mineral resources

Department:
Mineral Resources
REPUBLIC OF SOUTH AFRICA

SCOPING REPORT

FOR LISTED ACTIVITIES ASSOCIATED WITH MINING RIGHT AND/OR BULK SAMPLING ACTIVITIES INCLUDING TRENCHING IN CASES OF ALLUVIAL DIAMOND PROSPECTING.

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: VARDOCUBE (PTY) LTD.

TEL NO: 053 832 3298
FAX NO: NONE
POSTAL ADDRESS: 87 CENTRAL ROAD, HERLEAR, KIMBERLEY
PHYSICAL ADDRESS: 87 CENTRAL ROAD, HERLEAR, KIMBERLEY
FILE REFERENCE NUMBER SAMRAD: TO BE ISSUED

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 permit are submitted in the exact format of, and provide all the information required in terms of, this template. Furthermore please be advised that failure to submit the information required in the format provided in this template will be regarded as a failure to meet the requirements of the Regulation and will lead to the Environmental Authorisation being refused.

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

OBJECTIVE OF THE SCOPING PROCESS

1) The objective of the scoping process is to, through a consultative process—

(a) identify the relevant policies and legislation relevant to the activity;
(b) motivate the need and desirability of the proposed activity, including the need and desirability of the activity in the context of the preferred location;
(c) identify and confirm the preferred activity and technology alternative through an impact and risk assessment and ranking process;
(d) identify and confirm the preferred site, through a detailed site selection process, which includes an impact and risk assessment process inclusive of cumulative impacts and a ranking process of all the identified alternatives focusing on the geographical, physical, biological, social, economic, and cultural aspects of the environment;
(e) identify the key issues to be addressed in the assessment phase;
(f) agree on the level of assessment to be undertaken, including the methodology to be applied, the expertise required as well as the extent of further consultation to be undertaken to determine the impacts and risks the activity will impose on the preferred site through the life of the activity, including the nature, significance, consequence, extent, duration and probability of the impacts to inform the location of the development footprint within the preferred site; and
(g) identify suitable measures to avoid, manage, or mitigate identified impacts and to determine the extent of the residual risks that need to be managed and monitored.

_____

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

LIST OF MAPS IN APPENDIX 4

LIST OF ACRONYMS AND ABBREVIATIONS

BFS	Bankable Feasibility Study
CBA	Critical Biodiversity Area
CRR	Comment and Response Register
Cu	Copper
DEA	Department of Environmental Affairs
DMR	Department of Mineral Resources
DSR	Draft Scoping Report
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EIR	Environmental Impact Report
EMPr	Environmental Management Programme
ESA	Ecological Support Area
FSR	Final Scoping Report
I&APs	Interested and Affected Parties
IDP	Integrated Development Plan
IWULA	Integrated Water Use Licence Application
IWWMP	Integrated Water and Wastewater Management Plan
kl	Kilolitre
ktpa	Kiltons per annum
ktpm	Kiltons per month
l	litre
LHOS	Long Hole Open Stoping
LOM	Life of Mine
m	Metre
mamsl	Metres above mean sea level
mm	Millimetre
MPRDA	Minerals and Petroleum Resources Development Act
MR	Mining Right
MRA	Mining Right Application
Mtpa	Million tons per annum
NEMA	National Environmental Management Act
NEM:AQA	National Environmental Management: Air Quality Act
NEM:BA	National Environmental Management: Biodiversity Act
NEM:WA	National Environmental Management: Waste Act
NHRA	National Heritage Resources Act
NWA	National Water Act
p.a.	Per annum
PCM	Prieska Copper Mine
PCML	Prieska Copper Mine Limited
PR	Prospecting Right
PRA	Prospecting Right Application

RWD	Return Water Dam
S&EIR	Scoping and Environmental Impact Reporting
SAHRA	South African Heritage Resource Agency
SDF	Spatial Development Framework
SLM	Siyathemba Local Municipality
WML	Waste Management Licence
Zn	Zinc

1 CONTACT PERSON AND CORRESPONDENCE ADDRESS

1.1 DETAILS OF THE EAP WHO PREPARED THE REPORT

Name of the Practitioner:	ABS Africa (Pty) Ltd.
Tel No.:	+27 11 805 0061
E-mail address:	paul@abs-africa.com / chane@abs-africa.com

1.2 EXPERTISE OF THE EAP

1.2.1 THE QUALIFICATIONS OF THE EAP

Name: Mr. Paul Furniss

Academic Qualifications:

- Bachelor of Agricultural Science in Animal Science: University of Pretoria, 1998
- Bachelor of Science (Honours) in Wildlife Management: University of Pretoria, 1999
- Master of Science in Environmental Science (Water Resource Management): University of Pretoria, 2000

Professional Registration:

- Pr.Sci.Nat. Professional Natural Scientist (Environmental Science): The South African Council for Natural Scientific Professions, 2007.
- Certified Environmental Assessment Practitioner: Environmental Assessment Practitioners Association of South Africa.

Name: Ms. Chané Pretorius

Academic Qualifications:

- Bachelor of Science in Tourism: North West University, 2010
- Bachelor of Science (Honours) in Geography: University of Johannesburg, 2011

1.2.2 SUMMARY OF THE EAPS PAST EXPERIENCE

ABS Africa (Pty) Ltd is a professional environmental advisory company with a focus on the mining environment. The ABS Africa personnel included in the project team structure for the independent environmental assessment have collectively completed more than 100 EIAs across the African continent.

Much of this experience has been gained in undertaking complex and challenging EIAs involving the management of specialist teams, conducting public participation processes, aligning international standards with in-country legislation and interfacing with project engineering teams.

The EAP responsible for this submission has 16 years environmental assessment and management experience in the energy, water, mining and infrastructure sectors. His project experience includes conducting environmental assessment studies in South Africa, Guinea, Nigeria, Lesotho, Democratic Republic of Congo, Sudan, Namibia, Botswana, Zimbabwe, and Mozambique.

Please refer to Appendix 1 and Appendix 2 for a record of the experience of the EAP.

2 DESCRIPTION OF THE PROPERTY

2.1 OVERVIEW

The historical Prieska Copper Mine (PCM) mine is situated approximately 3 km south of Copperton and 60 km south-west of the town of Prieska in the Northern Cape Province. The mine falls within the authority of the Siyathemba Local Municipality (Appendix 4 Map 1). The site is accessed via the R357 from Prieska. The mine was owned and operated by Prieska Copper Mine Limited (PCML), a subsidiary of Anglo-Transvaal Consolidated Investment Company Limited (Anglovaal), between 1971 and 1991. The mine operations ceased in 1991 and rehabilitation and closure of the mine was undertaken in accordance with agreements reached with the Department of Mineral and Energy Affairs. A closure certificate was issued by the latter on 19 October 1995. No mining activities have taken place at PCM since 1991.

Orion Minerals (Orion), through its subsidiary company of Vardocube (Pty) Ltd., is the holder of a prospecting right in the Copperton area of the Northern Cape Province. The prospecting right was recently executed, and drilling of the Volcanogenic Massive Sulphide (VMS) Deposit, to confirm the mineral resource estimate for Cu and Zn has commenced.

The applicant (Vardocube) is applying for a Mining Right for the Prieska Zinc Copper Project (Vardocube Section). The activity being applied for is exclusively for underground mining with no requirement for any surface area disturbance within the proposed mining right area.

The proposed Vardocube mining right area is adjacent to the Repli Trading No. 27 (Pty) Ltd. (Repli) mining right area. Repli is also a subsidiary of Orion and a Mining Right Application (DMR Reference No: NC30/5/1/2/3/2/1/10138 MR) for Repli was submitted in April 2018 and is expected to be finalised by the first quarter of 2019.

The Copperton Deposit extends across the Repli and Vardocube prospecting right areas. Through its subsidiary company Vardocube, Orion therefore intends to access and mine the full extent of the deposit of interest including the Vardocube mining area via the refurbished existing Hutchings Shaft, situated on Portion 25 of the Farm Vogelstruisbult 104, within the proposed Repli mining right area. The Vardocube Section could not be included in the Repli Mining Right Application as the two companies (Vardocube and Repli), have different ownership structures.

A commercial agreement will be entered into between Repli and Vardocube so that relevant infrastructure and facilities established to support the proposed Repli surface and underground mining will also be used for the underground mining of the Vardocube Section of the deposit

The infrastructure and facilities to be established by Repli have been designed with sufficient capacity to accommodate the additional ore and tailings that will be generated from the Vardocube underground mining.

PCM was one of South Africa's first mines to have a decline from surface, using trackless mining methods. Almost all the underground development took place in a competent footwall unit.

PCM was serviced by one main vertical men and rock shaft, four ventilation shafts and the decline. The Hutchings Shaft is an 8.8 m diameter vertical shaft sunk down to approximately 1 km below surface. The decline has a length of approximately 7.1 km.

Approximately 37 km of underground roadways are underground and various pump stations are still in place from the historical dewatering activities.

Underground mining will focus on exploiting what remains of the Deep Sulphide Exploration Target. Ore production will come from stoping areas below the -900m Level. Access to some of these deeper stoping areas was already established as part of the trial mining that was undertaken before mining operations ceased in 1991.

Blasted ore will be hoisted from underground and processed on surface through the Repli process plant and associated infrastructure, situated on Portions 1 and 25 of the Farm Vogelstruisbult 104.

A Scoping and Environmental Impact Reporting (S&EIR) process is being undertaken in support of the Mining Right Application (MRA) and Environmental Authorisation (EA) required for the proposed underground mining activity.

TABLE 2-1: DESCRIPTION OF THE PROPERTIES

FARM NAMES:	Remaining Extent of Portion 1 of the Farm Vogelstruisbult 104
APPLICATION AREA (HA):	6 085.5029 Ha
MAGISTERIAL DISTRICT:	Prieska, Northern Cape
MUNICIPALITIES	Siyathemba Local Municipality Pixley ka Seme District Municipality
DISTANCE AND DIRECTION TO NEAREST TOWNS	Copperton is situated approximately 3 km north of the proposed underground mining area. Prieska is approximately 60 km to the north-east.

TABLE 2-2: 21 DIGIT SURVEYOR-GENERAL CODE FOR EACH FARM PORTION

FARM NAME	PORTION	TITLE DEED	21 DIGIT SURVEY OR GENERAL CODE FOR EACH FARM PORTION
Vogelstruisbult 104	RE/1	T18939/2003	C06000000000010400001

The surface area of the entire property included in the mining right application area measures approximately 6 085 hectares in extent.

2.2 LOCALITY MAP

Please refer to Appendix 4 Map 1.

3 DESCRIPTION OF THE SCOPE OF THE PROPOSED OVERALL ACTIVITY

3.1 LISTED AND SPECIFIED ACTIVITIES

(Please refer to Appendix 4 Map 2 for the outline of the underground extent of the target orebody).

NAME OF ACTIVITY (ALL ACTIVITIES INCLUDING ACTIVITIES NOT LISTED) (E.G. 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.)	AERIAL EXTENT OF THE ACTIVITY HA OR M^2	LISTED ACTIVITY MARK WITH AN X WHERE APPLICABLE OR AFFECTED	APPLICABLE LISTING NOTICE (GNR 544, GNR 545 OR GNR 546)/NOT LISTED
Blasting (underground)	30, 39 (Ha)[1]	X	GNR 984 (17)
Loading, hauling and transport of ore (underground)	30, 39 (Ha)[1]	X	GNR 984 (17)

[1] Approximate surface area extent of the Vardocube Section of the orebody proposed to be mined.

3.2 DESCRIPTION OF THE ACTIVITIES TO BE UNDERTAKEN

3.2.1 MINING METHOD

Historic underground mining successfully extracted 46 Mt of sulphide ore from steep dipping, continuous open stopes, down to a depth of 900 m at a mining rate of 250 ktpm of ore. Excavations that were established to access production areas and transport ore back to the underground crusher are expected to still be in useable condition. This pre-existing network of excavations will provide the initial access and support ventilation for the planned mining until expanded upon.

Underground mining of the Vardocube section of the ore deposit will be an extension of the same mining method used for the adjacent Repli section of the ore deposit.

Waste rock will remain underground at designated worked-out stope ends for future use as backfill wherever possible. Access to the underground mine will be via the refurbished existing Hutchings Shaft and rehabilitated decline ramp.

Mine production will be achieved using a combination of two mining methods:

- The continuation of longhole sub-level open stoping (LHOS), supplemented with pastefill and waste rock, where the orebody is steep enough for longhole stoping; and
- The introduction of drift-and-fill, where the orebody dip becomes too flat to allow gravitational flow of ore from the stopes.

3.2.1.1 Long Hole Open Stoping

LHOS will be established by first developing access drifts (typically 4.5 m wide x 4.5 m high) parallel to the strike in the footwall and at a predetermined distance from the reef contact. The access drifts will be developed at typically 20 m vertical intervals to match the designed stope heights. Cross-cuts will then be developed from the footwall access drift, perpendicular to the strike of the ore body to intersect and traverse the ore zone, terminating at the hanging wall contact. Crosscuts will be established along the orebody to service each stoping block.

Ore drill drives will then be developed in the ore zone, along strike of the ore, on the footwall side of the ore zone. The drill drive will be developed to define the full strike length of the orebody.

Each stope block will have a strike length of typically 60 m, with a group of three stopes adjacent to each other and separated from the next group by a 30m-wide rib pillar.

The two end stopes in each group, adjacent to the rib pillars, will be mined out first as primary stopes. Once the primary stopes are mined out and backfilled with cemented rock fill (CRF), pastefill, waste rock or hydraulic fill, the middle or secondary stopes are then to be extracted. The remaining rib pillars will be extracted opportunistically as a tertiary production stage, depending on ground conditions. A typical LHOS layout is illustrated in Figure 3-1.

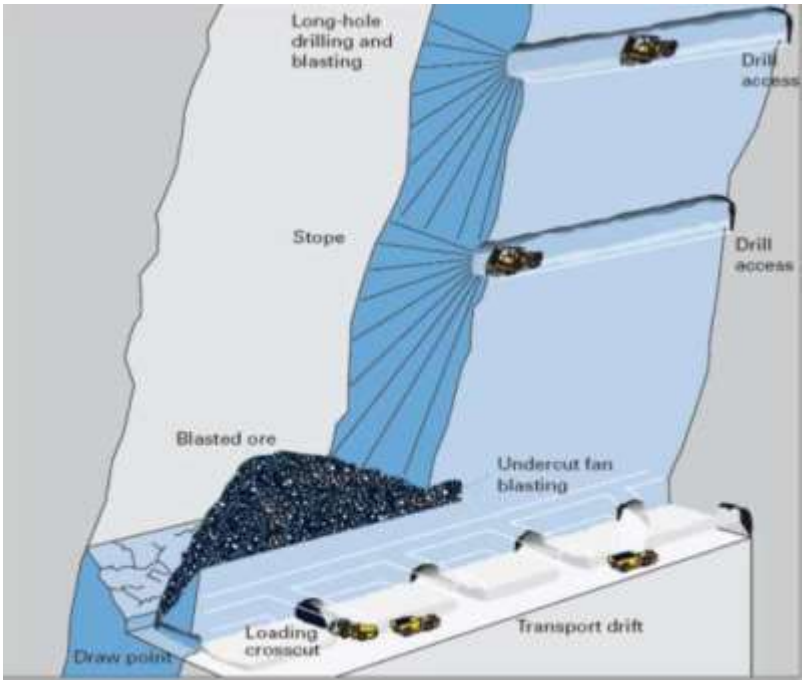
Once a stoping zone is established, the stoping front will retreat up-dip, with the lowest stopes being mined first, backfilled and used as the mucking floor for the adjacent upper stopes.

A typical LHOS stope is commenced by first establishing a raise at one end of the stope to link the lower drill drive to the one vertically above it. The raise is then widened to the width of the ore zone to create the relief slot, by blasting longholes drilled around the raise.

Production blast holes are drilled, either as down-holes or up-holes in rows, with the row interval spaced 1.5 m to 2.0 m along strike (termed the ring burden). Within each row, blast holes are collared in the drill drive and fanned out to cover the ore zone. Spacing of the drill holes at the toe of each hole is kept to below 2.0 m (spacing).

Once the slot is established, rings are fired sequentially into the created void, until the whole stope is blasted.

Remote control LHD units be used to muck the stope. The LHD will muck to reloading bays in the access drives.



Source: Orion Minerals, 2018. Scoping Study Report

FIGURE 3-1: TYPICAL LONGHOLE OPEN STOPE LAYOUT

Once a stope is emptied, the primary stopes will be filled with cemented rock fill, containing a 5 to 7% cement binder. The stopes will be filled via the upper cross-cut and drill drive until tightly filled. Secondary stopes will be mined adjacent to the backfilled primary stopes after sufficient fill cure time is allowed, typically more than 14 days. Secondary stopes are then to be filled with unconsolidated backfill.

Ammonium nitrate and fuel oil (ANFO) is assumed for most production blasting, with bulk emulsion explosives used only when wet conditions are encountered. The powder factors for the primary and secondary stopes have assumed to be 1.5 and 1.2 kg/t of ore, respectively, including the drop raise blasting.

3.2.1.2 Drift and Fill

Where vertical thickness of the ore is not high enough for efficient LHOS, orebody dip too flat or ground conditions inappropriate, then drift-and-fill (D&F) mining will be used.

The drift-and-fill sequence can be described as follows:

- A series of on-strike and on-ore access drives, typically 4.5m wide x 4.5m high, spaced at 60m along-dip intervals and parallel to each other are first established, (these are the equivalent of LHOS level drill drives);
- Primary drift drives are then developed from the access ore drives, in both the up-dip and down dip direction, sub-parallel to the dip direction. The drift drives will be developed within the ore zone and at the upper extent of it. The drift drives will be extended to either breakthrough to the adjacent access ore drive or meet up with a corresponding drift drive from the adjacent access ore drive;
- Primary drift drives are established at intervals that leave sufficient room for secondary and then tertiary drives to be later developed;
- Where ore remains underfoot of the drift drive, the ore is removed by benching the floor; and
- Once benching is completed and the drives emptied, backfilling is done using cement rock fill, as is to be done for LHOS.

A three-stage extraction sequence will be used to ensure that there is always adequate support (either virgin ground, well-cured CRF, paste fill or other selected supplementary support method) adjacent to a drift being extracted and no slender backfill ribs are formed.

Where backfill walls are exposed, (especially primary drifts), cement content will be increased to ensure freestanding backfill. The secondary drifts will require less cement and tertiary only enough cement to prevent liquefaction. A typical D&F layout is illustrated in Figure 3-2.

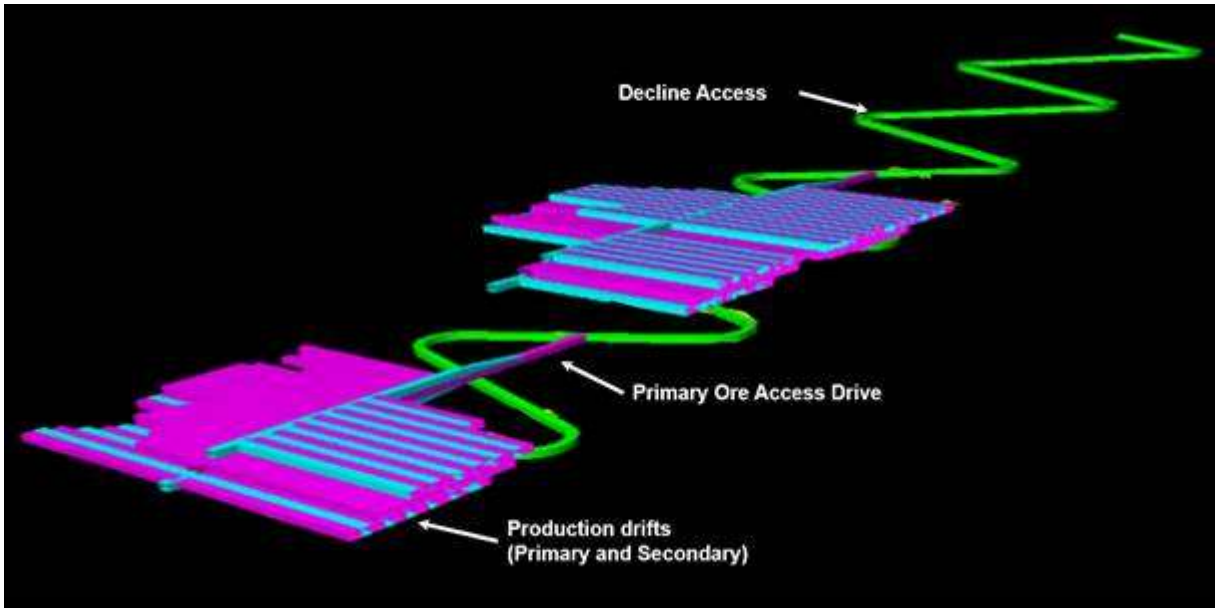


FIGURE 3-2: TYPICAL DRIFT AND FILL LAYOUT

3.2.1.3 Underground Material Handling Systems[1]

Mining consumables and materials will be stored on surface (within the Repli mining right area) and transported underground to section buffer stores for distribution to mining areas as required. All the underground material handling systems used for mining of the Repli deposit will also be used for the mining of the Vardocube section.

Blasted rock will be truck hauled from mining areas and tipped into designated truck tips. Electric locos will haul hoppers from the loading points below the orepasses to the existing rail tips feeding the underground crusher station.

Ore will be crushed UG (nominally to minus 150 mm) and hoisted to surface via the Hutchings Shaft.

To minimise electrical energy requirements, limited compressed air will be used for workshops, refuge bays and potential gas (methane) control. Diesel-driven electro-hydraulic drill jumbos and roof bolters will be used. 40t underground trucks (some fitted with ejector buckets) will transport broken rock. LHD's will muck broken rock.

All infrastructure to support the deeps sulphide mining will be positioned underground. Engineering shops and stores will be located at the trackless mining workshop.

3.2.1.4 Mine Ventilation

No new or additional mine ventilation shafts are required for the underground mining of the Vardocube Section.

The Hutchings Shaft and Main Decline on the Repli mining right area will be used as the primary intakes. The Boehmka and Beecroft Shafts (also on the Repli mining right area) will be refurbished as up-cast ventilation shafts. New ventilation fans will be erected on the shaft collars. Deepening these shafts will allow sufficient ventilation to reach the new underground workings below the 1024 level. Underground return airways required to transport air to the new up-cast shaft positions will be identified and refurbished.

[1] Mine Design Criteria, DRA 2018. PCM-DRA2071-ME-DC-001

Refurbishing of required tunnels will include clearing any restrictions that may have developed over time to eliminate pressure losses in the ventilation system.

Additional raise-bore ventilation airways will be installed to allow fresh air to enter the development and production area along strike as the mine develops over time. Moveable fans will be used for ventilation throughout the underground mine and will range in ratings from 22 kW to 50 kW depending on the areas and tunnel length to be ventilated. 22 kW fans will also be utilised to provide ventilation in workshops, offices and pump stations.

Where appropriate the old working areas will be sealed off with ventilation walls and installing mechanical ventilation doors where required.

3.2.1.5 Backfilling

Backfilling for the Vardocube section will be similar to that undertaken for the adjacent Repli section.

A combination of paste backfill and waste rock backfill will be used to fill both LHOS and D&F mining stopes. It is estimated that approximately 80% of all mining areas will be backfilled. Once LHOS have been established and access for trucks are available, 40 tonne ejector bucket truck will haul and dump development waste into completed LHOS stopes prior to completion of the paste filling process. Where possible, LHD's will dump waste rock in D&F heading prior to paste fill.

The waste rock will typically be placed un-cemented, followed by the introduction of a free-flowing tailings-cement mix to fill the voids. A full cement backfill will be required in places to create a stable wall.

The paste plant that was constructed for the open pit will be utilised for the underground mining backfill requirements. Tailings from the TSF will be used with cement at various mix ratios depending on the fill and strength requirement.

The backfill delivery system will be based on a dedicated 250 mm HDPE pipeline from surface via one of the existing ventilation shafts to the 310 m level. From this point the pipe-line will be fed down newly installed ventilation raise-bore holes into the Deeps mining section. It is planned to install a piping system within the mining areas to allow two stopes to be filled at any one time.

Water will be used to flush the backfill pipelines between fill cycles. This water will be pumped out of the underground workings and returned to surface for reuse in the Repli Mine backfill plant or process plant.

3.2.1.6 Access[2]

The rehabilitated and refurbished Hutchings Shaft (within the Repli mining right area) will be used as the main access for men and material. A rock hoist will be used to hoist ore production to surface. Material will be loaded onto rail bound cars and lowered to the main production level (level 957) for distribution to working areas and underground buffer stores.

Trackless Mining Machines (TMMs) will travel from underground workshops to working areas above level 957. New decline ramps (5 m H x 6 m W) will be developed at 9-degree declination to access mining areas below the current infrastructure.

Gathering haulages (5mW x 5mH) will lead from the decline ramps to access the mining blocks. Drift and fill mining development will be a minimum size of 4mW x 4mH to accommodate mining equipment.

[2] Mine Design Criteria, DRA 2018. PCM-DRA2071-ME-DC-001

3.2.1.7 Dewatering of Underground Workings

Construction Phase Dewatering

No construction phase dewatering of the Vardocube Section is required as the flooded underground workings will be dewatered ahead of the Repli mining activities commencing.

Operational Phase Dewatering

The hydrogeological study indicates that the rate of groundwater seepage for underground mining in the area is expected to be very low (indicative average flow of 5 l/s), as the rock formations are expected to be unfractured with low permeability and thus not transmitting groundwater.

To ensure safe access for mining of the Vardocube Section, water will continue to be removed from the underground workings and managed as part of the Repli dewatering management system.

3.2.2 GEOTECHNICAL INVESTIGATIONS

Observations from the existing tunnels in the upper levels of the historical mine indicate very competent rock and very little tunnel support was installed. Localised roof-bolting was carried out in isolated areas where small amounts of fracturing was observed. Considering the time from when these tunnels were first opened, the rock conditions are still very competent.

Geotechnical studies carried out on the hanging-wall rocks, footwall rocks and the mineralised zone of the orebody indicate competent rock for all three rock types (Figure 3-3).

RQD (Rock Quality Designation)	Rock quality classification
0 -25%	Very Poor
25% - 50%	Poor
50% - 75%	Fair
75% - 90%	Good
90% - 100%	Excellent

RMR (Rock Mass Rating)	Rock quality classification
0-21	Very Poor
21 – 40	Poor
41 – 60	Fair
61 - 80	Good
81 - 100	Excellent

Q Index rating	Rock quality classification
0.001 - 0.01	Exceptionally Poor
0.01 - 0.1	Extremely Poor
0.1 - 1.0	Very Poor
1.0 - 4.0	Poor
4.0 - 10	Fair
10.0 - 40.0	Good
40.0 - 100.0	Very Good
100.0 -400.0	Extremely Good
400.0 - 1000	Exceptionally Good

FIGURE 3-3: UNDERGROUND ROCK QUALITY METRICS

Pattern bolting in all new development ends will be carried out. Tunnel dimensions will be 6 x 5 metres for main ramps and footwall tunnels while stope access tunnels will be 4 x 4 metres.

The planned rock support is described below;

- 2 m resin grouted roof-bolts on a 1.5 x 1.5 m pattern for all tunnel development

- Meshing and lacing in addition to the bolting pattern will be installed over the last 10 m of access tunnels intersecting the deposit
- Larger excavations such as the crusher chamber and workshops will require primary roof-bolts as described above with additional 6.5 m cable anchors on a 3 m spacing. 50 mm of shotcrete will then be applied.

3.2.3 MINE INFRASTRUCTURE AND MINE FACILITIES

Mine infrastructure and facilities established as part of the Repli Mining Right Application and which will be used by agreement between the two companies for the processing of the ore from the Vardocube Section includes:

- The refurbishment and refitting of the Hutchings Shaft, ventilation fans, underground workshops, pump stations, electrical substations, dirty and clean water system;
- Establishment of new offices, stores, accommodation, ablution facilities, change-houses, workshops, washbay facilities, fuel storage and dispensing facilities, and refuge chambers;
- Water reticulation, compressed air reticulation, power reticulation, engineering systems, communications network; emergency alarm system, lighting, rock conveying services, and materials handling; and
- Surge silos, a primary underground crusher, shaft ore conveying linking up with a secondary crusher and related process plant facilities on surface to support ore processing.

No dedicated infrastructure or facilities is thus required for the mining of the Vardocube Section.

3.2.3.1 Power

Power will be obtained from the nearby Eskom Cuprum Substation. The Cuprum Substation is supplied by the Kronos Substation nearby which is linked to the national grid via a 400 kV line. The surface and underground power reticulation established by Repli will be used for the electrical power requirements associated with the mining of the Vardocube Section.

3.2.3.2 Explosives Magazine

Explosives required for the blasting of the Vardocube Section will be stored in the same explosives magazine to be utilised by Repli.

3.2.3.3 Water

The underground mining process itself does not require any water use. Water will however be required for flushing of the backfill pipelines between fill cycles and for suppression of dust generated during drilling.

In general, water requirements for processing of the ore at the Repli processing plant is expected to be in the order of 1 m^3 per tonne of run-of-mine (ROM) ore processed.

Potable water will be available on site, supplied via the bulk pipeline from Prieska. All water and wastewater infrastructure established by Repli will, by agreement between the two companies, be used for the mining of the Vardocube Section.

3.2.3.4 Sewage

Chemical toilets will be used for the underground mining. These will be serviced at the required frequency by a contractor.

3.2.3.5 Non-Mineral Waste Management

All solid waste generated underground will be removed to surface and managed through the Repli waste management system.

4 POLICY AND LEGISLATIVE CONTEXT

A non-exhaustive summary list of the various legislation applicable to the proposed development is provided in Appendix 3.

Table 4-1 provides a description of the legislation which has particular importance to the S&EIR process being undertaken for the development.

TABLE 4-1: 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
ACTS	
National Environmental Management Act, 1998 (Act No. 107 of 1998)(NEMA)	NEMA provides 18 specific principles relating to Environmental Management. Of key importance are the precautionary principle and the polluter pays principle. The 18 principles of NEMA are to be recognised during the undertaking of the Impact Assessment Process and play a key role during the decision-making process. Section 24 of NEMA requires environmental authorisation to be obtained for certain activities identified in three listing notices, published on 4 December 2014. The procedure for obtaining an environmental authorisation requires either a basic assessment (activities in Listing Notice 1 and 3) or scoping and Environmental Impact Assessment (activities in Listing Notice 2) process to be undertaken to inform the application for authorisation. **The proposed underground mining falls within the ambit of listed activities in Listing Notice 2. Since activities in Listing Notice 2 apply to the proposed mining activities, a S&EIR process is being followed. The S&EIR process is being undertaken in compliance with the requirements of NEMA and the EIA Regulations, 2014.**
Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA)	The MPRDA regulates the acquisition, use and disposal of mineral and petroleum rights. **Vardocube is applying for a mining right in terms of section 22 of the MPRDA.**
National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) (NEM:WA)	The NEM: WA provides for the reform of waste management legislation and repeals or amends the legislation under which waste was previously regulated. Part 4 of the NEM: WA pertains to listed waste management activities. In accordance with section 19(2) of the NEM: WA, the Minister published a schedule of listed waste management activities in Government Notice (GN) 921 of 29 November 2013. These are considered activities that have or are likely to have a detrimental effect on the environment.

	According to regulation 2 of GN 921, no person may commence, undertake, or conduct a listed waste management activity unless a licence is issued in respect of that activity. **No Waste Management Licence will be required for the proposed Vardocube MRA as the proposed mining does not involve any listed waste management activities.**
Mine Health and Safety Act, 1996 (Act No. 29 of 1996) (MHSA)	The objective of the Act is to cover all aspects relating to health and safety of employees and other persons on the mine property. The Act places the responsibility on the mine owner for ensuring that the mine is designed, constructed and equipped in a manner which allows for a safe and healthy working environment. **The safety precautions in Section 7 of the MHSA have been incorporated in the environmental sensitivity map.**
The National Water Act, 1998 (Act No. 36 of 1998)(NWA)	The National Water Act, 1998 (Act No. 36 of 1998), identifies 11 consumptive and non-consumptive water uses, which must be authorised under a tiered authorisation system, which include Scheduled uses, General Authorisations, or Licenses. In terms of the National Water Act, the following water uses are identified: (a) Taking water from a water resource; (b) Storing water; (c) Impeding or diverting the flow of water in a watercourse; (d) Engaging in a stream flow reduction activity contemplated in section 36; (e) Engaging in a controlled activity identified as such in section 37(1) or declared under section 38(1); (f) Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit; (g) Disposing of waste in a manner which may detrimentally impact on a water resource; (h) Disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process; (i) Altering the bed, banks, course or characteristics of a watercourse; (j) Removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people; and (k) Using water for recreational purposes. **This listed activity may be triggered by the dewatering which will be needed to access the orebody. Dewatering is a water use requiring licensing in terms of the National Water Act 36 of 1998.**
National Environmental Management: Air Quality Act 2004 (Act No. 39 of 2004)(NEM:AQA)	The main objectives of the National Environmental Management: Air Quality Act 2004 (Act no. 39 of 2004) (NEM: AQA) are to protect the environment by providing reasonable legislative and other measures to: ➲ Prevent air pollution; and ➲ Promote conservation and secure ecologically sustainable development. **No AEL application has been identified as being necessary for the Vardocube Project.**
Hazardous Substances Act (Act No. 15 of 1973)	The objective of the Act is to provide for the control of substances which may cause injury or ill health to or death of human beings due to their toxic, corrosive, irritant, strongly sensitizing or flammable nature or the generation of pressure. In terms of the Act, substances are divided into schedules, based on their relative degree of toxicity and the Act provides for the control of

	importation, manufacture, sale, use, operation, application, modification, disposal and dumping of substances in each schedule. **Several chemicals likely to be used in the servicing and maintenance of underground machinery and equipment, such as chemicals typically found in petroleum products, are regulated in terms of this Act. With all appropriate controls in place, the intended use and handling of these chemicals will not conflict with the Act. The EMPr will provide details in this regard.**
National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA)	The NHRA describes the importance of heritage in the South African context, and designates the South African Heritage Resource Agency (SAHRA) as guardian of the national estate which may include heritage resources of cultural significance that link to biodiversity, such as places to which oral traditions are attached or which are associated with living heritage, historical settlements, landscapes and natural features of cultural significance, archaeological and paleontological sites, graves and burial grounds, or movable objects associated with living heritage. Section 38 of the Act requires a Heritage Impact Assessment (HIA) to be undertaken for various types of development. If the HIA demonstrates that the development will have an impact on a heritage resource, approval from the South African Heritage Resource Agency, or the relevant provincial heritage authority is needed prior to proceeding with the development. **With mining intended to take place at a depth of more than 900 m below natural ground level, no impact to heritage resources is expected. An HIA was completed as part of the environmental authorisation process for the Prieska Zinc Copper Project. This HIA included a palaeontological assessment of a study area incorporating the Vardocube Section. The assessment indicated low to very low palaeontological sensitivity for the area.**
Astronomy Geographic Advantage Act, 2007 (Act No. 21 of 2007)	Provides for the protection, preservation and maintenance, in respect of radio frequency interference or interference in any other way, of declared astronomy advantage areas. Three Central Astronomy Advantage Areas have been established to date, namely: ➲ The Northern Cape Province, excluding Sol Plaatje Municipality ➲ The Karoo Core AAA ➲ The Karoo Central AAA **The proposed mining right area is located within the Northern Cape Province and the Karoo Central AAA. Restrictions may apply with respect to mine-related radio and electrical activities, if these are deemed to interfere with SKA equipment.**
GUIDELINES	
Department of Environmental Affairs Guideline Series 7: Public Participation (2012)	The public participation guideline outlines the importance of public participation as well as the minimum legal requirements for the public participation process, the steps to be taken and the guideline for planning a public participation process. **The public participation process for this application has incorporated relevant requirements of the guideline.**
Department of Environmental Affairs Guideline Series 9: Need and Desirability (2012)	The need and desirability guideline highlights the importance of establishing and assessing the need and desirability for a project. The consideration of need and desirability in the EIA decision making process requires the consideration of the strategic importance of the development alongside the broader societal need and public interests. **The need and desirability description for the proposed development has taken cognisance of this guideline.**

4.1 LISTED ACTIVITIES IDENTIFIED IN TERMS OF NEMA, NEM:WA AND NWA

TABLE 4-2: NEMA LISTED ACTIVITIES APPLICABLE TO THE PCM PROJECT

NEMA LISTED ACTIVITIES		
REGULATION	**ACTIVITY NUMBER**	**SUMMARY DESCRIPTION**
GN R.984, 8 December 2014 (as amended on 7 April 2017) Listing Notice 2: Scoping and EIA	2(6)	The development of facilities or infrastructure for any process or activity which requires a permit or licence or an amended permit or licence in terms of national or provincial legislation governing the generation or release of emissions, pollution or effluent, excluding— (i) activities which are identified and included in Listing Notice 1 of 2014; (ii) activities which are included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case the National Environmental Management: Waste Act, 2008 applies; (iii) the development of facilities or infrastructure for the treatment of effluent, polluted water, wastewater or sewage where such facilities have a daily throughput capacity of 2 000 cubic metres or less; or (iv) where the development is directly related to aquaculture facilities or infrastructure where the wastewater discharge capacity will not exceed 50 cubic metres per day. **This listed activity may be triggered by the dewatering which will be needed to access the orebody. Dewatering is a water use requiring licensing in terms of the National Water Act 36 of 1998.**
GN R.984, 8 December 2014 (as amended on 7 April 2017) Listing Notice 2: Scoping and EIA	2(17)	Any activity including the operation of that activity which requires a mining right as contemplated in section 22 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002), including: (a)associated infrastructure, structures and earthworks, directly related to the extraction of a mineral resource; or (b) the primary processing of a mineral resource including winning, extraction, classifying, concentrating, crushing, screening or washing. **This application for EA is submitted in support of a mining right application for underground mining as per the Mineral and Petroleum Resources Development Act, 28 of 2002.**

4.2 REQUIRED ENVIRONMENTAL LICENCES

The proposed mine development requires a Mining Right as contemplated in section 22 of the Mineral and Petroleum Resources Development Act No. 28 of 2002 (MPRDA). In addition to the Mining Right, the proposed activities also require that the applicant obtain an Environmental Authorisation in terms of the National Environmental Management Act 107 of 1998 (NEMA).

Based on initial feedback from discussions with the DWS, it is not anticipated that a Water Use Licence will be required for the mining of the Vardocube Section as dewatering is already included in the Integrated Water Use Licence Application (IWULA) submitted to the DWS by Repli. All underground water required to be removed for safe access to the Vardocube Section will be managed through the Repli dewatering infrastructure.

5 NEED AND DESIRABILITY OF THE PROPOSED ACTIVITIES

5.1 NEED

Recent drilling of the Vardocube Section of the orebody has confirmed that there is valuable zinc and copper metal in the orebody which, through the arrangement with the adjacent Repli operation, can be mined in a cost-effective manner. The market demand for zinc and copper concentrate is strong with a projection for a supply-side constraint for these metals, especially in developed economies. The proposed development is ideally situated to provide for this demand.

In addition to the export market need for zinc and copper concentrate, there is a significant need in South Africa for developments which facilitate economic growth and provide employment opportunities at a local and regional scale. The royalties arising from the mineral extraction, payable to the South African Government in terms of the MPRDA, will provide revenue to the country. The construction and operational phases of the development will furthermore result in employment opportunities and contribute to local economic development through the procurement of goods and services and the implementation of the mine's social development commitments.

5.2 DESIRABILITY

Due to the nature of mineral extraction and processing, underground mining developments do have various physical, social and environmental hazards. These hazards are generally controlled through the application of various engineering design standards and the health, safety and environmental procedures and plans which the operating company implements during the day to day operation of the site.

No significant risks or impacts associated with the proposed underground mining have been identified at this stage. The proposed use of Repli infrastructure and facilities for the mining of the Vardocube Section, including the TSF, WRD, process plant and other surface infrastructure, is beneficial in terms of reducing the potential cumulative impacts from the proposed mining.

Establishment of dedicated infrastructure and facilities for mining and mineral processing of the Vardocube Section would have a significantly greater environmental impact in terms of, among others, resource consumption, emissions to air and water, and loss of natural habitat.

Using the Repli infrastructure and facilities is desirable both in terms of economic feasibility and in reducing potential direct, indirect and cumulative impacts of the proposed mining to the environment. This is consistent with the principles for sustainable development in NEMA. The proposed development has also been found to be consistent with the spatial development planning context applicable to the area. With the appropriate environmental controls in place, the proposed development is also considered to be compatible with surrounding land uses.

Accordingly, it is concluded that there is a need for the project and that undesirable aspects of the development can be satisfactorily mitigated.

6 PERIOD FOR WHICH THE ENVIRONMENTAL AUTHORISATION IS REQUIRED

In terms of the MPRDA, the maximum period a mining right may be issued for is 30 years, with the option to renew for another 30 years. The planned Life of Mine (LOM) for the Prieska Zinc Copper Project based on identified mineral resources and expected extensional exploration targets is estimated at 25 years. The mining of the Vardocube Section will be completed within this 25-year LOM period.

7 DESCRIPTION OF THE PROCESS FOLLOWED TO REACH THE PROPOSED PREFERRED SITE

7.1 DETAILS OF ALL ALTERNATIVES CONSIDERED

7.1.1 THE PROPERTY ON WHICH OR LOCATION WHERE IT IS PROPOSED TO UNDERTAKE THE ACTIVITY

The location of the proposed underground mining activities in the Vardocube Section are fixed by the orebody and the mineral resources which are being targeted.

7.1.2 THE TYPE OF ACTIVITY TO BE UNDERTAKEN

Underground mining and ore handling is the only activity relevant to this assessment.

7.1.3 THE DESIGN OR LAYOUT OF THE ACTIVITY

The underground mine design is based on safely accessing and optimally mining the orebody.

No site layout alternatives for surface infrastructure has been considered as no surface infrastructure will be established as part of the mining.

7.1.4 THE TECHNOLOGY TO BE USED IN THE ACTIVITY AND THE OPERATIONAL ASPECTS OF THE ACTIVITY

The proposed mining method of LHOS and Drift and Fill methods proposed for underground mining are the only methods deemed suitable for the safe and efficient extraction of the ore.

7.1.5 THE OPTION OF NOT IMPLEMENTING THE ACTIVITY

Should the proposed project not be implemented:

- Underground mining of Vardocube will not proceed;
- The financial and broader socio-economic value associated with the extraction, processing and sale of the minerals will not be realised; and
- The royalties and tax revenue from the underground mining will not accrue to the South African Government.

7.2 DETAILS OF THE PUBLIC PARTICIPATION PROCESS FOLLOWED

7.2.1 NOTIFICATION

Interested & Affected Parties (I&APs), including landowners, land users and surrounding landowners/land users, have previously been consulted with in terms of the application for a prospecting right and associated environmental authorisation for prospecting on Portion 1 of Vogelstruisbult 104. This consultation process was undertaken in February 2017.

In addition, access agreements have been signed between the Applicant and the surface right owners of the affected properties for prospecting on Portion 1 of Vogelstruisbult 104. A confidential agreement has also been signed between Orion and a solar PV power plant operator.

Building on this prior and ongoing consultation, the following tasks will be undertaken, providing opportunities for interested and affected parties (I&APs) to participate in the S&EIR Process, including the site selection and alternatives analysis process:

- Pre-application meeting with the competent authority;
- Directly affected landowners and land occupiers will be identified and notified of the mining development and the S&EIR Process underway;

- Statutory advertisements (English and Afrikaans) will be placed in the relevant regional (Volksblad) and local (Noordwester) newspapers;
- Placement of site notices at various locations within the study area;
- Distribution of a letter to key stakeholders, including an invitation to participate;
- Distribution of the Draft Scoping Report (DSR) and Draft Environmental Impact Report (DEIR) for public comment. The draft reports will be available electronically and hard copies will also be placed at the municipal offices in Copperton, Prieska, Marydale and Niekerkshoop; and
- Meetings with I&APs on request.

As part of the Project notification activities, the Draft Scoping Report will be made available for public review and comment for a period of 30 days.

All issues raised by I&APs will be captured in a Comments and Response Report (CRR). The CRR will contain comments forwarded to project team members, raised at various meetings, received through comment sheets, letters, faxes and e-mail. The updated CRR will accompany the corresponding Scoping and EIA Reports.

7.2.2 DRAFT SCOPING REPORT

As part of project notification, this Draft Scoping Report will be made available for public review and comment for a period of 30 days. The report is available as follows:

- By download: http://www.abs-africa.com/project-documents/
- By e-mail: prieskappp@abs-africa.com
- Hard copies were made available for review at the following venues:
  - Alkantpan Lodge in Copperton
  - Prieska Municipal Library, Stewart Street, Prieska
  - Orion Minerals Office, Loots Boulevard, Prieska
  - Marydale Municipal Office, Van Wyk Street, Marydale
  - Niekerkshoop Municipal Office, Church Street, Niekerkshoop

Various key stakeholder meetings undertaken as part of the Notification Phase of the Project are summarised in Table 7-1.

The register of I&APs, copies of written notification, site notices and newspaper notices developed and distributed to date are provided in Appendix 6.

TABLE 7-1: STAKEHOLDER MEETINGS

STAKEHOLDER	DATE
Department of Mineral Resources	31 July 2018

7.2.3 SUMMARY OF ISSUES RAISED BY I&APS

Comments received during the stakeholder meetings and review period for the Draft Scoping Report will be used to update the Final Scoping Report.

Ongoing briefings with I&APs will continue throughout the S&EIR Process. These briefings will take the form of telephonic and e-mail interactions and meetings to be held in strategic locations within the study area as and when required. Throughout the S&EIR Process, the PPP Team will compile and maintain an electronic database of I&APs that will contain a full and complete record of all public participation activities.

I&AP Comments and Responses that were captured as part of the Vardocube Prospecting Right Application process are summarised as follows:

- The impact of activities on dust;
- Access and security;
- The implementation of buffer zones with regards to solar farms and other sensitive receptors.

8 THE ENVIRONMENTAL ATTRIBUTES ASSOCIATED WITH THE SITES

The proposed activity is an underground mine with no surface development or disturbance. Notwithstanding this, a summary description of the attributes associated with both the surface and underground environment is provided as underground mining can still have indirect impacts to the surface environment by, for example, altering the hydrology of wetland systems, where there is a hydrological link between these systems and groundwater.

The baseline specialist studies undertaken as part of the S&EIR Process for the adjacent Repli MRA and associated application for EA, included parts of Portion 1 of Vogelstruisbult 104. Summary descriptions of the findings of these specialist studies, as relevant to the Vardocube Section, are therefore included in the sections below.

8.1 CLIMATE

PCM is situated in the BWh (mild desert climate) of the Köppen Climate Classification System. Climatic conditions are characterised by warm to hot summers, high evaporation and dry warm winters, a mean annual rainfall of 198 mm and a large degree of variability in the monthly rainfall. Potential evaporation is extremely high. The temperatures are highest in January and coldest month in July.

8.1.1 MEAN ANNUAL RAINFALL

Preliminary investigation of the site hydrological characteristics by Peens & Associates (2017) indicate a Mean Annual Rainfall of 198 mm for the site. Rainfall is strongly seasonal with approximately 60% of the yearly rainfall falling in the summer months (October to January) (Table 8-1).

8.1.2 MEAN ANNUAL EVAPORATION

Regional evaporation data obtained from gauging stations operated by the Department of Water and Sanitation (DWS) was used by Peens & Associates (2017) to calculate a Mean Annual Evaporation (MAE) of 2714 mm for the area (Table 8-1).

TABLE 8-1: MEAN MONTHLY AND ANNUAL RAINFALL AND EVAPORATION

MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANNUAL
RAINFALL													
MM	26.6	31.2	41.0	23.3	9.3	4.8	5.2	5.5	5.2	12.2	15.3	18.8	**198**
%	13.4	15.7	20.7	11.8	4.7	2.4	2.6	2.8	2.6	6.1	7.7	9.5	100
EVAPORATION													
MM	283	336	380	373	295	241	158	109	82	100	146	211	**2 714**
%	10.4	12.4	14.0	13.7	10.9	8.9	5.8	4.0	3.0	3.7	5.4	7.8	100

Source: Peens & Associates (2017)

8.1.3 TEMPERATURE

High maximum and very low minimum temperatures characterise the environment. The temperatures are highest in January with an average around 26.9°C. July is the coldest month with 9.8°C on average.

TABLE 8-2: MEAN MONTHLY AND ANNUAL TEMPERATURES

MONTH	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	ANNUAL
RAINFALL													
MIN	12.1	15	17.8	19.2	18.5	16	11.3	5.9	1.5	1	3.7	7.5	**10.8**
MAX	29.2	31.3	34.1	34.6	33.8	31	26.8	22.3	18.8	18.6	21.7	25.2	**27.3**
AVE	**20.6**	**23.1**	**25.9**	**26.9**	**26.1**	**23.5**	**19**	**14.1**	**10.1**	**9.8**	**12.7**	**16.3**	

Source: South African Weather Service (Prieska Weather Station)

8.1.4 WIND SPEED AND DIRECTION

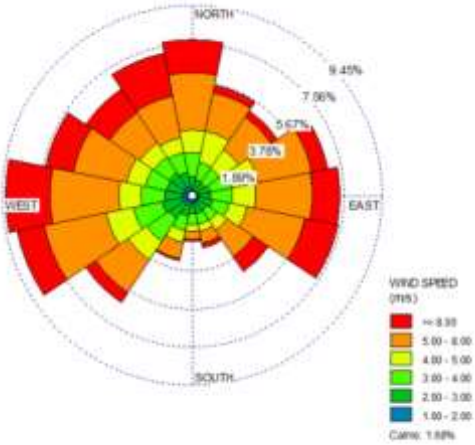
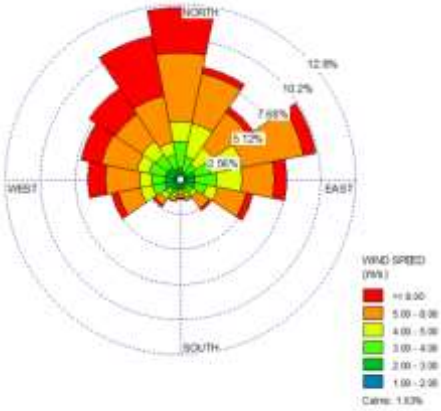
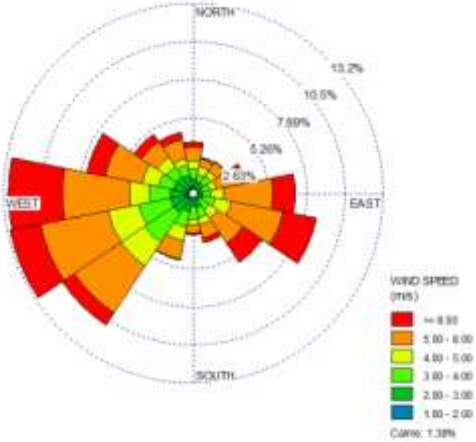
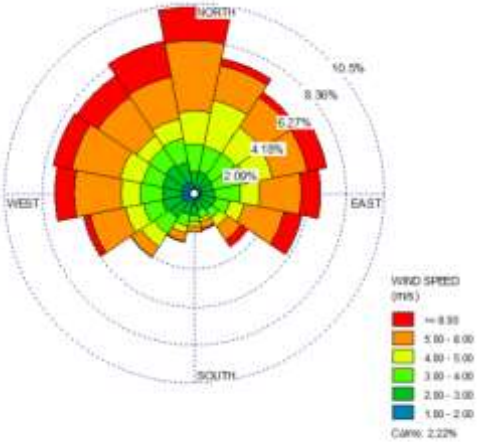
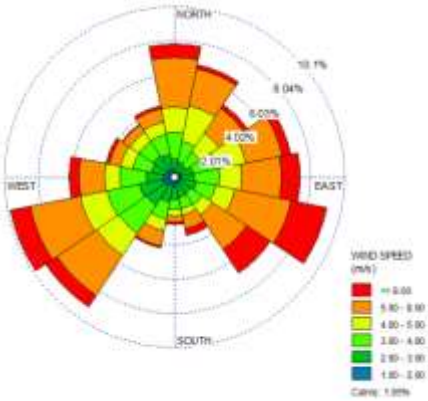
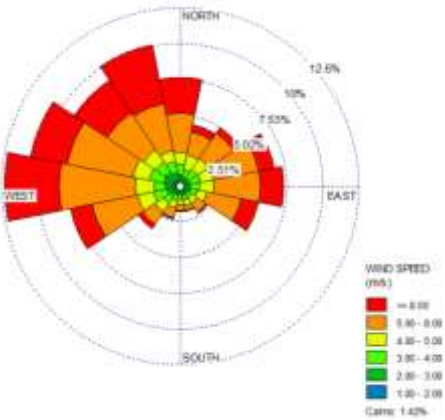
Dominant wind directions and wind speed across the site are presented in Figure 8-1. Seasonal and daytime/night-time variation in wind speeds and direction are also shown.

Wind roses comprise 16 spokes, which represent the directions from which the wind blew during a specific period. The colours used in the wind roses reflect the distinct categories of wind speeds; for example, yellow representing winds in between 1.5 and 2 m/s. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories. The frequency with which calms occurred, i.e. periods during which the wind speed was below 1 m/s are also indicated.

Annual average wind direction is dominant from the west and west-west-south. Winds from the north, east and east-east-south are also frequent. Wind is a characteristic of the region, with calm conditions (wind speed less than 1m/s) only being present for 1.58% of the time.

There is a distinct seasonal variation between summer and winter wind direction with predominant winds in winter being from the north and north-north-west. In summer, the predominant wind direction is from the west and west-west-south with south-easterly winds also important. Autumn and spring wind direction is similar to that of winter and summer respectively.

Daytime average wind direction is from the south-west and south-east whereas night-time wind direction is predominantly from a westerly direction. Wind speeds are stronger during night-time compared with daytime conditions.

	
Annual Average	**Winter Average**
	
Summer Average	**Autumn Average**
	
Daytime Average	**Night-time Average**

Source: MM5 Data (2014-2016)

FIGURE 8-1. AVERAGE ANNUAL WIND DIRECTION AND SPEED FOR COPPERTON

8.1.5 TOPOGRAPHY

The area is flat with no significant natural physiographic features present in the area (Appendix 4 Map 4). The terrain type can be described as slightly irregular plains. Elevation across the site varies from approximately 1100 mamsl (metres above mean sea level) in the east to approximately 1080 mamsl in the west.

8.1.6 GEOLOGY

The Prieska Orebody is hosted by highly deformed metamorphic rocks of the Copperton Formation of the Areachap Group, which forms part of the Namaqualand Metamorphic Province.

The copper-zinc orebody forms part of a varied sequence of chemical sediments located at the contact between streaky to banded quartz-feldspar-hornblende gneisses and a sequence of varied banded mafic gneisses and amphibolites. Outcrops in the MRA area are sparse and most of the area is covered by thin sand and scree cover and up to 5m thick calcrete. In the southern corner of the MRA surface area tillite, mudstone and shale of the younger Dwyka Formation unconformably overly the rocks of the Copperton Formation.

Regional geology is shown in Appendix 4 Map 5.

8.1.7 RADIOACTIVITY

Laboratory assay data from rock samples removed during the Repli prospecting drilling programme showed some variation in the concentration of total Uranium (U) and Thorium (Th). The average concentration of total U and total Th in the rock samples was however below the 0.5 Bq/g regulatory limit at which material is considered to be radioactive.

A screening investigation on the U-238, U-234, U-235 and Th-232 radionuclide isotopes in the Repli tailings testwork was undertaken to determine if the concentrations of these isotopes may be enriched during mineral processing and thus result in radioactivity levels in the tailings exceeding the 0.5 Bq/g or 500 Bq.kg-1 (nuclide specific) regulatory limit. The results indicated that all the nuclides were significantly below the exemption level of 500 Bq.kg-1 (radionuclide specific). This means that the material associated with the samples was not considered as radioactive material per se.

Since the rock material from the Vardocube section is from the same orebody as that proposed to be mined by Repli, no difference in the total concentration of Uranium (U) and Thorium (Th) is expected.

8.1.8 SOILS AND AGRICULTURAL LAND CAPABILITY

A baseline soils and agricultural land capability survey has been undertaken for the area by Eco Soil (2017). A summary of the findings of this survey are presented below.

Red/yellow apedal, freely drained soils with a high base status characterise the largest part of the MRA surface area (Appendix 4 Map 6). The Ah93 soil group occupies a large percentage of land in the south of the site. The soils are shallow (less than 450 mm deep) and of low agricultural potential and have rock, weathered rock or calcrete as underlying material. Clay contents are generally less than 15 % and the soils may therefore be susceptible to wind erosion.

There is no peat or soils with a high potential agricultural value within the MRA surface area. The area can be classed in land capability class III: Soils not suitable for arable agriculture, but suitable for grazing.

Land use of the areas surrounding the PCM site is restricted to low intensity grazing. The natural grazing capacity of the site is approximately 35-40 hectares per large stock unit. The combination of low rainfall, high potential evaporation, high maximum and low minimum temperatures, as well as low potential shallow soils limits agricultural activities.

8.1.9 TERRESTRIAL ECOLOGY

A baseline terrestrial ecology survey has been undertaken for the area by Ecorex Consulting Ecologists (2017). This study area included a significant portion of the proposed Vardocube Mining Right Area. A summary of the findings of this survey are presented below.

8.1.9.1 Regional Context - National Vegetation Types

The study area is situated within the Nama-Karoo Biome. The flora of the Nama-Karoo is not as diverse and rich as the adjacent Succulent Karoo and does not contain any centres of plant endemism. Three geographically distinct bioregions are present within this biome, namely the Bushmanland, Upper Karoo and Lower Karoo. The study area is situated within the Bushmanland Bioregion at the junction of two national vegetation types, namely Bushmanland Arid Grassland (NKb3) and Bushmanland Basin Shrubland (NKb6). (Appendix 4 Map 7).

Bushmanland Arid Grassland has a conservation status of Least Threatened although only small areas are officially conserved in Augrabies National Park and Goegap Nature Reserve. Bushmanland Basin Shrubland is not represented in any official conservation areas, but shows no sign of serious habitat transformation and has a conservation status of Least Threatened.

8.1.9.2 Local Context - Vegetation Assemblages

A large proportion of the study area still comprises Natural Habitat that appears to be relatively undisturbed and is particularly well represented in the eastern half of the study area. This vegetation varies from open grassland to relatively dense shrubland and is likely to be representative of Bushmanland Basin Shrubland, with elements of Bushmanland Arid Grassland present. This is the vegetation assemblage in which plant species of conservation concern are most likely to be found and is the habitat that is most likely to support populations of fauna species of conservation concern.

Three broad-scale vegetation communities have been identified within the study area, based primarily on analysis of high-resolution satellite imagery.

These are as follows:

- Modified Habitat.
- Undisturbed Natural Habitat; and
- Disturbed Natural Habitat.

All the areas that have been cleared of natural habitat, such as buildings and historical mining facilities, are classified as Modified Habitat.

Undisturbed Natural Habitat was classified into three distinct vegetation communities or assemblages. These are described in Figure 8-2.

FIGURE 8-2: UNDISTURBED NATURAL HABITAT IN THE STUDY AREA

VEGETATION COMMUNITY	DESCRIPTION	PHOTOGRAPH
Aizoaceae dwarf shrubland on calcrete plains	This vegetation community is found on plains throughout the project area, specifically where calcrete is prominent on the soil surface. It is the vegetation community that is most representative of Bushmanland Basin Shrubland in the project area. *Aizoaceae* dwarf shrubland differs from *Rhigozum* dwarf shrubland in having noticeably higher diversity of dwarf shrubs and much lower proportional grass cover.	
Rhigozum trichotomum dwarf shrubland on sandy plains	*Rhigozum* dwarf shrubland is found on the deeper, red to reddish brown sands in the project area, usually with little or no evidence of calcrete on the soil surface. While this vegetation community is still representative of Bushmanland Basin Shrubland, it contains elements of Bushmanland Arid Grassland as well, particularly the relative abundance of grass cover.	
Pans	Several circular to sub-circular ephemeral pans are found in the eastern half of the study area, as well as a few adjacent to the north-eastern boundary. None of the pans held any water during fieldwork and comprised either bare soil or heavily grazed seasonal grassland. Species richness appears to be low, but could not be assessed because of the lack of visible above-ground foliage. Most of the plant species present are likely to be habitat specialists adapted to the extremes of flooding and extended drought, justifying an elevated conservation importance for this vegetation assemblage.	

Disturbed Natural Habitat refers to areas of Natural Habitat that have not been transformed by construction of infrastructure such as roads, buildings or tailings storage facilities, but have been degraded through human activity such as movement of heavy machinery or dumping of building rubble.

Alien invasive plant thickets were mapped within the Degraded Natural Habitat mapping unit. These thickets are found most often in areas that have previously been degraded or transformed, as well as around edges of pans or livestock watering points. The invasive alien tree species *Prosopis glandulosa* is the dominant, while the closely related *Prosopis velutina* is present in small numbers. Species representative of the original Natural Habitat state are usually present, particularly *Rhigozum trichotomum*, which is an indigenous invader of disturbed habitats.

This degraded Natural Habitat still contains a seedbank of the original flora and some original plant cover and has a significantly higher potential for restoration than Modified Habitat does. Most of the areas of degraded Natural Habitat are situated adjacent to Modified Habitat.

8.1.9.3 Species of Conservation Concern

The vast majority of the plant species occurring in the general vicinity of the study area are currently classified as either Least Concern (661 spp) or Not Evaluated (66 spp).

One species, *Listia minima*, is classified as Data Deficient (Taxonomically Problematic) and cannot be assessed until its taxonomy is resolved (Victor, 2006). The following three species of conservation concern have been confirmed to occur in the QDS:

- *Hoodia officinalis* subsp. *officinalis*;
- *Phyllobolus amabilis*; and
- *Aloidendron dichotomum* (Quiver Tree).

None of these species were located during fieldwork.

8.1.9.4 Endemic Plant Species

The Copperton study area is situated at the southern boundary of the Griqualand West Centre of Plant Endemism as defined by Frisby (2016). Five of the 26 endemic or near-endemic GWCPE species have been confirmed to occur in the general vicinity of the study area, namely *Calobota cuspidosa* (Fabaceae), *Justicia thymifolia* (Acanthaceae), *Phyllobolus amabilis* (Aizoaceae), *Putterlickia saxatilis* (Celastraceae) and *Searsia tridactyla* (Anacardiaceae).

Dedicated searches for these and other GWCPE species were conducted in the project area during summer fieldwork but none were located. However, many species were in vegetative state, some without even having leaves present, and it is possible that GWCPE endemics may have been overlooked.

8.1.9.5 Protected Plant Species

Eleven of the plant species confirmed to occur in the project area during fieldwork are protected. One species is protected under Schedule 1 of the Northern Cape Nature Conservation Act (No. 9 of 2009), namely *Hoodia gordonii*, while nine species are protected under Schedule 2 of the same act. A single species, *Boscia albitrunca*, is protected under the National Forest Act (No. 84 of 1998).

8.1.9.6 Alien Invasive Plant Species

Two tree species are of particular concern and are classified as Category 3 invasive species in the Northern Cape under the National Environmental Management: Biodiversity Act (No.10 of 2004): Alien and Invasive Species Regulations, 2014: Honey Mesquite (*Prosopis glandulosa*) and Velvet Mesquite (*P. velutina*). *Prosopis glandulosa* is relatively common in the project area and has invaded degraded areas in the vicinity of the mine and at most of the pans and livestock watering points. *Prosopis velutina* is less common and potentially a lower threat than *P. glandulosa*.

8.1.10 FAUNA

8.1.10.1 Mammals

Numerous small mammal species are endemic to the Namib-Karoo Biome, of which the following have been confirmed to occur within the general vicinity of the study area (Friedman & Daly, 2004): Western Rock Sengi (*Elephantulus rupestris*), Round-eared Elephant Shrew (*Macroscelides proboscideus*), Spectacled Dormouse (*Graphiurus ocularis*), Pygmy Rock Mouse (*Petromyscus collinus*), Brukkaros Pygmy Rock Mouse (*P. monticularis*), Bush Vlei Rat (Otomys unisulcatus), Brants's Whistling Rat (Parotomys brantsii) and Littledale's Whistling Rat (*P. littledalei*).

Two Vulnerable and five Near Threatened mammal species have been recorded in QDSs in the vicinity of the study area according to distribution maps in Friedman & Daly (2004), three of which have a moderate likelihood

of occurring because of the presence of suitable habitat, and one of which was confirmed to occur. A carcass of a sub-adult Brown Hyaena (*Parahyaena brunnea*), which is classified as Near Threatened, was recovered from within the study area. This species has large home ranges and is unlikely to be confined to the project area, although it could be resident. No threatened mammals are likely to be present within the project area.

8.1.10.2 Birds

Twenty-three species are listed by Barnes (1998) as being endemic to the Namib-Karoo biome i.e. not occurring outside of the biome, of which 15 species (65%) have been recorded within the general vicinity of the study area during the current Southern African Bird Atlas Project (SABAP2).

While only four of these species were located in the project area during fieldwork, it is likely that species such as Karoo Long-billed Lark *Certhilauda subcoronata*, Sickle-winged Chat *Cercomela sinuata* and Tractrac Chat *C. tractrac* also occur. A number of near-endemics such as Rufous-eared Warbler *Malcorus pectoralis*, Namaqua Sandgrouse *Pterocles namaqua* and White-throated Canary *Crithagra albogularis* were also observed during fieldwork. Two species that are endemic to the Kalahari-Highveld biome have also been recorded in the same area, both of which were confirmed to occur during fieldwork

The study area is also situated in a designated secondary Endemic Bird Area, namely the Karoo EBA (s047) (Barnes et al., 2001). There are no Important Bird Areas within the vicinity of the study area, the closest being the Platberg-Karoo Conservancy IBA (ZA037), approximately 130 km to the east (Barnes, 1998).

The quarter-degree grids 2922 CD and 3022 AB, in which the study area falls, currently have a combined list of 158 bird species recorded during the ongoing second Southern African Bird Atlas Project (SABAP2), a total probably approaching true species diversity. However, the small size of the study area, homogenous structure of vegetation, high degree of transformation and the lack of waterbodies make it unlikely that more than 40-50 species occur within the study area.

Six Endangered (EN), five Vulnerable (VU) and five Near Threatened (NT) species have been recorded from the general vicinity of the project area during SABAP2. One of the Endangered species, Ludwig's Bustard *Neotis ludwigii*, was located during fieldwork in shrubland east of Copperton within the study area and is possibly resident in very low numbers. Two Near Threatened species were also located in the project area during fieldwork. Pairs and small groups of Double-banded Courser *Rhinoptilus africanus* and several family groups of Karoo Korhaan *Eupodotis vigorsii* were seen and heard in shrubland. Karoo Korhaan is likely to be a breeding resident in the project area, while Double-banded Courser is more likely to be an irregular breeding visitor. Jenkins (2011) reported regularly active nests of Martial Eagle *Polemaetus bellicosus*, which is classified as Endangered, within 11 km south of the study area (on tower 512 of the HydraKronos 400 kV line), and within 22 km to the south-west (on tower 392 of the AriesKronos 400 kV line). Thus it is likely that this species regularly forages over the study area.

Two Vulnerable species have a moderate likelihood of occurring in the project area, based on assessment of habitat present in the project area and likelihood of occurring in proximity to disturbance, namely Lanner Falcon *Falco biarmicus* and Red Lark *Calendulauda burra*. Limited nesting habitat is present for Lanner Falcon, but it has fairly large foraging home ranges and is potentially a non-breeding visitor. Red Lark is a habitat specialist that prefers shrublands or grasslands on deep, sandy soils and is a potentially resident species in this habitat in the project area. One Near Threatened species has a moderate likelihood of occurring in the project area based on the above criteria, namely Sclater's Lark *Spizocorys sclateri*.

8.1.10.3 Herpetofauna (Reptiles and Amphibians)

The desktop study initially revealed that a total of 48 reptile species could be expected to occur within and surrounding the study area of which three species are endemic and three are considered as near-endemic (Bates et al., 2014). Only seven (15%) of these species were previously observed within the QDS of the study area (ReptileMap, 2017). Refinement of the list of expected species, based on the species and habitats observed within

the study area during the field survey, decreased the number of expected reptile species to 31 (probability of occurrence either medium or high). This is mostly due to the lack of extensive rocky or ridge habitats excluding strongly rupiculous species (e.g. *Karusasaurus polyzonus*), while the lack of large tracts of sandy soils and the complete absence of Camelthorn trees (*Vachellia erioloba*) excluded fossorial (e.g. *Acontias lineatus*) and arboreal (e.g. *Chamaeleo dilepis*) species respectively.

Reptile activity levels were very low during fieldwork, presumably due to very dry veld conditions, low humidity, cold temperatures and strong winds brought about by two consecutive cold fronts. A total of 15 reptile species (76 individuals) were observed during the survey. No species of conservation concern were observed.

For amphibians, an initial eleven species were expected to occur within and surrounding the study area of which only one species is considered endemic (Du Preez & Carruthers, 2009). A single species has been observed within the QDS of the study area (FrogMap, 2017). Refinement of the list of expected species, based on the species and habitats observed within the study area during the field survey, decreased the number of expected amphibian species to nine (probability of occurrence either medium or high). No amphibian species were observed in the project area during fieldwork. Additional fieldwork after the ephemeral pans had received some rain would have resulted in a few species being located, but fieldwork timing did not correspond with good rains.

No herpetofauna species currently designated as species of conservation concern have been observed within the focal QDS of the study area (2922CD) or the surrounding 8 QDS's. However, a single species that potentially occurs in the area is of concern and requires discussion. FrogMAP (2017) lists the Giant Bullfrog (*Pyxicephalus adspersus*) as Near Threatened (NT), while Du Preez & Carruthers (2009) list it as Vulnerable (VU) and NEMBA (2004) lists it as Protected. This species breeds in shallow temporary pans which are present within the study area and surroundings, and consequently have elevated biodiversity value. It has been classified as NT as a result of loss of its breeding habitat to urbanisation and agricultural use, as well as being particularly susceptible to collisions with vehicles on roads and is often targeted as a food source by people.

A recent observation of a skink specimen initially identified as a Thin-tailed Legless Skink (*Acontias gracilicauda*) near Postmasburg is believed to represent an undescribed species (W. Conradie [PEM] *pers. comm.*). No suitable habitat for this species was observed within the study area and it is therefore not expected to be influenced by the proposed development.

8.1.11 PRELIMINARY BIODIVERSITY VALUE ASSESSMENT

The Biodiversity Value (BV) of each habitat (modified and natural), determined qualitatively by integrating the Conservation Importance (CI) and Functional Importance (FI) of each community, is indicated in Table 8-3.

TABLE 8-3: BIODIVERSITY VALUE OF HABITATS

VEGETATION ASSEMBLAGES	CONSERVATION IMPORTANCE	FUNCTIONAL IMPORTANCE	BIODIVERSITY VALUE
PANS	High	High	High
NATURAL HABITAT (UNDISTURBED)	Moderate	Moderate	Moderate
NATURAL HABITAT (DEGRADED)	Moderate	Low	Low
MODIFIED HABITAT	Very Low	Very Low	Very Low

The Pan vegetation community was assessed as having High BV on account of high CI score on the basis of a potential for supporting species of conservation concern as well as a high proportion of habitat specialists, and a high FI score. Both *Aizoaceae* dwarf shrubland and *Rhigozum trichotomum* dwarf shrubland were rated as having Moderate BV as a result of moderate CI and FI values.

The Pans and both shrubland vegetation communities represent the untransformed natural habitat in the project area and are key habitats in which negative impacts need to be avoided and in which no infrastructure should be placed wherever possible. The ecologically compromised state of degraded Natural Habitat has resulted in a Low BV, although it is a habitat that still has some of the original vegetation cover and has a higher potential for restoration than Modified Habitat, which has a Very Low BV.

8.1.12 SURFACE WATER

The study area falls within the Orange (D) Primary catchment, the D5 Secondary catchment and the Lower Orange DWS water management area. It falls within the D54D quaternary catchment. The watershed associated with the survey area drains toward the Basterput se Leegte River within the adjacent catchment, which drains northwards into the Hartbees River, which then confluences with the Orange River near the town of Kakamas.

The quaternary sub-catchment's underlying geology consists of tillite, undifferentiated assemblage of compacted sedimentary extrusive and intrusive rocks as well as principally arenaceous strata. The underlying geology is covered with moderate to deep sandy soils with a medium erodibility index and an estimated annual sediment yield of 10 000 tons per annum. The entire catchment area falls with an endoreic area, which is classified as a catchment area that does not contribute to mean annual runoff. Hence, this catchment only produces runoff during major storms.

Several non-perennial rivers traverse the surface area. (Appendix 4 Map 8). Drainage across the site is generally from east to west.

Prior to its diversion, the historic alignment of one of the non-perennial rivers passed through the area now occupied by the historical mine surface infrastructure and sinkholes on the adjacent Portion 25 and 26 of Vogelstruisbult 104. The non-perennial river is not named; however, it is a tributary of the Hartbeest River, which discharges into the Lower Orange River. This watercourse has an effective catchment area of 259 km^2 and is currently diverted to the north and south of the historical mine surface infrastructure and sinkholes. The diversion consists of an earth channel with a berm on the lower ground side of the channel.

The proposed underground mine will not have an impact on any surface water resources in the area.

8.1.13 SURFACE WATER ECOSYSTEMS

A surface water ecosystems study has been undertaken for the area by Enviross (2018). This study area included a significant portion of the proposed Vardocube Mining Right Area. This study indicated that the region has an arid climate and therefore persistent surface water ecosystems are rare. Poorly-developed watercourses are commonplace, but defined channels are rare due to the generally low volumes of rainfall events. Most watercourses are barely perceptible and convey small volumes of water only during rainfall events, with no permanent aquatic habitat noted throughout the survey site. Watercourses are therefore thought to be limited to stormwater drainage toward more developed watercourses located further downstream of the site.

Few wetland features were observed within the area, which was expected because of the arid climate. A single naturally-occurring wetland unit that supports a surface water ecosystem was identified. The wetland / pan is within 100 m of the proposed main access road to the Repli mine. This is an existing road.

No surface water ecosystems are expected to be impacted by the proposed underground mining of the Vardocube Section.

8.1.14 GROUNDWATER

A groundwater specialist study was undertaken by ILEH (2018). The study included the Vardocube Section.

From a geohydrological perspective three aquifers are present. The upper 15m of the geological succession comprises unconsolidated sand, calcrete and clay, which is expected to be dry except after a rainfall event. The unconsolidated sediments are underlain by a fractured gneiss aquifer, which is estimated to be approximately 100m thick. Groundwater is associated with fractures and faults. The fieldwork data suggests the transmissivity of the gneiss varies between 0,2 and 32 m2/d. The matrix of this aquifer is expected to have a low transmissivity, probably around 0,2 m2/d or lower. The average depth to groundwater in this aquifer is 18m, but it is dewatered locally around the historical PCM underground workings. This aquifer is regionally important, as it is used for private groundwater abstraction.

A lower fractured rock aquifer is present at depths greater than 100m. There is currently no information available to characterise this aquifer. The monitoring boreholes drilled during the current project extended to depths of between 80 and 150m below surface and target the upper fractured rock aquifer discussed above. Literature-based aquifer characteristics were therefore used to assess impacts associated with the deep fractured rock aquifer.

A hydrocensus was completed in order to identify and characterise private groundwater use in the vicinity of the PCM operations. A total of 32 boreholes were located. These boreholes are drilled to an average depth of 40 m. Half of the boreholes identified were dry or not in use. Groundwater is solely used for stock watering and none of the boreholes identified during the hydrocensus are used for potable supply. A borehole on the farm Vogelstruisbult, situated east of the PCM mining area is reported to have a high yield, but on average the yields of boreholes identified are low.

A total of 12 groundwater monitoring boreholes were drilled around the proposed project as well as around the historical TSF. One borehole was drilled to a depth of 150 m at the historical TSF. The remainder of the boreholes were drilled to 80 m below surface. The depth to groundwater in these boreholes varies between 6 m and 35 m below surface, with an average depth of 20 m. Regionally, groundwater flows in a south-westerly direction at a gradient of 1:125. Groundwater flow patterns indicate a lowering in groundwater levels around the historical PCM mine and a mound in groundwater levels around the historical TSF.

The sparse intersection of water-bearing features in the boreholes drilled suggests that the aquifers have been dewatered to a large extent in the immediate vicinity of the mine. The information also confirms that groundwater occurrence is erratic in this arid environment.

Aquifer tests were completed on the five boreholes that intersected groundwater. The results indicate that two boreholes had yields of 4,5 l/s (150 000 lph) and 1,9 l/s (82000 lph). The yields of the remainder of the boreholes are low, on average 0,06 l/s (2500 lph). The results of the aquifer tests were also used to calculate the transmissivity and storage coefficients for the boreholes. These parameters describe the aquifer conditions intersected in each borehole. Higher transmissivity and storage coefficient values are associated with stronger aquifers.

The results indicate that the fractured rock aquifers present are heterogeneous with transmissivities varying between 0,2 and 6,2 m^2/d.

The average calculated storage coefficient from the tests is $1{,}16 \times 10^{-3}$. These values are typical of the rock formations intersected.

The outcome of the chemical analysis of the groundwater samples taken from the hydrocensus boreholes indicate that regionally, groundwater is saline with elevated total dissolved solids, chloride and in some instances sulphate concentrations.

The groundwater in private boreholes has also been contaminated with nitrates that are most probably associated with agricultural activities. Elevated selenium and uranium levels are typical for the region, but may result in chronic health risks if ingested over prolonged periods of time.

Groundwater quality in the mining area is characterised by increased sulphate and manganese concentrations. The most significant impact on groundwater quality at the PCM operations is associated with the historical TSF. Sulphate concentrations in this area exceed 2500 mg/l in two of the monitoring boreholes.

The potential sources to groundwater contamination identified from the available dataset includes the following:

- The historical TSF on Portion 0 of the Farm Slimes Dam 154. Groundwater monitoring information indicates that this facility is already impacting on groundwater quality;
- The proposed new TSF. It is noted that the new TSF will be lined, thus reducing the impact on groundwater quality associated with the facility significantly;
- The underground workings; and
- The effluent dam, which will contain poor quality water pumped to surface from the underground workings. This dam will also be lined, thus significantly reducing the risk of groundwater contamination.

Contamination from these sources may reach the aquifers vertically through the unsaturated soil horizon and the weathered aquifer from surface sources of contamination like the historical TSF. Once the potential contamination reaches the fractured rock aquifer, the preferential flow paths would be the faults and fractures present. Groundwater will also flow through the rock matrix, but at much lower rates compared to the preferential pathways.

The receptors to groundwater contamination includes the following:

- Existing private groundwater users; and
- Non-perennial streams near the mining area. It is however noted that these streams are dry and this impact is therefore not anticipated to be of significance.

8.1.15 AIR QUALITY

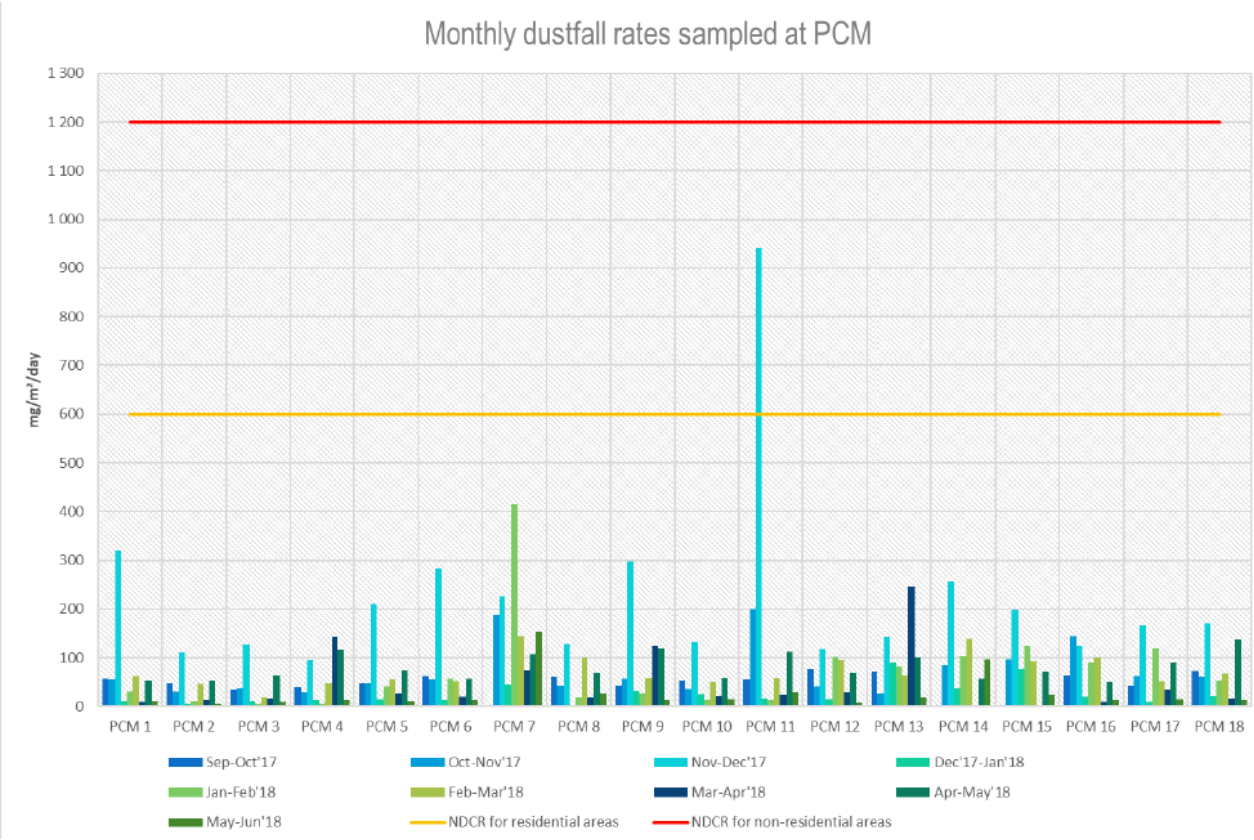
There are no ambient air quality monitoring stations near PCM. The ambient air quality in the area is however expected to be within the acceptable range of all the pollutants specified in the National Ambient Air Quality Standards, Government Notice 1210, promulgated in terms of the National Environmental Management: Air Quality Act 39 of 2004. This is attributed to the remoteness of the site and the absence of any significant atmospheric emission sources in the region.

Existing sources of emissions to the local airshed are expected to be from the following activities:

- Dust entrainment from vehicles using unsurfaced roads and tracks;
- Burning of biomass;
- Windblown dust and particulate emissions from exposed areas, including historical mining structures such as the TSF and WRD; and
- Alkantpan activities.

A dustfall network has been established by Repli to develop a pre-mining record of dustfall. The network comprises of 18 dust buckets, positioned in relation to prevailing wind direction, planned prospecting and mining activities and site-specific conditions.

Acceptable dustfall rates in terms of the National Dust Control Regulations, 2013 Government Notice 827, promulgated in terms of the National Environmental Management: Air Quality Act 39 of 2004 for residential areas is less than 600 mg/m^2/day and for non-residential areas less than 1200 mg/m^2/day. Results from 9 months of monitoring indicate that the pre-mining dustfall levels are very low (Figure 8-3).



Source: Airshed Planning Professionals (2018)

FIGURE 8-3: DUSTFALL RATES

Dustfall rates increased from the Sep/Oct 2017 sampling period to Nov/Dec 2017 sampling period but decreased significantly between the Nov/Dec 2017 and Dec 2017/Jan 2018 sampling period. This may be attributed to the decline in on-site activities over the December holiday period, also resulting in less traffic on the roads. There was a slight increase in the dustfall rates for the period Jan/Feb 2018 and again in Feb/Mar 2018, with a decrease in Mar/Apr 2018. The Apr/May 2018 results show a slight increase again, but with a lower maximum dustfall rate and a higher minimum dustfall rate than the previous sampling period. For the period May/Jun 2018 the dustfall rates decreased to similar levels recorded during Dec 2017/Jan 2018.

8.1.16 ENVIRONMENTAL NOISE

A baseline environmental noise survey has been undertaken for the area by Airshed Planning Professionals (2017).

A summary of the findings of this survey are presented below. It is expected that the surface mining and associated activities undertaken by Repli will be the most significant contribution to noise in the area and that the proposed underground mining of the Vardocube Section will not have any significant additional impact on noise sensitive receptors.

8.1.16.1 Baseline Noise Survey Results

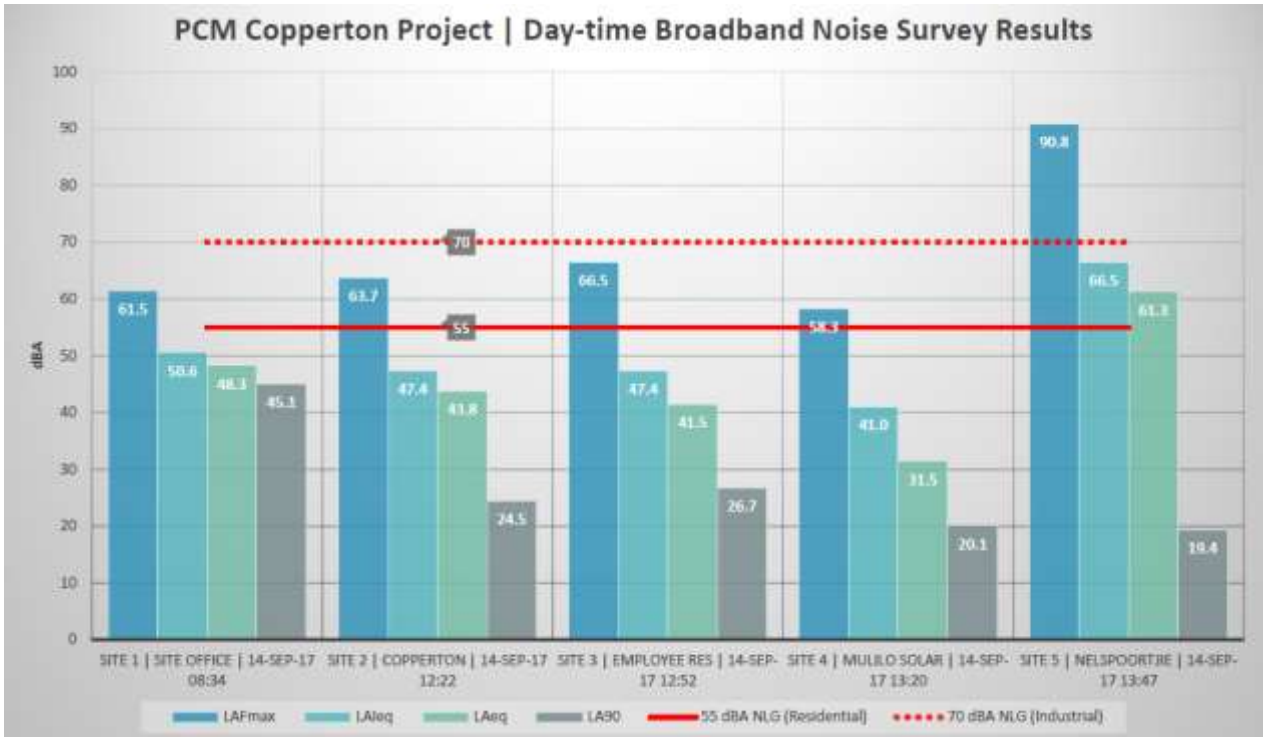
The baseline noise survey results for daytime and night-time are presented in Figure 8-4.

The following can be noted with respect to the daytime noise measurement results:

- Measurements indicate day-time ambient noise levels that are comparatively quite but influenced by occasional noisy incidents such as vehicle pass-bys;
- On-site drilling (prospecting) activities were clearly audible at on-site survey sites (Site 1, Site 3, and Site 4);
- The measured noise levels are considered typical of rural and suburban areas according to SANS 10103;
- Recorded on-site LAeq's ranged between 31.5 dBA and 48.3 dBA and are therefore in compliance with IFC guidelines for industrial receptors (70 dBA) and residential, institutional and educational receptors (55 dBA);
- At Copperton, LAIeq, LAeq, and LA90 of 47.4 dBA, 43.8 dBA, and 24.5 dBA were recorded respectively. Levels correspond to what is typically expected in rural areas and are currently compliant with the IFC guideline for residential, institutional and educational receptors (55 dBA); and
- At the Nelspoortjie farmstead entrance, next to the R357, LAIeq, LAeq, and LA90 of 66.5 dBA, 61.3 dBA, and 19.4 dBA were recorded respectively. The large difference in recorded LAIeq, LAeq, and LA90 is attributed to vehicle pass-bys. Levels correspond to what is typically expected in urban areas with main roads and are currently not compliant with the IFC guideline for residential, institutional and educational receptors (55 dBA).

The following can be noted with respect to the night-time noise measurement results:

- Measurements indicate night-time ambient noise levels that are quiet but influenced by occasional noisy incidents such as vehicle pass-bys;
- On-site drilling (prospecting) activities were audible at all survey sites;
- On-site LAIeq's ranged between 38.4 dBA and 42 dBA which is considered typical of rural and suburban areas according to SANS 10103;
- Recorded on-site LAeq's ranged between 30.3 dBA and 41 dBA and are therefore in compliance with IFC guidelines for industrial receptors (70 dBA) and residential, institutional and educational receptors (45 dBA); and
- At Copperton, LAIeq, LAeq, and LA90 of 36.3 dBA, 31.8 dBA, and 28.7 dBA were recorded respectively. Levels were very low and comparable to what is typically expected in rural areas. They are currently also compliant with the night-time IFC guideline for residential, institutional and educational receptors (45 dBA).
- At the Nelspoortjie entrance, next to the R357, LAIeq, LAeq, and LA90 of 38.4 dBA, 27.6 dBA, and 19.4 dBA were recorded respectively. Levels correspond to what is typically expected in rural areas and are compliant with the night-time IFC guideline for residential, institutional and educational receptors (55 dBA).



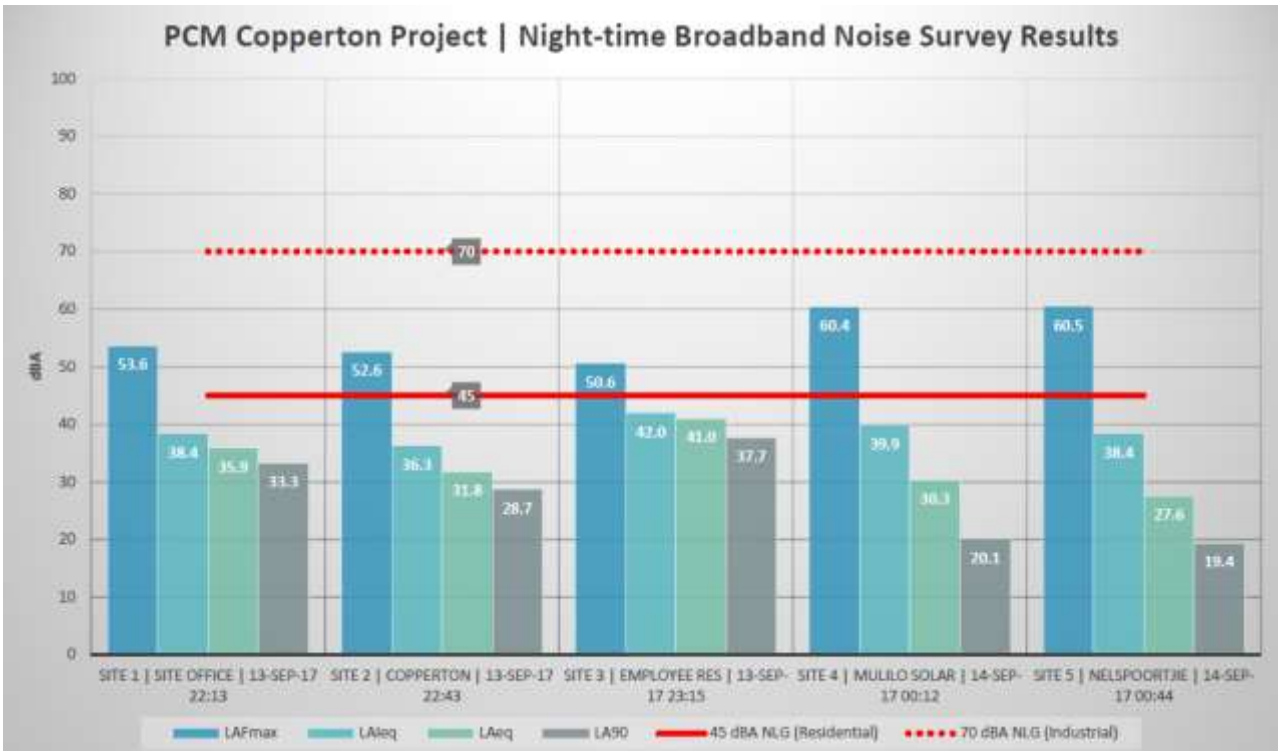


FIGURE 8-4: DAY AND NIGHT-TIME BASELINE NOISE SURVEY RESULTS

8.1.17 HERITAGE

A baseline heritage and paleontological survey has been undertaken for the area by Heritage Contracts and Archaeological Consulting (2017). This study area included a significant portion of the proposed Vardocube Mining Right Area. A summary of this survey is provided below.

8.1.17.1 Literature Review

Beaumont *et al.* (1995: 240) observed that "thousands of square kilometres of Bushmanland are covered by a low density lithic scatter". These artefacts are generally very well weathered and mostly pertain to the Early Stone Age (ESA) and Middle Stone Age (MSA). Occasional Late Stone Age (LSA) artefacts are also noted. What is noteworthy of the Northern Cape archaeological record is the presence of pans which frequently display associated archaeological material.

Of interest, is the work of Kiberd (2001, 2005, 2006) who excavated Bundu Pan, some 25 km to 30 km northwest of Copperton. The site yielded ESA, MSA and LSA horizons and the artefacts were accompanied by warthog and equid teeth to name a few (Beaumont *et al.* 1995).

Orton (2011) noted that to the northwest, west and southwest of Copperton sites have been investigated by Beaumont and colleagues (1995), Smith (1995) and Parsons (2003, 2004, 2007, 2008) yielding LSA deposits. Work on these sites led to a distinction between hunter-gatherer and herder sites, based on stone artefact assemblages (Beaumont *et al.* 1995). All these Later Stone Age sites have very few, if any, organic items on them. The only organic material found on sites like these is fragments of ostrich eggshell probably belonging to broken water containers. Such flasks have been widely recorded across the Northern Cape (Morris 1994).

8.1.17.2 Archaeology

Based on research conducted in the area ESA, MSA and LSA scatters as well as sites can be expected in the larger study area. Due to the development of the study area that would have impacted on surface indicators of heritage sites no significant archaeological sites or finds are expected. Impacts to heritage resources will occur primarily during the construction phase and no impacts are expected during the operation and decommissioning phase.

8.1.17.3 Historical Period Finds

Historical finds include middens, structural remains and cultural landscape. Due to the large scale, mining related development of the study area and surrounds from 1972 it is assumed that structures are younger than 60 years and not protected by the NHRA. Impacts to heritage resources will occur primarily during the construction phase and no impacts are expected during the operation and decommissioning phase.

8.1.17.4 Burials and Cemeteries

Graves and informal cemeteries can be expected anywhere on the landscape and studies in the surrounding areas recorded informal graves and unmarked graves. The graveyard in Copperton will not be affected in anyway by the proposed development.

8.1.17.5 Palaeontology

A Heritage Impact Assessment (HIA) was completed as part of the environmental authorisation process for the Prieska Zinc Copper Project. This HIA included a palaeontological assessment of a study area incorporating the Vardocube Section. The assessment indicated low to very low palaeontological sensitivity for the area.

8.1.18 SOCIO-ECONOMIC ENVIRONMENT[3]

8.1.18.1 Siyathemba Local Municipality

The proposed Vardocube mining right area is located within Ward 4 of the Siyathemba Local Municipality (SLM), which is managed by the Pixley Ka Seme District Municipality, within the Northern Cape Province of South Africa. The towns of Brakbos, Brulpoort, Draghoender, Koegas, Marydale, Niekerkshoop, Prieska, Shamley's Farm, Uitvlug, and Westerberg fall within the boundaries of the SLM (Figure 8-5).

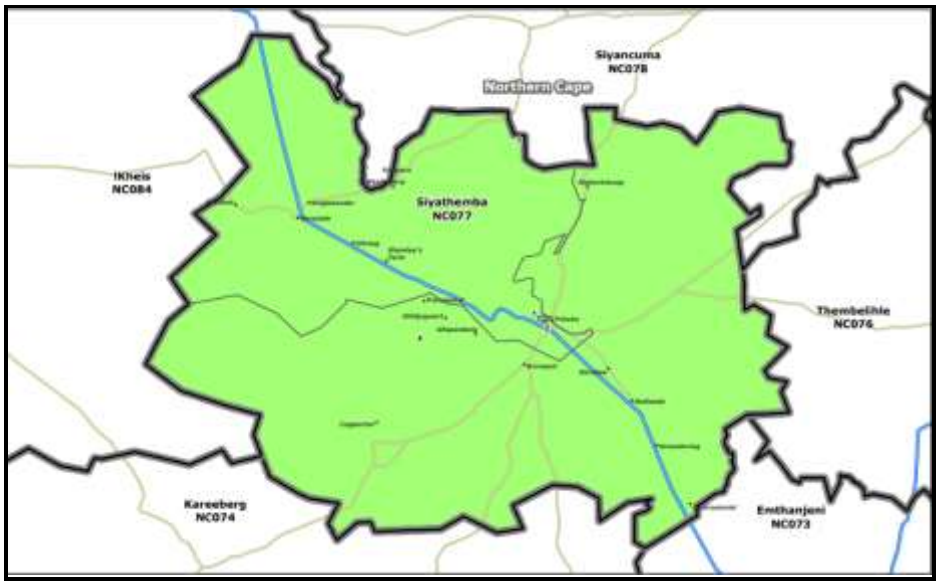


FIGURE 8-5: GEOGRAPHICAL BOUNDARY OF THE SLM

SLM was established in 2001 and is a category B municipality. It is located within the central easterly parts of the Northern Cape Province along the Orange River. It Is approximately 220 km away from the nearest business center of Kimberley. The surface area of the municipality is approximately 8 200 km^2, accounting for 8% of the total district surface area and approximately 3% of the provincial area. A summary of the key statistics of the municipality is provided in Table 8-4.

8.1.18.2 Spatial and Regional Development Planning

The SLM Spatial Development Framework (SDF) was compiled in 2006 and, according to the SLM IDP (2017-2018), is no longer used for guiding for development planning in the municipality. No development planning guidelines or objectives have therefore been defined for Copperton or the proposed MRA surface area.

Similarly, no local or regional development plans for the Copperton area have been proposed.

8.1.18.3 Population

There are approximately 22 000 people residing in the municipality. This represents approximately 1.9% of the total population in the Northern Cape. The population of Siyathemba contracted by 0.4% on average per annum between 2000 and 2010. The decline of the Siyathemba population was mainly driven by lower fertility rates.

The death rate (the number of deaths per 1,000 people in a year) increased from 11.2 deaths per 1,000 people in 1995 to 11.6 during 2010.

[3] There is a general lack of recent published demographic and other socio-economic data for the SLM. Except where noted, the information in this section has been summarised from Statistics South Africa Census Data (2011) and the SLM Local Economic Development Strategy (2012)

This is significantly lower than the death rates recorded over the same period for the Northern Cape and South Africa. The reason for the lower death rate in the study area was mainly the result of lower HIV/AIDS prevalence rates when compared with South African averages.

The most dominant population group in the SLM are Coloured individuals, who represent more than 75% of the total population in the municipal area. Black African and White population groups comprise around 12% and 8% of the population respectively. The dominant languages in the SLM are Xhosa and Afrikaans. Afrikaans is the most widely spoken language (78%).

TABLE 8-4: KEY STATISTICS OF SIYATHEMBA LOCAL MUNICIPALITY

KEY STATISTICS	NUMERICAL VALUE
Total population	21,591
Young (0-14)	30,8%
Working age	63,2%
Elderly (65+)	6%
Dependency Ratio	58,2%
Gender Ratio	99.3%
Growth Rate	1.57% (2001 - 2011)
Population density	1 person/km^2
Unemployment rate	24.3%
Youth unemployment rate	30.2%
No schooling aged 20+	11.5%
Higher education aged 20+	5.3%
Matric aged 20+	18%
Number of Households	5.831%
Number of Agricultural Households	1.334%
Average Household size (person)	3.6
Female headed households	36.1%
Formal dwellings	88.6%
Housing owned/paying off	54.3%
Flush toilet connected to sewerage	64.9%
Weekly refuse removal	73.9%
Piped water inside dwelling	43.1%
Electricity for lighting	86.2%

Source: Statistics South Africa (2011)

8.1.18.4 Educational Facilities and Education

There is a total of 10 schools (3 combined, 6 primary and 1 secondary) within the SLM (SLM IDP 2017-2018).

4.2% of the municipal population has not attended any type of a schooling system, while 48.5% have primary school education. A little over 1700 individuals (4%) have graduated from a University / Technikon.

In Siyathemba, around 14% of adults have a matric certificate compared to 24.7% in the Northern Cape. The percentage of the population with a tertiary education in Siyathemba (5.1%) is also lower than that for the Northern Cape (7.3%).

8.1.18.5 Access to Water, Sewage and Solid Waste Services

SLM is the Water Services Authority (WSA) and Water Services Provider (WSP) for the 3 towns within their area of authority. Piped water is accessed by about 98% of the SLM population and about 90% of the municipal population have access to flush toilets[4].

Siyathemba has three water supply schemes. For the Copperton and surrounding areas, water is provided from the Water Treatment Works in Prieska. Water abstraction is from the Orange River. Waterborne sanitation is only available in the urban areas of Prieska.

About 75% of the population have access to a weekly refuse collection service[5]. There is an existing licensed waste disposal site in Prieska. This facility is a G:C:B$^-$ licensed facility and can only accept general waste. According to the SLM IDP (2017-2018), the site has a remaining airspace of 20 years. SLM has indicated that the site is not well managed at present due to financial and personnel constraints[6]. A new incinerator is proposed to be installed at the facility, the timing of which is unclear.

8.1.18.6 Housing

Within the Pixley Ka Seme District Municipality, 87.2% of households live in formal units, while 12.8% are found in informal housing units.

A variety of residential components are available within the municipal boundaries. More than 81% of household dwellings found in Siyathemba can be classified as houses or brick structures on separate stands. The average for the Northern Cape is 77.4%. Some 8.6% of local dwellings can be described as shacks.

The average household size in the larger Pixley Ka Seme District Municipality is about 3.7, female headed households is about 36.90%, formal dwellings at 86.30% and the housing owned is at 52.00%.

8.1.18.7 Public Safety and Security

There are three police stations within the SLM, situated in Marydale, Niekerkshoop, and Prieska respectively. There is no municipal fire-fighting capability in the SLM and no disaster manager plan for the municipality.

8.1.18.8 Community Health and Health Facilities

There is a total of 4 health facilities within the SLM, namely Niekerkshoop Clinic, E'Thembeni Clinic, Marydale PHCC, and Prieska Clinic.

The 2010 HIV/AIDS prevalence rate of the Siyathemba population was 6%. This is lower than the prevalence rates in the Northern Cape (8%) and South Africa (13%). However, since 2000, the number of people living with HIV/AIDS in the Siyathemba municipal area more than doubled from about 400 to just over 1,200 people in 2010. The prevalence rate is expanding faster in Siyathemba (at 11% p.a.) when compared with South Africa (at 6% on average p.a. since 2000).

SLM manages 3 cemeteries in Prieska, and 2 cemeteries in Niekerkshoop and Marydale. Expansion of the cemeteries in each of these towns is planned.

8.1.18.9 Electricity and Energy

Around 86% of household dwellings found in Siyathemba have access to electricity. This indicator is on par with the provincial average.

[4] SLM Water Services Development Plan, 2017

[5] SLM IDP (2017-2018)

Between 2006 and 2011, there was a general increase in the use of electricity as a primary source of energy. This is due to local electrical infrastructure improvements across the province (SLM IDP, 2016).

As shown in the graph below, the majority of the population have access to electricity, which is used primarily for cooking, heating and lighting. The proportion of households within the municipality that use electricity for lighting has increased from 57% in 1996 to approximately 84% in 2011.

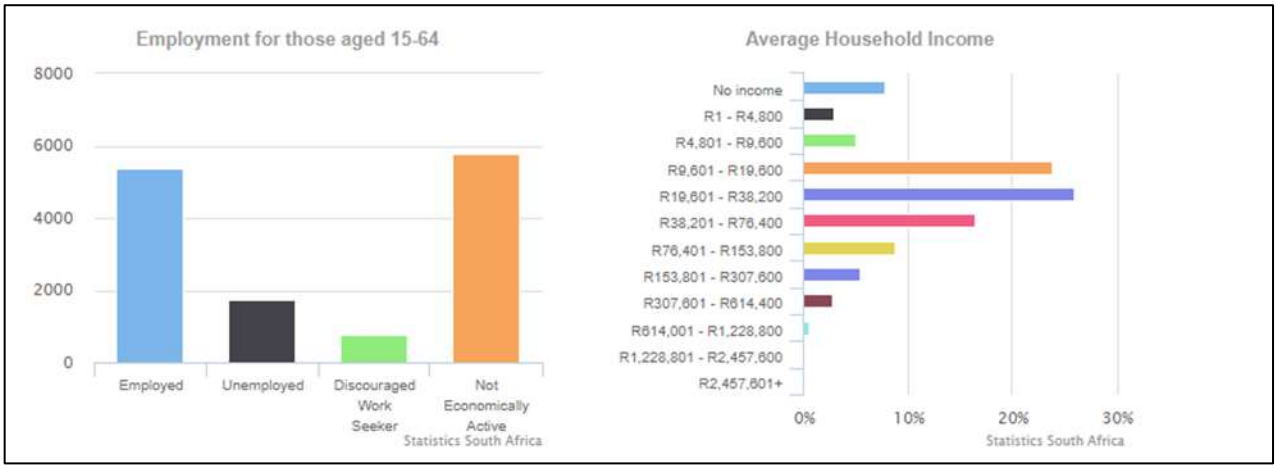
Although relatively expensive, paraffin and gas are used for cooking and heating in some places. Households using electricity as a source of energy for cooking increased from 48% in 1993 to 74% in 2011.

8.1.18.10 Employment[6]

Between 2001 and 2011, there has been a decrease in the number of people employed and a concomitant increase in the number of unemployed people across the Pixley Ka Seme District Municipality.

For Siyathemba, 5 787 individuals remain as being economically inactive, while 5 370 are employed. The unemployment rate in SLM in 2011 was 24.3%.

The average household income is approximately R9 000 – R19 500. Obtaining any form of income generating employment within the municipality has become increasingly difficult in recent years. This is attributed to the lack of education, resulting in the uneducated experiencing the highest incidences of poverty.



Source: Statistics South Africa (2011)

FIGURE 8-6: SUMMARY OF EMPLOYMENT AND INCOME IN SLM

8.1.18.11 Labour

The labour participation rate across the Pixley Ka Seme District Municipality is 50%. The labour dependency ratio for Siyathemba is estimated at 2 (An additional two persons are supported by every person in the labour force).

Other significant labour ratio statistics for SLM are provided in Table 8-5.

[6] SLM IDP (2017-2018)

TABLE 8-5 LABOUR RATIOS FOR SLM

LABOUR PARTICIPATION RATE	LABOUR DEPENDENCY RATIO	LABOUR YOUTH DEPENDENCY RATIO	LABOUR AGED DEPENDENCY RATIO
48	2	0.4	84

Source: SLM IDP (2017-2018)

8.1.18.12 Economy

The SLM Local Economic Development (LED) Vision is "Ensuring long term economic sustainability through local value addition and social upliftment, as well as integrated community development. We strive towards an economy owned by local people."

The regional and local economy is poorly diversified with a reliance on, in the case of SLM, the government and agriculture sectors. The mining and manufacturing sectors provide very few of the employment opportunities in the SLM.

The mining sector is identified within the SLM IDP (2017-2018) as a sector with development potential.

The following can be noted with respect to the economy of the SLM and the potential economic influence of the proposed mine development:

- SLM is a small economy. Larger rural municipalities in South Africa have a Gross Geographic Product (GGP) of between R5bn and R10bn. By contrast, SLM has an estimated GGP of R 1.3 bn. A GGP is simply the sum of all salaries and wages, depreciation and operating profits in an economy. This means the new mine, with 450 employees, could add an annual GGP of R216 million per annum, or 16,6% of GGP to the local economy. This is significantly high. Another perspective is that the average salaries and wages in mining is R120 000 per annum and hence 450 new employees in the SLM has a purchasing power of R54 million per annum;
- The small economy in SML is a result of two factors, one the lack of rainfall that results in less than productive land (thus demand for land is low), and two, as a result, its low population. In addition, there is no innovation in the local economy;
- Furthermore, the average income per capita in SLM is half of that of the average income in South Africa, which furthermore reduces the economic quality of life of the SLM population because they have less disposable income, in a remote area where the prices of goods are more than the average South Africa prices due to high transport costs;
- The quality of social services is rated much higher by the SLM population than the average South African because the demand for services is much less locally; and
- The lack of adequate employment opportunities is the most significant concern for the SLM population. There are almost 14 000 people in the workforce in Siyathemba and just over 4 000 formal jobs. Thus two-thirds of the working population does not have formal jobs.

8.2 DESCRIPTION OF THE CURRENT LAND USES

Current land uses within the proposed MRA surface area are as follows:

- Grazing of livestock;
- An operating 20 MW solar power plant and a proposed solar PV power plant are within the proposed MRA surface area boundary;
- Windmills and related agricultural infrastructure;
- Two existing quarry operations;

- The Alkantpan landing strip;
- Road to Copperton and Alkantpan from the R357;
- Disused rail siding; and
- Alkantpan Test Range.

Land uses on immediately adjacent properties include the following:

- Various infrastructure associated with the historical PCM;
- Registered servitude between the historical mineral processing area and the historical TSF
- Grazing of livestock;
- Residential town of Copperton;
- The proposed Copperton Wind Farm borders the proposed MRA surface area boundary in the north-east;
- Several proposed solar PV projects are situated towards the south and south-east of the proposed MRA surface area boundary;
- Eskom Cuprum Substation;
- Windmills and related agricultural infrastructure;

8.2.1 EXISTING SURFACE LAND USES

Copperton is situated to the north of the proposed Vardocube underground mining operation. The town is still in use, though only 40 of the original 300 houses now remain. The full extent of the town is excluded from the proposed Vardocube mining right area. Similarly, Portions 5 and 6 of the Farm Vogelstruisbult 104, are excluded from the MRA. The Eskom Cuprum Substation is located on these properties.

An operating 20 MW solar power plant is situated towards the middle of the MRA surface area boundary. Other existing infrastructure within the MRA surface area includes partially intact stormwater diversion berms constructed by PCML in the 1970s, the access road to Copperton and PCM from the R357, a disused rail spur and several mine houses used, at present, by contractors involved with the prospecting activities.

The remainder of the MRA surface area is largely undisturbed scrubland used for grazing of small livestock.

There is no registered land claims applicable to Portion 1 of Vogelstruisbult 104.

8.2.2 SURROUNDING LAND USES

Surrounding landowners and land users comprise of the historical PCM, private landowners and the Alkantpan Test Range (to the west). Several proposed renewable energy (wind and solar) projects are situated towards the east and south of the proposed MRA surface area boundary. (Appendix 4 Map 3).

Most of the buildings and related infrastructure associated with the historical PCM were demolished when the mine closed in 1991. The western section of the Repli MRA surface area is characterised by remnants of the demolished infrastructure remaining from the historical mining between 1971 and 1991. Remaining surface infrastructure includes the Hutching Shaft column, crusher bins, flotation dams and a concentrate drying slab.

The historical tailings storage facility containing the residues from the historical mining borders the proposed Vardocube MRA surface area in the south-west.

8.3 DESCRIPTION OF SPECIFIC ENVIRONMENTAL FEATURES AND INFRASTRUCTURE ON THE SITE

8.3.1 SURFACE WATER FEATURES AND WETLANDS

Several non-perennial rivers traverse the proposed Vardocube Mining Right Application (MRA) surface area.

In addition to the non-perennial rivers, there are several wetlands (endorheic pans) present within the proposed Vardocube MRA surface area. With no surface infrastructure applicable to the proposed underground mining and with mining anticipated to occur at a depth of more than 900 m below natural ground level, no impact to wetlands/pans is expected. The location of all watercourses and the applicable buffers, namely 100 m for non-perennial rivers and 500 m for wetlands (pans), are shown in Appendix 4 Map 14.

8.3.2 PROTECTED AREAS

There are no protected areas in close proximity (within 10 km) of the MRA surface area boundary. The nearest protected area is the Witsand Provincial Nature Reserve, located approximately 150 km to the north of the MRA surface area boundary (Appendix 4 Map 12).

8.3.3 CRITICAL BIODIVERSITY AREA AND ECOLOGICAL SUPPORT AREA

The Northern Cape spatial biodiversity plan identifies a Critical Biodiversity Area (CBA) across a portion of the MRA. This CBA follows the pre-diversion alignment of a non-perennial watercourse which was diverted as part of the historical mining activities undertaken by PCM.

The wetlands/pans scattered across the proposed MRA surface area are designated as Ecological Support Areas (ESA).

With all mining to be underground and no surface infrastructure to be established, no impact to CBA or ESA features are expected.

8.3.4 DECLARED KAROO CENTRAL ASTRONOMY ADVANTAGE AREA

8.3.4.1 Background

The proposed Vardocube mining area is situated within two declared Astronomy Advantage Areas (AAA), namely as follows:

- The Northern Cape Province; and
- The Karoo Central AAA.

Specifically, the Vardocube mining area is located within Advantage Area 3 of the Karoo Central AAA (Appendix 4 Map 13).

The AAAs are established in terms of the Astronomy Geographic Advantage Act 21 of 2007. The purpose of establishing the AAAs is to protect the radio astronomy work associated with the Square Kilometre Array (SKA) Project in Carnarvon. The cosmic rays which the SKA radio telescopes receive and interpret are extremely faint and are thus sensitive to interference from other radio devices as well as electromagnetic interference from electrical equipment. The radio interference protection philosophy associated with the AAAs is as follows[7]:

- Maximise the radio frequency spectrum available for the SKA so that the scientific work is not significantly compromised;
- Minimise the impact on local people and residual radio interference, and facilitate access to alternative radio communications;

[7] http://www.ska.ac.za/wp-content/uploads/2016/07/ska_sa_gaa_eng.pdf

- Restrictions on sources of radio frequency interference, for where there are no alternative options, will be highest close to the SKA Virtual Centre (or core) but decrease with distance.

Engagement with the Department of Science and Technology (DST) and the South African Radio Astronomy Observatory (SARAO) as part of Orion's Repli MRA to ensure that the mine activities will not have an impact on the SKA is ongoing.

8.4 ENVIRONMENTAL AND CURRENT LAND USE MAP

The following dominant current land use categories are recognised:

- Agriculture – grazing;
- Residential;
- Historical mining and related infrastructure; and
- Power infrastructure.

The environmental and current land use map is provided in (Appendix 4 Map 15).

9 IMPACTS IDENTIFIED

9.1 METHODOLOGY USED IN DETERMINING THE SIGNIFICANCE OF ENVIRONMENTAL IMPACTS

The first phase of impact assessment is the identification of the various project activities which may impact upon the identified environmental categories.

The identification of significant project activities is supported by the identification of the various receiving environmental receptors and resources. These receptors and resources allow for an understanding of the impact pathways and assessment of the sensitivity of the receiving environment to change.

The significance of the impact is then assessed by rating each variable numerically, according to defined criteria as provided in Table 9-1. The purpose of the significance rating of the identified impacts is to develop a clear understanding of the influences and processes associated with each impact.

The severity, spatial scope and duration of the impact together comprise the consequence of the impact; and when summed can obtain a maximum value of 15. The frequency of the activity and the frequency of the impact together comprise the likelihood of the impact and can obtain a maximum value of 10.

The values for likelihood and consequence of the impact are then read from a significance rating matrix as shown in Table 9-1 and Table 9-2.

The model outcome of the impacts is then assessed in terms of impact certainty and consideration of available information. The Precautionary Principle is applied in instances of uncertainty or lack of information by increasing assigned ratings or adjusting final model outcomes. In certain instances, where a variable or outcome requires rational adjustment due to model limitations the model outcomes are adjusted. Arguments and descriptions for such adjustments, as well as arguments for each specific impact assessments are presented in the text and encapsulated in the assessment summary table linked to each impact discussion.

TABLE 9-1: CRITERIA FOR ASSESSING THE SIGNIFICANCE OF IMPACTS

SEVERITY OF IMPACT	RATING
Insignificant / non-harmful	1
Small / potentially harmful	2
Significant / slightly harmful	3
Great / harmful	4
Disastrous / extremely harmful	5
SPATIAL SCOPE OF IMPACT	**RATING**
Activity specific	1
Area specific	2
Whole project site / local area	3
Regional	4
National/International	5
DURATION OF IMPACT	**RATING**
One day to one month	1
One month to one year	2
One year to ten years	3
Life of operation	4
Post closure / permanent	5
FREQUENCY OF ACTIVITY / DURATION OF ASPECT	**RATING**
Annually or less / low	1
6 monthly / temporary	2
Monthly / infrequent	3
Weekly / life of operation / regularly / likely	4
Daily / permanent / high	5
FREQUENCY OF IMPACT	**RATING**
Almost never / almost impossible	1
Very seldom / highly unlikely	2
Infrequent / unlikely / seldom	3
Often / regularly / likely / possible	4
Daily / highly likely / definitely	5

CONSEQUENCE

LIKELIHOOD

***Activity**: a distinct process or task undertaken by an organisation for which a responsibility can be assigned.*

***Environmental aspect**: an element of an organisation's activities, products or services which can interact with the environment.*

***Environmental impacts**: consequences of these aspects on environmental resources or receptors.*

***Receptors**: comprise, but are not limited to people or man-made structures.*

***Resources**: include components of the biophysical environment.*

***Frequency of activity**: refers to how often the proposed activity will take place.*

***Frequency of impact**: refers to the frequency with which a stressor will impact on the receptor.*

***Severity**: refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards.*

***Spatial scope**: refers to the geographical scale of the impact.*

***Duration**: refers to the length of time over which the stressor will cause a change in the resource or receptor.*

TABLE 9-2: SIGNIFICANCE RATING MATRIX

LIKELIHOOD (FREQUENCY OF ACTIVITY + FREQUENCY OF IMPACT)	CONSEQUENCE (SEVERITY + SPATIAL SCOPE + DURATION)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45
	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90
	7	14	21	28	35	42	49	56	63	70	77	84	91	98	105
	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120
	9	18	27	36	45	54	63	72	81	90	99	108	117	126	135
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150

TABLE 9-3: POSITIVE/NEGATIVE MITIGATION RATINGS

COLOUR CODE	SIGNIFICANCE RATING	VALUE	NEGATIVE IMPACT MANAGEMENT RECOMMENDATION	POSITIVE IMPACT MANAGEMENT RECOMMENDATION
	Very High	126-150	Improve current management	Maintain current management
	High	101-125	Improve current management	Maintain current management
	Medium-High	76-100	Improve current management	Maintain current management
	Low-Medium	51-75	Maintain current management	Improve current management
	Low	26-50	Maintain current management	Improve current management
	Very Low	1-25	Maintain current management	Improve current management

9.2 THE POSITIVE AND NEGATIVE IMPACTS THAT THE PROPOSED ACTIVITY AND ALTERNATIVES WILL HAVE ON THE ENVIRONMENT AND THE COMMUNITY THAT MAY BE AFFECTED

At this stage in the S&EIR Process, the list of potential impacts from the underground mining is still being compiled. A summary of the most significant aspects and impacts identified to date is as follows:

- **Socio-economic:** The project is likely to contribute positively to the local and regional socio-economic environment. This includes procurement of local goods and services, employment opportunities for local communities as well as other South African citizens, income generation, skills development and education opportunities, local economic development, GDP improvement and wealth creation and the distribution of revenue and wealth.
- **Health and Safety:** Underground mining presents several health and safety hazards to employees which can result in serious injuries and fatalities.
- **Groundwater**: The use of explosives as well as solvents, lubricant and fuels underground may impact on aquifers, if not mitigated. Mining of the Vardocube Section may result in an increased volume of groundwater requiring management over the LOM through the Repli dewatering management system. The mining may have an impact on the dewatering cone of depression, the extent of which was modelled

for the adjacent proposed Repli mining area. This model will be updated, and the results provided in the Draft EIR.

- **Mineral waste:** The tailings slurry from the processing of the ore in the Repli process plant will be managed in the Repli TSF. There is sufficient design capacity in the engineered, lined TSF structure to accommodate the additional mineral waste from Vardocube and the impact is therefore considered to be of low significance;
- **Water:** Additional water will be required for the processing of the ore in the Repli process plant. The proposed source of the water is the Alkantpan pipeline from Prieska. There is sufficient water available from Prieska and the additional water requirement for the processing of the Vardocube ore is, relative to the water demand for Repli, expected to be low; and
- **Blast vibration:** Waste rock and ore will be drilled and blasted as part of the mining operations. Vibration levels experienced at surface are expected to be well below the levels at which structural damage could occur.

9.3 THE POSSIBLE MITIGATION MEASURES THAT COULD BE APPLIED AND THE LEVEL OF RISK

The mitigation hierarchy is being applied throughout the S&EIR Process.

The mitigation hierarchy is an approach to mitigation planning and can be summarised into the following steps:

- Avoidance;
- Minimisation;
- Restoration; and
- Offsets.

At this stage in the S&EIR Process, mitigation measures are predominantly focussed on avoidance and minimisation. This is being done through activities such as the site layout selection process and implementation of the environmental design criteria including the environmental sensitivity plan, by the engineering team.

In the Impact Assessment Phase, the findings and recommendations of the specialist studies will be used to develop the environmental and operational controls which will be more focused on impact minimisation and restoration (as part of mine rehabilitation and closure).

Although mitigation measures are still being developed, the project activities proposed are typical of underground mining projects and there is substantial local and international experience in the development and implementation of controls to avoid and minimise the range and type of potentially harmful impacts which may be associated with the project. Therefore, at this stage in the S&EIR Process, the risk associated with the mitigation measures is generally considered to be low.

9.3.1 THE OUTCOME OF THE SITE SELECTION MATRIX AND FINAL SITE LAYOUT PLAN

The project site has been selected based on the findings of the prospecting activities which have confirmed the presence of a mineable resource.

9.3.2 MOTIVATION WHERE NO ALTERNATIVE SITES WERE CONSIDERED

No alternative sites have been considered as the site is defined by the presence of a mineable resource. In addition, the target orebody is an extension of the orebody proposed to be mined by Orion's subsidiary Repli from the adjacent Portion 25 of Vogelstruisbult 104. Vardocube will make use of the mine infrastructure established by Repli rather than establishing its own mine infrastructure. By sharing the mine infrastructure, Orion will therefore be optimising its capital expenditure and reducing the cumulative impact of its mining activities.

10 PLAN OF STUDY FOR THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

10.1 DESCRIPTION OF ALTERNATIVES TO BE CONSIDERED INCLUDING THE OPTION OF NOT GOING AHEAD WITH THE ACTIVITY

Other than the no-go option, no other alternatives are relevant to the proposed mining of the Vardocube Section.

10.2 DESCRIPTION OF THE ASPECTS TO BE ASSESSED AS PART OF THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

All project activities identified in Section 3 of this report will be assessed as part of the EIA Process.

10.3 DESCRIPTION OF ASPECTS TO BE ASSESSED BY SPECIALISTS

The environmental baseline and findings of the specialist studies undertaken as part of the Repli S&EIR Process, which have relevance to the mining of the Vardocube section, will be incorporated into the Draft EIR.

No new specialist studies are considered to be necessary to inform the EIR for the Vardocube Section. The following specialist studies will however be updated to ensure that the risks and impacts associated with the Vardocube mining are properly assessed:

- Updating of the groundwater model and impact assessment report to account for the additional mining area and the possible effects on groundwater quality and quantity in the study area; and
- Updating of the geochemical characterisation study by subjecting a limited number of rock core samples, representative of the Vardocube deposit, to a static leach analysis to confirm the expectation that the ore and waste rock material will not incur any additional geochemical risk to that assessed for Repli.

10.4 PROPOSED METHOD OF ASSESSING THE ENVIRONMENTAL ASPECTS INCLUDING THE PROPOSED METHOD OF ASSESSING ALTERNATIVES

The environmental aspects assessed by specialists and the methods used involve the following:

- Collation and review of available information;
- Field surveys specifically involving baseline surveys and monitoring, where required;
- Responding to comments received from stakeholders on the Draft Scoping Report and Draft EIR;
- Impact assessment and reporting;
- Input into the monitoring plans; and
- Incorporation of authority review comments.

Specialist study reports will be made available for public comment at the same time as the release of the Draft EIR for comment. The structure and content of each specialist study report will be based on the requirements of Appendix 6 of Government Notice R.982 promulgated in terms of sections 22(5) and 44 of NEMA.

The broad scope of work for the specialist studies considered to be necessary to inform the S&EIR process for the Vardocube Section is as follows:

10.4.1 GROUNDWATER

The scope of work for the groundwater study will include the following:

- Updating of the groundwater model and impact assessment report to account for the additional mining area and the possible effects on groundwater flows; and

- Updating of the geochemical characterisation study by subjecting a limited number of rock core samples, representative of the Vardocube deposit, to a static leach analysis to confirm the expectation that the ore and waste rock material will not incur any additional geochemical risk to that assessed for Repli.

10.4.2 MINE REHABILITATION AND CLOSURE

A conceptual Closure Plan will be prepared, focussing on the rehabilitation and closure of the Vardocube Section. The structure and content of the Closure Plan will be based on the requirements of Appendix 5 of Government Notice R.982 promulgated in terms of sections 22(5) and 44 of NEMA. In general, the Closure Plan will comprise of the following:

- A statement detailing company policy on rehabilitation and closure which would specify the completion criteria for the rehabilitation and closure process, the standards to be achieved, and the parameters against which success would be evaluated;
- A summary of the expected environmental and social impacts associated with the project, both during and after operations, with the emphasis on potential residual impacts;
- A summary of the environmental and social management commitments arising from the EIA and public participation processes;
- The formulation, at a conceptual level, of descriptions of the rehabilitation and closure works to be applied to the achievement and monitoring of the closure objectives;
- The compilation of schedules of quantities describing the closure process, based upon which the works can be priced;
- The compilation of a life of mine financial model of the rehabilitation and closure process, with the objective of determining the financial provisions required to ensure the successful implementation of the closure process; and
- The compilation of a report describing the closure plan and associated financial provisions.

10.5 THE PROPOSED METHOD OF ASSESSING DURATION SIGNIFICANCE

The impact assessment methodology is described in Section 9 of this report.

10.6 THE STAGES AT WHICH THE COMPETENT AUTHORITIES WILL BE CONSULTED

TABLE 10-1: STAGES AT WHICH THE COMPETENT AUTHORITIES WILL BE CONSULTED

TASK NAME	DATE
Distribute Draft Scoping Report for Public Comment	October 2018
Submit MR and EA Application	September 2018
Submit Final Scoping Report	November 2018
Authorities Accept Scoping Report (within 43 days of receipt of Scoping Report)	January 2019
Distribute Draft EIR/EMPr	February 2019
Submit Final EIR/EMPr (within 106 days of acceptance of Scoping Report by authority)	March 2019
Authority Decision on EA Application	July 2019

10.7 PARTICULARS OF THE PUBLIC PARTICIPATION PROCESS WITH REGARD TO THE IMPACT ASSESSMENT PROCESS THAT WILL BE CONDUCTED

Public participation during this phase will be at a lower intensity than during Scoping. All registered I&APs will be kept informed about progress and the key upcoming dates when members of the public can input into the Impact Assessment Process and outcomes.

10.7.1.1 Public Review of the Draft EIA Report

Public participation during the Impact Assessment Process will focus on:

- A review of the findings of the EIA, presented in the Draft EIR, EMPr and its accompanying suite of specialist reports; and
- Distribution of relevant reports to the public for review and comment.

During the latter part of the Impact Assessment, a personalised letter and media advertisement will be prepared to inform stakeholders and the public of the availability of the Draft EIR. Meetings will be held with I&APs as and when required to discuss the Draft EIR findings and to record comments.

The reports will be made available for review at public places as used for the DSR review.

10.7.1.2 Final EIA Report

Similar to the FSR, all registered I&APs will be notified of the submission of the Final EIR to the competent authority. This letter will inform I&APs of where substantive changes have been made to the EIA Report and associated specialist study reports.

10.7.1.3 Notification of Decision on Applications

Stakeholders will be advised via personalised letters and through media advertisements of the competent authority decisions on the application for EA. Stakeholders will also be advised of the appeal process.

10.7.2 DESCRIPTION OF THE INFORMATION TO BE PROVIDED TO INTERESTED AND AFFECTED PARTIES

All registered I&APs will be provided with access to the Draft and Final versions of the Scoping Report, EIR and EMPr.

10.8 DESCRIPTION OF THE TASKS THAT WILL BE UNDERTAKEN DURING THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

10.8.1 SPECIALIST STUDIES

Several detailed specialist studies were undertaken as part of the Repli S&EIR Process. The environmental baseline and findings of the specialist studies undertaken as part of the Repli S&EIR Process, which have relevance to the mining of the Vardocube section, will be incorporated into the Draft EIR.

No new specialist studies are considered to be necessary to inform the Vardocube S&EIR Process.

The following studies will however need to be updated to ensure that the risks and impacts associated with the Vardocube mining are properly assessed:

- Updating of the groundwater model and impact assessment report to account for the additional mining area and the possible effects on groundwater flows; and
- Updating of the geochemical characterisation study by subjecting a limited number of rock core samples, representative of the Vardocube deposit, to a static leach analysis to confirm the expectation that the ore and waste rock material will not incur any additional geochemical risk to that assessed for Repli.

10.8.2 DRAFT ENVIRONMENTAL IMPACT REPORT (EIR)

The specialist studies will form the basis of the compilation of the Draft EIR. The structure and content of the Draft EIR will address the requirements of the Environmental Impact Assessment Regulations, 2014 (as amended) and be prepared in the DMR template.

Copies of the Draft EIR will be distributed and made available at accessible venues within the project area for comment by registered I&APs.

10.8.3 DRAFT ENVIRONMENTAL MANAGEMENT PROGRAMME (EMPR)

The key objectives of an EMPr are to set out the management and monitoring measures required to both minimise any potentially adverse environmental impacts and enhance the environmental benefits of the Project, and to ensure that responsibilities and appropriate resources are efficiently allocated to implement the plan.

Management and monitoring measures will be developed from the recommendations and mitigation measures listed in the EIR.

10.8.4 CLOSURE PLAN

A conceptual Closure Plan will be prepared for the Development. The structure and content of the Closure Plan will be based on the requirements of Appendix 5 of Government Notice R.982 promulgated in terms of sections 22(5) and 44 of NEMA.

10.8.5 FINAL EIR AND EMPR

The Draft EIR and EMPr will be updated based on the comments received from registered I&APs. The reports will be submitted to the DMR. Registered I&APs will be notified of the availability of the Final EIR and EMPr. Additional comments received from registered I&APs through the public comment period and at feedback meetings will be included in the Issues Response Report. This report will be included as an appendix to the Final EIR to allow registered I&APs to confirm how their comments and concerns have been addressed.

Regulation 24(1) of Government Notice R.982 provides that the DMR must review the Final EIR and EMPr and issue a decision on the EA application within 107 days of submission of the document.

10.8.6 NOTIFICATION OF DECISION

Upon receipt of the decision on the EA, the EIA Project Team will assist the applicant in making the application decisions available to all registered I&APs and notifying them of the appeal procedure to be followed in terms of the National Appeal Regulations [Government Notice No. R.993 promulgated in terms of section 44(1a) and 43(4) of NEMA].

10.9 MEASURES TO AVOID, REVERSE, MITIGATE, OR MANAGE IDENTIFIED IMPACTS AND TO DETERMINE THE EXTENT OF THE RESIDUAL RISKS THAT NEED TO BE MANAGED AND MONITORED

The preliminary identification of impacts and associated mitigation measures are presented in Table 10-2. These will be further investigated during the impact assessment phase.

TABLE 10-2: THE POSSIBLE MITIGATION MEASURES THAT COULD BE APPLIED AND THE LEVEL OF RISK

ACTIVITY **whether listed or not listed.** (E.g. 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.)	**POTENTIAL IMPACT** (e.g. dust, noise, drainage surface disturbance, fly rock, surface water contamination, groundwater contamination, air pollution etc….etc…)	**MITIGATION TYPE** **(modify, remedy, control, or stop)** **through (e.g. noise control measures, storm-water control, dust control, rehabilitation, design measures, blasting controls, avoidance, relocation, alternative activity etc. etc)** **E.g. Modify through alternative method.** **Control through noise control Control through management and monitoring through rehabilitation**	**POTENTIAL FOR RESIDUAL RISK**
Dewatering (underground)	➲ Groundwater contamination from mining activities including spillages and leaks of hazardous substances from underground mining equipment and machinery ➲ Lowering of groundwater levels affecting surrounding land users	➲ To ensure safe access for mining, water will continue to be removed from the underground workings and managed through the Repli mine dewatering system. ➲ Inspect and maintain underground pollution control facilities. ➲ Implement the groundwater monitoring programme which includes monitoring of existing boreholes to ensure continuity of water supply.	Low residual risk with all management controls properly implemented
Blasting (Underground)	➲ Impacts to human health and safety including injuries and possibly fatalities from rockfalls, blasting incidents and other underground mining hazards ➲ Community complaints regarding blasting	➲ Avoid / minimise human health and safety risks through design and operational controls, including the implementation of a comprehensive health and safety programme. ➲ Good public relations by ensuring both production personnel and the local community understand the nature of blast and ground vibration.	Low potential for any residual risk given the nature of the impact, receiving environment and confidence in the mitigation measures

		➲ Establishment of a community engagement forum and grievance mechanism by which community complaints can be submitted to the mine.	
Materials Handling, Transport of Man and Machinery (underground)	➲ Injury or death ➲ Occupational exposure respiratory impacts arising from elevated PM 2.5 and PM 10 levels ➲ Degradation of groundwater quality	➲ Avoid / minimise human health and safety risks through design and operational controls, including the implementation of a comprehensive health and safety programme. ➲ Application of dust suppression on underground roads when necessary to ensure compliance with occupational exposure requirements. ➲ All vehicles, equipment and machinery used for underground mining equipped with drip trays and spill response kits. ➲ Polluted material treated with appropriate absorbents or removed from areas where incidents have occurred. This material properly contained before being disposed of at appropriately licensed waste management facilities. ➲ All underground equipment and vehicles properly maintained.	If controls properly implemented as part of a comprehensive health and safety programme, residual risk will be moderate to low
Mining Support Activities (underground) - Hazardous Substances Management - Waste Management	➲ Degradation of groundwater quality	➲ Minimising underground electrical energy requirements through design and operational controls. ➲ The transport, storage, use and disposal of hazardous chemical substances carefully controlled. ➲ Secondary containment facilities for hazardous substances provided, and spills cleaned up promptly. ➲ Chemical toilets serviced at the required frequency by a contractor. ➲ Inspect and maintain underground water management and pollution control facilities and systems.	Low residual risk with all management controls properly implemented

		➲ Opportunities for the reuse of waste streams considered on an ongoing basis throughout the life of the operation. ➲ Waste generated underground segregated into general and hazardous waste and contractors appointed to remove the waste to licensed waste disposal facilities. ➲ A safety data sheet will be prepared for each waste stream classified as hazardous and the sheet will be displayed at the most appropriate location in closest proximity to the waste storage facility. ➲ Any container or storage facility holding hazardous waste will be labelled to reflect details of the contents and date of storage. ➲ Any hazardous waste which is stored in such a manner that it cannot be labelled will have a record reflecting the date and quantities of waste placed in the waste storage facility and the cumulative quantity of waste stored in the facility.	
Mine Closure	➲ Sterilisation or limitation of post-closure land use options as a result of mine subsidence	➲ Avoid / minimise through design and operational controls. ➲ Development of an underground mine closure plan which optimises post-closure land use options. ➲ Implementation of rehabilitation measures concurrent with mining to minimise the extent of final rehabilitation required at mine closure.	Low residual risk with all management controls properly implemented

10.10 OTHER INFORMATION REQUIRED BY THE COMPETENT AUTHORITY

In 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.

The proposed underground mining is not anticipated to have any impact on any directly affected person. This will be confirmed and reported in the Draft EIR.

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

No archaeological or paleontological resources have been identified in the study area.

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

All reasonable and feasible alternatives in terms of site layout, location, public participation, potential impacts and mitigation have been addressed throughout this report. Any investigative detail not addressed in this report will form part of the Impact Assessment phase of this project and will be documented in the Draft EIR.

11 REFERENCES

ABS Africa, 2018. Draft Environmental Impact Assessment for the Prieska Zinc Copper Project

ABS Africa, 2018. Integrated Water and Waste Management Plan for the Prieska Zinc Copper Project

ABS Africa, 2018. Prieska Copper Zinc Project: Waste Classification Report for Various Waste Streams as per the Requirements of NEM:WA

ABS Africa, 2018. Scoping Report for the Prieska Zinc Copper Project

ABS Africa, 2018. Social Impact Assessment for the Prieska Zinc Copper Project

ABS Africa, 2018. Visual Impact Assessment for the Prieska Zinc Copper Project

Airshed Planning Professionals, 2018. Air Quality Specialist Study for the Prieska Zinc Copper Mine

Airshed Planning Professionals, 2018. Noise Specialist Study for the Orion Minerals NL Prieska Copper Mine

AquiSim Consulting, 2018. Interpretation of Full Spectrum Radio Analysis Results of Two Tailings Samples Prieska Zinc Copper Project

ECOREX Consulting, 2017. Terrestrial Ecology Study for the Prieska Zinc Copper Project

Ecosoil, 2018. Soil Classification and Land Capability of the Prieska Copper Mine Project Area

DRA, 2018. Mine Design Criteria PCM-DRA2071-ME-DC-001

HCAC - Heritage Consultants, 2018. Heritage Impact Assessment for the Prieska Zinc Copper Project

Irene Lea Environmental and Hydrogeology, 2018. Geohydrological Specialist Study for the Prieska Zinc Copper Project

M&S Consulting, 2012. Groundwater Assessment

Orion Gold NL, 2017. Prieska Copper Mine Scoping Study

Orion Minerals, 2018. Housing and Accommodation Strategy

Orion Minerals, 2018. Prieska Zinc Copper Project Scoping Study Report

Peens & Associates, 2018. Hydrological Specialist Report for the Prieska Zinc Copper Project

Rorke, A.J, 2018. Impact Evaluation of Blasting for the Prieska Zinc Copper Project

Siyathemba Local Municipality, 2006. Spatial Development Framework

Siyathemba Local Municipality, 2017. Integrated Development Plan 2017 - 2018

Siyathemba Local Municipality, 2017. Water Services Development Plan

Siyazi Limpopo Consulting Services, 2018. Traffic Impact Assessment for the Prieska Zinc Copper Project

UNDERTAKING OF CORRECTNESS OF INFORMATION

I Paul Furniss herewith undertake that the information provided in the foregoing report is correct, and that the comments and inputs from stakeholder and interested and affected parties has been correctly recorded in the report.

Signature of the EAP

Date:

UNDERTAKING REGARDING LEVEL OF AGREEMENT

I Paul Furniss herewith undertake that the information provided in the foregoing report is correct, and that the level of agreement with interested and affected parties and stakeholders has been correctly recorded and reported herein.

Signature of the EAP

Date:

APPENDIX 1: EAP CV

CURRICULUM VITAE

PAUL FURNISS

ENVIRONMENTAL ADVISOR / ENVIRONMENTAL ASSESSMENT PRACTITIONER

BACKGROUND

Paul is a Director of ABS Africa. He has 16 years environmental assessment and management experience in the energy, water, mining and infrastructure sectors. His project experience includes conducting environmental assessment studies in South Africa, Guinea, Lesotho, Democratic Republic of Congo, Sudan, Namibia, Botswana, Zimbabwe, and Mozambique.

In the role of environmental manager, he has been responsible for the setup and auditing of environmental construction management procedures for a range of developments. Having led various environmental due diligence assessments for mining clients and project financiers, he has a good understanding of international environmental governance requirements including Equator Principles and IFC Performance Standards.

FIELDS OF COMPETENCE

- Environmental and Social Impact Assessments for the energy, water, mining, and infrastructure sectors
- Integration of environmental management principles into EPCM activities throughout the project lifecycle
- Environmental risk and screening assessments
- Environmental permitting
- Environmental auditing
- Environmental due diligence studies
- Strategic environmental assessment
- Integrated waste management

ACADEMIC QUALIFICATIONS

- Bachelor of Agricultural Science in Animal Science: University of Pretoria, 1998
- Bachelor of Science (Honours) in Wildlife Management: University of Pretoria, 1999
- Master of Science in Environmental Science (Water Resource Management): University of Pretoria, 2000

PROFESSIONAL REGISTRATION

Pr.Sci.Nat. Professional Natural Scientist (Environmental Science): The South African Council for Natural Scientific Professions, 2007

Certified Environmental Assessment Practitioner: Environmental Assessment Practitioners Association of South Africa

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDIES

PRIESKA ZINC COPPER PROJECT – SOUTH AFRICA (2017-2018)

Environmental Assessment Practitioner for an environmental authorisation, waste management license and integrated water use licence for the proposed re-establishment of the Prieska Copper Mine, near Copperton in the Northern Cape Province.

TRI-K GOLD PROJECT – GUINEA (2017-2018)

Environmental Assessment Practitioner for an IFC-compliant ESIA for a greenfields gold mining project in the Mandiana Prefecture of Guinea.

Lenasia South Hospital Project – South Africa (2016)

Environmental Assessment Practitioner for an environmental authorisation, waste management license and atmospheric emission license for the conversion of a community health centre into a Level 1 District Hospital.

Sedibeng Water Hartswater Regional Office Project – South Africa (2016-2017)

Environmental Assessment Practitioner for a rapid environmental screening assessment and compilation of an Environmental Management Plan for the new Sedibeng Water Regional Office in Hartswater.

Springs Fresh Produce Market Expansion Project – South Africa (2016-2017)

Environmental Assessment Practitioner for an environmental authorisation for the expansion of the Springs Fresh Produce Market.

Morupule B Units 5 & 6 – Botswana (2015-2016)

Specialist consultant for a JBIC and IFC compliant ESIA for a 300 MW thermal coal power plant.

EDF Project Tizert – Morocco (2015-2016)

Technical advisory services for an IFC-compliant ESIA for a copper mine and associated facilities in the Taroudant Province.

Pumpi Copper and Cobalt Project – Democratic Republic of Congo (2014 – 2016)

Project Environmental Manager responsible for a comprehensive update of the Environmental Impact Study for an open-cast copper and cobalt mine, process plant and associated infrastructure.

Hassaï VMS Project – Sudan (2014 – 2015)

Lead consultant responsible for the legal register, review and gap analysis of environmental and social aspects for a gold mining and processing prefeasibility study at the Hassaï Mine.

Thusanang Housing Project – South Africa (2013)

Project Environmental Manager for the EIA and EMP for a 4000 unit residential 1 housing development for Anglo American Platinum, Rustenburg Local Municipality and the Department of Human Settlements.

Manganese Project – Burkina Faso and Côte d'Ivoire (2013)

Environmental coordinator for a prefeasibility study for a proposed mine, port and rail project for the export of Manganese from Burkina Faso to the Port of Abidjan.

Mineral Sands Project – Mozambique (2012)

Environmental programme manager responsible for establishing and coordinating all social and environmental studies for a pre-feasibility study for a large mineral sands project in Mozambique.

Confidential Project – Mozambique (2012)

Project Environmental Manager responsible for the preparation of environmental and social design criteria and high-level comparison of different rail alignment and port location options for a coal export project.

Landau Lifex Project - South Africa (2012)

Project Environmental Manager responsible for the compilation of non-mineral waste management plan and hazardous substances plan as part of a pre-feasibility study for Anglo American Thermal Coal.

Confidential Project – South Africa (2011-2012)

Project Environmental Manager for a pre-feasibility study for the development of a new iron and steel plant in South Africa including all associated infrastructure. Inputs included a multi-criteria site selection analysis and coordination of all environmental and social assessment inputs to the study.

National Integrated Resource Plan – Namibia (2011)

Environmental advisor responsible for the assessment and description of the environmental and social issues associated with primary and secondary generation options.

150 MW Wind Farm Project – Lesotho (2011)

Project Environmental Manager responsible for the management and coordination of all environmental studies and environmental approval processes required for a 150 MW wind farm development in the Lesotho Highlands.

Transnet Capital Expansion Programme – South Africa (2008-2011)

Mobilised as a full-time Environmental Manager for the Richards Bay region for the HMG-Joint Venture. The latter was established as the EPCM agent for the Transnet Capital Projects operating division of Transnet Limited. The role involved management and coordination of numerous environmental studies throughout the project lifecycle process including an environmental resource economic study for the Port of Richards Bay, environmental authorisation processes and fatal flaw assessments.

Nuclear 1 Project – South Africa (2008)

Senior Project Scientist for the EIA and EMP for the proposed construction of a conventional nuclear power station and associated infrastructure in the Western Cape.

Pebble-Bed Modular Reactor Demonstration Power Plant Project – South Africa (2007-2008)

Project Manager and Senior Project Scientist for the Impact Assessment Phase of the EIA and EMP for the proposed Pebble Bed Modular Reactor Demonstration Power Plant in the Western Cape.

600 MW Morupule B Power Station Project – Botswana (2008)

Team Leader for the 600 MW Morupule B coal-fired power station in Botswana. Compilation of the ESIA in a manner that complied with Botswana legislation and World Bank Group requirements.

Ingula Pumped Storage Scheme – South Africa (2007)

Project Manager for seven mining permit applications for borrowpits in the Free State and KwaZulu-Natal Provinces for the Ingula (previously Braamhoek) Pumped Storage Scheme Project.

Gaborone Wastewater Reclamation Project– Botswana (2007)

Senior Project Scientist for the Gaborone Wastewater Reclamation EIA. This project was aimed at determining the feasibility of reclaiming wastewater for direct potable reuse in Gaborone and its satellite villages.

Selebi-Phikwe Water Master Plan – Botswana (2006)

Senior Project Scientist for the EIA, EMP and Public Consultation Process for the Selebi-Phikwe Water Master Plan.

Hydra-Perseus 765kV Power Line EIA – South Africa (2007)

Senior Project Scientist for the EIA for the 260 km 765 kV transmission power line from the Hydra to Perseus Substations.

ENVIRONMENTAL MANAGEMENT, COMPLIANCE MONITORING AND REGULATION

Dingleton Resettlement Project – South Africa (2014)

Project Environmental Control Officer responsible for compilation of an Environmental Execution Plan for the Feasibility Study and the setup and implementation of the environmental compliance monitoring requirements for the project implementation phase.

DEA Compliance Monitoring Project - South Africa (2007)

Task Team Leader for the Department of Environmental Affairs (DEA) Compliance Monitoring Project. The project involved the development of guidelines, systems and programmes for the Compliance Monitoring Directorate of DEA including compilation of a guideline for Emergency Incident reporting in terms of section 30 of the National Environmental Management Act, 1998 (Act 107 of 1998) and a compliance monitoring protocol for environmental authorisations.

JOHANNESBURG CITY PARKS GENERIC EMP - SOUTH AFRICA (2006)

Project Manager and Senior Project Scientist for the Generic EMP for Johannesburg City Parks (JCP). The Generic EMP was developed as a tool for managing the activities of all contractors employed to undertake construction work in the Public Open Spaces within the jurisdiction of the JCP.

ENVIRONMENTAL AUDITS AND DUE DILIGENCE

CONFIDENTIAL PROJECT – SOUTH AFRICA (2017)

Technical due diligence of environmental risks and closure liabilities associated with several operating gold and coal mine assists in South Africa.

CHROME ASSET ACQUISITION – SOUTH AFRICA (2016)

Technical due diligence review of an existing chrome washing facility. The due diligence required identification of environmental and social risks, a review of all existing environmental licenses and consideration of rehabilitation and closure liabilities.

CONFIDENTIAL PROJECT – GUINEA (2012)

Environmental specialist responsible for advising on environmental risks associated with a potential project acquisition of an iron ore resource in West Africa.

SOLAR ENERGY FACILITY – SOUTH AFRICA (2012)

Environmental specialist for a lender's technical due diligence review against local regulations, International Finance Corporation performance standards and Equator Principles for a proposed 30 MW solar energy facility in the Western Cape Province.

WIND ENERGY FACILITY – SOUTH AFRICA (2012)

Environmental specialist for a technical due diligence review against local regulations, International Finance Corporation performance standards and Equator Principles for a proposed new wind energy facility in the Western Cape Province.

SUSTAINABILITY REPORTING

SASOL LIMITED SUSTAINABILITY ASSURANCE PROJECT – SOUTH AFRICA (2009)

Project Manager for the 2009 sustainability reporting assurance engagement for Sasol Limited. The engagement consisted of assuring sustainable performance data from health and safety, environmental and social indicators. Site audits were undertaken at numerous operational sites representative of Sasol's different business units.

ANGLO AMERICAN PLC SUSTAINABILITY ASSURANCE PROJECT – VARIOUS COUNTRIES (2009)

Project Manager for the 2009 sustainability reporting assurance engagement for Anglo American plc. This assurance engagement comprised of site audits at representative operations within Anglo Platinum, Kumba Iron Ore, Scaw, Anglo Coal and Tarmac. The site audits were undertaken in South Africa, Brazil, Chile, Australia and the United Kingdom with twenty sustainability indicators in key performance areas of human capital, natural capital and social capital.

STRATEGIC ENVIRONMENTAL ASSESSMENTS

SEA FOR THE PORT HARCOURT MASTERPLAN – NIGERIA (2008)

Project Manager and Senior Project Scientist for the Strategic Environmental Assessment of the Masterplan for the city of Port Harcourt. The Masterplan was to provide for the development of a new city, appropriately designed for the current and future population of the existing Port Harcourt.

SEA FOR ELECTRICITY DISTRIBUTION INFRASTRUCTURE FOR THE MAGALIESBERG AND SURROUNDING AREAS - SOUTH AFRICA (2007)

Project Manager and Senior Project Scientist for the Strategic Environmental Assessment of the Magaliesberg and Surrounding Areas for Eskom Distribution. The SEA considered the environmental attributes of the study area and provided an environmental planning framework specific to the needs of Eskom Distribution.

SEA for Heritage Park - South Africa (2006)

Senior Project Scientist for the Strategic Environmental Assessment of the one million ha Heritage Park. This ecologically sensitive and socio-economically complex Park encompasses Pilansberg and Madikwe Nature Reserve and crosses the border between South Africa and Botswana.

APPENDIX 2: EAP COMPANY EXPERIENCE

ABS Africa

Sustainability Advisors

Company Profile

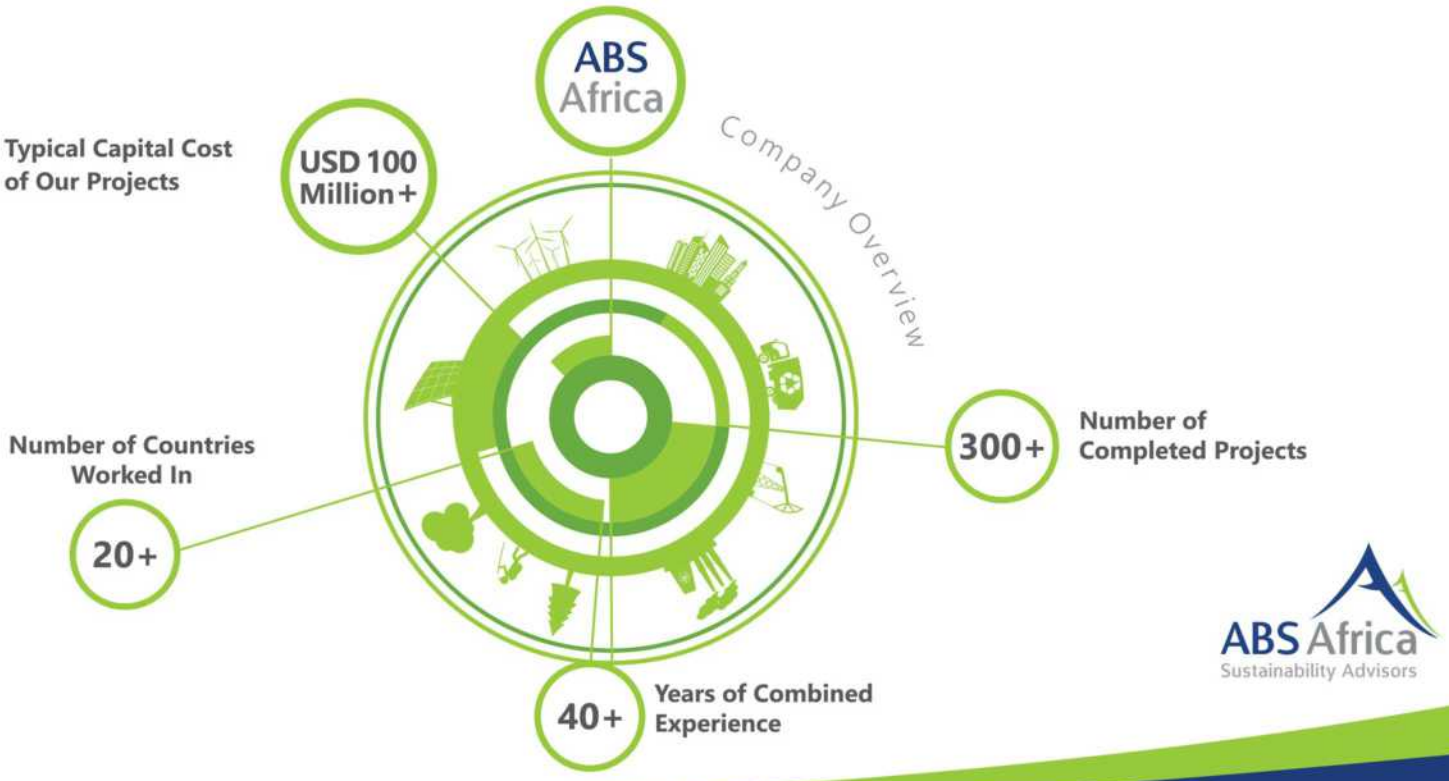
www.abs-africa.com

Company overview

Advisory on Business and Sustainability Africa (Pty) Ltd. (ABS Africa) provides advisory and consulting services focussed on sustainable development. The company was established in recognition of the need for business-specific and flexible professional advisory services on sustainability planning and implementation.

With more than 40 years collective experience in the mining, energy, and infrastructure sectors, our capabilities include prefeasibility and feasibility environmental assessments, independent competent persons reporting, environmental licensing, sustainability reporting, due diligence audits, compliance monitoring, resettlement planning, mine closure planning and spatial analysis.

The foundation of our service offering is our value system. We are committed to being unconditionally honest, excellent in the services we offer and available to our clients for as long as they think we can add value to their business.



ABS Africa
Sustainability Advisors

ABS Africa

ABS Africa offers a complete range of sustainability services to clients in the mining, infrastructure and energy sectors.

We understand the complexity of environmental and social systems and the significant role these play in the long-term sustainability of a business.

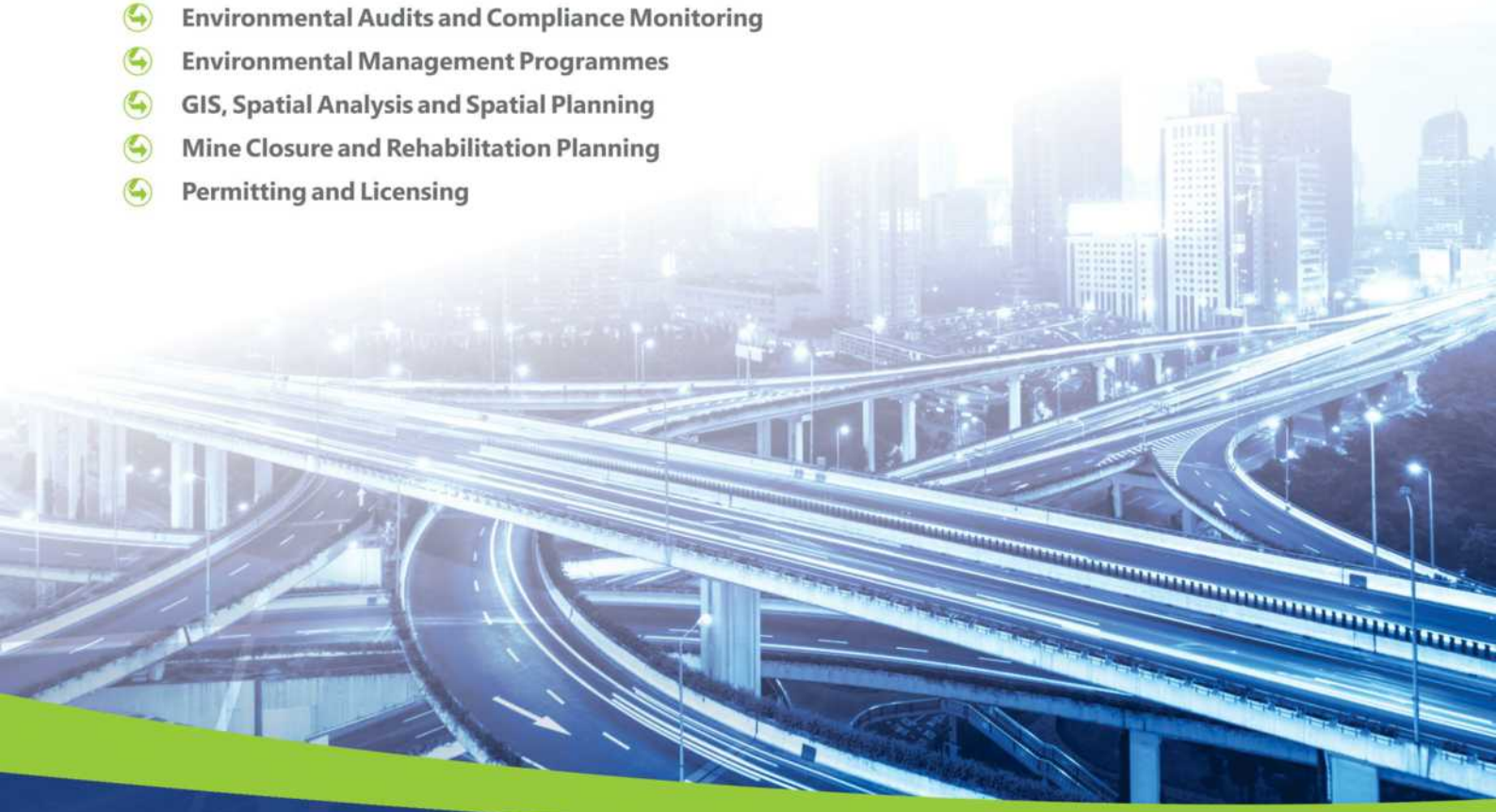
From complex Environmental and Social Impact Assessments (ESIAs) to specialist advisory services in water, biodiversity, air quality, soils, and waste, our team of social and environmental professionals have been privileged to work for public and private sector institutions across the African continent.

We have established a network of selected specialist expertise and in-country sustainability professionals across Africa to complement our team. Through this network, we are able to ensure that our service, quality and value proposition remains consistent, regardless of where we work.

Developed from our success in the resources sector, we have gained considerable experience in the application of best practice standards and guidelines including the IFC Performance Standards and Equator Principles.

Our Core Services are as Follows:

- Sustainable Development Advisory Services
- Due Diligence Investigations and Review
- Environmental Assessment
- Environmental Audits and Compliance Monitoring
- Environmental Management Programmes
- GIS, Spatial Analysis and Spatial Planning
- Mine Closure and Rehabilitation Planning
- Permitting and Licensing



Capabilities

Sustainable Development Advisory Services

From early sustainable development interventions in the mid-1990s to the more recent commitments reached at COP21 and the UN Post-2015 Development Agenda, the ABS Africa team of professionals are privileged to be involved in advising clients on a range of sustainability aspects. We provide advisory services across the sustainable development continuum including sustainability business risk and opportunity assessments, carbon, GHG and climate change planning, and sustainability reporting. ABS Africa is a member of the Green Building Council of South Africa (GBCSA).

Due Diligence Investigations and Review

As trusted advisors to financial institutions, private investors, project owner's and some of the largest project engineering companies in the world, we have applied our expertise in advising clients on the potential risks and mitigation measures associated with acquisitions, third party reviews, recommissioning and other related activities.

Environmental Assessment

Our team of social and environmental professionals have completed numerous Environmental and Social Impact Assessments (ESIAs) in the mining, energy and infrastructure sectors. We have experience in applying our environmental assessment expertise throughout the project development process, from screening studies in concept stage to the successful completion of complex ESIAs compliant with international standards. With a project footprint encompassing most regions in Africa, we are familiar with the need to ensure that the assessment process addresses both in-country legal requirements and the IFC Performance Standards and Equator Principles.

Environmental Audits and Compliance Monitoring

From rapid gap analysis audits to comprehensive facility audits of complex industrial sites, we have experience in conducting audits against license conditions, company management systems and international best practice. We have assisted in the development of a guideline on compliance monitoring for a regulatory agency and provided compliance monitoring services during the construction phase of various developments including residential, port, rail and petroleum storage.

Capabilities

Environmental Management Programmes

Having been responsible for the setup and implementation of environmental management controls for the construction phase of a variety of large infrastructure projects, we are familiar with the challenges of constructing a development within the ambit of overly restrictive or inflexible management measures. From basic construction environmental management plans for small infrastructure developments to IFC-compliant Environmental Management Programmes with Action Plans, we have experience in compiling management plans and programmes which are risk-based, flexible and pragmatic.

GIS, Spatial Analysis and Spatial Planning

Our GIS capability includes a range of services including basic mapping for environmental assessments, environmental monitoring, floodline analysis and environmental permit applications. Spatial analysis, 3D analysis, geodatabases and the classification and interpretation of remotely sensed data is also undertaken. With access to a range of spatial data through our preferred partners, we also advise clients on the selection of the most appropriate spatial data for a particular project application.

Mine Closure Planning and Implementation

Working with selected specialists, ABS Africa has experience in the quantification of closure liabilities, the development and compilation of closure plans, specifications and the more practical aspects of setting up and managing rehabilitation and closure contracts.

Permitting and Licensing

Supported by our selected network of specialists and in-country environmental professionals, ABS Africa has considerable experience in obtaining the various environmental permits that may be required for a development. These include waste management licences, atmospheric emission licences, heritage permits, water use licences and permits for the relocation and/or removal of fauna and flora.

CONTACT US

Johannesburg

info@abs-africa.com

+27 11 805 0061

PO Box 14003, Vorna Valley, 1686, South Africa

Building 2, Country Club Estate, Woodlands Drive,
Woodmead, 2052

Cape Town

info@abs-africa.com

+27 21 403 6570

Convention Towers, 1st Floor, Cnr Heerengracht &
Walter Sisulu Street, Foreshore, Cape Town, 8001

www.abs-africa.com

ABS Africa
Sustainability Advisors

Company Profile

APPENDIX 3: SUMMARY LIST OF KEY POLICY AND LEGISLATIVE INSTRUMENTS

Access to Land, Land Use and Development Planning

- Upgrading of Land Tenure Rights Act 112 of 1991
- Less Formal Township Establishment Act 113 of 1991
- Restitution of Land Rights Act 22 of 1994
- Land Reform (Labour Tenants) Act 3 of 1996
- Communal Property Associations Act 28 of 1996
- Interim Protection of Informal Land Rights Act 31 of 1996
- Extension of Security of Tenure Act 62 of 1997
- Fencing Act 31 of 1963
- Prevention of Illegal Eviction from and Unlawful Occupation of Land Act 19 of 1998
- Communal Land Rights Act 11 of 2004
- The Development Facilitation Act 67 of 1995
- Local Government Transition Act 209 of 1993
- Local Government: Municipal Structures Act 117 of 1998
- Local Government: Municipal Systems Act 32 of 2000
- National Building Regulations and Building Standards Act 103 of 1977
- Northern Cape Planning and Development Act 7 of 1998
- Spatial Planning and Land Use Management Act 16 of 2013
- Astronomy Geographic Advantage Act 21 of 2007

Mining and Mineral Rights

- Minerals and Petroleum Resources Development Act 28 of 2002 (MPRDA)
- Minerals and Petroleum Resources Development Amendment Act 49 of 2008
- Mine Health and Safety Act 29 of 1996
- Nuclear Energy Act 46 of 1999
- National Nuclear Regulator Act 47 of 1999

Environmental Assessment

- National Environmental Management Act 107 of 1998 (NEMA)
- National Environmental Management Amendment Act 62 of 2008 (NEMA)
- National Environmental Management Laws Second Amendment Act 30 of 2013 (NEMA)
- National Environmental Management Laws Amendment Act 14 of 2013 (NEMA)
- National Environmental Management Laws Amendment Act 25 of 2014 (NEMA)

Protected Areas

- National Environmental Management: Protected Areas Act 57 of 2003 (NEMPAA)
- National Environmental Management: Protected Areas Amendment Act 21 of 2014
- National Forests Act 84 of 1998

Astronomy Geographic Advantage Act 21 of 2007

Agricultural Resources

- Conservation of Agricultural Resources Act 43 of 1983
- Subdivision of Agricultural Land Act 70 of 1970

Biodiversity

- National Environmental Management: Biodiversity Act 10 of 2004 (NEMBA)
- Game Theft Act 105 of 1991
- Animals Protection Act 71 of 1962
- National Veld and Forest Fire Act 101 of 1998
- Nature Conservation Ordinance 19 of 1974
- Northern Cape Nature Conservation Act 9 of 2009
- Municipal Ordinance PN955 of 1975

Water

- National Water Act 36 of 1998
- National Water Amendment Act 27 of 2014
- Water Services Act 108 of 1997

Roads and Traffic

- National Land Transport Act 5 of 1998
- Road Traffic Act 29 of 1989

Pollution

- Health Act 63 of 1977
- Hazardous Substances Act 115 of 1973
- National Environmental Management: Waste Act 59 of 2008
- National Environmental Management: Air Quality Act 39 of 2004 (NEMAQA
- National Environmental Management: Waste Amendment Act 26 of 2014
- Municipal Ordinance PN20 of 1974

Heritage Resources

- National Heritage Resources Act 25 of 1999
- World Heritage Convention Act 49 of 1999

APPENDIX 4: MAPS

MAP 1: REGIONAL LOCALITY MAP

Path: N:\520-001 Vardocube MRA\Mxd\Regional Locality 20180807 NHC.mxd

Prieska Zinc Copper Project (Vardocube Section)

Legend

- Vardocube Ore Body
- Vardocube Mining Right Area
- Repli Mining Right Area
- Farm Boundaries

ROAD NETWORK

- Main Road
- Secondary Road
- Railway line

REGIONAL LOCALITY

0 2,25 4,5 9 Kilometers

Reviewed:	Drawn by:
P. Furniss Environmental Scientist	NH Cele GIS Specialist

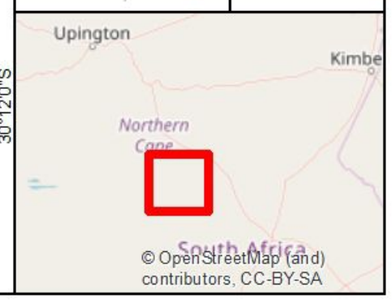
Coordinate System: GCS WGS 1984
Datum: WGS 1984

ABS Africa
Sustainability Advisors

Scale: 1:250 000

Version: Final

Date: 2018/08/29



22°0'0"E 22°4'0"E 22°8'0"E 22°12'0"E 22°16'0"E 22°20'0"E 22°24'0"E 22°28'0"E 22°32'0"E 22°36'0"E 22°40'0"E

29°40'0"S 29°44'0"S 29°48'0"S 29°52'0"S 29°56'0"S 30°0'0"S 30°4'0"S 30°8'0"S 30°12'0"S

Gelukspan
Salsola
Grasbult
Wyngaardtspan
Lemne
Klein Gelukpan
Kraanvoelpan
Van Wykspan
Bundu
Clerkenwell
Hedley Plains
Kraaiskop
Gemeend
Kielder
Boesmansberg
Eldorado
Grassmoor
Hoesmansberg
Nelspoortjie
Humansrus
Juriesleegte
R357
R386
Hoekplaas
Mierdam
Grootfourieskolk
Grenaatskop
Kleinfourieskolk
Springbokpoortjie
Doorndam
Kleinmark
Vredelus

MAP 2: LAYOUT OF ORE BODY

Path: N:\Projects\Prieska Copper Mine\Mod\Orion PCM Ore Body NHC 20180801.mxd

22°16'30"E 22°17'15"E 22°18'0"E 22°18'45"E

29°56'15"S 29°57'0"S 29°57'45"S 29°58'30"S

0 2 1 25 25 26 1 1 5 6 10

Repli

Vardocube

Prieska Zinc Copper Project (Vardocube Section)

Legend

- Repli Ore Body
- Vardocube Ore Body
- Proposed Vardocube MRA
- Proposed Repli MRA
- Farm Portions

ROAD NETWORK

- Main Road
- Secondary Road
- Access Roads
- Railway line

PCM Orebody Map

0 130 260 520 Meters

Reviewed:	Drawn by:
P. Furniss Environmental Scientist	NH Cele GIS Specialist

Coordinate System: GCS WGS 1984
Datum: WGS 1984

ABS Africa
Sustainability Advisors

Scale: 1:16 847

Version: Final

Date: 2018/08/29

MAP 3: SURROUNDING LANDOWNERS AND LANDUSERS

Path: N:\120-001 Vardocube MRA\Mxd\Surrounding Landowners (private) NHC 20180807.mxd

Prieska Zinc Copper Project (Vardocube Section)

OPERATING & PROPOSED DEVELOPMENTS

1. Altkanpan Test Range
2. Copperton Wind Farm
3. Struisbult PV2
4. Mulilo Solar PV
5. Kronos Solar PV1 Park
6. Kronos Solar PV2 Park
7. Kronos Solar PV3 Park
8. Hoekplaas Solar PV3
9. Hoekplaas Solar PV2
10. Hoekplaas Solar PV4
11. Mulilo Sonnedix Prieska PV
12. Klipgats Solar PV3
13. Mulilo Prieska PV
14. Klipgats Solar PV7
15. Eskom Yard
16. HR SEF 1
17. HR Solar 3
18. HR SEF 2
19. HR Solar 4 North
20. HR Solar 4 South

Legend

- Operating
- Proposed
- Possible Kronos Powerline Corridors
- ESKOM Yard
- Farm Boundaries
- Railway line

PROPOSED VARDOCUBE MRA

- Vardocube

RIVERS & STREAMS

- Perennial River
- Non-Perennial River
- Wetlands

ADJACENT LANDOWNERS

- PCML
- Private Landowner
- Gemeend Trust
- Request Trust
- Private Landowner
- Private Landowner
- Armscor Defence Institutes
- Private Landowner
- Private Landowner
- Private Landowner
- Private Landowner

DOONIES-PAN 106
BLAAUWBOSCH POORTJE 66
NELS POORTJE 103
SMOUS PAN 105
VOGELSTRUIS-BULT 104
GRAS-PAN 112
SLIMES DAM 154
HUMANSRUS 147
KLIPGATS PAN 117
HOEKPLAAS 146
UITSPANPAN 115

SURROUNDING LANDOWNERS

0 750 1 500 3 000 Meters

Reviewed:	Drawn by:
P. Furniss Environmental Scientist	NH Cele GIS Specialist

Coordinate System: GCS WGS 1984
Datum: WGS 1984

ABS Africa
Sustainability Advisors

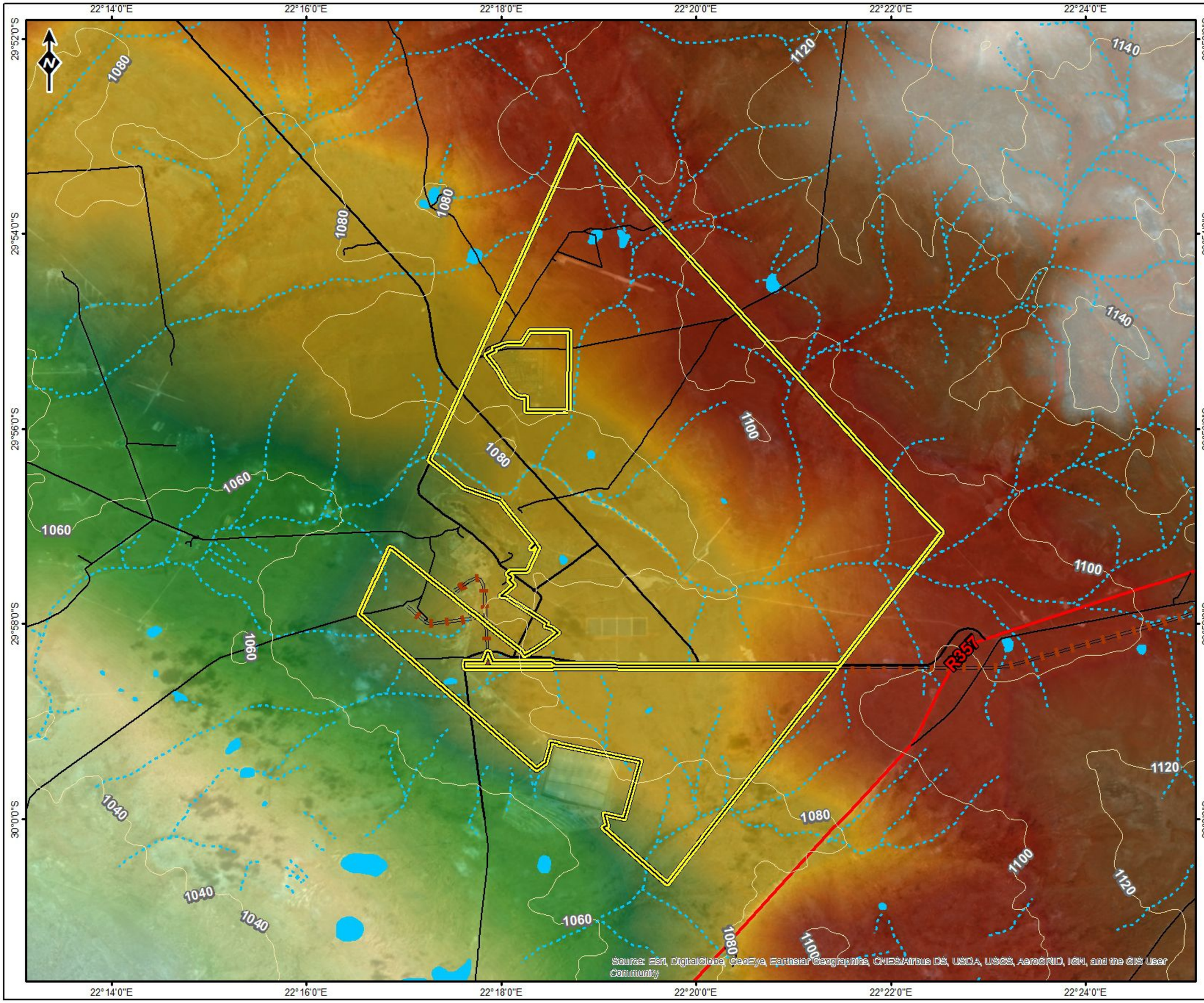
Scale: 1:100 000
Version: Final
Date: 2018/08/29

MAP 4: TOPOGRAPHY

Path: N:\126-001 Vardocube MRA\Mxd\Topography 20m NHC 20180807.mxd

22°14'0"E 22°16'0"E 22°18'0"E 22°20'0"E 22°22'0"E 22°24'0"E

29°52'0"S 29°54'0"S 29°56'0"S 29°58'0"S 30°0'0"S



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Prieska Zinc Copper Project (Vardocube Section)

Legend

20m Contours

PROPOSED VARDOCUBE MRA

Vardocube

ROAD NETWORK

Main Road

Secondary Road

Other Access

Railway line

RIVERS & STREAMS

Perennial River

Non-Perennial River

Wetlands

ELEVATION (meters)

- High : 1157
- Low : 1028

TOPOGRAPHY

0 750 1,500 3,000 Meters

Reviewed:	Drawn by:
P. Furniss Environmental Scientist	NH Cele GIS Specialist

Coordinate System: GCS WGS 1984
Datum: WGS 1984

ABS Africa
Sustainability Advisors

Scale: 1:66 000

Version: Final

Date: 2018/08/28

MAP 5: GEOLOGY

Path: N:\126-001 Vardocube MRA\Mxd\Geology NHC 20180807.mxd

22°14'0"E 22°16'0"E 22°18'0"E 22°20'0"E 22°22'0"E 22°24'0"E

29°52'0"S 29°54'0"S 29°56'0"S 29°58'0"S 30°0'0"S

Ms Mv Mg Mhe Qg C-Pd Mp Mu

Copperton Vogelstruisbult Protea Park 1093 Nelspoortjie Klipgats Pan 117 Ulfspan Pan 115 Hoekplaas 146 Humansrus 147 Nels Poortje 103 Mous-Pan 105

R357

Prieska Zinc Copper Project (Vardocube Section)

Legend

PROPOSED VARDOCUBE MRA

Vardocube

GEOLOGY

0 750 1500 3000 Meters

Reviewed:	Drawn by:
P. Furniss Environmental Scientist	NH Cele GIS Specialist

Coordinate System: GCS WGS 1984
Datum: WGS 1984

ABS Africa
Sustainability Advisors

Scale: 1:66 000

Version: Final

Date: 2018/09/10

MAP 6: SOILS

Prieska Zinc Copper Project (Vardocube Section)

Legend

PROPOSED VARDOCUBE MRA

- Vardocube

ROAD NETWORK

- Main Road
- Secondary Road
- Other Access
- Railway line

RIVERS & STREAMS

- Perennial River
- Non-Perennial River
- Wetlands

SOIL CHARACTERISTICS

- Avg Soil Depth
- Clay % Top Soils
- Water Holidng Capcity

SOILS

0 750 1,500 3,000 Meters

Reviewed:	Drawn by:
P. Furniss Environmental Scientist	NH Cele GIS Specialist

Coordinate System: GCS WGS 1984
Datum: WGS 1984

ABS Africa
Sustainability Advisors

Scale: 1:66 000

Version: Final

Date: 2018/08/28

MAP 7: VEGETATION

Path: N:\126-001 Vardocube MRA\Mxd\Vegetation NHC 20180808.mxd

Prieska Zinc Copper Project (Vardocube Section)

Legend

Farm Boundaries

PROPOSED VARDOCUBE MRA

Vardocube

VEGETATION

Bushmanland Arid Grassland

Bushmanland Basin Shrubland

ROAD NETWORK

Main Road

Secondary Road

Other Access

Railway line

RIVERS & STREAMS

Perennial River

Non-Perennial River

Wetlands

VEGETATION

0 1050 2100 4200 Meters

Reviewed:	Drawn by:
P. Furniss Environmental Scientist	NH Cele GIS Specialist

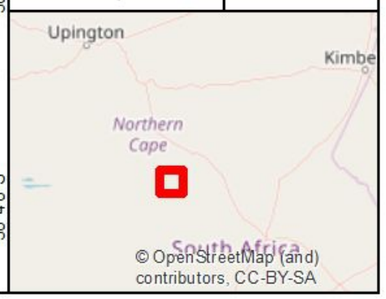
Coordinate System: GCS WGS 1984
Datum: WGS 1984

ABS Africa
Sustainability Advisors

Scale: 1:100 000

Version: Final

Date: 2018/08/28



22°10'0"E 22°12'0"E 22°14'0"E 22°16'0"E 22°18'0"E 22°20'0"E 22°22'0"E 22°24'0"E 22°26'0"E

29°50'0"S 29°52'0"S 29°54'0"S 29°56'0"S 29°58'0"S 30°0'0"S 30°2'0"S 30°4'0"S

MURRIES PAN 107
BLAAUWBOSCH POORTJE 66
DOONIES PAN 106
BOSJESMANS BERG 67
NELS POORTJE 103
SMOUS PAN 105
VOGELSTRUIS-BULT 104
DRIELINGS PAN 101
GRAS-PAN 112
HUMANSRUS 147
HUMANSRUS 147
SLIMES DAM 154
R357
UITSPAN PAN 115
UITSPAN PAN 115
RIDGIL KLIPGATS PAN 117
HOEKPLAAS 146
PLAT SJAMBOK 102
ROODE DAM 114
KAFFIRS KOLK 118
KAFFIRS KOLK 118

MAP 8: QUARTERNARY CATCHMENTS

Path: N:\126-001 Vardocube MRA\Mxd\Quaternary Catchments NHC 20180808.mxd

Prieska Zinc Copper Project (Vardocube Section)

Legend

- Quaternary Catchments
- Farm Boundaries

PROPOSED VARDOCUBE MRA

- Vardocube

ROAD NETWORK

- Main Road
- Secondary Road
- Other Access
- Railway line

RIVERS & STREAMS

- Perennial River
- Non-Perennial River
- Wetlands

QUATERNARY CATCHMENTS

0 500 1000 2000 Meters

Reviewed:	Drawn by:
P. Furniss Environmental Scientist	NH Cele GIS Specialist

Coordinate System: GCS WGS 1984
Datum: WGS 1984

ABS Africa
Sustainability Advisors

Scale: 1:69 329

Version: Final

Date: 2018/08/28

22°13'0"E 22°14'0"E 22°15'0"E 22°16'0"E 22°17'0"E 22°18'0"E 22°19'0"E 22°20'0"E 22°21'0"E 22°22'0"E 22°23'0"E 22°24'0"E 22°25'0"E

29°53'0"S 29°54'0"S 29°55'0"S 29°56'0"S 29°57'0"S 29°58'0"S 29°59'0"S 30°0'0"S 30°1'0"S 30°2'0"S

DOONIES-PAN 106
D54G
SMOUS PAN 105
Alkantpan
opperton
NELS POORTJE 103
VOGELSTRUIS-BULT 104
D54D
GRAS-PAN 112
SLIMES DAM 154
R357
HUMANSRUS 147
KLIPGATS PAN 117
HOEKPLAAS 146
UITSPAN PAN 115

MAP 9: CRITICAL BIODIVERSITY AND ECOLOGICAL SUPPORT AREAS

Path: N:\126-001 Vardocube MRA\Mxd\Critical Biodiversity NHC 20180807.mxd

Prieska Zinc Copper Project (Vardocube Section)

Legend

- Farm Portions
- Orebody Model

PROPOSED VARDOCUBE MRA

- Vardocube

CRITICAL BIODIVERSITY ASSESSMENT

- Protected Area
- Critical Biodiversity Area One
- Critical Biodiversity Area Two
- Ecological Support Area
- Other Natural Areas

ROAD NETWORK

- Main Road
- Secondary Road
- Railway line

RIVERS & STREAMS

- Non-Perennial River

NC CRITICAL BIODIVERSITY AREAS

0 437.5 875 1,750 Meters

Reviewed:	Drawn by:
P. Furniss Environmental Scientist	NH Cele GIS Specialist

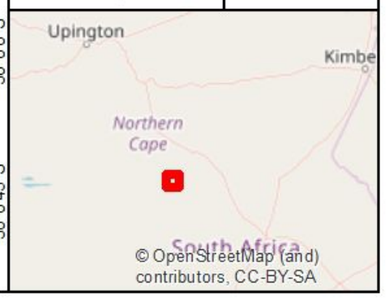
Coordinate System: GCS WGS 1984
Datum: WGS 1984

ABS Africa
Sustainability Advisors

Scale: 1:56 547

Version: Final

Date: 2018/08/28



Borehole 3

22°15'0"E 22°15'45"E 22°16'30"E 22°17'15"E 22°18'0"E 22°18'45"E 22°19'30"E 22°20'15"E 22°21'0"E 22°21'45"E 22°22'30"E 22°23'15"E 22°24'0"E

29°53'15"S 29°54'0"S 29°54'45"S 29°55'30"S 29°56'15"S 29°57'0"S 29°57'45"S 29°58'30"S 29°59'15"S 30°0'0"S 30°0'45"S

MAP 10: PROTECTED AREAS

Prieska Zinc Copper Project
(Vardocube Section)

Legend

- 5km Radius
- 10km Radius
- Protected Areas

PROPOSED VARDOCUBE MRA

- Vardocube

Augrabies Falls National Park
Witsand
Mokala National Park
Mokala National Park
Kalkfontein Dam Nature Reserve
Rolfontein
Rolfontein Nature Reserve
Doringkloof
Akkerendam Nature Reserve
Karoo National Park
Tankwa Karoo National Park
Camdeboo National Park

Upington
Postmasburg
Kimberley
Jan Kempdorp
Prieska
De Aar
Middelburg
Calvinia
Beaufort West
Graaff Reinet

NORTHERN CAPE

Hartbeesrivier
Rier River
Orange River
Carnavonleegte

1859 m
1808 m
1221 m
1233 m
1238 m
1553 m
1975 m
2469 m
1606 m
2424 m

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community

PROTECTED AREAS

0 15 30 60 Kilometers

Reviewed:	Drawn by:
P. Furniss Environmental Scientist	NH Cele GIS Specialist

Coordinate System: GCS WGS 1984
Datum: WGS 1984

ABS Africa
Sustainability Advisors

Scale: 1:1 900 000
Version: Final
Date: 2018/08/28

MAP 11: PCM IN RELATION TO THE KAROO CENTRAL AAA

Path: N:\126-001 Vardocube MRA\Mxd\SKA Locality NHC 20180807.mxd

Prieska Zinc Copper Project (Vardocube Section)

Legend

- SKA Virtual Center

PROPOSED VARDOCUBE MRA

- Vardocube

SKA AREAS

- Central Astronomy Advantage Area 1
- Central Astronomy Advantage Area 2
- Central Astronomy Advantage Area 3
- SKA Phase 1 Corridors

Project Location

Augrabies Falls National Park

Pella

Prieska

NORTHERN CAPE

NORTH CAP

Hartbeesrivier

Carnavonleegte

1176 m

1233 m

1238 m

1553 m

1606 m

Calvinia

Tankwa Karoo National Park

Karoo National Park

Beaufort West

Cederberg

WESTERN CAPE

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community

18°50'0"E 19°10'0"E 19°30'0"E 19°50'0"E 20°10'0"E 20°30'0"E 20°50'0"E 21°10'0"E 21°30'0"E 21°50'0"E 22°10'0"E 22°30'0"E 22°50'0"E 23°10'0"E 23°30'0"E

28°30'0"S 28°50'0"S 29°10'0"S 29°30'0"S 29°50'0"S 30°10'0"S 30°30'0"S 30°50'0"S 31°10'0"S 31°30'0"S 31°50'0"S 32°10'0"S 32°30'0"S

VARDOCUBE IN RELATION TO KAROO AAA

0 15 30 60 Kilometers

Reviewed:	Drawn by:
P. Furniss Environmental Scientist	NH Cele GIS Specialist

Coordinate System: GCS WGS 1984
Datum: WGS 1984

ABS Africa
Sustainability Advisors

Scale: 1:1 675 000

Version: Final

Date: 2018/08/28

MAP 12: DISTURBED AREAS

Path: N:\126-001 Vardocube MRA\Mxd\Disturbed Areas NHC 20180807.mxd

Prieska Zinc Copper Project (Vardocube Section)

Legend

- Decline Shaft
- Concrete reservoirs
- Hutchings Shaft
- Sinkholes
- Farm Portions
- Dosturbed Areas

PROPOSED VARDOCUBE MRA

- Vardocube

ROAD NETWORK

- Main Road
- Secondary Road
- Railway line

RIVERS & STREAMS

- Non-Perennial River
- Wetlands

Disturbed Areas

0 420 840 1680 Meters

Reviewed:	Drawn by:
P. Furniss Environmental Scientist	NH Cele GIS Specialist

Coordinate System: GCS WGS 1984
Datum: WGS 1984

ABS Africa
Sustainability Advisors

Scale: 1:54 172

Version: Final

Date: 2018/08/28

22°15'0"E 22°15'45"E 22°16'30"E 22°17'15"E 22°18'0"E 22°18'45"E 22°19'30"E 22°20'15"E 22°21'0"E 22°21'45"E 22°22'30"E 22°23'15"E 22°24'0"E

29°53'15"S 29°54'0"S 29°54'45"S 29°55'30"S 29°56'15"S 29°57'0"S 29°57'45"S 29°58'30"S 29°59'15"S 30°0'0"S 30°0'45"S

R357

MAP 13: CURRENT LANDUSES

Path: N:\126-001 Vardocube MRA\Mxd\Landuse NHC 20180808.mxd

Prieska Zinc Copper Project (Vardocube Section)

Legend

Operating

Proposed

PROPOSED VARDOCUBE MRA

Vardocube

LANDUSE

Historical mining and related infrastructure

Power infrastructure

Residential

Agriculture - grazing

ROAD NETWORK

Main Road

Secondary Road

Other Access

Railway line

RIVERS & STREAMS

Perennial River

Non-Perennial River

Wetlands

LANDUSE

0 700 1400 2800 Meters

Reviewed:	Drawn by:
P. Furniss Environmental Scientist	NH Cele GIS Specialist

Coordinate System: GCS WGS 1984
Datum: WGS 1984

ABS Africa
Sustainability Advisors

Scale: 1:65 000

Version: Final

Date: 2018/08/29

22°14'0"E 22°16'0"E 22°18'0"E 22°20'0"E 22°22'0"E 22°24'0"E

29°52'0"S 29°54'0"S 29°56'0"S 29°58'0"S 30°0'0"S

SMOUS PAN 105

NELS POORTJE

KLIPGATS PAN 117

UITSPAN PAN 115

HUMANSRUS 147

R357

MAP 14: ENVIRONMENTAL SENSITIVITY PLAN

Path: N:\126-001 Vardocube MRA\Mxd\Environmental Sensitivity Plan NHC 20180808.mxd

22°15'0"E 22°15'45"E 22°16'30"E 22°17'15"E 22°18'0"E 22°18'45"E 22°19'30"E 22°20'15"E 22°21'0"E 22°21'45"E 22°22'30"E 22°23'15"E 22°24'0"E

29°52'30"S 29°53'15"S 29°54'0"S 29°54'45"S 29°55'30"S 29°56'15"S 29°57'0"S 29°57'45"S 29°58'30"S 29°59'15"S 30°0'0"S 30°0'45"S

N

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Prieska Zinc Copper Project (Vardocube Section)

Legend

- Orebody Model
- 500m Buffer
- 500m C&I Buffer

PROPOSED VARDOCUBE MRA

- Vardocube

ROAD NETWORK

- Main Road
- Secondary Road
- Railway line
- 100m GN704 Buffer
- Wetlands
- 1:100 Year Floodline

Sensitivity Map

0 440 880 1 760 Meters

Reviewed:	Drawn by:
P. Furniss Environmental Scientist	NH Cele GIS Specialist

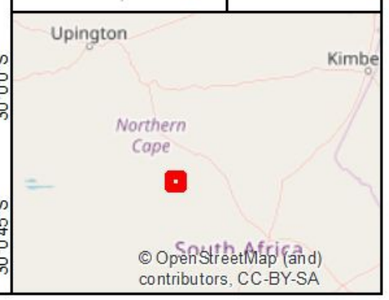
Coordinate System: GCS WGS 1984
Datum: WGS 1984

ABS Africa
Sustainability Advisors

Scale: 1:56 513

Version: Final

Date: 2018/08/28



APPENDIX 5: REGISTERED LAND CLAIMS LETTER

COMMISSION ON RESTITUTION OF LAND RIGHTS

OFFICE OF THE REGIONAL LAND CLAIMS COMMISSIONER: NORTHERN CAPE
Hyesco Arcade, 4-8 Old Main Road, Kimberley, 8300 | PO Box 2458, Kimberley, 8300
Tel: (053) 807 5700 | Fax: (053) 831 6501

Enquiries: Nqabisa Mkalipi

Applicant: **ABS AFRICA**

1. **LAND CLAIMS ENQUIRY: FARM VOGELSTRUIS-BULT 104 PORTION 1, PROVINCE NORTHERN CAPE**
2. **FARM VOGELSTRUIS-BULT 104 PORTION 25, PROVINCE NORTHERN CAPE**
3. **FARM VOGELSTRUIS-BULT 104 PORTION 26, PROVINCE NORTHERN CAPE**
4. **FARM SLIMS DAM 154 PORTION 0, PROVINCE NORTHERN CAPE**

We refer to your letter dated: 29 November 2017

We confirm that as at the date of this letter no land claims appear on our database in respect of the Property. This includes the database for claims lodged by 31 December 1998; and those lodged between 1 July 2014 and 27 July 2016 in terms of the Restitution of Land Rights Amendment Act, 2014. Whilst the Commission takes reasonable care to ensure the accuracy of the information it provides, there are various factors that are beyond the Commission's control, particularly relating to claims that have lodged but not yet been gazetted such as:

1. Some Claimants referred to properties they claim dispossession of rights in land against using historical property descriptions which may not match the current property description; and

2. Some Claimants provided the geographic descriptions of the land they claim without mentioning the particular actual property description they claim dispossession of rights in land against.

The Commission therefore does not accept any liability whatsoever if through the process of further investigation of claims it is found that there is in fact a land claim in respect of the above property.

If you are aware of any change in the description of the above property after 19 June 1913 kindly supply us with such description so as to enable us to do a further search.

Yours faithfully

COMMUNICATION DIVISION

OFFICE OF THE REGIONAL LAND CLAIMS COMMISSION: NORTHERN CAPE

NQABISA MKALIPI

DATE: 29/11/2017

APPENDIX 6: PUBLIC PARTICIPATION MATERIALS

DISCLAIMER

Advisory on Business and Sustainability Africa (Pty) Ltd. (ABS Africa) has prepared this report specifically for Vardocube (Pty) Ltd.

The contents of this report:

- Are based on the legal requirements for undertaking an Environmental Impact Assessment, as defined in the National Environmental Management Act, 1998 (Act No. 107 of 1998) and the scope of services as defined within the contractual undertakings between Vardocube and ABS Africa.
- Are specific to the intended development at the proposed site. The report shall not be used nor relied upon neither by any other party nor for any other purpose without the written consent of ABS Africa. ABS Africa accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.
- Reflect the best judgement of ABS Africa in light of the information available at the time of preparation. The analyses contained in this report has been developed from information provided by Vardocube and other parties. This information is not within the control of ABS Africa and ABS Africa has not audited such information and makes no representations as to the validity or accuracy thereof.

info@abs-africa.com

+27 11 805 0061

www.abs-africa.com

ABS Africa

Sustainability Advisors