible. Erosion of the streambanks should be prevented by immediate rehabilitation of any disturbed areas.

12.4.2 Vegetation types

Both the Aggeneys Gravel Vygieveld and the Bushmanland Sandy Grassland vegetation types are classified as 'least threatened' (Mucina & Rutherford 2006, NEM:BA 2011). The significance of habitat loss on the property is therefore low from the point of view of the overall condition and the total area covered by the vegetation types in the region.

12.4.3 Indigenous vegetation

- NCNCA protected species on the proposed sites include *Boscia foetida* subsp. *foetida*, *Euphorbia* spp., *Avonia* spp., *Hoodia gordonii* and *Mesembryanthemum* spp. (see Appendix D for GPS coordinates of individual plants in the fields). The necessary flora permits are required from the Northern Cape Department of Environment and Nature Conservation to adhere to the Northern Cape Nature Conservation Act (Act No. 9 of 2009) in terms of the removal or destruction of protected flora.
- Recommendations to reduce the impact of clearance of protected species includes:
 - Limit clearance of natural vegetation and disturbance to the footprint of the proposed haul road.
 - Rehabilitate disturbed areas as soon as possible after construction.

12.4.4 Alien invasive plant species

Mitigation targets are to minimise loss or disturbance of natural vegetation and to re-vegetate denuded and disturbed areas as soon as possible. A program for the early detection and control of declared weedy and alien invasive species should be initiated (or may already be in place at BMM).

12.4.5 Fauna

The indigenous shrubs and dwarf shrubs on site, especially *Boscia foetida* subsp. *foetida*, *Sisyndite sparteae*, *Rhigozum trichotomum*, *Eriocephalus* spp., *Monechma* spp. and *Tetraena* spp. should be protected as far as possible because they form important food sources and habitat for various animal species. The underbrush normally associated with these species also forms an important micro-habitat for a number of animal species.

CHAPTER 13

CONCLUSIONS AND RECOMMENDATIONS

13.1 Sensitivity

The sensitivity of the four plant communities (habitats) ranged from **very low** to **low**. **This implies that from an ecological perspective no 'no-go' areas were identified that had to be avoided when constructing the proposed haul road.**

Nevertheless, the proposed haul road will cross a number of ephemeral drainage lines, and in terms of the NEMA Listings (2017) watercourses and a buffer of at least 32 m from the edge of the watercourse are usually excluded from any development. Environmental Authorisation will therefore be required for Activity 12 (Listing 1, GNR 327) as well as Activity 14 (Listing Notice 3, GNR 324, 2017).

13.2 Significance of impacts

The significance of the impacts on the vegetation after mitigation (residual), i.e. the removal or clearance of vegetation on the footprint of the haul road would be **high**. **Beyond the footprint, environmental functions and processes should however, not be altered and the impact for the site as a whole could be rated as low.** All other impacts, i.e. loss of species, water flow, erosion, run-off, dust, noise and fauna were considered to be **very low to low**.

13.3 Present Ecological Status (PES)

The results of this PES analysis showed that the ephemeral drainage lines were currently considered to be **Category A: unmodified or approximated natural condition**.

13.4 Ecological Importance and Sensitivity (EIS)

A median score of <1.0 was obtained which means that the delineations falls in the **Category D: Marginal/Low** category, i.e. delineations that are not ecologically important and sensitive (unique) at any scale. The biodiversity of these ephemeral drainage lines is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers.

13.5 Risk Assessment Matrix (RAM)

Overall, the ecosystem structure and function of the ephemeral drainage lines should not be adversely affected by the development. The probability or likelihood of the development having significant impacts on the drainage lines is also fairly low.

The **risk** is rated as **Low** and described as "acceptable as is or requirement for mitigation should be considered". The impact on the ephemeral drainage lines and resource quality was evaluated as small and could be easily mitigated.

13.6 Threatened, protected and endemic species

Only one individual of a threatened plant species was recorded on site. This individual of *Aloidendron dichotomum* (VU) would however, not be affected by the selected haul road route.

The two 'Vulnerable' animal species (*Panthera pardus* and *Felis nigripes*) are unlikely to be affected by the development.

One of the provisions in the Northern Cape Nature Conservation Act (NCNCA 2009) is that no person may without a permit, pick, import, export, transport, possess, cultivate or trade in a specimen of a specially protected plant or a protected plant species. **Two specially protected plant species and 21 protected plant species were recorded on site. Although most of these species are quite common, permits will have to be acquired for the removal of all protected plant species.**

Overall recommendation

Based on the low sensitivity (Chapter 8), unmodified or approximated natural condition for PES (Chapter 10), low/marginal for EIS (Chapter 11) and low Risk Assessment (Chapter 12), the project could be approved provided all mitigation measures are applied.

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APPENDIX A

ECOLOGICAL RISK ASSESSMENT

The risk assessment matrix is provided separately as an Excel file, titled:

Risk Assessment Matrix Aggeneys Haul Road DWS 24 10 2018.xlsx

RISK MATRIX (Based on DWS 2015 publication: Section 21 c and I Water Use Risk Assessment Protocol)

NAME and REGISTRATION No of SACNASP Professional member: ...Dr Noel van Rooyen...Reg no. ...401430/83; Prof Gretel van Rooyen Reg no. 400509/14.....

Risk to be scored for construction and operational phases of the project. MUST BE COMPLETED BY SACNASP PROFESSIONAL MEMBER REGISTERED IN AN APPROPRIATE FIELD OF EXPERTISE.

No.	Phases	Activity	Aspect	Impact	Severity								Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Confidence level	Control Measures	Borderline LOW MODERATE Rating Classes	PES AND EIS OF WATERCOURSE
					Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph + Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence												
1	Construction	Construction of road: Clearing of vegetation along route and when crossing ephemeral watercourses	Drainage pattern change due to road	The road construction may affect the level of soil erosion, water drainage and siltation of the watercourses. The higher road level will affect drainage down the slopes. The stream bank and bed condition will not be affected except limited adverse effects where the road crosses the watercourses due to culverts in the stream beds. With proper maintenance and repair of roads the impacts on the watercourses should be negligible.	2	1	2	2	1.8	1	2	4.75	1	1	5	2	9	43	L	90	Insert culverts in all watercourses. Implement measures to control erosion.		PES: A; EIS: D	
			Installation of culverts for stream crossings		2	1	2	1	1.5	1	2	4.5	1	2	1	2	6	27	L	90	Installation of culverts to allow unrestricted flow of water			
			Reshaping of stream banks at crossings		1	1	1	2	1	1.2	1	2	4.2	1	2	1	1	5	21	L	90			
			Loss of biodiversity (fauna & flora)		1	1	1	2	1	1.3	1	2	4.25	1	2	1	1	5	21	L	90	Avoid unnecessary clearing of vegetation beyond footprint. Apply for permits for protected species.		
			Impeding the flow of water		2	2	1	1	1.5	1	2	4.5	1	2	5	2	10	45	L	90	Insert culverts in all watercourses	x		
			Soil erosion		2	2	1	1	1.5	1	2	4.5	1	2	1	2	6	27	L		Implement measures to prevent soil erosion			
2	Operational	Operation of road: Clearing of vegetation along route and when crossing ephemeral watercourses	Drainage pattern change due to road level	Very little impact envisaged. The higher road level will affect drainage down the slopes. Maintenance of culverts to allow unrestricted flow of water.	2	1	2	1	1.5	1	3	5.5	1	2	1	3	7	39	L	90	Implement proper culvert maintenance to ensure culverts are not blocked.		PES: A; EIS: D	
			Road and culvert maintenance	Herbicides for weedy herbs should be used with great care. Alien plants should be controlled.	2	1	1	1	1.3	1	3	5.25	1	2	1	2	6	32	L	90	Invasive alien plant species should be controlled.			
			Impeding the flow of water		1	1	1	1	1	1	3	5	1	1	5	3	10	50	L	90	Implement proper culvert maintenance to ensure culverts are not blocked.			
			Soil erosion		1	2	1	2	1.5	1	3	5.5	2	2	1	3	8	44	L	90	Implement measures to prevent soil erosion			

APPENDIX B

Plant species list of the BMM haul road site, based on the vegetation survey

*Species names in red indicate protected species (NCNCA 2009).

Total species per growth form category:

Shrubs	7
Dwarf shrubs	33
Forbs	29
Geophytes	2
Grasses	10
Succulents	10
Aliens	1
Total	92

Shrubs

<i>Boscia foetida</i> subsp. <i>foetida</i>	LC
<i>Diospyros austro-africana</i>	LC
<i>Lycium oxycarpum</i>	LC
<i>Montinia caryophyllacea</i>	LC
<i>Parkinsonia africana</i>	LC
<i>Phaeoptilum spinosum</i>	LC
<i>Sisyndite spartea</i>	LC

Dwarf shrubs

<i>Antherothamnus pearsonii</i>	LC
<i>Aptosimum spinescens</i>	LC
<i>Eriocephalus scariosus</i>	LC
<i>Eriocephalus scariosus</i>	LC
<i>Galenia fruticosa</i>	LC
<i>Hermannia spinosa</i>	LC
<i>Hermannia stricta</i>	LC
<i>Kissenia capensis</i>	LC
<i>Lacomucina lineatum</i>	LC
<i>Limeum aethiopicum</i>	LC
<i>Lycium cinereum</i>	LC
<i>Melolobium microphyllum</i>	LC
<i>Microloma incanum</i>	LC
<i>Monechma</i> cf. <i>divaricatum</i>	
<i>Monechma incanum</i>	LC
<i>Monsonia crassicaule</i>	LC
<i>Osteospermum sinuata</i>	LC

<i>Plinthus karoocicus</i>	LC
<i>Portulacaria fruticulosa</i>	LC
<i>Mesembryanthemum tretragonum</i>	LC
<i>Pteronia</i> cf. <i>mucronata</i>	LC
<i>Pteronia</i> sp.	
<i>Rhigozum trichotomum</i>	LC
<i>Ruschia centrocapsula</i>	LC
<i>Salsola</i> cf. <i>tuberculata</i>	
<i>Tetraena chrysopteron</i>	LC
<i>Tetraena decumbens</i>	LC
<i>Tetragonia arbuscula</i>	LC
<i>Tetragonia reduplicata</i>	LC

Forbs

<i>Acanthopsis hoffmannseggiana</i>	DDT
<i>Amellus epaleaceus</i>	LC
<i>Avonia albissima</i>	LC
<i>Avonia papyracea</i>	LC
<i>Blepharis macra</i>	LC
<i>Blepharis mitrata</i>	LC
<i>Chascanum garipense</i>	LC
<i>Codon royeri</i>	LC
<i>Dicoma capensis</i>	LC
<i>Didelta carnososa</i>	LC
<i>Foveolina dichotoma</i>	LC
<i>Gazania lichtensteinii</i>	LC
<i>Gisekia africana</i>	LC
<i>Heliophila</i> spp.	
<i>Hermannia affinis</i>	LC
<i>Hermbsstaedtia glauca</i>	LC
<i>Indigastrum</i> sp.	
<i>Kewa salsoloides</i>	LC
<i>Kohautia cynanchica</i>	LC
<i>Leobordea</i> sp.	
<i>Mesembryanthemum crystallinum</i>	LC
<i>Monsonia parvifolia</i>	LC
<i>Peliostomum leucorrhizum</i>	LC
<i>Rogeria longiflora</i>	LC
<i>Sericocoma avolans</i>	LC
<i>Sesamum capense</i>	LC
<i>Tetraena simplex</i>	LC
<i>Trianthema parvifolia</i>	LC
<i>Ursinia nana</i>	LC

Geophytes

Geophyte	
<i>Ornithogalum</i> sp.	

Grasses

<i>Aristida engleri</i>	LC
<i>Enneapogon desvauxii</i>	LC
<i>Enneapogon scaber</i>	LC
<i>Eragrostis obtusa</i>	LC
<i>Phragmites australis</i>	LC

<i>Schmidtia kalahariensis</i>	LC
<i>Stipagrostis brevifolia</i>	LC
<i>Stipagrostis ciliata</i>	LC
<i>Stipagrostis obtusa</i>	LC
<i>Stipagrostis uniplumis</i>	LC

Succulents

<i>Aloidendron dichotomum</i>	VU
<i>Anacampseros baeseckeii</i>	LC
<i>Augea capensis</i>	LC
<i>Drosanthemum</i> sp.	
<i>Euphorbia gariepina</i>	LC
<i>Euphorbia rhombifolia</i>	LC
<i>Hoodia gordonii</i>	DDD
<i>Kleinia longiflora</i>	LC
<i>Larryleachia</i> cf. <i>marlothii</i>	LC
<i>Mesembryanthemum arenosus</i>	LC
<i>Mesembryanthemum noctiflora</i>	LC
<i>Mesembryanthemum schenkii</i>	LC
<i>Mesembryanthemum</i> sp.	
<i>Tylecodon rubrovenosus</i>	LC

Aliens

<i>Prosopis glandulosa</i>	
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APPENDIX C

Plant species list of the Aggeneys region based on

NewPosa data, SANBI

(between 29.2° - 29.3° S; 18.7° - 18.9° E)

Acanthaceae	<i>Acanthopsis hoffmannseggiana</i> (Nees) C.B.Clarke
Crassulaceae	<i>Adromischus diabolicus</i> Toelken
Crassulaceae	<i>Adromischus nanus</i> (N.E.Br.) Poelln.
Hyacinthaceae	<i>Albuca glandulifera</i> J.C.Manning & Goldblatt
Asphodelaceae	<i>Aloe microstigma</i> Salm-Dyck
Anacampserotaceae	<i>Anacampseros filamentosa</i> (Haw.) Sims subsp. <i>namaquensis</i> (H.Pearson & Stephens) D.Rowley
Menispermaceae	<i>Antizoma miersiana</i> Harv.
Scrophulariaceae	<i>Aptosimum tragacanthoides</i> E.Mey. ex Benth.
Poaceae	<i>Aristida adscensionis</i> L.
Poaceae	<i>Aristida engleri</i> Mez var. <i>engleri</i>
Poaceae	<i>Aristida congesta</i> Roem. & Schult. subsp. <i>congesta</i>
Asparagaceae	<i>Asparagus exuvialis</i> Burch. forma <i>exuvialis</i>
Asparagaceae	<i>Asparagus suaveolens</i> Burch.
Zygophyllaceae	<i>Augea capensis</i> Thunb.
Anacampserotaceae	<i>Avonia papyracea</i> (E.Mey. ex Fenzl) G.D.Rowley subsp. <i>papyracea</i>
Anacampserotaceae	<i>Avonia albissima</i> (Marloth) G.D.Rowley
Anacampserotaceae	<i>Avonia recurvata</i> (Schonland) G.D.Rowley subsp. <i>recurvata</i>
Acanthaceae	<i>Barleria rigida</i> Nees
Asteraceae	<i>Berkheya spinosissima</i> (Thunb.) Willd. subsp. <i>spinosissima</i>
Asteraceae	<i>Berkheya canescens</i> DC.
Acanthaceae	<i>Blepharis mitrata</i> C.B.Clarke
Acanthaceae	<i>Blepharis macra</i> (Nees) Vollesen
Capparaceae	<i>Boscia foetida</i> Schinz subsp. <i>foetida</i>
Amaryllidaceae	<i>Brunsvigia comptonii</i> W.F.Barker
Amaryllidaceae	<i>Brunsvigia namaquana</i> D.Mull.-Doblies & U.Mull.-Doblies
Verbenaceae	<i>Chascanum garipense</i> E.Mey.
Cucurbitaceae	<i>Coccinia rehmannii</i> Cogn.
Boraginaceae	<i>Codon royenii</i> L.
Burseraceae	<i>Commiphora gracilifrons</i> Dinter ex J.J.A.van der Walt
Aizoaceae	<i>Conophytum angelicae</i> (Dinter & Schwantes) N.E.Br.
Aizoaceae	<i>Conophytum marginatum</i> Lavis subsp. <i>haramoepense</i> (L.Bolus) S.A.Hammer
Aizoaceae	<i>Conophytum calculus</i> (A.Berger) N.E.Br. subsp. <i>vanzylia</i> (Lavis) S.A.Hammer
Cucurbitaceae	<i>Corallocarpus dissectus</i> Cogn.
Crassulaceae	<i>Cotyledon orbiculata</i> L. var. <i>orbiculata</i>
Crassulaceae	<i>Crassula muscosa</i> L. var. <i>muscosa</i>
Crassulaceae	<i>Crassula sericea</i> Schonland var. <i>sericea</i>
Crassulaceae	<i>Crassula exilis</i> Harv. subsp. <i>exilis</i>
Crassulaceae	<i>Crassula deltoidea</i> Thunb.

Fabaceae	<i>Crotalaria meyeriana</i> Steud.
Fabaceae	<i>Crotalaria pearsonii</i> Baker f.
Cucurbitaceae	<i>Cucumis rigidus</i> E.Mey. ex Sond.
Cyperaceae	<i>Cyperus indecorus</i> Kunth var. <i>namaquensis</i> Kuk.
Caryophyllaceae	<i>Dianthus namaensis</i> Schinz
Asteraceae	<i>Dicoma capensis</i> Less.
Asteraceae	<i>Didelta carnosa</i> (L.f.) Aiton var. <i>carnosa</i>
Asteraceae	<i>Dimorphotheca polyptera</i> DC.
Aizoaceae	<i>Dinteranthus puberulus</i> N.E.Br.
Ebenaceae	<i>Diospyros ramulosa</i> (E.Mey. ex A.DC.) De Winter
Hyacinthaceae	<i>Drimia intricata</i> (Baker) J.C.Manning & Goldblatt
Aizoaceae	<i>Drosanthemum hispidum</i> (L.) Schwantes
Aizoaceae	<i>Drosanthemum subcompressum</i> (Haw.) Schwantes
Aizoaceae	<i>Drosanthemum breve</i> L.Bolus
Plumbaginaceae	<i>Dyerophytum africanum</i> (Lam.) Kuntze
Boraginaceae	<i>Ehretia</i> sp.
Poaceae	<i>Enneapogon desvauxii</i> P.Beauv.
Poaceae	<i>Enneapogon cenchroides</i> (Licht. ex Roem. & Schult.) C.E.Hubb.
Poaceae	<i>Enneapogon scaber</i> Lehm.
Poaceae	<i>Eragrostis nindensis</i> Ficalho & Hiern
Asteraceae	<i>Eriocephalus scariousus</i> DC.
Asteraceae	<i>Eriocephalus</i> sp.
Euphorbiaceae	<i>Euphorbia gariepina</i> Boiss.
Euphorbiaceae	<i>Euphorbia spinea</i> N.E.Br.
Euphorbiaceae	<i>Euphorbia gariepina</i> Boiss. subsp. <i>gariepina</i>
Asteraceae	<i>Euryops subcarnosus</i> DC. subsp. <i>vulgaris</i> B.Nord.
Asteraceae	<i>Felicia muricata</i> (Thunb.) Nees subsp. <i>muricata</i>
Poaceae	<i>Fingerhuthia africana</i> Lehm.
Apocynaceae	<i>Fockea comaru</i> (E.Mey.) N.E.Br.
Urticaceae	<i>Forsskaolea candida</i> L.f.
Aizoaceae	<i>Galenia africana</i> L.
Aizoaceae	<i>Galenia sarcophylla</i> Fenzl
Asteraceae	<i>Gazania lichtensteinii</i> Less.
Gisekiaceae	<i>Gisekia africana</i> (Lour.) Kuntze var. <i>africana</i>
Asteraceae	<i>Gorteria diffusa</i> Thunb. subsp. <i>diffusa</i>
Asteraceae	<i>Gorteria alienata</i> (Thunb.) Stangb. & Anderb.
Asphodelaceae	<i>Haworthiopsis tessellata</i> (Haw.) G.D.Rowley var. <i>tessellata</i>
Asteraceae	<i>Helichrysum marmarolepis</i> S.Moore
Asteraceae	<i>Helichrysum tomentosulum</i> (Klatt) Merxm. subsp. <i>aromaticum</i> (Dinter) Merxm.
Asteraceae	<i>Helichrysum pumilio</i> (O.Hoffm.) Hilliard & B.L.Burt subsp. <i>pumilio</i>
Brassicaceae	<i>Heliophila deserticola</i> Schltr. var. <i>deserticola</i>
Brassicaceae	<i>Heliophila trifurca</i> Burch. ex DC.
Malvaceae	<i>Hermannia spinosa</i> E.Mey. ex Harv.
Malvaceae	<i>Hermannia disermifolia</i> Jacq.
Malvaceae	<i>Hermannia stricta</i> (E.Mey. ex Turcz.) Harv.
Malvaceae	<i>Hermannia minutiflora</i> Engl.
Malvaceae	<i>Hermannia gariepina</i> Eckl. & Zeyh.
Amaranthaceae	<i>Hermestaedia glauca</i> (J.C.Wendl.) Rchb. ex Steud.
Malvaceae	<i>Hibiscus elliotiae</i> Harv.
Hydnoraceae	<i>Hydnora africana</i> Thunb.
Fabaceae	<i>Indigastrum argyroides</i> (E.Mey.) Schrire
Fabaceae	<i>Indigofera heterotricha</i> DC. subsp. <i>pechuelii</i> (Kuntze) Schrire
Scrophulariaceae	<i>Jamesbrittenia aridicola</i> Hilliard
Acanthaceae	<i>Justicia spartioides</i> T.Anderson
Asteraceae	<i>Kleinia longiflora</i> DC.

Rubiaceae	<i>Kohautia caespitosa</i> Schnizl. subsp. <i>brachyloba</i> (Sond.) D.Mantell
Hyacinthaceae	<i>Lachenalia polypodantha</i> Schltr. ex W.F.Barker
Santalaceae	<i>Lacomucinaea lineata</i> (L.f.) Nickrent & M.A.Garcia
Apocynaceae	<i>Larryleachia picta</i> (N.E.Br.) Plowes
Hyacinthaceae	<i>Ledebouria</i> sp.
Fabaceae	<i>Leobordea platycarpa</i> (Viv.) B.-E.van Wyk & Boatwr.
Fabaceae	<i>Lessertia</i> sp.
Fabaceae	<i>Lessertia depressa</i> Harv.
Limeaceae	<i>Limeum aethiopicum</i> Burm.f. var. <i>intermedium</i> Friedrich
Fabaceae	<i>Lotononis falcata</i> (E.Mey.) Benth.
Aizoaceae	<i>Mesembryanthemum lignescens</i> (L.Bolus) Klak
Aizoaceae	<i>Mesembryanthemum crystallinum</i> L.
Aizoaceae	<i>Mesembryanthemum schenkii</i> Schinz
Aizoaceae	<i>Mesembryanthemum oculatum</i> N.E.Br.
Aizoaceae	<i>Mesembryanthemum nucifer</i> (Ihlenf. & Bittrich) Klak
Aizoaceae	<i>Mesembryanthemum noctiflorum</i> L. subsp. <i>stramineum</i> (Haw.) Klak
Aizoaceae	<i>Mesembryanthemum tetragonum</i> Thunb.
Apocynaceae	<i>Microcoma incanum</i> Decne.
Montiniaceae	<i>Montinia caryophyllacea</i> Thunb.
Scrophulariaceae	<i>Nemesia maxii</i> Hiern
Asteraceae	<i>Nidorella resedifolia</i> DC. subsp. <i>resedifolia</i>
Asteraceae	<i>Othonna furcata</i> (Lindl.) Druce
Asteraceae	<i>Othonna daucifolia</i> J.C.Manning & Goldblatt
Anacardiaceae	<i>Ozoroa dispar</i> (C.Presl) R.Fern. & A.Fern.
Poaceae	<i>Panicum arbusculum</i> Mez
Sapindaceae	<i>Pappea capensis</i> Eckl. & Zeyh.
Asteraceae	<i>Pegolettia retrofracta</i> (Thunb.) Kies
Geraniaceae	<i>Pelargonium xerophyton</i> Schltr. ex R.Knuth
Geraniaceae	<i>Pelargonium crithmifolium</i> Sm.
Geraniaceae	<i>Pelargonium spinosum</i> Willd.
Asteraceae	<i>Pentzia argentea</i> Hutch.
Asteraceae	<i>Pentzia globosa</i> Less.
Asteraceae	<i>Pentzia lanata</i> Hutch.
Polygalaceae	<i>Polygala seminuda</i> Harv.
Portulacaceae	<i>Portulaca pilosa</i> L.
Didiereaceae	<i>Portulacaria fruticulosa</i> (H.Pearson & Stephens) Bruyns & Klak
Didiereaceae	<i>Portulacaria namaquensis</i> Sond.
Asteraceae	<i>Pteronia unguiculata</i> S.Moore
Asteraceae	<i>Pteronia mucronata</i> DC.
Bignoniaceae	<i>Rhigozum trichotomum</i> Burch.
Aizoaceae	<i>Ruschia centrocapsula</i> H.E.K.Hartmann & Stuber
Aizoaceae	<i>Ruschia cradockensis</i> (Kuntze) H.E.K.Hartmann & Stuber
Aizoaceae	<i>Ruschia</i> sp.
Amaranthaceae	<i>Salsola</i> sp.
Amaranthaceae	<i>Salsola kalaharica</i> Botsch.
Amaranthaceae	<i>Salsola kali</i> L.
Amaranthaceae	<i>Salsola barbata</i> Aellen
Amaranthaceae	<i>Salsola rabieana</i> I.Verd.
Lamiaceae	<i>Salvia garipensis</i> E.Mey. ex Benth.
Poaceae	<i>Schmidtia kalahariensis</i> Stent
Asteraceae	<i>Senecio niveus</i> (Thunb.) Willd.
Asteraceae	<i>Senecio sisymbriifolius</i> DC.
Amaranthaceae	<i>Sericocoma avolans</i> Fenzl
Zygophyllaceae	<i>Sisyndite sparteae</i> E.Mey. ex Sond.
Solanaceae	<i>Solanum capense</i> L.

Solanaceae	<i>Solanum burchellii</i> Dunal
Solanaceae	<i>Solanum humile</i> Lam.
Apocynaceae	<i>Stapelia similis</i> N.E.Br.
Poaceae	<i>Stipagrostis obtusa</i> (Delile) Nees
Poaceae	<i>Stipagrostis ciliata</i> (Desf.) De Winter var. <i>capensis</i> (Trin. & Rupr.) De Winter
Poaceae	<i>Stipagrostis uniplumis</i> (Licht.) De Winter var. <i>uniplumis</i>
Poaceae	<i>Stipagrostis anomala</i> De Winter
Fabaceae	<i>Tephrosia dregeana</i> E.Mey. var. <i>dregeana</i>
Fabaceae	<i>Tephrosia limpopoensis</i> J.B.Gillett
Zygophyllaceae	<i>Tetraena retrofracta</i> (Thunb.) Beier & Thulin
Aizoaceae	<i>Trianthema parvifolia</i> E.Mey. ex Sond.
Zygophyllaceae	<i>Tribulus pterophorus</i> C.Presl
Zygophyllaceae	<i>Tribulus terrestris</i> L.
Boraginaceae	<i>Trichodesma africanum</i> (L.) Lehm.
Aizoaceae	<i>Trichodiadema littlewoodii</i> L.Bolus
Aizoaceae	<i>Trichodiadema obliquum</i> L.Bolus
Poaceae	<i>Tricholaena capensis</i> (Licht. ex Roem. & Schult.) Nees subsp. <i>capensis</i>
Crassulaceae	<i>Tylecodon rubrovenosus</i> (Dinter) Toelken
Asteraceae	<i>Ursinia nana</i> DC. subsp. <i>nana</i>
Santalaceae	<i>Viscum rotundifolium</i> L.f.
Zygophyllaceae	<i>Zygophyllum</i> sp.

APPENDIX D

Protected plant species list and location on site (for permitting requirements NCNCA 2009)

See Figure 13: Vegetation map

<i>Aloidendron dichotomum</i>	-	one young individual in plant community 2, outside road route
<i>Anacampteros baeseckii</i>	-	locally in plant community 2
	-	GPS: 29 15' 10.8" S; 18 46' 33.9" E
<i>Avonia albissima</i>	-	widespread in plant community 1
<i>Avonia papyracea</i>	-	locally in plant communities 1 & 2
<i>Boscia foetida</i> subsp. <i>foetida</i>	-	locally in plant community 2
	-	GPS: 29 15' 10.3" S; 18 46' 35.9"
	-	GPS: 29 15' 09.6" S; 18 46' 38.3" (two individuals)
	-	GPS: 29 15' 08.6" S; 18 46' 37.9" E
<i>Drosanthemum</i> sp.	-	locally in plant community 2
<i>Euphorbia gariepina</i>	-	widespread in plant communities 1 - 4
<i>Euphorbia rhombifolia</i>	-	locally in plant community 4
	-	GPS: 29 15' 04.1" S; 18 46' 07.8" E
<i>Galenia fruticosa</i>	-	common weed, rare on site
<i>Hoodia gordonii</i> (2 individuals)	-	GPS: 29 15' 09.7" S; 18 46' 18.7" E
	-	GPS: 29 15' 10.3" S; 18 46' 35.6" E
<i>Larryleachia</i> cf. <i>marlothii</i>	-	GPS: 29 15' 09.0" S; 18 46' 20.2" E
	-	GPS: 29 15' 10.7" S; 18 46' 25.6" E
	-	GPS: 29 15' 06.1" S; 18 46' 43.5" E
<i>Mesembryanthemum arenosus</i>	-	widespread in plant communities 1 & 3
<i>Mesembryanthemum crystallinum</i>	-	locally in plant communities 3 & 4
<i>Mesembryanthemum noctiflorum</i>	-	locally in plant community 2
<i>Mesembryanthemum schenkii</i>	-	locally in plant community 2
<i>Mesembryanthemum tetragonum</i>	-	locally in plant community 4
<i>Microlooma incanum</i>	-	one individual in plant community 3
<i>Mesembryanthemum</i> sp.	-	locally in plant community 3
<i>Plinthus karooicus</i>	-	locally in plant community 3
<i>Ruschia centrocapsula</i>	-	locally in plant community 2
	-	GPS: 29 15' 08.7" S; 18 46' 37.9" E
<i>Tetragonia arbuscula</i>	-	locally in plant community 3 & 4
<i>Tetragonia reduplicata</i>	-	locally in plant community 2 & 3
<i>Trianthema parvifolia</i>	-	common species in plant communities 1, 2 & 3

APPENDIX E

DIFFERENTIAL TABLE OF THE VEGETATION ON SITE*

Plant community number	1		2		3						4				
Sample plot number	1	1	1	1	1					1			1	3	2
	5	7	1	5	2	4	3	6	4	8	9	0	1	3	2
Species group 1															
<i>Larryleachia cf. marlothii</i>	.	+	.	+	+	.
<i>Avonia albissima</i>	+	+	+	+
<i>Mesembryanthemum arenosus</i>	+	.	.	+	+	.
<i>Sesamum capense</i>	.	+
<i>Amellus epaleaceus</i>	.	+
<i>Pteronia sp.</i>	.	.	+
Species group 2															
<i>Ruschia centrocapsula</i>	+
<i>Drosanthemum sp.</i>	+
<i>Aloidendron dichotoma</i>	+
Species group 3															
<i>Boscia foetida</i>	+	+
<i>Mesembryanthemum schenkii</i>	+	+
<i>Mesembryanthemum noctiflora</i>	+	+
<i>Anacampseros baeseckeii</i>	+	+
<i>Tylecodon rubrovenosus</i>	+	+
Geophyte	+	+
Species group 4															
<i>Ursinia nana</i>	.	.	+	+	+	+
<i>Monsonia crassicaule</i>	+	.	.	.	+
<i>Avonia papyracea</i>	.	+	.	.	+
Species group 5															
<i>Aristida engleri</i>	1
<i>Microloma incanum</i>	+
<i>Leobordea sp.</i>	+
<i>Chascanum garipense</i>	+
<i>Ornithogalum sp.</i>	+
<i>Pteronia cf. mucronata</i>	+
Species group 6															
<i>Tetraena chrysopteron</i>	+	+
<i>Osteospermum sinuata</i>	+
<i>Plinthus karoocicus</i>	+
<i>Parkinsonia africana</i>	+
<i>Kohautia cynanchica</i>	+
Species group 7															
<i>Monechma cf. divaricatum</i>	+	.	.	.	+
<i>Melolobium microphyllum</i>	+	.	.	+
<i>Acanthopsis hoffmannseggiana</i>	+	.	.	+

<i>Mesembryanthemum</i> sp. + 																																																																																																																																																																			
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<i>Lacomucina lineatum</i>																																																																																																																																																																										
<i>Tetragonia reduplicata</i>																																																																																																																																																																										
<i>Eragrostis obtusa</i>																																																																																																																																																																										
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<i>Stipagrostis uniplumis</i>	+	+	+	+																																																																																																																																																											
<i>Hermannia stricta</i>	+	+	+																																																																																																																																																										
<i>Sisyndite sparteae</i>	1	.	+																																																																																																																																																										
<i>Diospyros austro-africana</i>																																																																																																																																																										
<i>Augea capensis</i>																																																																																																																																																										
<i>Antherothamnus pearsonii</i>																																																																																																																																																										
<i>Mesembryanthemum tetragonum</i>																																																																																																																																																										
<i>Monsonia parvifolia</i>																																																																																																																																																										
<i>Phaeoptilum spinosum</i>																																																																																																																																																										
<i>Hermannia affinis</i>																																																																																																																																																										
<i>Foveolina dichotoma</i>																																																																																																																																																										
<i>Euphorbia rhombifolia</i>																																																																																																																																																										
Species group 13																																																																																																																																																																										
<i>Tetragonia arbuscula</i>	+	.	.	+																																																																																																																																																									
<i>Mesembryanthemum crystallinum</i>	+	.	.																																																																																																																																																									
<i>Lycium oxycarpum</i>	+	.	+																																																																																																																																																									
Species group 14																																																																																																																																																																										
<i>Limeum aethiopicum</i>	+	.	.	+																																																																																																																																																									
<i>Blepharis mitrata</i>	+	.	.	+																																																																																																																																																									
<i>Lycium cinereum</i>	+	.	.	+																																																																																																																																																									
<i>Stipagrostis brevifolia</i>	+	.	.	+																																																																																																																																																									
<i>Monechma incanum</i>	+	.	.	+																																																																																																																																																									
<i>Eriocephalus scariosus</i>	+	.	.	+																																																																																																																																																									
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<i>Rhigozum trichotomum</i>	+	+	1	a	.	+	+	.	+																																																																																																																																																									
<i>Kleinia longiflora</i>	+	+	.	+	+	.	+																																																																																																																																																									
<i>Stipagrostis ciliata</i>	+	.	+	+	+	+	+																																																																																																																																																									
<i>Stipagrostis obtusa</i>	+	+	.	+	+	+	+	+																																																																																																																																																									
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<i>Euphorbia gariepina</i>	<table border="1"> <tbody> <tr> <td>+</td><td>.</td><td>+</td><td>.</td><td>.</td><td>.</td><td>1</td><td>+</td><td>+</td><td>.</td><td>+</td><td>+</td><td>.</td><td>.</td><td>.</td><td>.</td><td>+</td> </tr> <tr> <td>+</td><td>1</td><td>+</td><td>+</td><td>1</td><td>+</td><td>.</td><td>.</td><td>+</td><td>+</td><td>.</td><td>+</td><td>+</td><td>.</td><td>+</td><td>+</td><td>+</td> </tr> <tr> <td>.</td><td>.</td><td>+</td><td>+</td><td>+</td><td>+</td><td>+</td><td>+</td><td>+</td><td>+</td><td>.</td><td>.</td><td>+</td><td>+</td><td>.</td><td>.</td><td>+</td> </tr> <tr> <td>.</td><td>.</td><td>+</td><td>+</td><td>+</td><td>+</td><td>+</td><td>+</td><td>.</td><td>.</td><td>.</td><td>.</td><td>+</td><td>+</td><td>.</td><td>.</td><td>+</td> </tr> <tr> <td>+</td><td>+</td><td>+</td><td>+</td><td>.</td><td>.</td><td>.</td><td>+</td><td>.</td><td>+</td><td>.</td><td>+</td><td>.</td><td>+</td><td>+</td><td>.</td><td>+</td> </tr> <tr> <td>+</td><td>+</td><td>+</td><td>.</td><td>.</td><td>.</td><td>.</td><td>+</td><td>.</td><td>+</td><td>1</td><td>+</td><td>.</td><td>1</td><td>+</td><td>+</td><td>+</td> </tr> <tr> <td>+</td><td>+</td><td>.</td><td>.</td><td>+</td><td>.</td><td>.</td><td>.</td><td>+</td><td>+</td><td>+</td><td>+</td><td>+</td><td>.</td><td>.</td><td>.</td><td>+</td> </tr> <tr> <td>1</td><td>.</td><td>.</td><td>.</td><td>.</td><td>+</td><td>+</td><td>.</td><td>.</td><td>+</td><td>+</td><td>.</td><td>.</td><td>.</td><td>.</td><td>.</td><td>+</td> </tr> <tr> <td>+</td><td>.</td><td>+</td><td>+</td><td>+</td><td>+</td><td>.</td><td>.</td><td>.</td><td>.</td><td>+</td><td>.</td><td>.</td><td>.</td><td>.</td><td>.</td><td>+</td> </tr> </tbody> </table>																	+	.	+	.	.	.	1	+	+	.	+	+	+	+	1	+	+	1	+	.	.	+	+	.	+	+	.	+	+	+	.	.	+	+	+	+	+	+	+	+	.	.	+	+	.	.	+	.	.	+	+	+	+	+	+	+	+	.	.	+	+	+	+	+	.	.	.	+	.	+	.	+	.	+	+	.	+	+	+	+	+	.	+	1	+	.	1	+	+	+	+	+	.	.	+	.	.	.	+	+	+	+	+	.	.	.	+	1	+	+	.	.	+	+	+	+	.	+	+	+	+	+	+
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<i>Enneapogon desvauxii</i>																																																																																																																																																																										
<i>Heliophila</i> spp.																																																																																																																																																																										
<i>Galenia</i> sp.																																																																																																																																																																										
<i>Didelta carnosa</i>																																																																																																																																																																										
<i>Salsola cf. tuberculata</i>																																																																																																																																																																										
<i>Gazania lichtensteinii</i>																																																																																																																																																																										
<i>Enneapogon scaber</i>																																																																																																																																																																										
<i>Kewa salsoloides</i>																																																																																																																																																																										

*The differential table is compiled following the Braun-Blanquet phytosociological approach (Werger 1974). The columns represent the sample plots and the rows represent the plant species. Plots with a similar species composition are grouped together to identify plant communities.

The canopy cover estimates (the values in the matrix) are according to the scale used in the Braun-Blanquet approach:

- + means a canopy cover/abundance estimate of less than 1%;
- 1 means a canopy cover of 1 – 5%;
- 2a means a canopy cover value of >5 to 15%;
- 2b means a canopy cover value of >15 – 25%;
- 3 means a canopy cover value of >25 – 50%;
- 4 means a canopy cover value of >50 – 75%; and
- 5 means a canopy cover value of >75%.

APPENDIX F

LISTS OF ANIMAL SPECIES

Mammals

(Du Plessis 1969, Mills & Hess 1997, Van der Walt 2000, Friedmann & Daly 2004, Skinner & Chimimba 2005, Red data book of mammals 2012 & Todd, 2012)

Artiodactyla/Perissodactyla/Proboscidea

Gemsbok	LC
Grey duiker	LC
Klipspringer	LC
Springbok	LC
Steenbok	LC

Hyracoidea

Rock hyrax	LC
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Carnivora

Aardwolf	LC
African wild cat	LC
Bat-eared fox	LC
Black-backed jackal	LC
Black-footed cat	VU
Cape fox	LC
Caracal	LC
Honey badger	LC
Leopard	VU
Slender mongoose	LC
Small grey mongoose	LC
Small-spotted genet	LC
Striped pole-cat	LC
Suricate	LC
Yellow mongoose	LC

Chiroptera

Angolan hairy bat	NT
Cape serotine bat	LC
Egyptian slit-faced bat	LC
Darling's horse-shoe bat	LC
Dent's horse-shoe bat	NT
Flat-headed free-tail bat	LC
Egyptian free-tail bat	LC

Insectivora

Reddish-grey musk shrew	LC
Lesser red musk shrew	LC
Lagomorpha	
Cape hare/desert hare	LC
Scrub/savanna hare	LC
Primata	
Vervet monkey	LC
Chacma baboon	LC
Rodentia	
Namaqua rock mouse	LC
Cape short-eared gerbil	LC
Hairy-footed gerbil	LC
Cape porcupine	LC
Large-eared mouse	LC
Multimammate mouse	LC
Brant's whistling rat	LC
Springhare	LC
Dassie rat	LC
Pygmy rock mouse	LC
Xeric four-striped mouse	LC
Pouched mouse	LC
Bushveld gerbil	LC
Ground squirrel	LC
Macroscelidea/Pholidota/Tubulidentata	
Bushveld sengi	LC
Western rock sengi	LC
Round-eared sengi	LC
Aardvark	LC

Avifauna

(Todd 2012)

Family	Species	Status
Accipitridae	<i>Aquila pennatus</i>	LC
Accipitridae	<i>Aquila verreauxii</i>	LC
Accipitridae	<i>Buteo rufofuscus</i>	LC
Accipitridae	<i>Buteo vulpinus</i>	LC
Accipitridae	<i>Circaetus pectoralis</i>	LC
Accipitridae	<i>Circus maurus</i>	NT
Accipitridae	<i>Elanus caeruleus</i>	LC
Accipitridae	<i>Gyps africanus</i>	VU
Accipitridae	<i>Melierax canorus</i>	LC
Accipitridae	<i>Melierax gabar</i>	LC
Accipitridae	<i>Polemaetus bellicosus</i>	VU
Accipitridae	<i>Milvus migrans</i>	LC
Alaudidae	<i>Calandrella cinerea</i>	LC
Alaudidae	<i>Calendulauda africanoides</i>	LC
Alaudidae	<i>Calendulauda burra</i>	LC
Alaudidae	<i>Calendulauda sabota</i>	LC
Alaudidae	<i>Certhilauda curvirostris</i>	LC
Alaudidae	<i>Chersomanes albofasciata</i>	LC
Alaudidae	<i>Eremopterix australis</i>	LC
Alaudidae	<i>Eremopterix verticalis</i>	LC
Alaudidae	<i>Galerida magnirostris</i>	LC
Alaudidae	<i>Mirafra apiata</i>	LC
Alaudidae	<i>Spizocorys conirostris</i>	LC
Alaudidae	<i>Spizocorys sclateri</i>	NT
Alaudidae	<i>Spizocorys starki</i>	LC
Anatidae	<i>Alopochen aegyptiacus</i>	LC
Anatidae	<i>Anas capensis</i>	LC
Anatidae	<i>Anas erythrorhyncha</i>	LC
Anatidae	<i>Anas smithii</i>	LC
Anatidae	<i>Anas undulate</i>	LC
Anatidae	<i>Netta erythrophthalma</i>	LC
Anatidae	<i>Oxyura maccoa</i>	LC
Anatidae	<i>Plectropterus gambensis</i>	LC
Anatidae	<i>Tadorna cana</i>	LC
Apodidae	<i>Apus affinis</i>	LC
Apodidae	<i>Apus apus</i>	LC
Apodidae	<i>Apus bradfieldi</i>	LC
Apodidae	<i>Apus caffer</i>	LC
Apodidae	<i>Tachymarptis melba</i>	LC
Ardeidae	<i>Ardea cinerea</i>	LC
Ardeidae	<i>Ardea melanocephala</i>	LC
Ardeidae	<i>Bubulcus ibis</i>	LC
Ardeidae	<i>Egretta intermedia</i>	LC
Ardeidae	<i>Ixobrychus minutus</i>	LC
Burhinidae	<i>Burhinus capensis</i>	LC
Capitonidae	<i>Tricholaema leucomelas</i>	LC
Caprimulgidae	<i>Caprimulgus rufigena</i>	LC
Charadriidae	<i>Charadrius hiaticula</i>	LC
Charadriidae	<i>Charadrius pallidus</i>	NT

Charadriidae	<i>Charadrius pecuarius</i>	LC
Charadriidae	<i>Charadrius tricollaris</i>	LC
Charadriidae	<i>Vanellus armatus</i>	LC
Charadriidae	<i>Vanellus coronatus</i>	LC
Ciconiidae	<i>Ciconia nigra</i>	NT
Coliidae	<i>Colius colius</i>	LC
Coliidae	<i>Urocolius indicus</i>	LC
Columbidae	<i>Columba guinea</i>	LC
Columbidae	<i>Columba livia</i>	LC
Columbidae	<i>Oena capensis</i>	LC
Columbidae	<i>Streptopelia capicola</i>	LC
Columbidae	<i>Streptopelia semitorquata</i>	LC
Columbidae	<i>Streptopelia senegalensis</i>	LC
Corvidae	<i>Corvus albus</i>	LC
Corvidae	<i>Corvus capensis</i>	LC
Cuculidae	<i>Chrysococcyx caprius</i>	LC
Estrildidae	<i>Amadina erythrocephala</i>	LC
Estrildidae	<i>Estrilda astrild</i>	LC
Estrildidae	<i>Lagonosticta senegala</i>	LC
Falconidae	<i>Falco biarmicus</i>	NT
Falconidae	<i>Falco chicquera</i>	LC
Falconidae	<i>Falco rupicoloides</i>	LC
Falconidae	<i>Polihierax semitorquatus</i>	LC
Fringillidae	<i>Crithagra albogularis</i>	LC
Fringillidae	<i>Crithagra atrogularis</i>	LC
Fringillidae	<i>Crithagra flaviventris</i>	LC
Fringillidae	<i>Emberiza capensis</i>	LC
Fringillidae	<i>Emberiza impetuani</i>	LC
Fringillidae	<i>Serinus alario</i>	LC
Glareolidae	<i>Cursorius rufus</i>	LC
Glareolidae	<i>Rhinoptilus africanus</i>	LC
Halcyonidae	<i>Alcedo cristata</i>	LC
Hirundinidae	<i>Delichon urbicum</i>	LC
Hirundinidae	<i>Hirundo albigularis</i>	LC
Hirundinidae	<i>Hirundo fuligula</i>	LC
Hirundinidae	<i>Hirundo rustica</i>	LC
Hirundinidae	<i>Riparia paludicola</i>	LC
Laniidae	<i>Lanius collaris</i>	LC
Laniidae	<i>Lanius minor</i>	LC
Laridae	<i>Chlidonias leucopterus</i>	LC
Malaconotidae	<i>Nilaus afer</i>	LC
Malaconotidae	<i>Telophorus zeylonus</i>	LC
Meropidae	<i>Merops apiaster</i>	LC
Meropidae	<i>Merops hirundineus</i>	LC
Motacillidae	<i>Anthus cinnamomeus</i>	LC
Motacillidae	<i>Anthus crenatus</i>	LC
Motacillidae	<i>Anthus similis</i>	LC
Motacillidae	<i>Motacilla aguimp</i>	LC
Motacillidae	<i>Motacilla capensis</i>	LC
Muscicapidae	<i>Batis pririt</i>	LC
Muscicapidae	<i>Bradornis infuscatus</i>	LC
Muscicapidae	<i>Muscicapa striata</i>	LC
Muscicapidae	<i>Stenostira scita</i>	LC
Nectariniidae	<i>Cinnyris chalybeus</i>	LC
Nectariniidae	<i>Cinnyris fuscus</i>	LC
Nectariniidae	<i>Nectarinia famosa</i>	LC
Otididae	<i>Ardeotis kori</i>	VU
Otididae	<i>Afrotis afra</i>	LC
Otididae	<i>Eupodotis vigorsii</i>	LC
Otididae	<i>Neotis ludwigii</i>	VU
Phasianidae	<i>Coturnix coturnix</i>	LC
Phoenicopteridae	<i>Phoenicopus ruber</i>	NT
Plataleidae	<i>Threskiornis aethiopicus</i>	LC

Ploceidae	<i>Euplectes orix</i>	LC
Ploceidae	<i>Passer diffuses</i>	LC
Ploceidae	<i>Passer domesticus</i>	LC
Ploceidae	<i>Passer melanurus</i>	LC
Ploceidae	<i>Philetairus socius</i>	LC
Ploceidae	<i>Plocepasser mahali</i>	LC
Ploceidae	<i>Ploceus velatus</i>	LC
Ploceidae	<i>Quelea quelea</i>	LC
Ploceidae	<i>Sporopipes squamifrons</i>	LC
Podicipedidae	<i>Tachybaptus ruficollis</i>	LC
Pteroclididae	<i>Pterocles bicinctus</i>	LC
Pteroclididae	<i>Pterocles namaqua</i>	LC
Pycnonotidae	<i>Pycnonotus nigricans</i>	LC
Rallidae	<i>Fulica cristata</i>	LC
Recurvirostridae	<i>Himantopus himantopus</i>	LC
Recurvirostridae	<i>Recurvirostra avosetta</i>	LC
Remizidae	<i>Anthoscopus minutus</i>	LC
Sagittariidae	<i>Sagittarius serpentarius</i>	NT
Scolopacidae	<i>Actitis hypoleucos</i>	LC
Scolopacidae	<i>Arenaria interpres</i>	LC
Scolopacidae	<i>Calidris ferruginea</i>	LC
Scolopacidae	<i>Calidris minuta</i>	LC
Scolopacidae	<i>Tringa glareola</i>	LC
Scolopacidae	<i>Tringa nebularia</i>	LC
Scolopacidae	<i>Tringa stagnatilis</i>	LC
Scopidae	<i>Scopus umbretta</i>	LC
Strigidae	<i>Bubo africanus</i>	LC
Strigidae	<i>Bubo capensis</i>	LC
Struthionidae	<i>Struthio camelus</i>	LC
Sturnidae	<i>Creatophora cinerea</i>	LC
Sturnidae	<i>Lamprotornis nitens</i>	LC
Sturnidae	<i>Onychognathus nabouroup</i>	LC
Sylviidae	<i>Acrocephalus baeticatus</i>	LC
Sylviidae	<i>Acrocephalus gracilirostris</i>	LC
Sylviidae	<i>Cisticola juncidis</i>	LC
Sylviidae	<i>Cisticola subruficapilla</i>	LC
Sylviidae	<i>Eremomela gregalis</i>	LC
Sylviidae	<i>Eremomela icteropygialis</i>	LC
Sylviidae	<i>Eurypytila subcinnamea</i>	LC
Sylviidae	<i>Malcorus pectoralis</i>	LC
Sylviidae	<i>Parisoma layardi</i>	LC
Sylviidae	<i>Parisoma subcaeruleum</i>	LC
Sylviidae	<i>Phragmacia substriata</i>	LC
Sylviidae	<i>Phylloscopus trochilus</i>	LC
Sylviidae	<i>Prinia flavicans</i>	LC
Sylviidae	<i>Prinia hypoxantha</i>	LC
Sylviidae	<i>Sylvietta rufescens</i>	LC
Turdidae	<i>Cercomela familiaris</i>	LC
Turdidae	<i>Cercomela schlegelii</i>	LC
Turdidae	<i>Cercomela sinuata</i>	LC
Turdidae	<i>Cercomela traqrac</i>	LC
Turdidae	<i>Cercotrichas coryphoeus</i>	LC
Turdidae	<i>Cossypha caffra</i>	LC
Turdidae	<i>Monticola brevipes</i>	LC
Turdidae	<i>Myrmecocichla formicivora</i>	LC
Turdidae	<i>Oenanthe monticola</i>	LC
Turdidae	<i>Oenanthe pileata</i>	LC
Turdidae	<i>Turdus olivaceus</i>	LC
Tytonidae	<i>Tyto alba</i>	LC
Upupidae	<i>Upupa africana</i>	LC
Zosteropidae	<i>Zosterops pallidus</i>	LC

Reptiles

(2918B grid ADU database, Todd 2012, Bates *et al.*
2014)

Scientific name	Common name	IUCN status
Tortoises and Terrapins:		
<i>Psammobates tentorius</i>	Bushmanland Tent Tortoise	LC
Snakes:		
<i>Aspidelaps lubricus</i>	Coral Shield Cobra	LC
<i>Bitis arietans</i>	Puff Adder	LC
<i>Bitis caudalis</i>	Horned Adder	LC
<i>Bitis cornuta</i>	Many-horned Adder	LC
<i>Bitis xeropaga</i>	Desert Mountain Adder	LC
<i>Boaedon capensis</i>	Brown House Snake	LC
<i>Dasypeltis scabra</i>	Common/Rhombic Egg Eater	LC
<i>Dipsina multimaculata</i>	Dwarf Beaked Snake	LC
<i>Lamprophis guttatus</i>	Spotted Rock Snake	LC
<i>Naja nigricollis woodi</i>	Black Spitting Cobra	LC
<i>Naja nivea</i>	Cape Cobra	LC
<i>Namibiana occidentalis</i>	Western Thread Snake	LC
<i>Prosymna bivittata</i>	Two-striped Shovel-snout	LC
<i>Psammophis namibensis</i>	Namib Whip Snake	LC
<i>Psammophis notostictus</i>	Karoo Sand or Whip Snake	LC
<i>Pseudaspis cana</i>	Mole Snake	LC
<i>Rhinotyphlops lalandei</i>	Delalande's Beaked Blind Snake	LC
<i>Rhinotyphlops schinzi</i>	Schinz's Beaked Blind Snake	LC
<i>Telescopus beetzii</i>	Beetz's Tiger Snake	LC
Lizard and Skinks:		
<i>Acontias lineatus</i>	Striped Legless Skink	LC
<i>Agama aculeata</i>	Western Ground Agama	LC
<i>Agama anchietae</i>	Anchieta's Agama	LC
<i>Agama atra</i>	Southern Rock Agama	LC
<i>Karusasaurus polyzonus</i>	Karoo Girdled Lizard	LC
<i>Meroles knoxii</i>	Knox's Desert Lizard	LC
<i>Meroles suborbitalis</i>	Spotted Desert Lizard	LC
<i>Nucras tessellata</i>	Western Sandveld Lizard	LC
<i>Ouroborus cataphractus</i>	Armadillo Girdled Lizard	LC
<i>Pedioplanis inornata</i>	Plain Sand Lizard	LC
<i>Pedioplanis laticeps</i>	Cape Sand Lizard	LC
<i>Pedioplanis lineoocellata</i>	Spotted Sand Lizard	LC
<i>Pedioplanis namaquensis</i>	Namaqua Sand Lizard	LC
<i>Pedioplanis undata</i>	Western Sand Lizard	LC
<i>Trachylepis capensis</i>	Cape Skink	LC
<i>Trachylepis occidentalis</i>	Western Three-Striped Skink	LC
<i>Trachylepis spilogaster</i>	Kalahari Tree Skink	LC
<i>Trachylepis sulcata sulcata</i>	Western Rock Skink	LC
<i>Trachylepis variegata</i>	Variegated Skink	LC

Chameleons:

<i>Chamaeleo namaquensis</i>	Namaqua Chameleon	LC
<i>Chondrodactylus angulifer</i>	Giant Ground Gecko	LC
<i>Chondrodactylus bibronii</i>	Bibron's Tubercled Gecko	LC
<i>Chondrodactylus turneri</i>	Turner's Tubercled Gecko	LC
<i>Lygodactylus bradfieldi</i>	Bradfield's Dwarf Gecko	LC
<i>Pachydactylus mariquensis</i>	Marico Thick-toed Gecko	LC
<i>Pachydactylus montanus</i>	Namaqua Mountain Gecko	LC
<i>Pachydactylus purcelli</i>	Purcell's Thick-toed gecko	LC
<i>Pachydactylus rugosus</i>	Common Rough Gecko	LC
<i>Pachydactylus haackei</i>	Haacke's Thick-toed Gecko	LC
<i>Ptenopus garrulous maculatus</i>	Spotted Barking Gecko	LC

Amphibians

(2918B grid, ADU database)

Scientific Name	Common Name	Status
<i>Vandijkophrynus gariiepensis</i>	Karoo Toad	LC
<i>Vandijkophrynus robinsoni</i>	Paradise Toad	LC
<i>Phrynomantis annectens</i>	Marbled Rubber Frog	LC
<i>Xenopus laevis</i>	Common Platanna	LC

Scorpions

(2918B grid, ADU database, Van der Walt 2000)

Family

Hormuridae
Hormuridae
Buthidae
Buthidae
Buthidae
Buthidae
Buthidae
Buthidae
Buthidae
Buthidae
Buthidae
Buthidae
Buthidae
Buthidae
Buthidae
Scorpionidae
Scorpionidae
Scorpionidae
Scorpionidae
Scorpionidae

Species

Hadogenes phyllodes
Hadogenes zumpti
Hottentotta arenaceus
Karasbergia methueni
Parabuthus brevipennis
Parabuthus capensis
Parabuthus granulatus
Parabuthus leavipes
Parabuthus nanus
Parabuthus raudus
Parabuthus schlechteri
Uroplectes carinatus
Uroplectes gracilior
Uroplectes schlechteri
Opisthophthalmus carinatus
Opisthophthalmus gigas
Opisthophthalmus longicauda
Opisthophthalmus lornae
Opisthophthalmus wahlbergii

Butterflies

(2918B grid, ADU database)

Family	Scientific name	Common name	Red list category
HESPERIIDAE	<i>Spialia nanus</i>	Dwarf sandman	Least Concern (SABCA 2013)
LYCAENIDAE	<i>Aloeides barklyi</i>	Barkly's copper	Least Concern (SABCA 2013)
LYCAENIDAE	<i>Aloeides damarensis damarensis</i>	Damara copper	Least Concern (SABCA 2013)
LYCAENIDAE	<i>Azanus ubaldus</i>	Velvet-spotted babul blue	Least Concern (SABCA 2013)
LYCAENIDAE	<i>Brephidium metophis</i>	Tinktinkie blue	Least Concern (SABCA 2013)
LYCAENIDAE	<i>Chilades trochylus</i>	Grass jewel	Least Concern (SABCA 2013)
LYCAENIDAE	<i>Chrysoritis chryasantas</i>	Karoo opal	Least Concern (SABCA 2013)
LYCAENIDAE	<i>Cigaritis namaqua</i>	Namaqua bar	Least Concern (SABCA 2013)
LYCAENIDAE	<i>Leptotes pirithous pirithous</i>	Common zebra blue	Least Concern (SABCA 2013)
LYCAENIDAE	<i>Phasis clavum clavum</i>	Namagua arrowhead	Least Concern (SABCA 2013)
LYCAENIDAE	<i>Stugeta subinfusata reynoldsi</i>	Dusky marbled sapphire	Least Concern (SABCA 2013)
LYCAENIDAE	<i>Zizeeria knysna knysna</i>	African grass blue	Least Concern (SABCA 2013)
NYMPHALIDAE	<i>Acraea horta</i>	Garden acraea	Least Concern (SABCA 2013)
NYMPHALIDAE	<i>Danaus chrysippus orientis</i>	African monarch, Plain tiger	Least Concern (SABCA 2013)
NYMPHALIDAE	<i>Hypolimnas misippus</i>	Common diadem	Least Concern (SABCA 2013)
NYMPHALIDAE	<i>Junonia hierta cebrene</i>	Yellow pansy	Least Concern (SABCA 2013)
NYMPHALIDAE	<i>Vanessa cardui</i>	Painted lady	Least Concern (SABCA 2013)
NYMPHALIDAE	<i>Ypthima asterope hereroica</i>	African ringlet	Least Concern (SABCA 2013)
PIERIDAE	<i>Belenois aurota</i>	Brown-veined white	Least Concern (SABCA 2013)
PIERIDAE	<i>Catopsilia florella</i>	African migrant	Least Concern (SABCA 2013)
PIERIDAE	<i>Colotis euippe omphale</i>	Smoky orange tip	Least Concern (LC)
PIERIDAE	<i>Pontia helice helice</i>	Common meadow white	Least Concern (SABCA 2013)
PIERIDAE	<i>Teracolus agoye bowkeri</i>	Speckled sulphur tip	Least Concern (SABCA 2013)
PIERIDAE	<i>Teracolus eris eris</i>	Banded gold tip	Least Concern (SABCA 2013)

APPENDIX G

PHOTO-SERIES OF THE SELECTED ROUTE OF THE PROPOSED HAUL ROAD

- A. Photo-series from **east** (from Broken Hill rock waste dump) to the connection with the current haul road in the **west**.



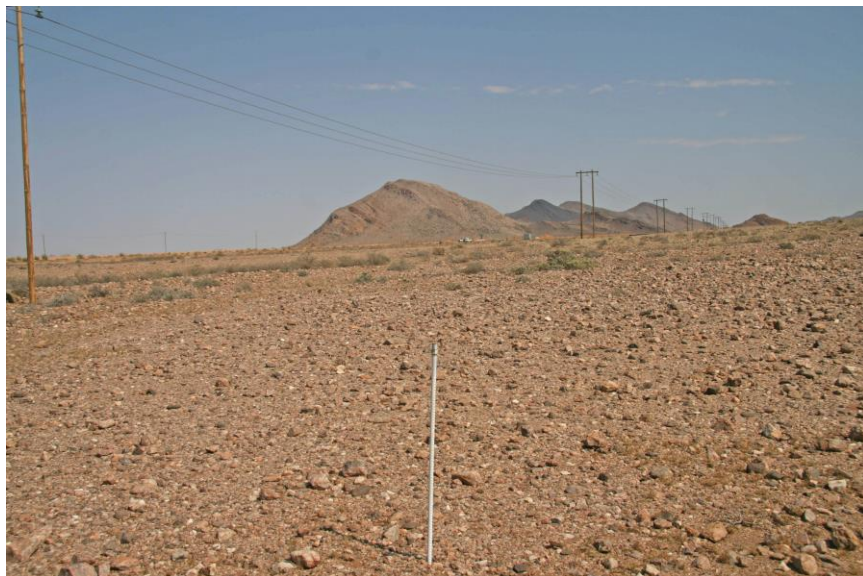




Photo-series of the preferred route of the haul road from the **west** to the Broken Hill rock dump site in the **east**.







APPENDIX H

Curriculum vitae: DR NOEL VAN ROOYEN

1. Biographical information

Surname	Van Rooyen
First names	Noel
ID number	501225 5034 084
Citizenship	South African
Business address	Ekotrust CC 7 St George Street Lionviham 7130 Somerset West South Africa
Mobile	082 882 0886
e-mail	noel@ekotrust.co.za
Current position	Member of Ekotrust cc
Professional registration	Botanical Scientist : Pr.Sci.Nat; Reg no. 401430/83

Academic qualifications include BSc (Agric), BSc (Honours), MSc (1978) and DSc degrees (1984) in Plant Ecology at the University of Pretoria, South Africa. Until 1999 I was Professor in Plant Ecology at the University of Pretoria and at present I am a member of Ekotrust cc.

2. Publications

I am the author/co-author of 123 peer reviewed research publications in national and international scientific journals and was supervisor or co-supervisor of 9 PhD and 33 MSc students. More than 300 projects were undertaken by Ekotrust cc as consultant over a period of more than 28 years.

Books

VAN ROOYEN, N. 2001. **Flowering plants of the Kalahari dunes**. Ekotrust CC, Pretoria. (In collaboration with H. Bezuidenhout & E. de Kock).

Author / co-author of various chapters on the Savanna and Grassland Biomes in:

LOW, B. & REBELO, A.R. 1996. **Vegetation types of South Africa, Lesotho and Swaziland**, Department of Environmental Affairs and Tourism, Pretoria.

KNOBEL, J. (Ed.) 1999, 2006. **The Magnificent Natural Heritage of South Africa**. (Chapters on the Kalahari and Lowveld).

VAN DER WALT, P.T. 2010. **Bushveld**. Briza, Pretoria. (Chapter on Sour Bushveld).

Contributed to chapters on vegetation, habitat evaluation and veld management in the book:

BOTHMA, J. du P. & DU TOIT, J.G. (Eds). 2016. **Game Ranch Management**. 5th edition. Van Schaik, Pretoria.

Co-editor of the book:

BOTHMA, J. du P. & VAN ROOYEN, N. (eds). 2005. **Intensive wildlife production in southern Africa**. Van Schaik, Pretoria.

2. Ekotrust CC: Core Services

Ekotrust CC specializes in vegetation surveys, classification and mapping, wildlife management, wildlife production and economic assessments, vegetation ecology, veld condition assessment, carrying capacity, biodiversity assessments, rare species assessments, carbon pool assessments and alien plant management.

3. Examples of projects

Numerous vegetation surveys and vegetation impact assessments for Baseline, Scoping and Environmental Impact Assessments (EIA's) were made both locally and internationally.

Numerous projects have been undertaken in game ranches and conservation areas covering aspects such as vegetation surveys, range condition assessments and wildlife management. Of note is the Kgalagadi Transfrontier Park; iSimangaliso Wetland Park, Ithala Game Reserve, Phinda Private Game Reserve, Mabula Game Reserve, Tswalu Kalahari Desert Reserve, Maremani Nature Reserve and Associate Private Nature Reserve (previously Timbavati, Klaserie & Umbabat Private Game Reserve).

Involvement in various research programmes: vegetation of the northern Kruger National Park, Savanna Ecosystem Project at Nylsvley, Limpopo; Kuiseb River Project (Namibia); Grassland Biome Project; Namaqualand and Kruger Park Rivers Ecosystem research programme.

4. Selected references of projects done by Ekotrust CC

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- VAN ROOYEN, N., VAN ROOYEN, M.W. & GROBLER, A. 2004. Habitat evaluation and stocking rates for wildlife and livestock - PAN TRUST Ranch, Ghanzi, Botswana.
- VAN ROOYEN, N. 2004. Vegetation and wildlife of the Greater St Lucia Wetland Park, KZN.
- VAN ROOYEN, N. & VAN ROOYEN, M.W. 2008. Vegetation classification, habitat evaluation and wildlife management of the proposed Royal Big Six Nsubane-Pongola Transfrontier Park, Swaziland. Ekotrust cc.
- VAN ROOYEN, N., VAN DER MERWE, H. & VAN ROOYEN, M.W. 2011. The vegetation of Vaalputs. Report to NECSA.
- VAN ROOYEN, M.W. & VAN ROOYEN, N. 2013. Carbon in the woody vegetation in the Mayoko area, Republic of Congo. Report to Flora, Fauna & Man Ecological Consultants.
- VAN ROOYEN, M.W. & VAN ROOYEN, N. 2013. Resource assessment of *Elephantorrhiza elephantina* on farms (or portions) of Abbey, Tweed, Concordia and Bellville, Northern Cape. Report to CSIR.
- VAN ROOYEN, N. & VAN ROOYEN, M.W. 2014. Ecological evaluation and wildlife management on Ndzalama Nature Reserve and adjacent farms, Gravelotte, Limpopo province.
- VAN ROOYEN, M.W. & VAN ROOYEN, N. & VAN DEN BERG, H. 2016. Kathu Bushveld study: Research offset for first development phase of Adams Solor Energy Facility. Project conducted for Department of Environment and Nature Conservation Northern Cape (DENC) and the Department of Agriculture, Forestry and Fisheries (DAFF).
- VAN ROOYEN, N. & VAN ROOYEN, M.W. 2016. Ecological evaluation of the farm Springbokoog in the Van Wyksvlei region of Northern Cape, including a habitat assessment for the introduction of black rhinoceros. Ekotrust cc.
- VAN ROOYEN, N. & VAN ROOYEN, M.W. 2017. Biophysical assessment of Vrysoutpan, Northern Cape. Ekotrust cc, Somerset West.
- VAN ROOYEN, N. & VAN ROOYEN, M.W. 2018. Present ecological status; ecological importance and sensitivity; and Ecological risk assessment of the proposed vinyard development on Deo Gloria, Northern Cape. Ekotrust cc, Somerset West.

5. Selected publications

- VAN ROOYEN, N. 1978. A supplementary list of plant species for the Kruger National Park from the Pafuri area. *Koedoe* 21: 37 - 46.
- VAN ROOYEN, N., THERON, G.K. & GROBBELAAR, N. 1981. A floristic description and structural analysis of the plant communities of the Punda Milia - Pafuri - Wambiya area in the Kruger National Park, Republic of South Africa. 2. The sandveld communities. *Jl S. Afr. Bot.* 47: 405 - 449.
- VAN ROOYEN, N., THERON, G.K. & GROBBELAAR, N. 1986. The vegetation of the Roodeplaat Dam Nature Reserve. 4. Phenology and climate. *S. Afr. J. Bot.* 52: 159 - 166.
- VAN ROOYEN, N. 1989. Phenology and water relations of two savanna tree species. *S. Afr. J. Sci.* 85: 736 - 740.
- VAN ROOYEN, N., BREDEKAMP, G.J. & THERON, G.K. 1991. Kalahari vegetation: Veld condition trends and ecological status of species. *Koedoe* 34: 61 - 72.
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- VAN ROOYEN, N., BREDEKAMP, G.J., THERON, G.K., BOTHMA, J. DU P. & LE RICHE, E.A.N. 1994. Vegetational gradients around artificial watering points in the Kalahari Gemsbok National Park. *J. Arid Environ.* 26: 349-

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- STEYN, H.M., VAN ROOYEN, N., VAN ROOYEN, M.W. & THERON, G.K. 1996. The phenology of Namaqualand ephemeral species: the effect of sowing date. *J. Arid Environ.* 32: 407 - 420.
- JELTSCH, F., MILTON, S.J., DEAN, W.R.J. & VAN ROOYEN, N. 1997. Analyzing shrub encroachment in the southern Kalahari: a grid-based modelling approach. *Journal of Applied Ecology* 34 (6): 1497 - 1509.
- VAN ROOYEN, N. & VAN ROOYEN, M.W. 1998. Vegetation of the south-western arid Kalahari: an overview. *Trans. Roy. Soc. S. Afr.* 53: 113 -140.
- DE VILLIERS, A.J., VAN ROOYEN, M.W., THERON, G.K. & VAN ROOYEN, N. 1999. Vegetation diversity of the Brand-se-Baai coastal dune area, West Coast, South Africa: a pre-mining benchmark survey for rehabilitation. *Land Degradation & Development* 10: 207 - 224.
- VAN ESSEN, L.D., BOTHMA, J. DU P., VAN ROOYEN, N. & TROLLOPE, W.S.W. 2002. Assessment of the woody vegetation of Ol Choro Oiroua, Masai Mara, Kenya. *Afr. J. Ecol.* 40: 76 - 83.
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- VAN DER MERWE, H., VAN ROOYEN, M.W. & VAN ROOYEN, N. 2008. Vegetation of the Hantam-Tanqua-Roggeveld subregion, South Africa Part 2. Succulent Karoo Biome-related vegetation. *Koedoe* 50: 160-183.
- VAN ROOYEN, M.W., VAN ROOYEN, N. & BOTHMA, J. DU P. 2008. Landscapes in the Kalahari Gemsbok National Park, South Africa. *Koedoe*: 50: 32-41.
- VAN ROOYEN, M.W., HENSTOCK, R., VAN ROOYEN, N. & VAN DER MERWE, H. 2010. Plant diversity and flowering displays on old fields in the arid Namaqua National Park, South Africa. *Koedoe* 52: Art. #1004, 7 pages. DOI: 10.4102/koedoe.v52i1.1004.
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APPENDIX I

Curriculum vitae: PROF MW (GRETEL) VAN ROOYEN

1. Biographical information

Surname	Van Rooyen	Maiden name	Rösch
First names	Margaretha Wilhelmine		
ID number	5004130033084	Citizenship	South African
Home address	7 St George Street Lionviham 7130 Somerset West	Work address	Department of Botany University of Pretoria Pretoria 0002 South Africa
Mobile	072 0253386		
e-mail	gretel@ekotrust.co.za		
Current position	Honorary Professor in Plant Ecology Scientific advisor - Ekotrust cc		
Academic qualifications	BSc; BSc (Hons), HNOD, MSc (Botany), PhD (Plant ecology)		
Professional registration	Ecological Scientist: Pr.Sci.Nat. Reg. no. 400509/14		

2. Publications

I am author / co-author of more than 100 peer reviewed research publications and have presented / co-presented more than 100 posters or papers at international and national conferences. Five PhD-students and 29 Masters students have completed their studies under my supervision / co-supervision. I have co-authored a book as part of a series on the Adaptations of Desert Organisms by Springer Verlag (Van Rhee de van Oudtshoorn, K. & Van Rooyen, M.W. 1999. **Dispersal biology of desert plants**. Springer Verlag, Berlin) and two wildflower guides (Van Rooyen, G., Steyn, H. & De Villiers, R. 1999. **Cederberg, Clanwilliam and Biedouw Valley**. Wild Flower Guide of South Africa no 10. Botanical Society of South Africa, Kirstenbosch, and Van der Merwe, H. & Van Rooyen, G. **Wild flowers of the Roggeveld and Tanqua**). I have also contributed to six chapters in the following books: (i) Dean, W.R.J. & Milton, S.J. (Eds) *The Karoo: Ecological patterns and processes*. Cambridge University Press, Cambridge. pp. 107-122; (ii) Knobel, J. (ed.) *The magnificent heritage of South Africa*. Sunbird Publishing, Llandudno. pp. 94-107; (iii) Hoffman, M.T., Schmiedel, U., Jürgens, N. [Eds]: *Biodiversity in southern Africa. Vol. 3: Implications for landuse and management*: pp. 109–150, Klaus Hess Publishers, Göttingen & Windhoek; (iv) Schmiedel, U., Jürgens, N. [Eds]: *Biodiversity in southern Africa. Vol. 2: Patterns and processes at regional scale*: pp. 222-232, Klaus Hess Publishers, Göttingen & Windhoek; (v) Stoffberg, H., Hindes, C. & Muller, L. *South African Landscape Architecture: A Compendium and A Reader*. Chapter 10, pp. 129 – 140; and (vi) Stoffberg, H., Hindes, C. & Muller, L. *South African Landscape Architecture: A Compendium and A Reader*. Chapter 11, pp. 141 – 146.

3. Projects

Over the past 40 years my research has centred around the population biology, vegetation dynamics and classification of the vegetation in the Succulent Karoo (Namaqualand, Tanqua, Hantam, Roggeveld), Kalahari (arid grassland) and Namib Desert in Namibia. All three regions are relevant to the current project area.

8. Selected project references

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- VAN ROOYEN, M.W., VAN ROOYEN, N. & GAUGRIS, J.Y. 2018. Vegetation, plants and habitats of the Dish Mountain Project, Ethiopia. Biodiversity Baseline Report by FLORA FAUNA & MAN, Ecological Services Ltd.

9. Selected research publications

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- THERON, G.K., VAN ROOYEN, N. & VAN ROOYEN, M.W. 1980. The vegetation of the Lower Kuiseb River. *Madoqua* 11: 327-345.
- VAN ROOYEN, M.W., THERON, G.K. & GROBBELAAR, N. 1990. Life forms and dispersal spectra of the Namaqualand flora. *Journal of Arid Environments* 19: 133-145.
- VAN ROOYEN, M.W., GROBBELAAR, N., THERON, G.K. & VAN ROOYEN, N. 1991. The ephemerals of Namaqualand: Effects of photoperiod, temperature and moisture stress on development and flowering of three species. *Journal of Arid Environments* 20: 15 - 29.
- BENEKE, K., VAN ROOYEN, M.W., THERON, G.K. & VAN DE VENTER, H.A. 1993. Fruit polymorphism in ephemeral species of Namaqualand: III. Germination differences between polymorphic diaspores. *Journal of Arid Environments* 24: 333-344.
- STEYN, H.M., VAN ROOYEN, N., VAN ROOYEN, M.W. & THERON, G.K. 1996. The prediction of phenological stages in four Namaqualand ephemeral species using thermal unit indices. *Israel Journal of Plant Sciences* 44: 147-160.
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Appendix E:
**Previous Archaeology, Palaeontology and Heritage
Specialist Study Conducted Near the Site**

**Phase 1 Heritage Impact Assessment for the proposed
construction of a 800m section of gravel road and
associated infrastructure at the Black Mountain Decline
on the Farm Zuurwater 62 , Khai-Ma Local Municipality,
NC Province.**

Report prepared for
Endemic Vision Environmental Consultants
by
Paleo Field Services
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Executive Summary

A Phase 1 Heritage Impact Assessment was carried out for the proposed new linear development on the Farm Zuurwater 62, situated near the town of Aggeneys between Pofadder and Springbok in the Northern Cape Province, where the Black Mountain mining company plans to construct a 800m section of gravel road and associated infrastructure at the Black Mountain Decline area (Swartberg). The field assessment provided no above-ground evidence of prehistoric structures, buildings older than 60 years, or material of cultural significance or *in situ* archaeological sites within the study areas. The development footprint is not considered palaeontologically significant. No further palaeontological or archaeological mitigation is required, as long as all the planned activities are restricted to within the boundaries of proposed development footprint.

Table of Contents

Executive Summary.....	2
Introduction.....	4
Locality data.....	5
Background.....	6
Impact Assessment.....	8
Field Assessment.....	8
Impact Statement and Recommendation.....	9
References.....	9
Figures.....	12

Introduction

A Phase 1 Heritage Impact Assessment was carried out for the proposed new linear development on the Farm Zuurwater 62, situated near the town of Aggeneys between Pofadder and Springbok in the Northern Cape Province, where the Black Mountain mining company plans to construct a 800m section of gravel road and associated infrastructure at the Black Mountain Decline area (Swartberg). (**Fig. 1 & 2**). The region's unique and non-renewable archaeological and palaeontological heritage sites are 'Generally' protected in terms of the National Heritage Resources Act (Act No 25 of 1999, section 35) and may not be disturbed at all without a permit from the relevant heritage resources authority. As many such heritage sites are threatened daily by development, both the environmental and heritage legislation require impact assessment reports that identify all heritage resources including archaeological and palaeontological sites in the area to be developed, and that make recommendations for protection or mitigation of the impact of the sites.

The National Heritage Resources Act (NHRA) (No 25 of 1999) identifies what is defined as a heritage resource, the criteria for establishing its significance and lists specific activities for which a heritage specialist study may be required. In this regard, categories of development listed in Section 38 of the NHRA are:

- The construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;
- The construction of a bridge or similar structure exceeding 50m in length;
- Any development or other activity which will change the character of the site;
- Exceeding 5000 m² in extent;
- Involving three or more existing erven or subdivisions thereof;
- Involving three or more subdivisions thereof which have been consolidated within the past five years;
- Costs of which will exceed a sum set in terms of regulations by the South African Heritage Resources Agency (SAHRA).
- The rezoning of a site exceeding 10 000 m².
- Any other category of development provided for in regulations by the South African Heritage Resources Agency (SAHRA).

In many cases, the nature and degree of heritage significance is largely unknown pending further investigation (e.g. capped sites, assemblages or subsurface fossil remains). On the other hand, it is also possible that a site may contain heritage resources (e.g. structures older than 60 years), with little or no conservation value. In most cases it will be necessary to engage the professional opinion of a heritage specialist in determining whether or not further heritage specialist input in an EIA process is required.

Terms of Reference

- Identify and map possible heritage sites and occurrences using available resources.
- Determine and assess the potential impacts of the proposed development on potential heritage resources;
- Recommend mitigation measures to minimize potential impacts associated with the proposed development.

Methodology

The heritage significance of the affected area was evaluated through a desktop study and carried out on the basis of existing field data, database information and published literature. This was followed by a field assessment by means of a pedestrian survey. A Garmin Etrex Vista GPS hand model (set to the WGS 84 map datum) and a digital camera were used for recording purposes. Relevant archaeological and palaeontological information, aerial photographs and site records were consulted and integrated with data acquired during the on-site inspection.

Locality data

1 : 50 000 scale topographic map 2918 BA Haramoep

1 : 250 000 scale geological map 2918 Pofadder

The study areas consists of a more or less linear footprint totalling 0.7765 ha of mostly rocky terrain covered by red-brown residual soils, calcretes and wind-blown sands along the lower slope of Swartberg (Black Mountain Decline) (**Fig. 3**). Proposed development will include the upgrading and extension of a 800 m long gravel road (5600 m²) and three separate infrastructure areas covering 765m², 400m² and 1000m² respectively (**Table 1**). The area is underlain by sediments of the Namaqua-Natal Metamorphic Complex, where rocks of the Bushmanland Group and

Precambrian granites outcrop in places (**Fig. 4**). The prominent inselbergs and ranges of hills which characterise the arid landscape of the area are formed by the metavolcanic-metasedimentary units of the Bushmanland Group that usually occur as major, often overturned, synformal infolds in the associated granitic gneisses (Baillie *et al.* 2007). Geologically recent superficial deposits along the valley floors are largely made up of by gritty to gravelly, brown top soils composed of an admixture of weathered bedrock, calcretes and Quaternary wind-blown sands.

Table 1. GPS coordinates of the proposed development (see Fig. 3).

#	GPS Coordinates	
A	29°14'23.80"S	18°45'7.42"E
B	29°14'31.14"S	18°45'20.97"E
C	29°14'37.55"S	18°45'35.37"E

Background

Geologically recent superficial deposits along the valley floors are largely made up of Quaternary calcretes and sands. Cenozoic river terrace deposits between Upington and Pella consists of thin remnants preserved as bedrock lags and small sediment accumulations concentrated at local bedrock knickpoints (De Wit 2006). There are currently no records of vertebrate fossil remains from alluvial contexts associated with the Orange River in the region. Paleogene fossil assemblages are known from a crater-lake deposit within a volcanic pipe at Stompoor, located about 160 km due south of Upington, and include a diversity of fish, frogs, reptiles, insects, and palynological remains (Smith 1988). Fluvial deposits from the ancient Koa Valley have yielded fossil vertebrate bone as well as fossil wood (Maglio 1978; De Wit 1996; De Wit and Bamford 1993) while a rich, Middle Miocene vertebrate site is located further downstream in proto-Orange River gravel deposits on the Namibian side of the Orange River at Arrisdrift, about 40 km northeast of Oranjemund.

Archaeological and historical evidence show that the Middle Orange River and Bushmanland regions have been populated more or less continuously during prehistoric times and that the region was extensively occupied by Khoi herders and

San hunter-gatherers during the last 2000 years (Morris & Beaumont 1991; Beaumont *et al.* 1995; Smith 1995). According to Beaumont (1986) archaeological visibility in the region was high during the Last Glacial Maximum, a viewpoint that is in contrast to that indicated for southern Africa as a whole (Deacon and Thackeray 1984). Beaumont *et al.* 1995 also noted that MSA artifact occurrences are widespread in the Bushmanland area, but are mainly preserved as low density surface scatters on the landscape. Morris (2010, 2013a, 2013b) noted very sparse localized scatters of MSA stone tools at the top of Gamsberg, including a MSA knapping site, and ESA material, including a Victoria West core on quartzite within the Gamsberg basin. The importance of Gamsberg as an archaeological/historical focal point is further alluded to in early 19th century records (Penn 2005) as a place of refuge and conflict during the colonial frontier period and by the meaning of its name, which is derived from the Khoikhoi word Gaams, meaning ‘grassy spring’. The principal Khoikhoi inhabitants of the Middle Orange River were the Einiqua who belonged to the same language group as the Namaqua and Korana, namely the Orange River Khoikhoi (Penn 2005). The Einiqua occupied the area around and east of the Augrabies Falls while the Korana occupied the Middle-Upper Orange River further to the east. A large number of burial cairns were excavated near the Orange River in the Kakamas area and appear to be related to Korana herders (Morris 1995). It is pointed out that while Bushmanland sites in the surrounding area appear to be ephemeral occupations by small hunter-gatherer groups, substantial herder encampments found along the Orange River itself indicate that the banks and floodplains of the river were more intensely exploited (Morris & Beaumont 1991; Beaumont 1995). Hinterland sites are mainly restricted rock shelters near mountainous terrain sand dune deposits, or around seasonal pans and springs (Beaumont 1995). Herder sites with ample pottery have been recorded near Aggeneys and, east of Pofadder, at Schuitdrift South (Morris 1999) and historical records show that herder groups settled at the stronger springs such as Pella (Thompson 1827). Pella originated as Roman Catholic mission station, about 28 km northwest of Pofadder. It was established as a station of the London Missionary Society about 1806, was taken over by the Rhenish Missionary Society until 1869, and then by the Roman Catholics in 1874. The town of Pofadder developed from a station of the Inland Mission founded in 1875, and named after Klaas Pofadder, a Korana chief. The town was laid out in 1917 and a village management board was instituted in 1937. Originally named *Theronsville*, the name

Pofadder was restored in 1936. Grinding grooves have been found on rock outcrops in the Gamsberg area (Morris 2011) and rock paintings, grinding surfaces and cupules sites are known from the Black Mountain Mining property at Aggeneys and at the foot of the mountain on Zuurwater 62 (Morris 2013a). No Iron Age sites are expected to be found in this area as it falls outside the southwestern periphery of distribution of Iron Age settlement in the region (Humphreys 1976).

Impact Assessment

Nature of Impacts

It is expected that the proposed construction activities will be localized, and that potential palaeontological and archaeological impacts, if any, will be confined to the development footprint during the construction phase. Bedrock underlying the study area is not considered to be palaeontologically significant, because of the metavolcanic-metasedimentary nature of the strata. There is a low probability that well-developed Quaternary alluvial surface deposits may contain large vertebrate fossil remains or capped Stone Age occurrences. It is also likely that outcrop may yield rock art rock shelters with evidence of prehistoric human occupation.

Extent of Impact

Possible extent of impact following the construction activities will be locally restricted to potential damage or destruction as a result of excavations into Bushmanland Group strata and Quaternary overburden.

Duration of Impact

The proposed developments are considered long term with the consequence that any damage or destruction to geological strata and archaeological heritage within the affected area will be permanent.

Cumulative Impact

There currently exists a well-established mining footprint within a 50 km radius of the proposed developments. The proposed developments will be carried out on a landscape where mining activities is a common feature.

Field Assessment

The proposed footprint is primarily located on flat, open terrain covered by red-brown residual soils, calcretes and wind-blown sands. A foot survey along nearby drainage

lines (alluvium) indicate that impact on potential palaeontological heritage resources within the superficial sediments (overlying Quaternary sediments) is unlikely. No above-ground evidence was found of intact Stone Age archaeological assemblages or sites. The pedestrian survey also revealed no evidence of prehistoric structures, marked graves or rock art sites within the confines of the proposed development footprint.

Impact Statement and Recommendation

The field assessment provided no above-ground evidence of prehistoric structures, buildings older than 60 years, or material of cultural significance or *in situ* archaeological sites within the proposed development footprint. It is also considered unlikely that significant artefact occurrences will be found below the surface within the boundaries of the proposed development footprint. No further palaeontological or archaeological mitigation is required, as long as all the planned activities are restricted to within the boundaries of proposed development footprint.

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Figures

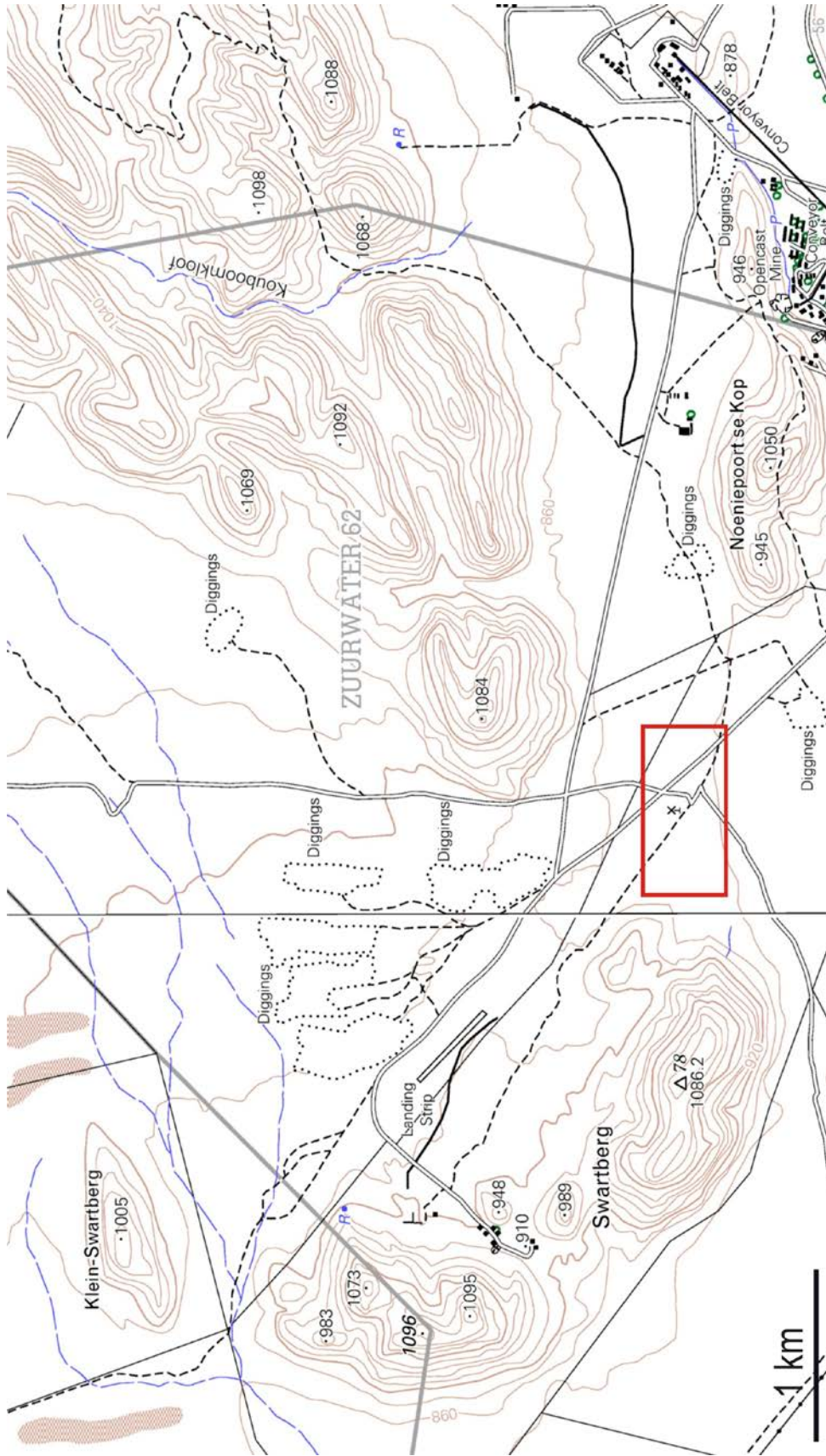


Figure 1. Locality map of the proposed Black Mountain Decline development (portion of 1:50 000 scale topographic map 2918BA Haramoep).

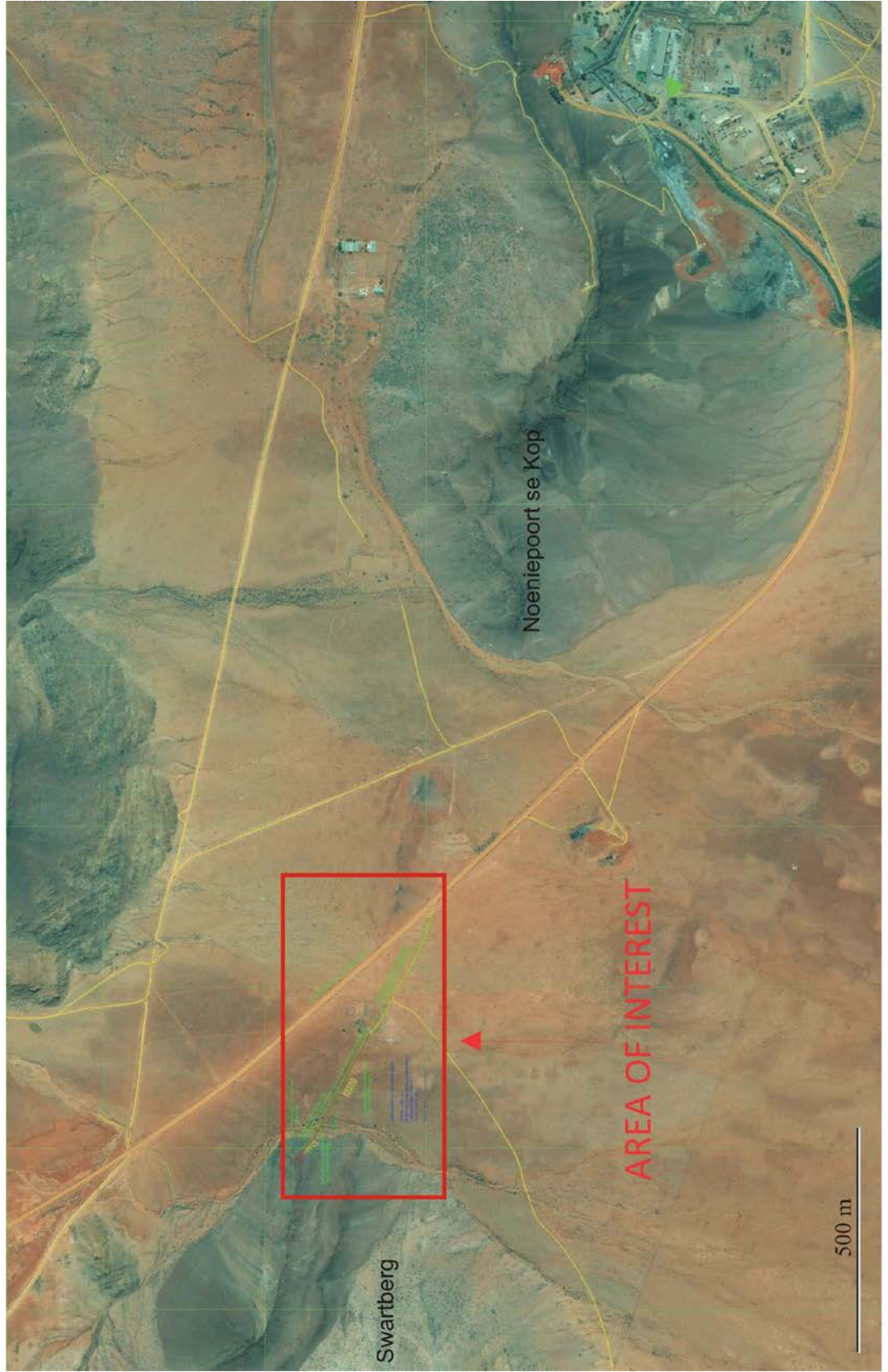


Figure 2. Aerial view of the proposed development footprint.

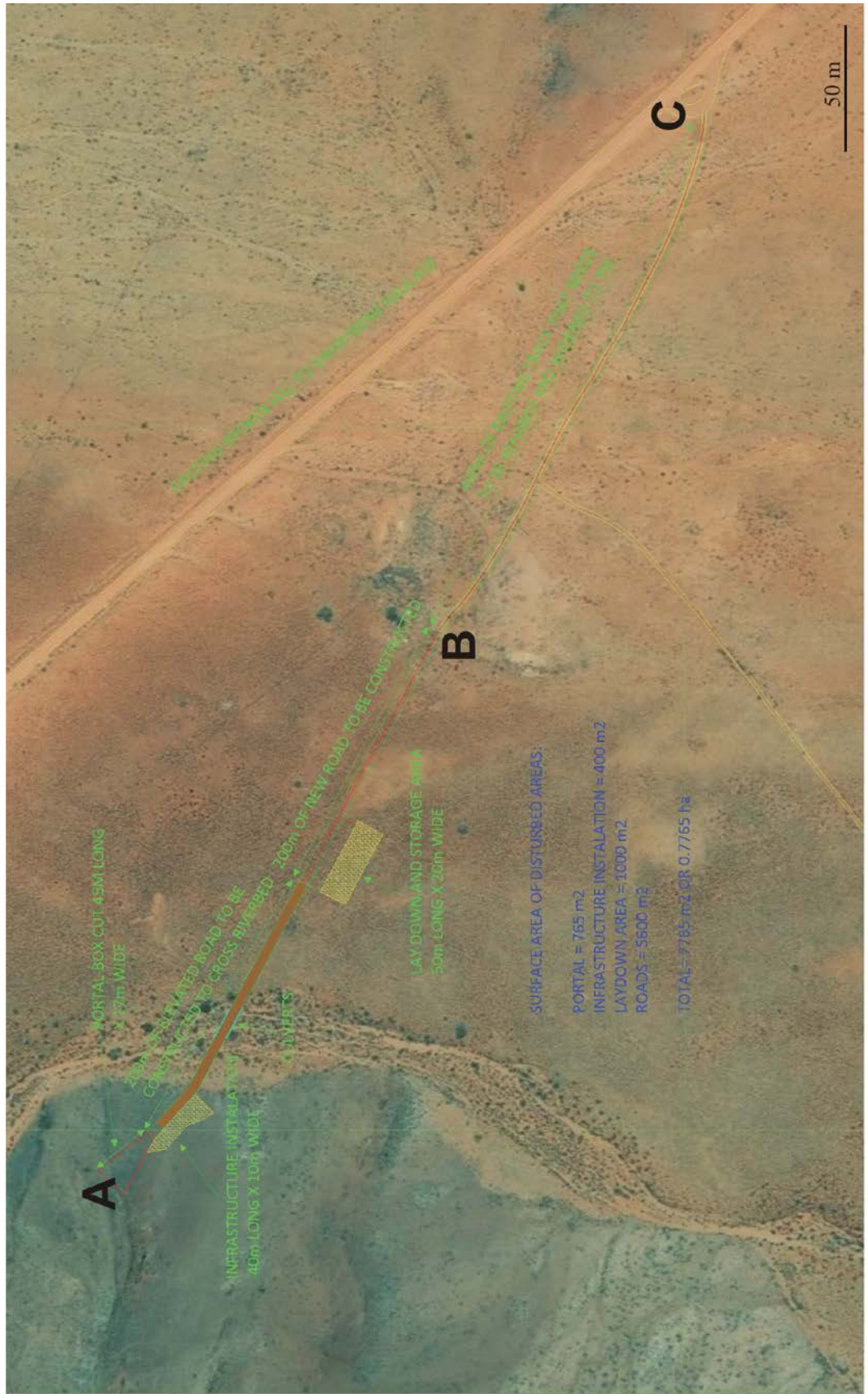


Figure 3. Layout of the proposed development footprint.

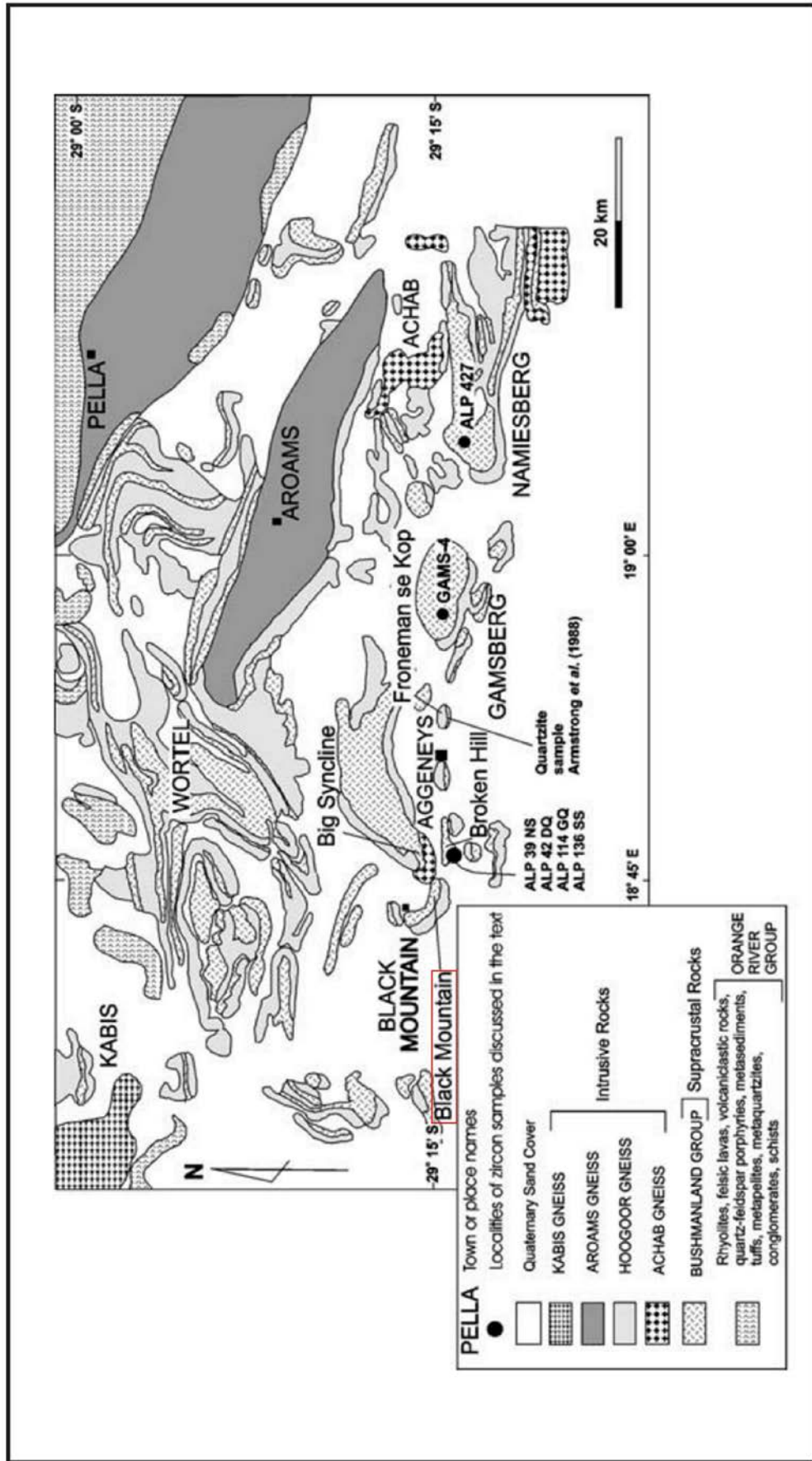


Figure 4. Simplified geological map of the area around Aggeneys and Gamsberg showing the various inselbergs and the distribution of the various granitic gneisses and the Bushmanland Group supracrustal succession (from Baillie *et al.* 2007).

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