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EKO•ENVIRONMENTAL

Draft Environmental Impact Assessment Report

THE REMHOOGTE MINE ON THE REMAINDER AND PORTION 1 OF THE FARM REMHOOGTE NEAR PRIESKA IN THE NORTHERN CAPE PROVINCE.

March 2016

DENC Ref. Nr.: 01/02/2015(L1.3.8)

Prepared for:

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Background

EKO Environmental is a Bloemfontein based company with expertise in specific environmental fields but also in the coordination of larger environmental management project that involves outside contracted expertise for specialist investigations.

We provide our clients with a professional service and cost effective solutions to their environmental problems to conduct their activities, development or explore natural resources like minerals, surface and ground water, without negatively impacting on the environment.

H2ON endeavours to provide a high quality service and prompt completion of deliverables

Fields of Expertise:

Environmental management	**Biomonitoring**
ISO14001 implementation and auditing	**Pollution control**
Water use licence applications	**Solid waste management**
Environmental impact assessments	**Geological and geohydrological**
Environmental auditing	**investigations**
Mining authorization application	**Heritage Impact Assessments**
Catchment Management	**Botanical Surveys**
Water Quality Assessments	**Rehabilitation**
Development and management of	**Ground- and surface water**
	monitoring programs

Professional Team:

Name	Qualification	Specialist field
Gys Hoon	B Sc, Geochemistry and Geology1988 B.Sc Honors in Geohydrology 1989 Professional Standing: Registered as a professional scientist: *Pr.Sci.Nat* 4 00004/93	Mining authorization applications ISO 14001:2004, audits, training and implementation Water use right applications Environmental Impact Assessments Groundwater investigations Environmental audits Water quality investigations

	SAATCA Registered ISO 14001 environmental management systems auditor: E061	Catchment management Development of environmental monitoring systems Environmental risk assessments Waste Management Application for mining authorization, water use authorizations and waste Disposal permits
Darius van Rensburg	2007- B.Sc spes Botany and Zoology 2008 – B.Sc Honors in Botany 2012 – M.Sc. in plant ecology	Ecological Assessments Biodiversity Ananlysis Environmental Impact Assessments Vegetation Assessments Riparian Vegetation Succulent Vegetation

EXECUTIVE SUMMARY

The proposed development was conducted in accordance with the Environmental Impact Assessments Regulations of 18 June 2010 in terms of the National Environmental Management Act (NEMA), 1998 (Act 107 of 1998). The Environmental Impact Assessment (EIA) process consisted of several phases:

- The notification stage in which directly affected landowners, neighbouring landowners, stakeholders, communities, interested parties, key stakeholders as well as authorities were notified of the proposed development. Initial information in the form of a Background Information Document was also supplied to these parties. A communication channel was initiated with these parties to obtain queries and concerns and also to provide information to these parties.
- The EIA stage wherein the specialist input is incorporated and the likely impacts arising from these are considered in respect of the proposed development. The phase includes the development of mitigation measures and the development of an Environmental Management Program (EMPr).

The diamond industry is an international trade and one that involves a number of processes between the mining and extraction of the rough product, through to the polished diamond jewellery of the retail sector. The value of the industry is primarily dependent on the consumers' demand.
The production from Remhoogte has an average stone size in excess of two carats, which being predominantly made of gem and near-gem quality, will likely have a current average value of more than USD 2 000 per carat. The mining project will employ a total of 185 people and invest a total of R 475 000 in Human Resource development, R 600 000 in Infrastructure Development Projects, R 100 000 in Sustainable local economic development and R 220 000 in the creation of Small and Medium Enterprises.

Likely impacts caused by current mining operations

Current mining and excavation is likely to have impacted moderately on surface topography. Although the mining area contains a relatively flat topography the excavation of material will have

an impact on topography as it will be unlikely to re-instate the topography to exactly the natural condition. Furthermore, previous mining activities has already impacted on topography which makes the establishment of the natural topography in these areas impossible.

The impact on soil erosion is not clearly evident as a result of current mining and is therefore not considered pronounced. However, clearing of vegetation is likely to cause some level of erosion and it is considered likely that a low amount of erosion is occurring.

Together with limited erosion, excavation and some alteration in topography an amount of loss in soil fertility is inevitable.

It is considered unlikely that any pronounced pollution or impact on surface and ground water has been caused by current mining activities.

Previous mining activities has caused damage to some of the endeorheic pans on the site. However, current mining has had a low impact due to the exclusion of these pans from the mining area.

Current mining has had a significant impact on the loss of natural vegetation. Through the excavation of material it is required to clear the vegetation layer and although rehabilitation seems to be adequate the re-establishment of an exact natural vegetation layer of similar species composition is unlikely. Together with this a low amount of protected species will also be removed. Although transplanting and re-establishment of protected species is taking place the success rate will never be 100%. Due to clearing of vegetation and disturbance of the soil profile the area is also susceptible to alien vegetation establishment. Currently no pronounced infestation is evident in mining areas although this will have to continually monitored.

The impact on fauna due to current mining is also considered to be significant as the clearing of vegetation will lead to the loss of habitat and the displacement of fauna.

The loss, damage and fragmentation of habitat is considered to have a low-moderate impact due to current mining activities. The scale of the mining area is not extensive and as long as rehabilitation is adequate it will not lead to fragmentation of habitats.

Dust emissions and noise pollution is considered a low impact due to the current mining activities. Constant monitoring and mitigation will keep these impacts low.

Due to the isolated location of the mine the visual impact is relatively low. Infrastructure and spoil heap height is not such that it negatively impacts on the visual aesthetics.

The impact on road traffic and safety and the deterioration of the road infrastructure is relatively low. Traffic on the public roads remain low and as a result deterioration of the public road is also low. Roads are being maintained in good order.

Current mining activities has excluded all sensitive heritage areas and consequently the impact on heritage resources is relatively low.

Security at the mining site is at a high level and consequently security risks and increase in crime is highly unlikely.

The relationship with I&AP's is currently still on a good standing.

TABLE OF CONTENT

1 INTRODUCTION

1.1 The Applicant

Name:	Pioneer Minerals (Pty) Ltd
Registration Nr:	1991/006123/07
Postal address:	P.O. Box 251, Barkley-West, 8375
Contact person:	Glenn Norton (Group Technical Manager)
Tel. Nr:	053 531 1300
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Fax Nr:	086 501 6328
E-mail:	roelieno@rockwelldiamonds.com

1.2 Name and address of the property owners

Remainder of the Farm Remhoogte 152

Name:	Anna Jacoba de Villiers
Postal address:	P.O.Box 44, Prieska, 8940
Cel. Nr:	082 906 7201
E-mail:	remhoogte@gmail.com

Remainder of Portion 3 of the farm Holsloot 47

Name:	Christa Millicint Muller
Postal address:	P.O. Box 139, Prieska, 8940
E-mail:	coeniemllr11@gmail.com

1.1 Name and address of the Environmental Assessment Practitioner

Name:	EKO Environmental
Postal Address:	Suite 158, Private Bag X01, Brandhof, 9324
Contact person:	Darius van Rensburg
Tel. Nr:	051 444 4700
Fax Nr:	086 697 6132
E-mail:	darius@ekogroup.co.za

1.2 The property

Properties Involved

Farm name and number: Remhoogte 152/RE

Farm portion: Remainder

Area: 1585.36 ha

Title deed: T66951/1988

Surveyor General Code: C06000000000015200000

Farm name and number: Holsloot 47/3

Farm portion: Portion 3

Area: 1049.59 ha

Title deed: T49642/2009

Surveyor General Code: C06000000000004700003

Province: Northern Cape Province

District Municipality: Pixley ka Seme District Municipality

Local Municipality: Siyathemba Local Municipality

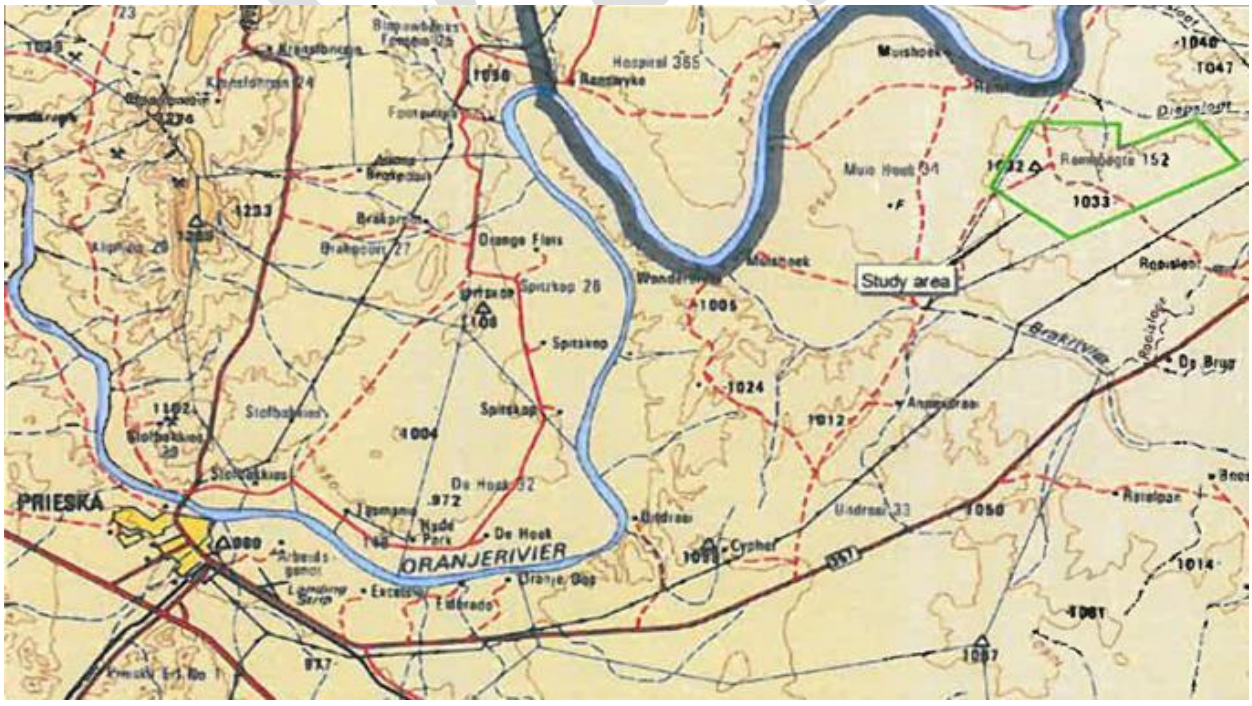

Figure 1: Location of the Remhoogte Mine

1.4.1 Direction to the nearest towns

The site is located near the town of Prieska. The site may be reached either from Prieska towards Kimberley on the R357 tarred road (35 km) and then turning left on the gravel road at the Remhoogte roadsign or from Douglas also on the R357 road (90 km) and turning right at the same gravel road.
The gravel road is followed for approximately 4 km where after the security gate of the mine is reached.

1.2.2 Orange River

The mining area is located approximately 4 kilometres south of the Orange River and also extracts water from the river via a pipeline.

1.2.3 Presence of servitudes

An Eskom electrical substation is situated on the site with a 32 kV power line providing electricity to the operation. The power line has a 11 m servitude.

1.2.4 Land tenure and use of immediately adjacent land

The farm Remhoogte 152/RE and Holsloot 47/3 are both bordered by farming properties. The land use on these farms is primarily associated with domestic livestock. Properties adjacent to the Orange River are also concerned with centre pivot irrigation. The neighbouring properties are as follows:

Table 1: Detail of landowners adjacent to Remhoogte 152/RE and Holsloot 47/3.

Owner	Farm name and number
Christa Muller	Rooisloot
Gerrie du Plesis	Bloukrans (Muis Hoek 34)
Bennie van Niekerk	Mooidraai 36
Hennie Groenewald	Mylpaal
Johan Gouws	Tendale
Michiel Jacobs	Greenvalley Nuts (Muis Hoek 34 Portions 17,19,21,22,23)
G.H. Gwells	Bloukrans School
Dirk Loots	Zwemkuil 37
Dannas Lubbe	Montery (Muis Hoek 34 Portions 22,28)
Charl de Villiers	Remhoogte

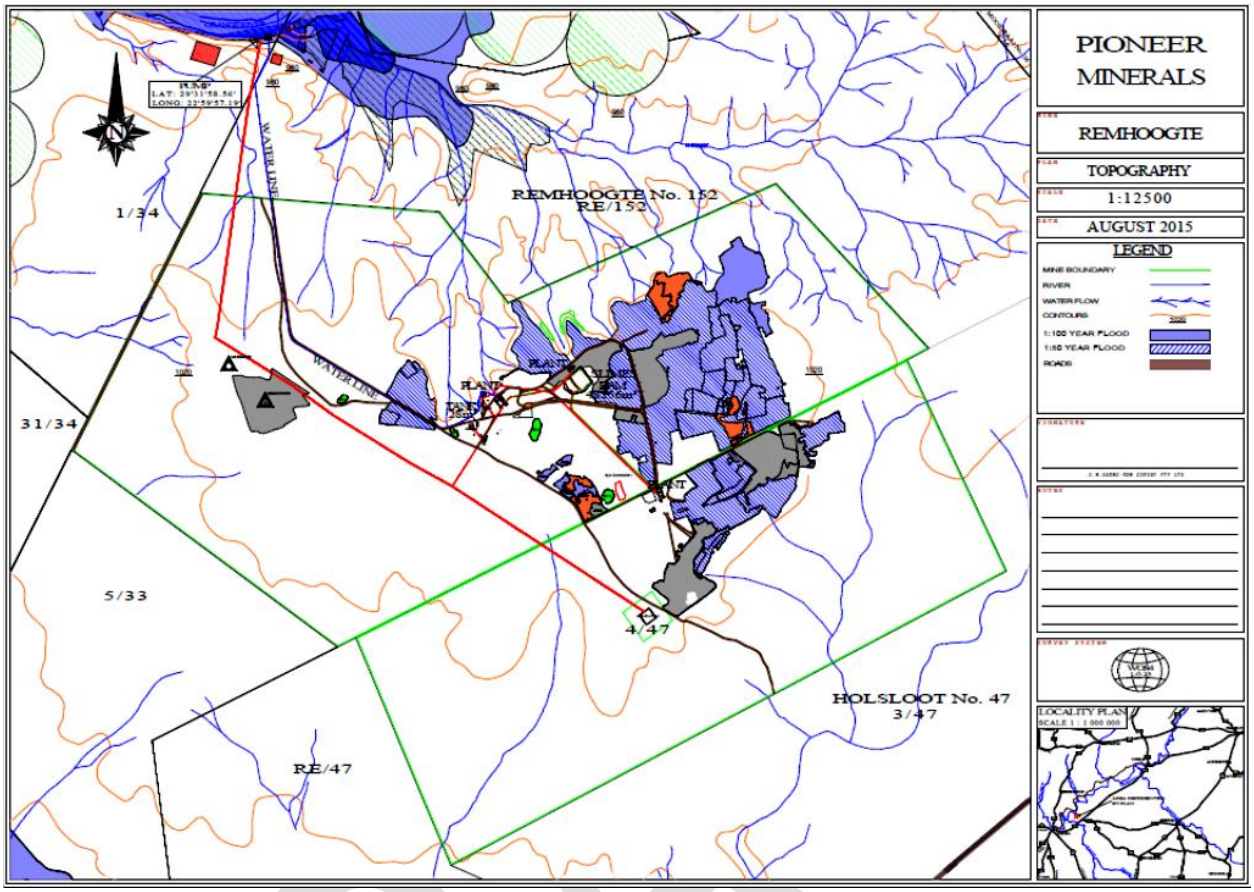

Figure 2: Map illustrating surrounding properties and mining area boundary.

2 DESCRIPTION OF THE RECEIVING ENVIRONMENT

2.1 Locality

The study area is located on a certain portion of the remainder of the Farm Remhoogte 152 in the Prieska Magisterial District in the Northern Cape Province. It falls under the Siyathemba Local Municipality and lies about 35 km northeast of Prieska and 240 km south of Kimberley on the R357 road (**Figure 3**). The study area lies approximately 2.7 km south of the Orange River and straddles quaternary drainage catchments D71D and D62J of the Lower Orange Water Management Area.

2.2 Current land use and surface infrastructure

This section provides an overview of the current land uses in the study area and what infrastructure already exists on and around the mining site. The surrounding land uses are mainly farming (i.e. cultivation, livestock, game) and mining.

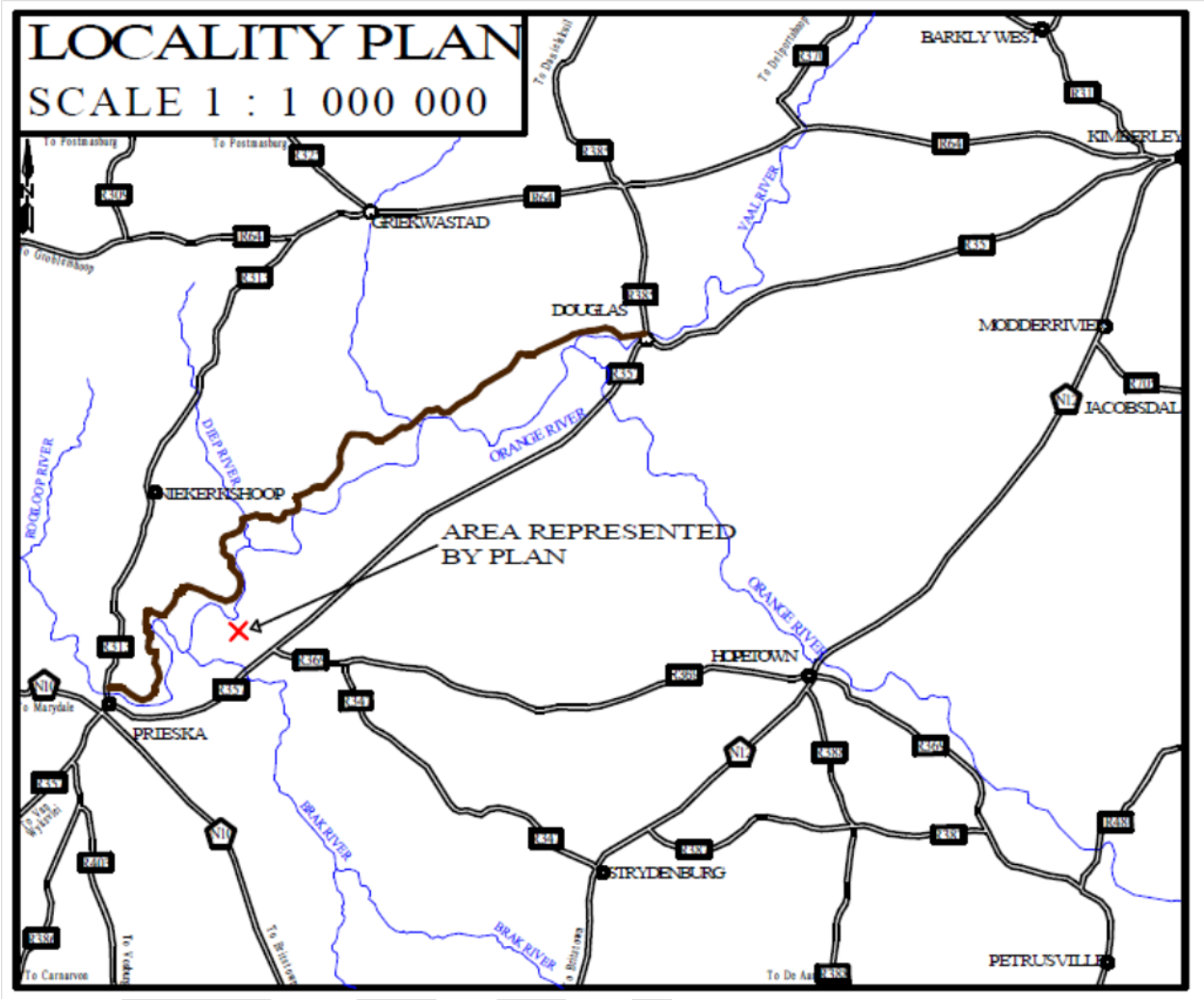

Figure 3: The locality of the Remhoogte mining area.

2.2.1 Roads

The main roads in the region of the study area are:

Road R357 (Figure 4a): This is a high order Class 2 provincial road traversing in a north-east and south-west direction in the vicinity of the site. The road links the towns of Prieska in the south-west with Douglas in the north-east. The road is a single carriageway with one lane per direction, and is in a very good structural condition due to surface rehabilitation in 2011.

Muishoek Road (Figure 4b): This is a mid-order municipal road traversing in a north-south direction to the west of the site. The road is surfaced from its intersection with the R357 in the south to the Brak River

Bridge in the north. The road continues as a gravel road further to the north. The speed limit on the road is 100 km/hr.

Rooisloot/Remhoogte Farm Access Road (Figure 4c): This is a low order farm access road intersecting with the R357 in the east and Muishoek Road in the west. The road traverses in a north-south direction and bisects the site.

2.2.2 Railways

There are no railways that traverse the study area. The nearest railway line intersects Prieska and traverses in a north-west and south-east direction.

2.2.3 Power lines

Electricity to the plant site area is supplied by a 32 kV Eskom distribution power line routed from a nearby Eskom substation. The distribution power line enters the study area in the south-west and provides power to the plant site area, the slimes dam, and a neighbouring mining site (**Figure 5**).

2.2.4 Residences

A farm house is situated north of the study site and does not fall within the mining area.

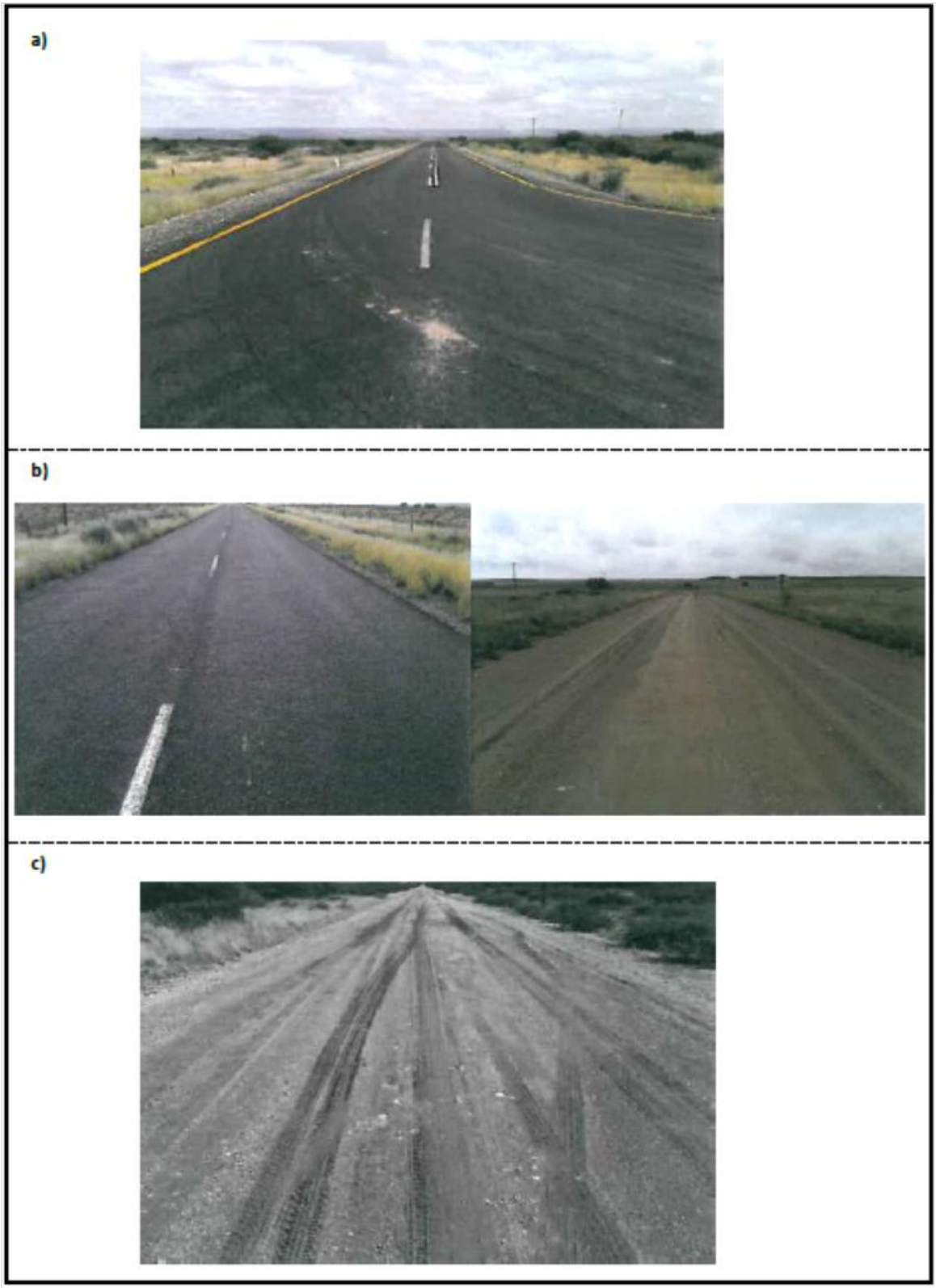

Figure 4: Main roads around the site a: R357 tarred road, b: Muishoek road, c: Rooisloot gravel road giving access to the Remhoogte mine.

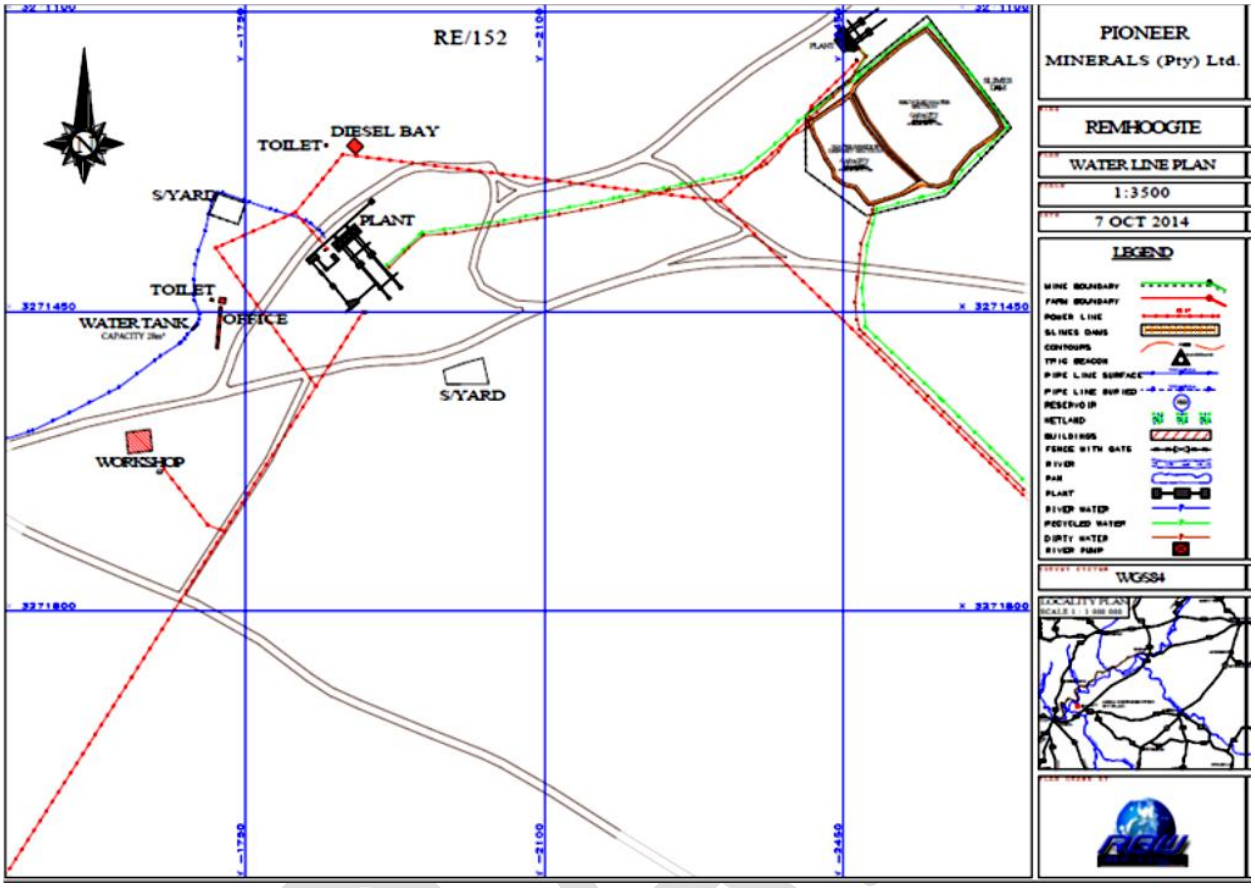

Figure 5: Layout of the power lines within the mining area.

2.2.5 Land use

Livestock farming accounts for more than 90 % of the agricultural land use and 75 % of the Siyathemba Local Municipality's agricultural GDP. Stock farming is primarily based on small stock (sheep and goats) on large commercial farms, for wool and carcass production. Game farming, primarily for hunting purposes, is also growing as a supplementary land use in the area. Major crop types that are cultivated in the Prieska district include maize and wheat, peanuts, lucerne and table grapes. Mining is also significant in the area.

The existing land uses in the study area comprise mainly of natural pastures for sheep. The carrying capacity for the area is low (3 to 4 per small animal unit). Agricultural activities are undertaken along the Orange River, but these areas fall outside the mining right area. A pan is used as a recreational facility.

2.3 Climate

The mine is situated in a dry region with a harsh climate, consisting of cold, dry winters and hot, semi-dry summers. Climatic data was obtained from literature and from data from Department Water Affairs, Water

Research Commission, and The South African Weather Bureau. Due to elevation characteristics as well as hydrological zone characteristics rainfall and evaporation data from the weather station D70E001 (Boegemos) are presented here.

2.3.1 Temperatures

The region experiences average midday temperatures between 19.2°C (in June) and 35.1°C in January (**Table 2**). The coldest temperatures are recorded in July (average of 1°C) at night. The area receives 37 frost days on average per year.

Table 2: Average daily temperatures for the site.

Month	Average daily minimum temperatures (˚C)	Average daily maximum temperatures (˚C)
Jan	18.9	35.1
Feb	18.2	33.7
Mar	15.7	31.2
Apr	10.8	26.3
May	5.3	22.6
Jun	1.5	19.2
Jul	1.0	19.7
Aug	3.4	22.0
Sep	7.7	26.2
Oct	11.3	28.8
Nov	15.0	31.9
Dec	17.5	24.1

2.3.2 Rainfall and evaporation

Prieska receives between 200 and 300 mm of rain annually, with the Boegemos station receiving a mean annual precipitation of 235.3 mm. Precipitation occurs mainly during autumn, with most rainfall received during February (41 mm) and March (40 mm). The lowest (5 mm) rainfall is experienced in June and July (**Figure 6**).

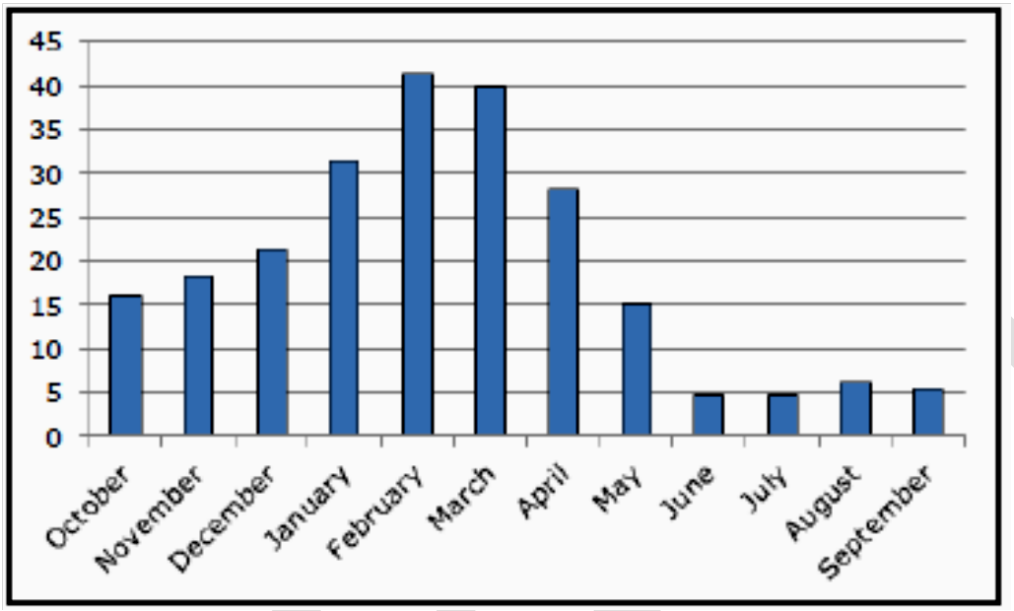

Figure 6: Mean annual precipitation at the Boegemos Weather station.

2.3.3 Evaporation

The mean annual evaporation at Boegemos is 2668.6 mm. Evaporation occurs mainly during summer, with most evaporation experienced during December (335 mm) and January (325 mm). The lowest (106 mm) evaporation is experienced in June (**Figure 7**).

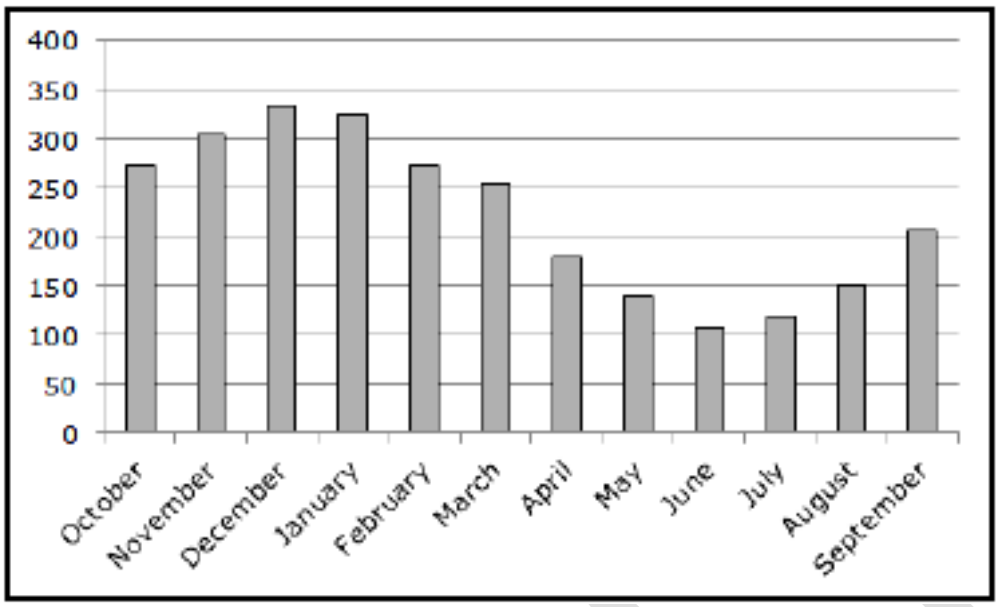

Figure 7: Mean annual evaporation at the Boegemos Weather station.

2.4 Topography

The topography of the study area is characteristics by very flat terrain with ground elevation lying between 950 and 1050 meters above sea level. Surface drainage is predominantly to the north into the Orange River and west into the Brak River. The terrain morphological class of the area is described as plains with low relief, with a distinct escarpment going into closed hills with moderate and high relief. The mining area is located at a flat terrain lying at an altitude of around 1000 m.a.s.l. (**Figure 8**).

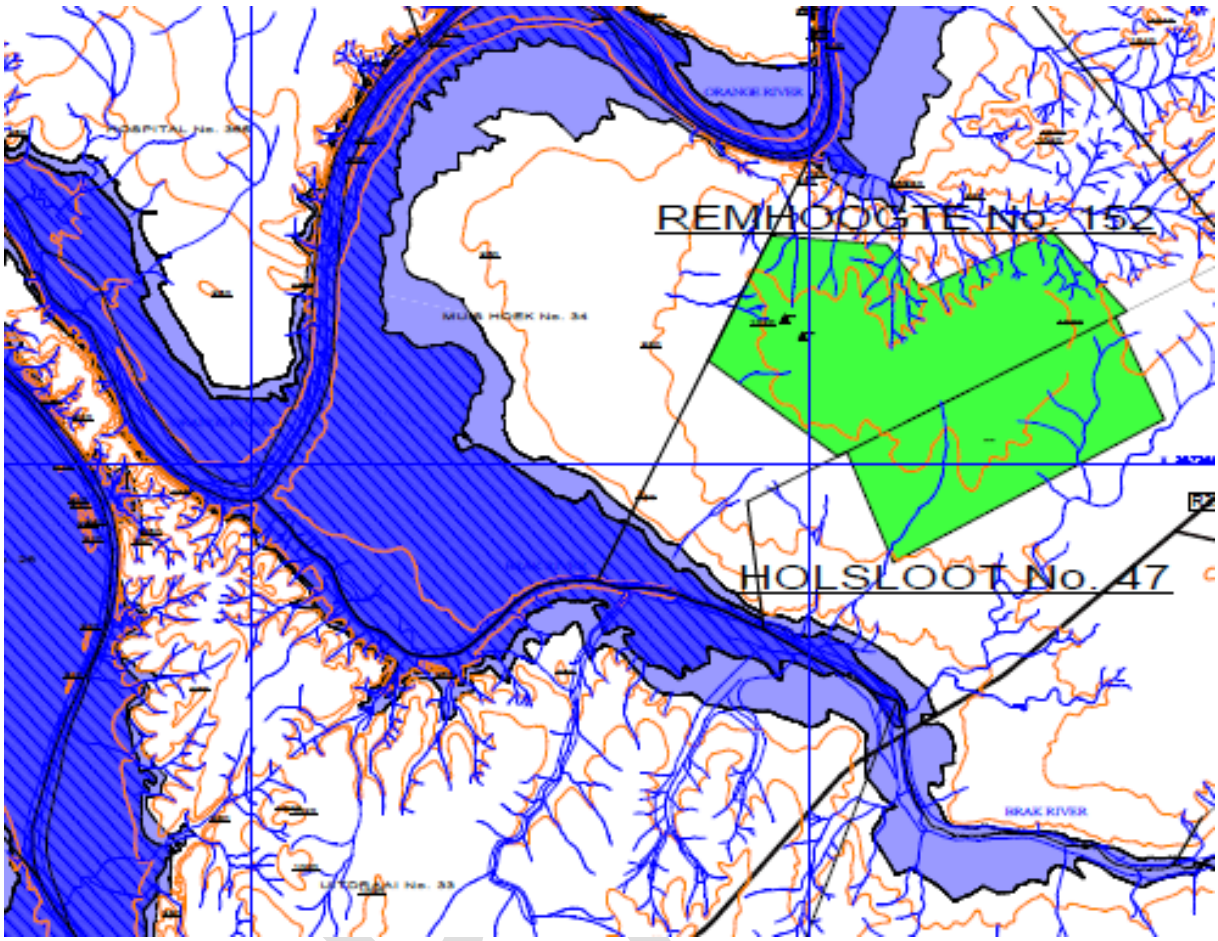

Figure 8: The location of the Remhoogte mining area in terms of topography and elevation.

2.5 Geology

2.5.1 Regional geology

The study area is located on the north-western margin of the Karoo Basin, which is filled with carboniferous glacial deposits of the Dwyka Formation. The glacial deposits have an estimated maximum thickness of 100 m. The Dwyka Formation represents the bedrock in the area and consists of tillite and diamictite. The Dwyka Formation is overlain by Quaternary deposits consisting of sand, gravel, calcrete and silcrete (**Figure 9**). Calcrete occurs as a very hard layer often exhibiting deep solution cavities or depressions which are filled with sand and gravel.

The alluvial terraces occur at three general elevations above the present Orange River; i.e. the lower (0 to 20 m), intermediate (30 to 50 m) and upper (60 to 110 m) terrace. The ages of these terraces young with

decreasing elevation and vary from Pleistocene-Pliocene, for the lower terraces, to Plio-Miocene for the upper terraces. Diamond content also generally decreases with elevation. Lower terrace deposits are generally covered by 1 to 4 m sand, whereas upper terrace deposits are capped by a hard calcrete layer of 2 to 3 m thick. This layer protected the gravel deposits from erosion and prevented exploitation in the past. Historical mining activity focussed on the unconsolidated Rooikoppie gravels overlying the calcrete layer. Lower and upper terraces on Remhoogte are situated at 15 m and 85 m respectively above the present bed of the Orange River. An alluvial floodplain deposit of fine sand and silt line the south bank of the Orange River in the northern parts of Remhoogte.

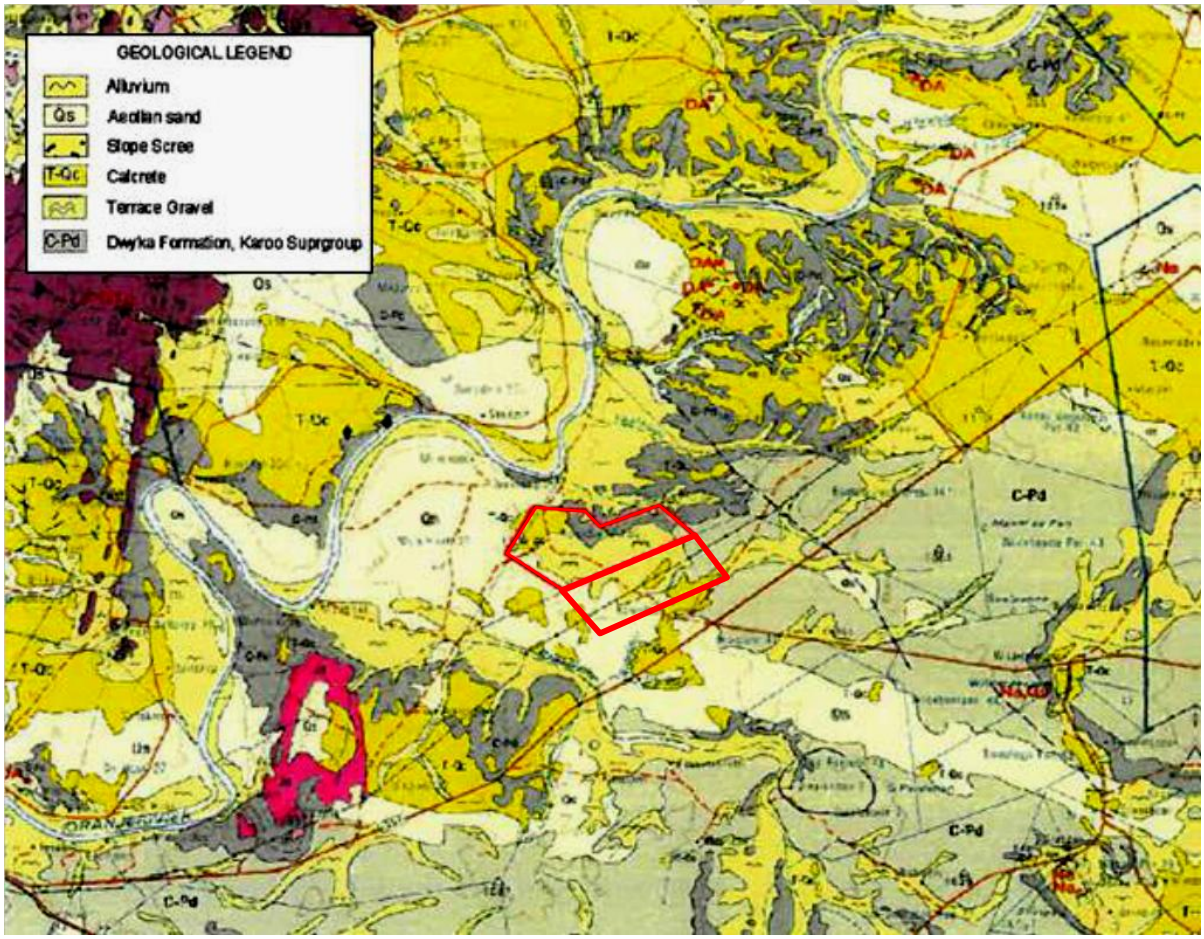

Figure 9: The regional geology in relation to the Remhoogte mining area (highlighted in red).

2.5.2 Diamond Deposits

Diamonds are found in the gravels. Numerous linear features inferred to represent dolerite dykes or faults are found in the region. Dolerite dykes are believed to have facilitated the deposition of diamonds by

causing turbulence in streams. This lead to excessive scouring of waterfalls and the formation of traps in which diamonds were collected. The gravel layers at Remhoogte were probably initially deposited in a meandering river environment similar to the other primary gravel deposits in the area (e.g. Saxendrift). Rooikoppie gravels overlie the entire occurrence of upper gravels on Remhoogte and have an average estimated thickness of about 0.5 m. The component clasts consist mainly of poorly rounded pebbles of banded iron formation with some subordinate chert, jasper, quartzite and lava.

The gravel is underlain by a very hard layer of calcrete and silcrete, often exhibiting deep solution cavities or depressions which are filled with Rooikoppie gravel. Primary (Upper) gravels on Remhoogte are only partly exposed in one prospecting trench and along the northern escarpment which forms the edge of the elevated terrace area. There is no overburden above the Rooikoppie gravel. Overburden as defined here, consists of a hard layer (0.5 to 2 m thick) of calcrete and silcrete containing a few clasts of banded iron formation, underlying the Rooikoppie gravel and overlying the upper gravel. The hard upper calcrete layer grades down into soft powdery calcrete and partly calcretized coarse boulder gravel and sand. The total average overburden thickness is 2 to 4 m.

The older gravels on Remhoogte have been deposited on a planed, slightly undulating bedrock floor that slopes gently northwards towards the Orange River. The bedrock consists mainly of soft Dwyka shale with minor tillite. A number of linear features identified during geological mapping of the deposit may represent dolerite dykes or faults in bedrock below the gravels. Such bedrock features normally cause extraordinary stream turbulence leading to excessive scouring or waterfalls and the formation of traps sites for diamonds.

2.6 Description of soils

2.6.1 Soils and land capability

The escarpment slope comprises Dwyka tillite exposure. The terrace is covered by calcrete and Rooikoppie gravel. **Figure 10** shows the soil map units found in the study area, while a summary of their associated soil characteristic is given in **Table 3**. The soil specialist report is attached as Appendix 1.

The soils of map unit Cg2 is of the Coega soil form and consists of dark reddish brown, apedal, loamy sand topsoil on a horizon consisting of a continuous, very hard, massive layer, cemented by carbonates (hardpan carbonate horizon or calcrete). The surface and top soil have 25 to 30 % gravel and stones. This map unit covers 23.18% of the area. The land capability of this map unit is grazing.

The soils of map unit Cv consists of structureless (apedal) soils, with dark brown, apedal, sandy topsoil on a dark brown, apedal, sandy loam, sub soil, underlain by a neocarbonate B horizon. The soils in this unit cover 17.54 % of the area and belong mainly to the Clovelly soil form. The land capability of this map unit is arable land. If it is irrigated it has a high potential, otherwise the land capability is grazing.

The Coega soils of Map unit Cg1 contain dark brown to brown, apedal, loamy sand topsoil on a hardpan carbonate horizon (calcrete). This map unit covers 15.14 % of the area and the land capability is grazing.

The soils of map units Gs1 and Gs2 are of the Glenrosa soil form with their topsoil being underlain by a stony or gravelly subsoil, grading into weathered rock. The Gs1 unit have dark grey, weakly structured, sandy clay loam topsoil rich in lime. The land capability is wilderness due to the steep slopes.

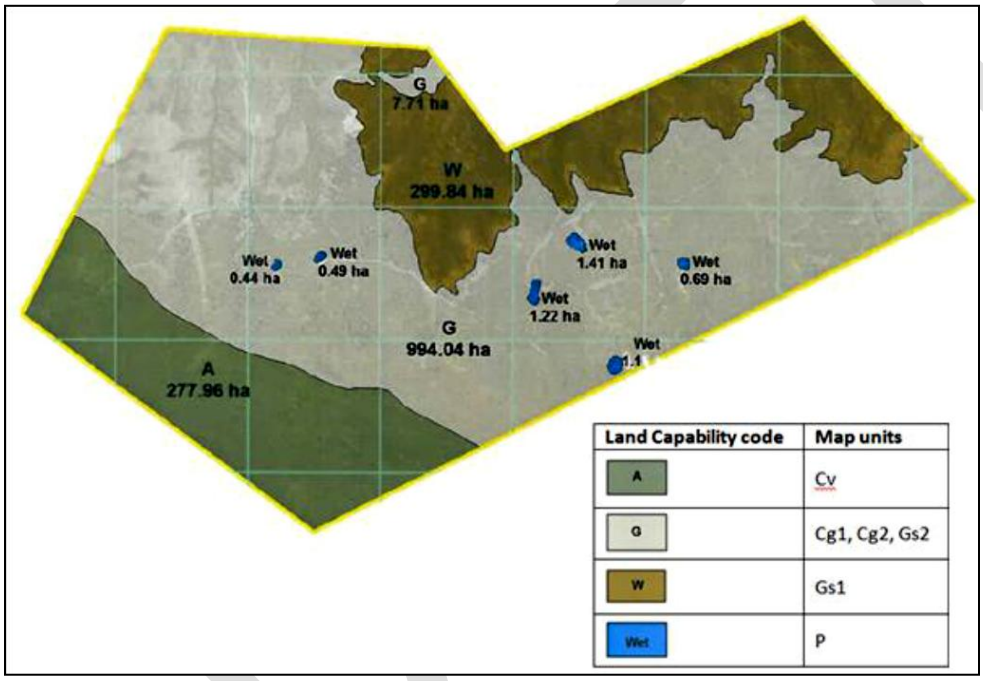

Figure 10: Soil and land capability map for the Remhoogte mining area.

2.6.2 Soil fertility

Soil analyses results are shown in **Table 3**. No abnormal or unexpected values or limitations could be observed from the results.

The soil reaction (pH) at the “plant” point in map unit Cg2 is moderately alkaline. The phosphorus (P) content of 25mg/kg soil is medium. The cations, Na, Ca and Mg is at normal levels, with K at a high level. The high pH value and K level is not abnormal or unexpected for the Coega soil form with its hardpan carbonate horizon (calcrete).

At the observation point "9" in map unit Gs2 the soil reaction (pH) is also moderately alkaline. The phosphorus (P) content of 8mg/kg is low, but expected for a virgin soil. The cations, Mg and Na is at normal levels and the Ca and K is high.

Table 3: A summary of the main soil characteristics associated with the soil mapping units.

Map unit	Dominant soil form	Sub dominant soil form	Effective depth (mm)	Description of mapping unit	Agricultural potenital	Area (ha)
Structureless (apedal) soils						
Cv	Clovelly 3100		1000 - 1200	Dark brown, apedal, sandy topsoil on a dark brown, apedal, sandy loam subsoil.	High to moderate	277.96
Calcareous soils						
Cg1	Coega 2000	Coega 1000	150 - 200	Dark brown to brown, apedal, loamy sand topsoil on a hardpan carbonate horizon (calcrete).	Low	239.95
Cg2	Coega 2000	Coega 1000 Glenrosa 1212	150 - 200	Dark reddish brown, apedal, loamy sand topsoil on a hardpan carbonate horizon (calcrete).	Low	367.29
Shallow soils						
Gs1	Glenrosa 1212		150 - 200	Dark grey, weakly structured, sandy clay loam topsoil on a stony, gravelly subsoil, grading into weathered rock.	Low	299.81
Gs2	Glenrosa 1211	Coega 2000	200 - 250	Dark reddish brown, apedal, loamy sand to sandy loam topsoil on a	Low	394.51

				stoney/gravelly subsoil, grading into weathered rock.		
Hydromorphic soils						
P	Katspruit			Pans	Low to none	5.41
Total:						**1584.93**

Table 4: Results for soil analyses done at Remhoogte

Sample site		**"plant"**		**"g"**	
Coordinates		29˚ 33' 34.0" S 23˚ 00' 13.9" E		29˚ 33' 43.6" S 23˚ 01' 40.0"	
Soil forms		Coega		Coega	
Horizon		A	C	A	C
Depth		0 - 150		0 - 150	
Sand	%	81.7		76.7	
Silt	%	12.6		14.2	
Clay	%	5.7		9.1	
Na	cmol.kg^{-1}	0.004		0.005	
K	cmol.kg^{-1}	0.863		0.685	
Ca	cmol.kg^{-1}	8.616		17.656	
Mg	cmol.kg^{-1}	1.241		0.809	
CEC	cmol.kg^{-1}	5.75		6.99	
EC (ms/m)		45		33	
P (mg/kg)		25		8	
pH (H_2O)		8.3		8.3	

2.6.3 Agricultural potential

The soil map units along with their agricultural potential classes and limiting factors are provided in **Table 5**. A large portion (82.12 %) of the study area (map units Cg1, Cg2, Gs1 and Gs2) is considered to be of low agricultural potential due to the shallow soil depth and high amount of stones and gravel in these soils. These soils is only suited for grazing and not for dry land or irrigation crop production.

Land in the Northern Cape Province is only considered to be of high potential if it is under permanent irrigation. The soils of map unit Cv is between 1000 and 1200 mm deep, with a high agricultural potential for crop production under irrigation. The annual rainfall is too low for dry land crop production.

2.6.4 Suitability for rehabilitation

The soils of map unit Cv would be the best suitable for rehabilitation because of its more favourable soil texture and structure. In contrast, the soils of map unit Cg1, Cg2, Gs1 and Gs2 are very shallow and would therefore be far less suitable for rehabilitation. In addition, the high content of stones and gravel result in a low volume of soil to work with for effective rehabilitation.

Table 5: Agricultural potential for soils at Remhoogte

Map units	Potential class	Limiting factor(s)	% of study area
Cv	High for irrigation	Few limitations; favourably textured soil and good soil depth	17.54
Cg1 Cg2	Low	Shallow soils with calcrete	38.31
Gs1 Gs2	Low	Shallow soils with gravel and stones	43.81
P	Low	Pans or closed depressions with seasonal water.	0.34

2.7 Geohydrology

Groundwater storage and movement at the study area is controlled by fractures, fissures and joints in the largely compact tillite/diamictite bedrock. Tillite does not fracture readily, consequently borehole yields are generally low ranging from 0.1 and 2 l/s. Higher borehole yields are however possible, particularly where fractured dolerite dyke margins are intersected. Groundwater recharge in the area is low, estimated to be about 8mm per annum. The poor recharge has implications on groundwater quality which is generally saline due to limited addition of fresh water.

The study area falls within a region where 45 m3 per hectare per annum of groundwater is allowed to be abstracted without a water use licence under the General Authorisation of the National Water Act of 1998. This translates to 125 932 m3 per annum for the mining property of 2789.49 ha.Ground water in the area is mainly used for domestic water supply and the provision of water for livestock and wildlife.

The geohydrological specialist report is attached as Appendix A2.

2.7.1 Ground water characteristics

According to data obtained from existing boreholes in and around the study area, ground water occurs at depths ranging from 25 m to 100 m below the surface, with an average depth of 57 m. Borehole yield ranges from 0.14 to 1.97 l/s, with an average of 0.75 l/s. Groundwater levels range from less than 5 m in river valleys to 53 m, with an average of 33 m (**Table 5**). The water table mimics surface topography, being shallow in low lying areas such as the Orange River valley (less than 5 m below surface) and deeper in the higher ground areas (about 40 m below surface). Ground water flows towards the Orange River.

Table 6: Description of existing boreholes found in and around the study area.

Borehole ID	Coordinates		BH depth (m)	Water level (m)	Water strike (m)	Blow yields (l/s)	Remark
	Latitude	Longitude					
2922DB00013	29.62639	22.93333		15	40	1	Borehole not identified
19007	29.45	22.95		18	51	0.42	Borehole not identified
2922DB00001	29.59222	22.9		66	89	-	Borehole not identified
2922DB00002	29.59222	22.90001		66	89	1.97	Borehole not identified
2923CA00004	29.50889	23.12556		-	-	-	Borehole not identified
2923CA00005	29.50889	23.12557		18.29	25.91	0.14	Borehole not identified
2923CA00006	29.5089	23.12556		-	-	-	Borehole not identified
2923CA00017	29.50972	23.12777		-	60	-	Borehole not identified
2923CA00018	29.58888	23.0875		42	42	0.2	Borehole not identified
REM BH 1	29.563056	23.033056	100	27.85	-	-	Equipped with wind pump; supplies water for game.
REM BH 2	29.563590	22.996440	15	Dry	-	-	Reported to have collapsed. Equipped with non-functional wind pump.
REM BH 3	29.584790	22.986340	-	38.21	-	-	Equipped with non-functional wind pump.
REM BH 4	29.533970	23.001470	-	8.1	-	-	Equipped with non-functional submersible

							pump. Used to have good quality water, but has deteriorated.
REM BH 5	29.540000	23.047500	-	-	-	-	Equipped with a functional solar pump. Water quality is good.
REM BH 6	29.586701	23.048642	-	-	-	-	
Statistical analysis	Minimum			15	25.91	0.14	
	Maximum			66	66	1.97	
	Average			33	53	0.75	
	Median			30.1	51.0	0.42	

2.7.2 Ground water quality

Ground water quality data for the area were obtained from the national ground water archives of the Department of Water Affairs. Data from 32 monitoring points were evaluated with a view to establish the ambient ground water quality at the study area. The positions of the monitoring points their results are presented in Table 7.2 of the specialist report (Appendix 2). These monitoring points could not be found in the field, suggesting that they may no longer be in use.

The results were evaluated against water quality guidelines for domestic use prescribed by the Department of Water Affairs. Ground water quality is characterised by elevated concentrations of nitrate, magnesium, chloride and sodium, in diminishing order. Sodium, chloride and magnesium are believed to represent the natural ground water quality in the area, while nitrate is suspected to be derived from agricultural activities.

Contour maps of electrical conductivity, nitrate, chloride and magnesium were produced and are shown in the ground water specialist report. The following characteristics have been observed:

- Electrical conductivity ranges from about 90 to 160 mS/m, placing the water in Class II to III.
- Nitrate ranges from 10 to 30 mg/l, placing the water in Class II to III
- Chloride ranges from 200 to 360 mg/l placing the water in Class II to III
- Magnesium ranges from 90 to 140 mg/l placing it in Class II to III

Ground water quality at the site is poor; attributed to the semi-arid environment characterised by low groundwater recharge, i.e. limited flushing of groundwater resources.

2.8 Surface water

The study area overlaps two quaternary catchments, namely D71D and D62J (**Figure 11**). Most of the proposed activities, including plant site, associated infrastructure, the slimes dam and access route, are located within the quaternary catchment D71D. The hydrological assessment report is attached in Appendix A3.

Figure 11: The location of the Remhoogte mining area in relation to quarternary catchments.

2.8.1 Existing river systems

An extensive network of irrigation canals provides water for intensive agricultural activities for large sections along the banks of the Orange River. The Lower Orange Water Management Area (WMA) forms the lower reaches of the larger Orange River Basin, but excludes the Vaal River Basin. The Orange River originates in the highlands of Lesotho, where it is known as the Qenqu River. It exits Lesotho in a south-westerly direction into South Africa where it forms a natural border between the Eastern Cape and the Free State before reaching the Gariep Dam, situated within WMA 13 (Upper Orange).

The area below the Gariep dam marks the boundary between the Eastern Cape, Free State and Northern Cape. The Orange River continues to flow in a north-westerly direction reaching Vanderkloof Dam, bordering the Free State and Northern Cape. The Orange River continues to flow in a north-westerly direction reaching Vanderkloof Dam, bordering the Free State and Northern Cape provinces. Downstream of the Vanderkloof Dam, the Orange River crosses the boundary between the Upper Orange and the Lower Orange WMAs. It then passes the small town of Hopetown, where after it reaches Douglas weir. Approximately 13 km west of Douglas, the Vaal River forms the main tributary to the Orange River, which marks the approximate boundary between the Upper and Lower Orange.

The Remhoogte mining area is approximately 96 km downstream of Douglas. The town of Douglas is situated upstream of this confluence of the Vaal and the Orange River. The Orange River continues to flow in a south-westerly direction before reaching the next small town of Prieska. The DWA compliance point (D7H002) is situated upstream of Prieska. From Prieska, the river curves to flow in a north westerly direction, where 115 km downstream from Prieska, the large Boegoeberg Weir is situated.

Figure 12: tributary of the Diepsloot stream, at the confluence with the Diepsloot.

Figure 13: The Diepsloot stream, upstream of the Orange River.

2.8.2 Endorheic pans

Endorheic pans are well defined, natural, shallow and circular to oval depressions with no outlet, which are semi-permanent or periodically filled with water and occur in areas of less than 500 mm MAP. Many of these pans dry up seasonally, mainly through loss of water by evaporation and they often have highly saline soils and contain high concentrations of sodium chloride and sulphates of sodium, calcium and magnesium. Although few vegetation studies have been done on pans, they are ecological importance as part of the broader landscape of arid regions and of further ecological interest for their own biota, specifically during the periods hat they hold water, and because of the briefness of those periods and the limited availability of water. Endorheic pans are contained in a topographic depression that has closed drainage, flat basin floors and usually circular to oval in shape; sometimes kidney-shaped or lobed.

Ten endorheic pans were identified in the study area (**Table 7**), of which EP 1 (**Figure 14**) holds high hydrological significance and must be preserved. No defined watercourses feeding the pans were identified on site or on contour maps; therefore these pans are considered to be off channel pans. Six of these pans have already been mined by previous owners.

As can be seen from Figure 14 below, the pans generally occur as flat shallow depressions and contain no endangered plant species. Wetlands as a habitat are under increasing threat; however, these pans are non-perennial with limited vegetation – no reeds or other typical wetland vegetation.

Table 7: The location of endorheic pans identified on the Remhoogte site

Endorheic Pan label	Location	
	Longitude	Latitude
Abondoned mine area 1	23.00317148	-29.55882242
Abondoned site 2	23.02482297	-29.55731979
Abandoned site 3	23.03356552	-29.56134956
EP1	23.00221527	-29.56130687
EP2	23.005835223	-29.56082876
EP3	23.01532910	-29.5626046
EP4	23.02263733	-29.5628778
EP5	23.01990528	-29.56076046
EP6	23.02174941	-29.55987255
EP7	23.02614346	-29.55892771
EP8	23.02960405	-29.55655994
EP9	23.03374766	-29.5601116
EP10	23.02878444	-29.56759058

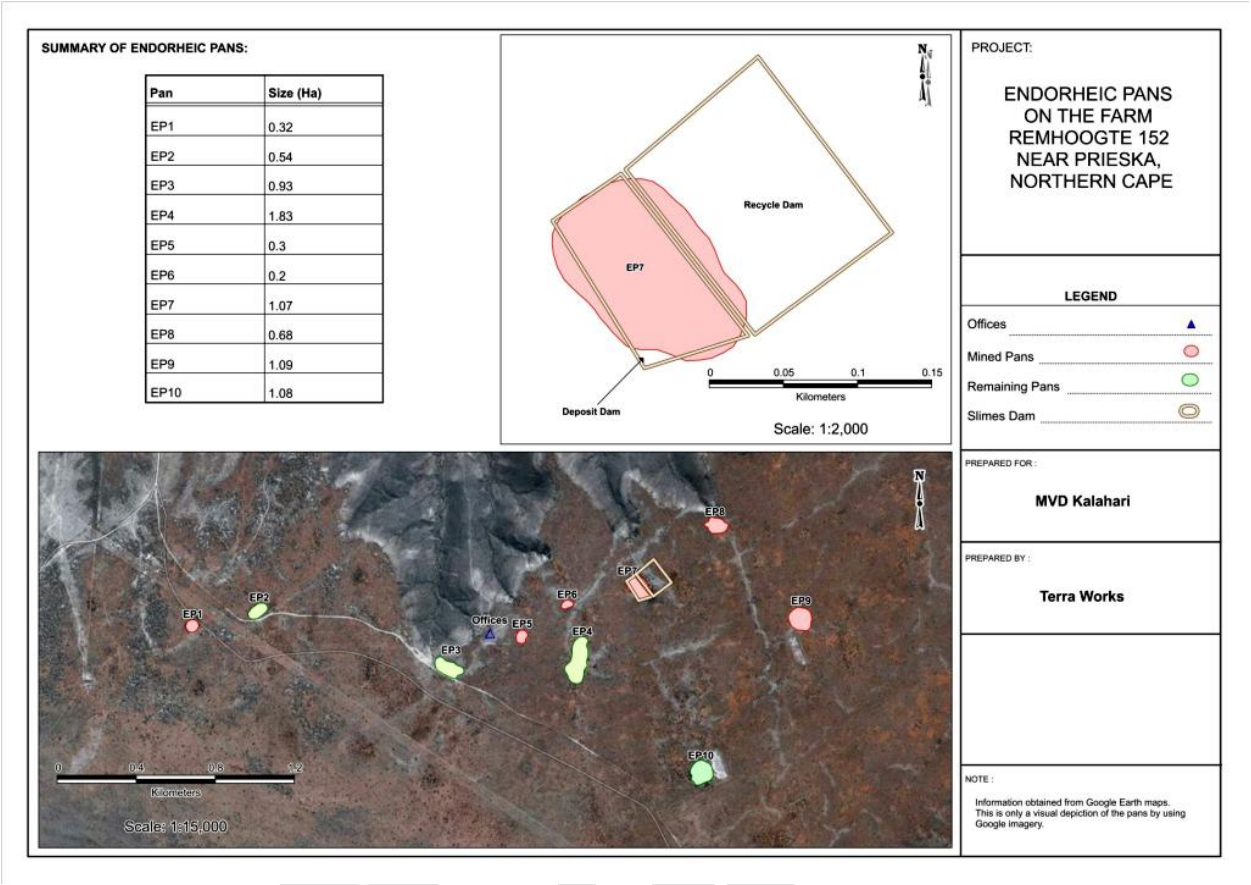

Figure 14: The location of ten endorheic pans in the Remhoogte mining area, of which EP1 is of high hydrological importance.

2.8.3 Surface water quality

Baseline water quality data was obtained from The Department of Water Affairs (Resource Quality Services). The data was taken at Monitoring point D7H002Q01 from the Orange River at Prieska and includes data from 1976. Approximately 410 samples were included to calculate the average water quality and results are shown in **Table 8**.

Resource Water Quality Objectives (RWQO) were developed from the Water Quality Guidelines for Domestic, agriculture and livestock; to limit adverse effects of pollutants in water resources. No RWQOs are currently available for the Orange River (Upper and Lower) and therefore the preliminary RWQOs for Prieska (Lower Orange WMA) were used to compare water quality of the study area.

The maximum recorded levels for Calcium, electrical conductivity, hardness, sodium and some nutrients exceeded the required limit. However, the average water quality falls within the acceptable range.

Table 8: Summary of water quality data from monitoring point D7H002Q01 compared to the Resource Water Quality Objectives. Noncompliance is indicated by *.

Description	Average	Minimum	Maximum	Resource water quality objective
Ca-Diss-Water	22.02	7.80	63.30	80
Cl-Diss-Water	12.52	1.50	118.90*	100
EC-Phys-Water	23.27	9.50	77.30*	55
HARD-Tot-Water	91.20	34.72	257.32*	200
K-Diss Water	1.77	0.15	18.96	25
Mg-Diss-Water	8.80	3.70	24.10	70
NH4-N-Diss-Water	0.06	0.02	1.42*	0.4
NO3+NO2-N-Diss-Water	0.42	0.02	1.42*	0.4
Na-Diss-Water	12.36	3.40	91.90*	70
PO4-Diss-Water	0.02	0.00	0.23	0.4
SO4-Diss-Water	15.22	2.00	96.90	100
pH-Diss-Water	7.58	4.79	8.83	Range

2.8.4 Runoff potential and flood calculations

The conditions that have an impact on the runoff coefficient are slope, vegetation cover and permeability and therefore it varies across any given landscape. The runoff coefficient for the mining site ranges between 0.18 and 0.25.

The non-perennial streams located on the northern sloping region of the study area originate within the study area; therefore the flood volumes from these tributaries are very low. However, the tributaries are located on steep slopes, which are associated with high flow velocity and narrow wetted perimeter.

Flood calculations showed that the peak flow for the 1:100 year flood event for the initial slimes dam area was 0.121 m3/s and yielded approximately 177m3. The peak flow for the 1:100 year flood event for the initial plant infrastructure areas was 0.091m3/s and yielded approximately 133m3.

2.9 Biodiversity

2.9.1 Vegetation communities

The study area falls within the Upper Gariep Alluvial Vegetation and the Northern Upper Karoo vegetation types as described by Mucina and Rutherford (2006). The Upper Gariep Alluvial Vegetation is found on the flat alluvial terraces and supports a complex of riparian vegetation. This vegetation type is dominated by *Acacia karroo* and consists of flooded grasslands and ephemeral herblands. The Northern Upper Karoo is a shrubland dominated by dwarf shrubs, grasses and *Acacia mellifera*.

The vegetation within the property is sub-divided according to the changes in soil structure, grazing gradients and topographical changes. The vegetation on the property can be divided into five distinct units, which are described in more detail below, and are presented in **Figure 15**. The biodiversity assessment report is attached as Appendix 4.

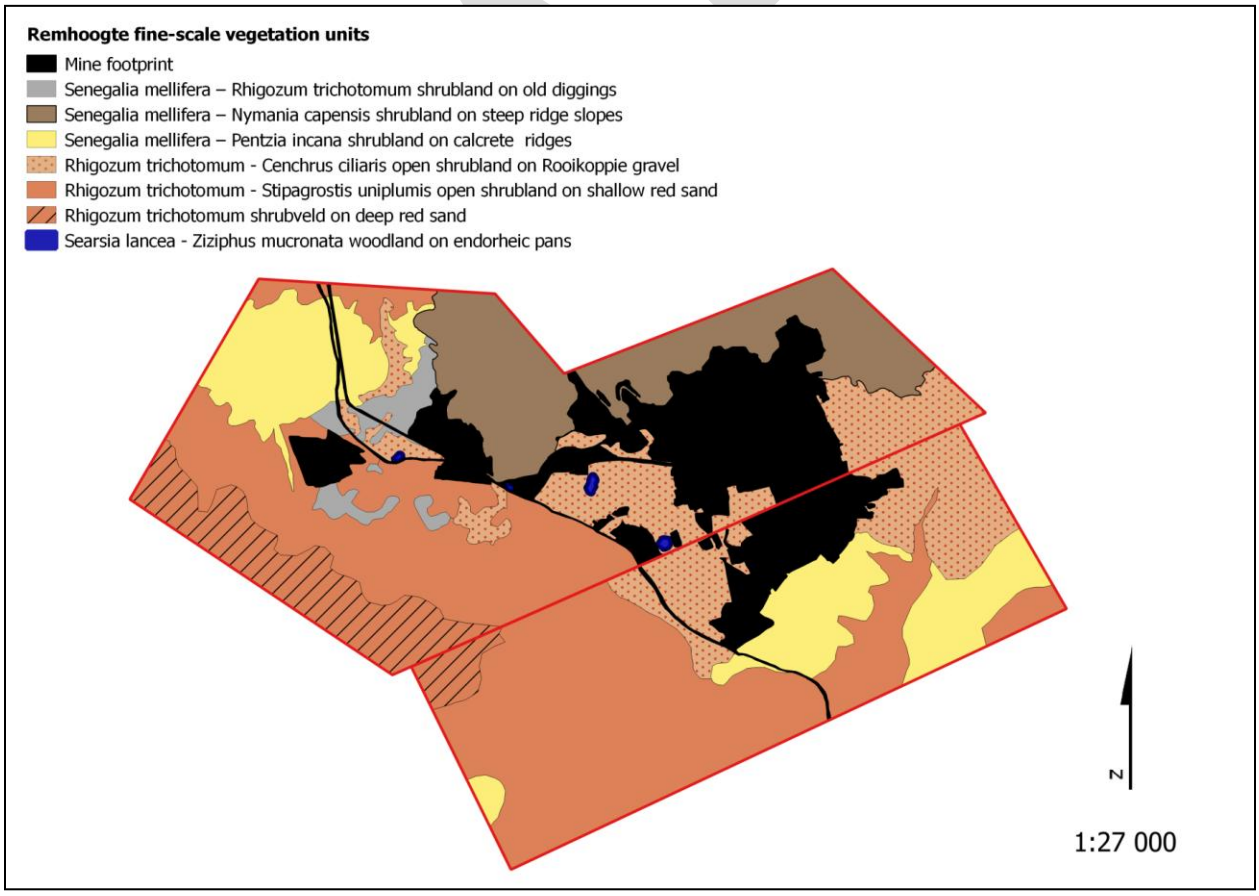

Figure 15: The vegetation communities of the Remhoogte mining area.

i) *Senegalia mellifera – Rhigozum trichotomum* shrubland on old diggings

This community occurs on the alluvial terraces where Rooikoppie gravels have been hand mined in the past. Vegetation has re-established on the tailings and on the associated disturbed areas (**Figure 16**), but the undergrowth is poorly developed. Rocks cover approximately 40 % of the surface and the large shrub *Senegalia mellifera* is by far the most dominant species. Other large shrubs like *Ziziphus mucronata, Rhigozum obovatum* and *Lycium bosciifolium* are also present. The smaller shrub layer is dominated by *Rhigozum trichotomum*, *Pentzia calcarea* and *Asparagus burchellii,* but *Aptosimum marlothii* and *Zygophyllum lichtensteinianum* are also common. *Cenchrus ciliaris* is the only grass encountered here. The protected tree *Boscia albitrunca* is present and occur as small or stunted shrubs. Other species that were recorded here include *Barleria rigida, Ledebouria revoluta and Nemesia* sp.

Figure 16: Vegetation that has re-established on historically hand mined Rooikoppie gravel is dominated by shrubs like *Senegalia mellifera* and *Rhigozum trichotomum.*

ii) *Senegalia mellifera – Nymania capensis* shrubland on steep ridge slopes

This community occurs on the rocky ridges in the north of the study area. Here, the vegetation occurs on shallow soils of the Glenrosa form, scattered among the rocks (**Figure 17**). *Senegalia mellifera* is the most conspicuous shrub on the ridge slopes, while *Nymania capensis, Rhigozum trichotomum* and *Eriocephalus decussatus* are also common. The grass layer is not well developed, but is dominated by *Anthephora*

pubescens. The protected species *Boscia albitrunca* and *Aloe claviflora* occur widespread on the ridges (Figure 10), while the listed *Acanthopsis hoffmannseggiana* was noted on the boundary of the ridge in an area already mined. Other species that are found here include *Zygophyllum lichtensteinianum, Phyllanthus maderaspatensis, Leonotis pentadentata*, *Cadaba aphylla, Ehretia rigida, Barleria rigida, Aptosimum spinescens, Felicia fascicularis, Thesium lineatum and Pteronia mucronata.*

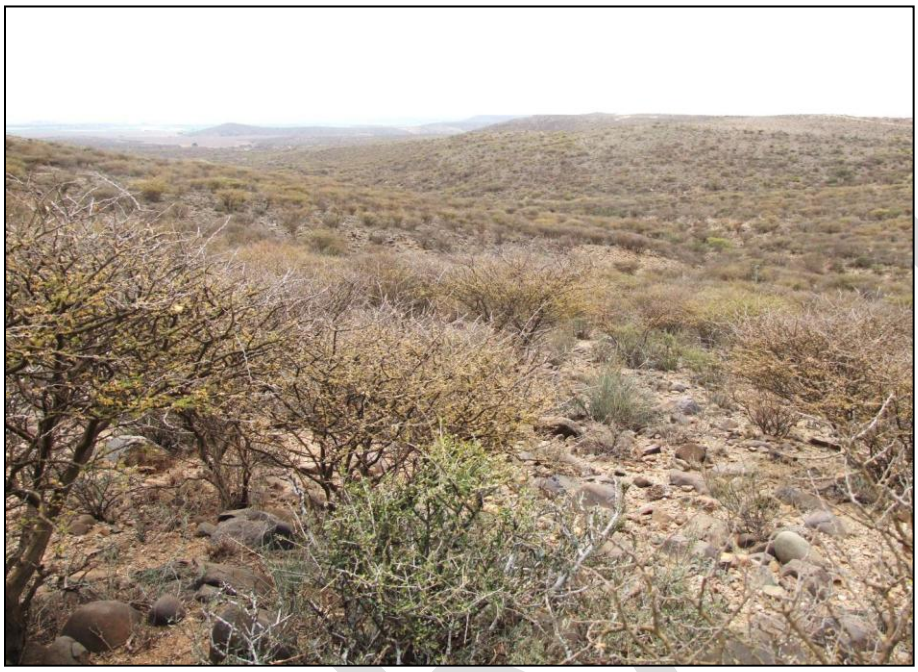

Figure 17: The shrubland on steep ridge slopes occurs on shallow soils among the rocks.

iii) *Senegalia mellifera – Pentzia incana shrubland on calcrete ridges*

This plant community is restricted to the calcrete ridges of the study area, where it grows sparsely on shallow rocky soils of the Coega form (**Figure 18**). *Senegalia mellifera* and *Pentzia incana* dominate the unit, but *Aizoon asbestinum* is also very common. Other conspicuous species include *Lycium cinereum, Pteronia mucronata, Rhigozum trichotomum, Salsola rabieana, Thesium lineatum, Zygophyllum lichtensteinianum* and *Felicia fascicularis*. The grass layer is moderately well developed and is dominated by *Stipagrostis ciliata, Stipagrostis obtusa and Fingerhuthia africana.* Protected species that are found here include *Boscia albitrunca, Aloe claviflora*, *Monsonia salmoniflora*, *Ruschia spinosa, Euphorbia braunsii* and *Hoodia gordonii*. Other species include *Barleria rigida*, *Gnidia polycephala, Kleinia longiflora, Leonotis*

pentadentata, Peliostomum origanoides, Polygala asbestina, Tapinanthus oleifolius, Rhigozum obovatum, Fagonia sp., *Geigeria* sp., *Asparagus* sp. and *Chenopodium* sp.

Figure 18: The vegetation on the calcrete ridges of the study area grows sparsely on shallow rocky soil

iv) *Rhigozum trichotomum – Cenchrus ciliaris* open shrubland on Rooikoppie gravel

This community is found on the alluvial terraces where Rooikoppie gravels are conspicuous. The vegetation grows on very shallow gravelly soils of the Coega form and is dominated by *Rhigozum trichotomum* (**Figure 19**). Other common shrubs found here include *Senegalia mellifera*, *Pentzia calcarea, Pentzia incana, Zygophyllum lichtensteinianum*, *Aptosimum albomarginatum, Eriocephalus decussatus* and *Lycium bosciifolium*. The grass layer is moderately well developed, where *Cenchrus ciliaris, Schmidtia pappophoroides* and *Stipagrostis uniplumis* are dominant, but *Anthephora pubescens* also occurs. The protected tree *Boscia albitrunca* occurs in high densities in this unit and ranges from small stunted shrubs to tall adult trees (Figure 13), and the provincially protected *Ruschia spinosa* also occurs in this unit. Other species found here include *Hermannia abrotanoides, Aptosimum spinescens, Barleria rigida, Felicia fascicularis, Kleinia longiflora, Limeum aethiopicum, Lycium cinereum, Sericocoma avolans, Asparagus burchellii, Dimorphotheca polyptera, Ledebouria revoluta, Peliostomum origanoides, Rosenia humilis, Chenopodium* sp., *Solanum* sp. and *Geigeria* sp.

Figure 19: The vegetation community on Rooikoppie gravel is dominated by *Rhigozum trichotomum*.

v) *Rhigozum trichotomum – Stipagrostis uniplumis* open shrubland on shallow red sand

This plant community is characterised by individual *Senegalia mellifera* shrubs scattered in a matrix dominated by *Rhigozum trichotomum* and *Stipagrostis uniplumis* (**Figure 20**). It is found on rather shallow sandy soils of the Clovelly form that host a variety of shrubs like *Pentzia calcarea*, *Aizoon schellenbergii, Lycium boschiifolium, Leonotis pentadentata, Pentzia incana, Aptosimum marlothii, Calobota spinescens* and *Salsola* sp. The grass layer is well developed and apart from the dominant *S. uniplumis* it also includes *Eragrostis lehmanniana, Stipagrostis obtusa, Stipagrostis ciliata, Aristida congesta* subsp. *congesta*, *Schmidtia kalihariensis* and *Centropodia glauca*. *Boscia albitrunca* is also widespread in this unit and other protected species found here include *Ruschia spinosa, Manulea sp.*and Amaryllidaceae sp. Other species found here include *Felicia clavipilosa* subsp. *clavipilosa, Gnidia polycephala, Grewia flava, Kleinia longiflora, Lycium cinereum, Pegolettia retrofracta, Arctotis leiocarpa, Grielum humifusum* var. *humifusum, Senecio erysimoides, Tapinanthus oleifolius, Zygophyllum lichtensteinianum, Asparagus burchellii, Barleria rigida, Chrysocoma ciliata, Dimorphotheca polyptera, Felicia muricata, Heliophila* sp., *Chenopodium* sp., *Ifloga* sp., *Ledebouria* sp. and *Nemesia* sp.

Figure 20: The plant community on red sand, where *Senegalia mellifera* is scattered in a matrix dominated by *Rhigozum trichotomum* and *Stipagrostis uniplumis*.

vi) *Rhigozum trichotomum* shrubveld on deep red sand

This community is very similar to the previous community, but differs in occurring on deeper red sandy soils of the Clovelly form and also in hosting very dense stands of *Rhigozum thrichotomum* (**Figure 21**). The grass layer is also much less developed, but includes the same grass species. Other species found here include *Pentzia calcarea, Lycium arenicola, Senecio erysimoides, Senegalia mellifera, Tapinanthus oleifolius, Asparagus exuvialis* forma *exuvialis, Dimorphotheca polyptera, Gnidia polycephala, Chrysocoma obtusata, Gazania jurineifolia* subsp. *jurineifolia* and *Heliophila* sp. Protected species include *Boscia albitrunca* and *Manulea* sp.

Figure 21: The plant community on deep red sand is dominated by *Rhigozum trichotomum.*

vii) *Searsia lancea - Ziziphus mucronata* woodland on endorheic pans

This community is restricted to hydromorphic soils from the Katspruit form, typically associated with the endorheic pans of the study area. The tree community characteristically occur on the periphery of the pans and include *Searsia lancea, Ziziphus mucronata, Vachellia karroo, Searsia burchellii, Grewia flava* and *Ehretia rigida.* The centre of the pan is dominated by *Eragrostis planiculmis*, but other species found here include *Chloris virgata, Panicum coloratum, Stipagrostis ciliata, Digitaria eriantha, Enneapogon cenchroides, Eragrostis obtusa, Cyperus capensis* and *Cyperus fulgens*.

2.9.2 Alien vegetation

Alien and alien invasive species that were recorded in and around the study area are listed in **Table 9.**

Table 9: A list of alien invasive species recorded in the study area.

Scientific name	Common name	Category
Prosopis glandulosa	Honey mesquite	Category 2: Declared invader
Argemone ochroleuca	White-flowered Mexican poppy	Category 1: Declared weed
Datura stramonium	Common thorn apple	Category 1: Declared weed
Nicotiana glauca	Wild tobacco	Category 1: Declared weed

2.9.3 Fauna

A list of all red data mammal species occurring in the study area was extrapolated from the Red Data Book for Mammals. Based on an evaluation of the habitat requirements for these red data species, the potential for these species occurring either on site or within 500 m of the property boundary is provided in Table 1 of the Botanical specialist report. The species that have a medium to high potential of occurring in the mining area include *Charadrius pallidus, Ephippiorhynchus senegalensis, Sagittarius serpentarius Aquila rapax, Gyps africanus* and *Falco biormicus.*

2.10 Air quality

Due to the types of activities present in the Northern Cape, the key air pollutants include households, ambient particulate matter (the mining industry), and crop spraying (usually on a two weekly basis during May-June and September-October). Pollution 'hot spots' may therefore be associated with these activities.

The main pressure causing an increase in particulate matter concentrations in the Northern Cape is the presence of mining activities. In surface mining, the actual mining excavation process leads to dispersion of particulate matter by wind. Impacts associated with particulate matter include adverse health effects (depending on chemical composition and particle size), nuisance effects, damage of materials and reduction in visibility.

Neighbouring land use in the study region comprises mainly agricultural (livestock farming) and mining activities. Fugitive dust emissions may occur as a result of vehicle entrainment of dust from local gravel roads, wind erosion from open areas and historical diggings, as well as dust generated by agricultural activities. Combustion of fuels, primarily wood and paraffin, may be a source of household emissions.

2.11 Noise

The surface infrastructure of the Remhoogte mine is situated in a rural environment, with typically low levels of noise, dominated by natural sounds and man-influenced sounds such as livestock, farming activities, and very occasional remote road and air traffic. However, existing mining activities of surrounding areas are already contributors to the present ambient noise climate in the area. It is nevertheless expected that the Remhoogte mine will cause potential nuisance to the current noise receptors, which is the farm house on Remhoogte and a school, located along the existing access road.

2.12 Traffic

A traffic assessment (Appendix 5) showed that the R357 and the Muishoek Road carry relatively low vehicular traffic during the morning peak hour. There were also no major capacity constraints at the key intersections of Muishoek Road and the Remhoogte / Rooisloot Farm access road.

At the time of compiling the traffic assessment report, no major roads were planned within the study area in the medium term. A light surface rehabilitation was however undertaken on the R357 in 2011, which comprised of a "chip-and-spray" seal. This entailed the spraying of a thin film of hot and fluid bitumen on the existing tarmarac, whereafter it was covered with a uniform layer of stone chips. This reseal intended to fill any voids and cracks on the road surface. In addition to this, patching of existing potholes was undertaken and the construction of edge-break points at accesses. The surface rehabilitation intended to prolong the road design life to last a further 10 years and to improve the road riding quality.

2.13 Heritage resources

Three elements of heritage significance were identified in the study area and include:

- Stone age
- Historic periods
- Graves, cemeteries and burial grounds
- Paleontology

A summary of the site of the identified archaeological sites and their significance is provided in **Table 10**, and the Heritage Impact assessment report is attached as Appendix A6.

Table 10: A summary of identified archaeological sites identified on Remhoogte.

Category according to NHRA	Identification/Description
Formal Protection	
National Heritage site (Section 27)	None
Provincial Heritage site (Section 27)	None
Provincial protection (Section 29)	None
Place listed in heritage register (Section 30)	None
General protection	
Structures older than 60 years (Section 34)	Yes

Archaeological site or material (Section 35)	Yes
Palaeontological site or material (Section 35)	None
Graves or burial grounds (Section 36)	Yes
Public monuments or memorials (Section 37)	None
Any other heritage resources	None

2.13.1 Stone Age

Stone Age artefacts, mostly dating to the Middle Stone Age occur in large numbers all over the study area (Remhoogte 152). These are mostly made from banded iron stone and Iron rich chert. Cores, flakes and tools were found (**Figure 22**). The tools are very rough and informal, and only a few typical tools were identified. The large number of side-struck flakes was significant. In some areas, on the hills closer to the river, the density of artefacts exceed more than 5/2m2, diminishing to 1/10m2 in the more sandy regions. This material is all surface material and is therefore unlikely to occur in primary context. Furthermore, previous mining activities disturbed the soil over large areas and would therefore have disturbed these artefacts even more.

Three areas of significance dating to the Stone Age have been identified, but only two areas are of importance for this study.

- The river bank seems to be rich in Later Stone Age occupation, with much material that has been uncovered here in the past. This material is viewed to have high significance on a regional level. This area will however not be impacted by the Remhoogte mining activities.
- Stone tools, mostly dating to the MSA, were found as surface material all over. During the site visit it was determined that this type of material occur in its largest concentrations in areas outside the mining area. This material is viewed to have medium significance on a regional level.
- The red dune areas are also considered to be important, especially for occupation during the Later Stone Age. Although the current surface indicators point to a low occurrence of material, important sites can be buried over time by natural processes such as dunes shifting from wind action. Material from this area is viewed to have high significance on a regional level.

Figure 22: Stone age material found in the study area.

The Holsoot area is underlain by Tertiary gravel deposits, calcretes and unconsolidated sandy deposits. Area 1 has already been extensively disturbed by mining activities, leaving no potential archaeological footprint. The site context of the stone tool surface scatters in Area 2 is clearly derived / removed / disturbed etc., but viewed within the context of cultural landscape, the weathered / *ex situ* stone tool scatters can be regarded as clear indication of Stone Age human presence on the landscape, and as such, is assigned an overall site rating of Generally Protected A (GP.A). It is therefore recommended that :

- Future mining activity into Area 2 is preceded by the establishment of a clearly demarcated 10 m-wide buffer zone along the eastern boundary of the study area (point A to B in Figure 2) in order to maintain a representative locality sample of the archaeological landscape.
- A representative sample of surface occurrences in Area 2 that lie outside the proposed buffer zone is mapped, recorded and photographed, and added to the buffer zone area for safekeeping.

Given the nature of the substantial sandy overburden present in Area 3 it is not possible to exactly predict potentially buried archaeological content under the sand unless fresh exposures indicate otherwise. Accordingly the Area 3 is rated *Generally Protected A (GP.A).* The exposure and subsequent reporting of

potentially intact archaeological material capped by the aeolian sandy deposits can be seen as a positive archaeological impact provided that proper mitigation measures are put in place. It is therefore advised that

- Future mining activity into Area 3 is accompanied by archaeological monitoring on a regular basis through spot checks of freshly dug test pits.

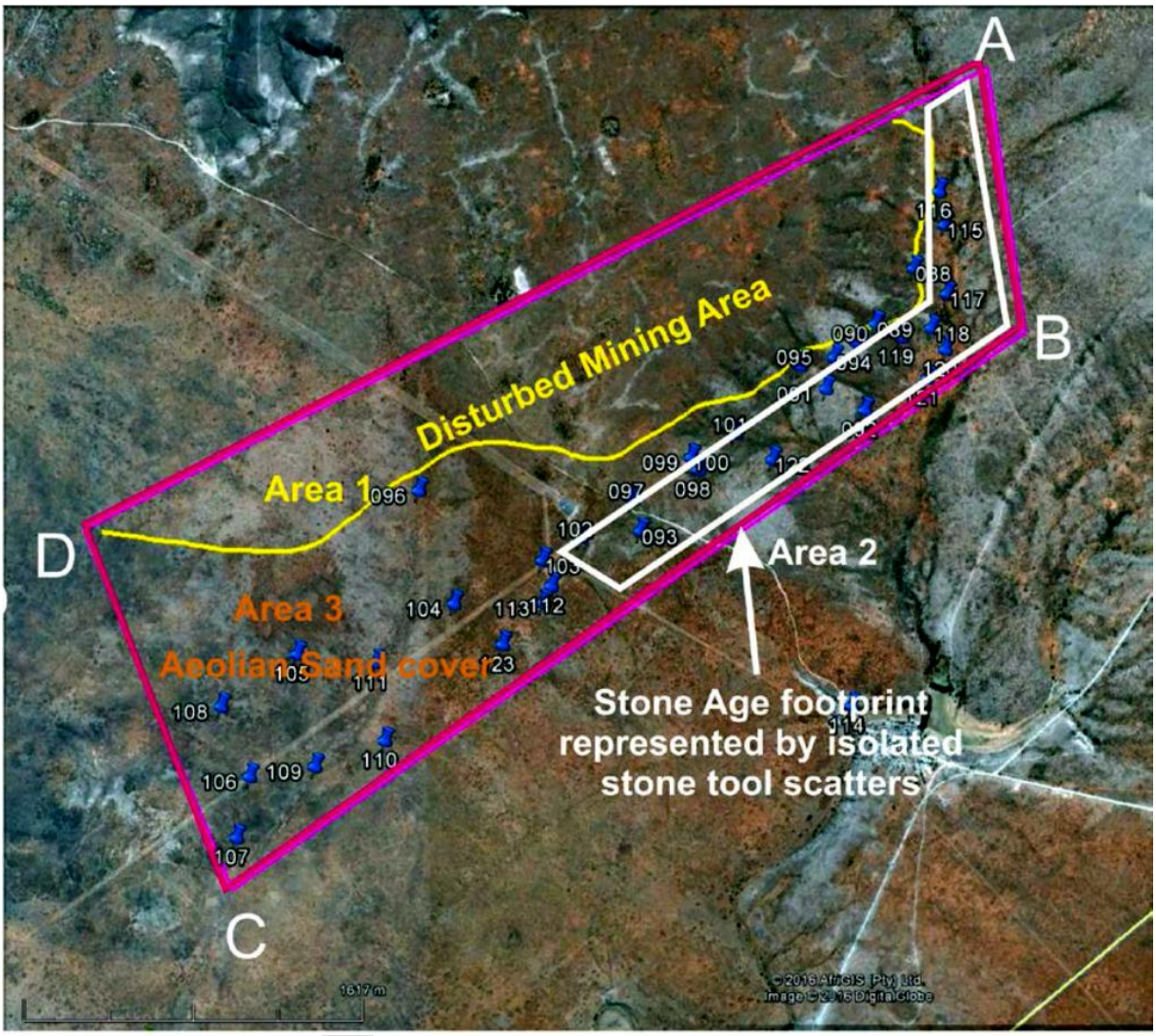

Figure 23: Figure of the holsloot area illustrating the different areas of significance.

2.13.2 Historic period

The historic period is based on archival sources as well as observations made during the site visit. Prospecting for diamonds started early and for example in 1919 three individuals, namely De Villiers,

Gurling and Pritchard applied for the right to dredge for diamonds on a portion of the Orange River, from the junction of the Vaal River and the Orange River all the way to Prieska.

In 1929 the farm Remhooogte, in the mining district of Barkley West, was proclaimed a “restricted alluvial digging for precious stones” and regulations were made for the distribution of claims. After a while (1931), a school was started, followed by shops and a hospital. However, as early as 1939 a section of the alluvial diggings was worked out and as a result it was de-proclaimed. This was followed by other de-proclamations between 1946 and 1963, when the last de-proclamation took place.

Considering the time mining activities took place at Remhoogte, during and after the great depression, it can shed much light on the plight of poor people, black and white, during this part of history. It is anticipated that an intensive survey of the area would lead to interesting information on the number of people involved and their way of life. This can be derived from their houses, refuse dumps, the cemetery and possibly interviews with former miners. This site is therefore evaluated to have a high significance on a regional level. The houses used by the miners seem to have been quite temporary and flimsy, and as a result very little of them remain. There is basically only a line of stones that indicate a foundation. Furthermore, the houses seem to have been located haphazardly across the countryside, most probably in areas where mining did not take place. A school and hospital also existed on the site and the foundation of the former can still be seen (**Figure 23**). Inspection reports on the school were regularly submitted by the Department of Education.

The diamond bearing gravel was extracted and then taken down to the river where there were sufficient water to wash it, in order to recover the diamonds. Remains of some of the equipment used for this are still found on the bank of the Orange River. Fresh drinking water was obtained from a well that is still in operation today (**Figure 28**).

Figure 23: Remains of an old school building.

Figure 24: Old wind pump found on Remhoogte, which is still in working condition.

2.13.3 Graces, cemeteries and burial grounds

A cemetery with probably more than 50 graves, including those of adults and children was identified (**Figure 25**).

Figure 25: A cemetery situated on Remhoogte.

2.13.4 Paleontology

The study area is underlain by Tertiary gravel deposits with a high potential for vertebrate fossils that are also much localized and rare but highly significant. Given the nature of fossil distribution within the intact alluvial gravels, it is not possible to exactly predict the buried fossil content of an area other than in general terms unless fresh exposures indicate otherwise. Accordingly the affected area is rated *Generally Protected A (GP.A).* The exposure and subsequent reporting of fossils to the relevant heritage authorities for excavation and recording can be considered a positive palaeontological impact provided that proper mitigation measures are put in place. It is therefore advised that excavations into calcrete deposits and underlying palaeo-gravels are accompanied by palaeontological monitoring on a regular basis through spot checks of freshly exposed sediments.

2.14 Socio-economic

The Remhoogte mining operation is located in the vast, sparsely populated Karoo region of South Africa, within the Siyathemba Local Municipality. The Siyathemba Local Municipality is one of eight local municipalities that make up the Pixley Ka Seme District Municipality.

The main settlements in the Siyathemba Local Municipality are the towns of Prieska, Marydale, Niekerkshoop, Draghoender and Copperton. Prieska is by far the largest town in the Local Municipality and functions as the administrative seat.

The total population of the Local Municipality is about 36 000. Coloureds make up 64 %, followed by Black Africans (26 %) and Whites (8 %). The population density is 2.1 people per km2. The age structure shows that 16 % of the population is between 0 and 6 years, while 8 % are 60 years or older. Furthermore, 31 % are between 7 and 19 years, while 50 % are of the economically active age group (20 to 59). This population structure has a high demand on the provision of social and physical facilities, like schools and primary health care centres in the district.

Key activities in the Local Municipality are mainly related to agriculture and mining. Little local beneficiation takes place. Tourism and game farming (mainly for hunting) are significant emerging land uses. Agricultural activities are by far the spatially most dominant land use, while extensive stock farming accounts for 98 % of agricultural land use. The mining sector historically played a role in the local economy, especially asbestos, copper and silver mining. Currently, mining activities are mainly related to alluvial diamond mining activities along the Orange River. The closure of asbestos mines and the Copperton mine has had a major lasting negative impact on the economy of the municipality.

The unemployment rate in the Local Municiapality was 14 % in 2001. The agricultural sector was the most important in terms of employment, accounting for 38 % of the total working population. The commercial service sector accounted for 23 %. Household income levels in the region are low. 64 % of household have an income of R 1000 or less per month.

The education levels in the region are also low and can be attributed to the rural nature of the area, as well as the substantial number of previously disadvantaged population groups who did not have equal access to education in the past era. Of the total population only 5 % had gained a matric certificate qualification and 2.6 % a degree, while 35 % only had a primary level education. Approximately 25 % had no education.

2.15 Limitations and assumptions

The assumptions made during this report were based on the experience of the EAP, current mining plans and schedules communicated by the applicant and specialist reviews. The assumptions were only made to ensure that their application in the study would not make the findings legally biased. All specialised fields considered principles, standards and methodologies, as required by their respective fields, for undertaking such investigations.

Some uncertainties in information provided include:

Vegetation

Due to the brief duration of the survey and the lack of seasonal coverage, the species list obtained during the site visit cannot be regarded as comprehensive. Ideally, a site should be visited several times during different seasons to ensure that the full complement of plant species present is captured. However, this is rarely possible due to time and cost constraints. The surveys are likely to have included the majority of the dominant and common species present.

The site visit for the study took place during late winter, which is not an optimal time of the year. Most grasses and annuals present were not flowering, and was therefore not in a favourable state for the assessment at the time of the site visit. The best time to evaluate vegetation in the study area is after at least some summer or late-summer rain when the vegetation has had a chance to respond and is in an actively growing state. The urgency of the survey for this project dictated that it should be done in August 2015. The results presented here can therefore only reflect the condition of the vegetation. Consequently, the timing of the site visit is considered to be a limiting factor which might compromise the results, as it is likely that there are species of conservation concern that were not visible at the time of sampling.

Soils

A hand auger was used to conduct the survey for a reconnaissance soil survey. Observation points were predetermined to represent the different geological units in the area. A detailed survey was done on the area where the infrastructure was initially planned to be erected, with an observation point where the mine site were to be constructed. Hence, detailed soil sampling was not done on the entire area earmarked for mining. Nevertheless, results from site observations could easily be extrapolated.

3 PUBLIC PARTICIPATION

The Public Participation Process (PPP) has been included in this process to allow consultative dialogue between the Environmental Assessment Practitioner (EAP) and Interested and Affected Parties (I&AP's). The PPP allows parties such as directly affected landowners, neighbouring landowners, stakeholders, communities, interested parties, key stakeholders as well as authorities to raise concerns and provide comments on the proposed project. The PPP also allows the Environmental Assessment Practitioner (EAP) to provide these interested and affected parties with detailed information regarding the project as well as respond to concerns and comments. This PPP was conducted as per Regulation 41 of Government Notice R.982 of 4 December 2014 in terms of NEMA, 1998.

The phases incorporated into the PPP can be summarised as follows:

- Initiation of the Public Participation Process (PPP) involves the notification of all Interested and Affected Parties (I&AP's) including neighbouring landowners, general public, stakeholders and authorities. Notification allows I&AP's the opportunity to raise concerns and provide comments and an I&AP register is opened where all contact details and comments and concerns are logged. This register is kept opened during the duration of the EIA process.
- During the EIA processes all registered I&AP's are provided with the opportunity to comment on the draft and final reports.
- After the competent authority has reached a decision and issued an Environmental Authorisation (EA) the applicant and I&AP's are notified and are given an opportunity to appeal the decision to the MEC of Environmental Affairs within the stipulated timeframes.
-

According to the EIA regulations the following pertains to the registered I&AP's:

- May participate in the application process
- May comment on any written communication submitted to the competent authority by the applicant or EAP.
- Must comment within the timeframes as stipulated in the EIA regulations.

- Must send a copy of all comments to the applicant or EAP if the comments if the comments were submitted directly to the competent authority
- Must disclose any direct business, financial, personal or other interests that the person has in the application being granted or refused

The following actions were taken as part of the PPP initiation of the project:

- Placing site notices at the entrance of the mining area, Remhoogte 152/RE and Holsloot 47/3 as well as at the Douglas Municipality and police station and the Prieska GWK co-operation and police station.
- Placing an advertisement on 18 November 2015 in the Noord Kaap local newspaper which is distributed free of charge to the local community in the Northern Cape.
- Providing directly affected landowners, neighbouring landowners, stakeholders, key stakeholders as well as authorities with a written notice informing them of the proposed development, the environmental authorisation process, the Public Participation Process as well as an invitation to register, request information or comment.
- Notifications were given to the above mentioned parties via fax, e-mail or registered mail.

All issues raised or comments given were incorporated into the Draft EIR.

Table 11: Authorities, stakeholders and I&AP's comments and responses.

I&AP's	Comment	Response
Department of Mineral Resources (DMR) - Livhuwani.malatjie@dmr.gov.za		
South African Heritage Resources Agency (SAHRA) - Andrew Salomon		
Agricultural and Rural Development - Viljoen Mothibi		
Department of Water and Sanitation (DWS) - A. Abrahams		
Siyathemba Local Municipality - Gert Bessies		
Pixley Ka Seme District Municipality -		

Rodney Pieterse		
Directly Affected Land Owners		
Neighbouring Landowners		

4 MOTIVATION FOR THE PROPOSED PROJECT

4.1 Motivation for the proposed project from a national perspective

The diamond industry is an international trade and one that involves a number of processes between the mining and extraction of the rough product, through to the polished diamond jewellery of the retail sector. The value of the industry is primarily dependent on the consumers' demand.

Over the past five years, the consumer demand for diamonds has shown positive nominal US Dollar (USD) growth, with annual growth of almost 5 % from 2008 to 2013. The value of diamond production was USD 14.09 billion in 2013, of which rough diamond production was an estimated 146 million carats. South Africa was the fifth biggest producing country, with its production increasing with 15% to a value of USD 1.19 billion.

The production from Remhoogte has an average stone size in excess of two carats, which being predominantly made of gem and near-gem quality, will likely have a current average value of more than USD 2 000 per carat. The mining project will employ a total of 185 people and invest a total of R 475 000 in Human Resource development, R 600 000 in Infrastructure Development Projects, R 100 000 in Sustainable local economic development and R 220 000 in the creation of Small and Medium Enterprises

5 CONSIDERATION OF ALTERNATIVES

The consideration of alternatives is a critical component of the EIA process, where an appropriate range of alternatives require consideration whilst achieving the desired objective of the proposed project. In order to ensure that the proposed development enables sustainable development, a number of feasible options must be explored. The various alternatives were assessed in terms of logistical practicality, environmental acceptability and economic feasibility. Alternatives for the locality of the mining operation do not form part of the discussion as the location of the mine is determined by the geological location of the mineral resource.

5.1 Land use

No specialist comparative land use assessments were conducted, but a soil and land capability evaluation determined that the mining area has low agricultural potential. The size and depth of the deposit has been determined by means of an extensive exploration programme over a period of years. Therefore mining land has been determined as the most feasible alternative. Furthermore, historical diggings have deteriorated the grazing potential and the carrying capacity. However, to ensure that the grazing use of the farms is not permanently lost due to mining activities, the mine will promote rehabilitation strategies to ensure that open pits are backfilled. There will be infield screening to ensure that all oversize material is deposited back into the pits. This material will be covered with the overburden (where available), and topsoil that has been previously put aside for this purpose. The post-mining land use will be determined so that the farms can still be used for grazing after mine closure.

5.2 Project infrastructure

5.2.1 Mining site

The advantages of undertaking an EIA for a Mining Right Application, is that it allows for the strategic placement of mine infrastructure by incorporating mining project demands, environmental sensitivities and IAP concerns, as identified during the EIA process. Thus, the mining site location is based on proximity to the access roads, proximity to the areas earmarked for mining and limited additional impact on the environment. This renders the consideration of further alternative locations in terms of the mine site location, other than the mine residue deposits, unnecessary.

5.2.2 Fuel storage tanks

Alternatives for fuel storage include surface storage, underground storage and the storage of fuel in mobile tanks with a metal bund wall. Underground storage has an adverse negative pollution potential, because it is not easy to monitor leakages. Remediation measures are also not as effective as compared to surface storage tanks. Mobile tanks are the most viable option for infield screening activities.

5.2.3 Water use

The temporary transfer of agricultural water from the farm Middelwater was considered. This farm is currently in a planning phase and therefore not utilising their allocated agricultural water. However, a pipeline was considered to be the best long term option. Therefore, a pipeline route was designed based on the principle of minimum impacts to the environment and to avoid the disturbance of graves (**Figure 25**). This pipeline utilises the current road reserve and thereby minimises the footprint of the operation.

5.2.4 Mine residue dam

Two alternative localities were considered for the mine residue dam and a risk assessment was completed following the SIMRAC Guidelines.

An area east of the mining offices complex was deemed undesirable, mainly because it lies in close proximity to the farm workers' accommodation; thereby endangers wandering people. The current locality of the mine residue dam (**Figure 28**) was selected based on the following considerations:

- The locality is already mined out
- It is within reach (1000 m) of the treatment plant
- It is situated near the access road to the mine
- No underlying ore bodies or geological discontinuities
- No geomorphological impacts
- No structures, dwellings or other points of risk on down-stream side
- Convenient material nearby for construction of dam
- Top soil from the treatment process will be available for final rehabilitation

5.3 Proceed with the no-go option

5.3.1 Land use

The current land use is grazing, with a low stocking rate for the region. If the mining operation does not continue, the farming of sheep and game will persist. The most significant activity associated with grazing is the provision of water. This could have a potential impact on the existing pans and ground water resource. EP 1 is the only pan that provides water for most parts of the year, while the other pans are seasonal and not linked to any drainage lines. Therefore alternative water sources are needed. Existing boreholes will be used as a substitute to provide water for animals. The mining operation will not abstract any ground water, while this alternative land use will require the use of ground water.

Cumulative impacts associated to grazing include overgrazing, with a potential of desertification.

5.3.2 Socio-economy

The Remhoogte project plan is to employ a total of 185 people. The non-approval if this mining operation would impact negatively on the employment rate for the region and the families who are likely to benefit from the positive employment opportunities. Simultaneously, it may have a negative effect on the economy of South Africa and the diamond industry as a whole.

Furthermore, the mining operation has committed to invest a total of R 475 000 in Human Resource development, R 600 000 in Infrastructure Development Projects, R 100 000 in Sustainable local economic development and R 220 000 in the creation of Small and Medium Enterprises. If the mining operation does not continue, these investments will be lost.

5.3.3 Biodiversity

The implementation of the Remhoogte mine will have a potential impact on the biodiversity through removal of indigenous vegetation and destruction of habitats. If no mining activities were to continue, the status quo would apply and no damage would accrue to the environment. It must be added, however, that the mine intends to conduct continuous rehabilitation on all areas where vegetation is cleared, as well as on mine residue deposits.

5.3.4 Heritage and cultural resources

In the event that the mining operation does not proceed, the heritage resources will remain as is. The protection and preservation of these resources are therefore not guaranteed. However, if the mining operation is approved, the heritage resources will be protected through the demarcation of no-go zones and fencing off of graves.

6 LEGISLATIVE FRAMEWORK

The aim of this component of the report is to provide a brief overview of the pertinent policies as well as legal and administrative requirements applicable to the mining operation.

6.1 Environmental Impact Assessment Requirements

The Constitution of South Africa

The mandate and directives for sustainable and participative local government are embodied in the 1996 Constitution of the Republic of South Africa. Chapter 2 of the Constitution states that everyone has the right to:

(a) an environment that is not harmful to their health or well-being

(b) have the environment protected, through reasonable legislative and other measures that

(i) Prevent pollution and degradation;

(ii) Promote conservation; and

(iii) Secure ecologically sustainable development and the use of natural resources while promoting justifiable economic and social development.

The Minerals and Petroleum Resource Development Act (MPRDA), 2002 (Act No 28 of 2002)

Mining operations can only commence once Pioneer Minerals has received authorisation from the Department of Minerals Resources (DMR) in terms of their Mining Right application. An Environmental Impact Assessment (EIA) and Environmental Management Programme (EMP) for the Remhoogte operation, as required in terms of section 39(1) of the Act, are required as part of the application for a Mining Right. The following issues require consideration whilst compiling the EIA:

- The objects of the MPRDA include giving effect to Section 24 of the Constitution by ensuring that the Nation's mineral and petroleum resources are developed in an orderly and ecologically sustainable manner while promoting justifiable social and economic development. (Section 2(h) of the MPRDA);

- Any prospecting or mining operation must be conducted in accordance with generally accepted principles of sustainable development by integrating social, economic, and environmental factors into the planning and implementation of mining projects, in order to ensure that exploitation of mineral resources serves present and future generations. (Section 37 (2) of the MPRDA);

- The principles set out in Section 2 of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) serve as guidelines for the interpretation, administration and implementation of the environmental requirements of the MPRDA (Section 37 (1) (b) of the MPRDA);

- Section 38(1) (a) of the MPRDA requires that effect be given to the general objectives of integrated environmental management laid down in the NEMA. Integrated environmental management (IEM) is a philosophy, which prescribes a code of practice for ensuring that environmental considerations are fully integrated into all stages of the development process in order to achieve a desirable balance between conservation and development.

- The required determination of a quantum of the financial provision as referred to in regulation 54 of the MPRDA, does not detract from the need for the EMP to identify all the environmental costs necessary to evaluate the achievement of the sustainable development objectives of the MPRDA. The EMP is, therefore, not merely a rehabilitation plan that identifies a quantum for financial provision, but rather a comprehensive programme that identifies all the costs necessary to inform the evaluation of the planning and implementation of a mining project.

- The EMP to be submitted is not limited to but must inter alia include the requirements of regulation 51 of the MPRDA. For instance, where regulation 51 (a) (ii) refers to the management of identified environmental impacts, and regulation 51 (b) (ii) refers to measures for the prevention, management and remediation of each environmental impact, these clearly must be understood in the context of the NEMA where the general objectives of IEM include ensuring that the effects of activities on the environment receive adequate

consideration before actions are taken in connection with them. This clearly requires a description of the mining project that lists each activity pertaining to the mining project, in order that each such activity can be assessed.

-

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

NEMA serves as a framework and provides general principles and guidelines, which must be adhered to. In accordance with NEMA's principles, development must be socially, environmentally and economically sustainable. NEMA contains two key concepts:

- The concept of needs, in particular the essential needs of the world's poor, to which overriding priority should be given, and
- The idea of limitations imposed by the state of technology and social organisation on the environment's ability to meet present and future needs.

(4) (a) Sustainable development requires the consideration of all relevant factors including the following:

(i) Disturbance of ecosystems and loss of biological diversity are avoided, or where they cannot be altogether avoided, are minimised and remedied;

(ii) Pollution and degradation of the environment are avoided, or, where they cannot be altogether avoided, are minimised and remedied;

(iii) Disturbance of landscapes and sites that constitute the nation's cultural heritage is avoided or where it cannot be altogether avoided, is minimised and remedied;

(iv) Waste is avoided or where it cannot be altogether avoided, minimised and reused or recycled where possible and otherwise disposed of in a responsible manner;

(v) Use and exploitation of non-renewable natural resources is responsible, equitable and considers the consequences of the depletion of the resource; and

(vi) Development, use and exploitation of renewable resources and the ecosystems, of which they are part, do not exceed the level or 'critical limits' beyond which their integrity is jeopardised.

The Remhoogte mine involves the following listed activities as stipulated in the EIA regulations as promulgated in terms of the NEMA:

The number and date of the relevant notice:	Activity No (s) (in terms of the relevant notice):	Listed activities described as per project description
Government Notice 1 Regulation 983 of 2014	9	The construction of a 4.37 km pipeline for the bulk transportation of water from the Orange River.
	14	The construction of three diesel storage facilities, with a combined capacity of 87 m^3.
	19	The excavation of a gulley along the banks of the Orange River in order to install a pipeline for water abstraction. Previous mining of endorheic pans on the mining area has occurred but has ceased and the remaining pans is excluded from mining.
	24	The development of roads with a width of 15 meters.
	56	The expansion of roads to material sites mined will continuously take place in order to gain access to these areas.
Government Notice 2 Regulation 984 of 2014	6	The mining operations require a Water Use License as well as a mining right.
	15	The mining operation will involve the clearing of more than 20 hectares.
	16	The slimes dam will have a final damwall height of 5 meters.
	17	The mining operations is in possession of a mining right.
	21	The mining operations include the primary processing of diamond mineral resources.

National Environmental Management: Biodiversity Act (NEMBA) (Act No. 10 of 2004)

NEMBA provides for the management and conservation of South Africa's biodiversity within the framework of NEMA; the protection of species and ecosystems that warrant national protection; the sustainable use of indigenous biological resources; the fair and equitable sharing of benefits arising from bio-prospecting involving indigenous biological resources; the establishment and functions of a South African National Biodiversity Institute; and for matters connected therewith.

As part of its implementation strategy, the National Spatial Biodiversity Assessment (NSBA) was developed. The NSBA (2005) classifies areas as worthy of protection based on biophysical characteristics, which are ranked according to priority levels. The approach used for biodiversity planning is systematic and entails the following principles:

- The need to conserve a representative sample of biodiversity pattern, such as species and habitats (the principle of representation);
- The need to conserve the ecological and evolutionary processes that allow biodiversity to persist over time (the principle persistence); and
- The need to set quantitative biodiversity targets that quantifies the degree of conservation required for each biodiversity feature in order to maintain functioning landscape and seascapes.

An important feature of this is focussing on the conservation of ecosystems as opposed to that of individual species. If the ecosystem is conserved, the individual species will also be included.
Furthermore, for the Remhoogte mine, the following section in Chapter 5 of NEMBA is also relevant:
Section 22(1): In addition to those activities defined as restricted activities in the Act, the following activities are prescribed as restricted activities -

(a) Allowing any specimen of an alien or listed invasive species to grow, breed or multiply;
(b) Allowing the movement or spread of a specimen of an alien or listed invasive species;
(c) Releasing a specimen of an alien or listed invasive species.

Conservation of Agricultural Resources Act (CARA) (Act 5.8 No. 43 of 1983

The purpose of this Act is to provide for control over the utilization of the natural agricultural resources of the Republic in order to promote the conservation of the soil, the water sources and the vegetation and the combating of weeds and invader plants; and for matters connected therewith. In order to achieve the objects of this Act the Minister may prescribe control measures which shall be complied with by land users to whom they apply. Such control measures may relate to:

- The cultivation of virgin soil;
- The utilization and protection of land which is cultivated;
- The irrigation of land;
- The prevention or control of waterlogging or salination of land;
- The utilization and protection of vleis, marshes, water sponges, water courses and water sources;
- The regulating of the flow pattern of run-off water;
- The utilization and protection of the vegetation;

- The prevention and control of veld fires;
- The control of weeds and invader plants;
- The restoration or reclamation of eroded land or land which is otherwise disturbed;
- The protection of water sources against pollution on account of farming practices;
- The construction, maintenance, alteration or removal of soil conservation works or other structures on land; and
- Any other matter which the Minister may deem necessary in order that the objects of this Act may be achieved.
-

National Water Act (NWA), 1998 (Act No. 36 of 1998)

The NWA guides the management of water in South Africa as a common resource. The Act aims to regulate the use of water and activities, which may impact on water resources through the categorisation of 'listed water uses' encompassing water extraction, flow attenuation within catchments as well as the potential contamination of water resources, where Department of Water Affairs is the administering body in this regard. In terms of the Remhoogte mine, Section 21 of the National Water Act defines the listed activities for the use of water as follows:

(a) Taking water from a water resource;
(b) Storing water;
(g) Disposing of waste in a manner which may detrimentally impact on a water resource

National Forest Act, 1998 (Act No. 84 of 1998)

The tree *Boscia albitrunca* (commonly known as Shepherd's tree) is protected in terms of Section 21 of the National Forest Act, 1998 (Act No. 84 of 1998). According to Section 15 of the above-mentioned Act, protected trees cannot be cut, destroyed, damaged or removed without a permit granted by the Minister of the Department of Agriculture, Forestry and Fisheries.

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

The NCNCA aims to provide for the sustainable utilisation of wild animals, aquatic biota and plants. For the Remhoogte mine, the following sections of the NCNCA is relevant:

Section 3(a) and 4(a): no person may, without a permit by any means hunt, kill, poison, capture, disturb, or injure any protected or specially protected animals.
Section 12 (1): no person may, on a land of which he or she is not the owner, hunt a wild animal without the written permission from the landowner.
Section 49 (1) and 50 (1): no person may, without a permit pick, transport, possess, or trade in a specimen of a specially protected (Schedule 1) or protected (Schedule 2) plants.
Section 51(2): no person may, without a permit, pick an indigenous plant (Schedule 3) in such manner that it constitutes large-scale harvesting.

National Heritage Resources Act (NHA) (Act 5.9 No. 25 of 1999)

The NHRA legislates the necessity for cultural and heritage impact assessment in areas earmarked for development, which exceed 0.5 ha or linear development exceeding 300 metres in length. The Act makes provision for the potential destruction to existing sites, pending the archaeologist's recommendations through permitting procedures. Permits are administered by the South African Heritage Resources Agency (SAHRA).

6.2 Other relevant legislation

- National Environmental Management: Air Quality Act (Act No. 39 of 2004);
- The Mine Health and Safety Act (Act No. 29 of 1996).

7 DETAILED DESCRIPTION OF THE PROJECT

The mining operation is based on alluvial diamond mine reserves which will be mined by means of an opencast method using heavy earthmoving machinery and occasional blasting. The ore will then be treated through a 4 pan plant. The diamondiferous ore will be screened, scrubbed, crushed and processed on site. The rough diamond product will then be removed from site for further beneficiation.

Machinery includes the following:

- Hydraulic excavators
- Articulated dump trucks
- Front End Loaders
- Bulldozers
- Grader
- Water truck

7.1 Target Minerals

Generally, diamond bearing mineral deposit can be subdivided into Rooikoppie-type gravels, basal gravels and suspended gravels. Mining of all three types of gravel have been scheduled for this operation and were further subdivided into mine blocks based on results from the exploration phase.

The mine plan will focus on 7.7 million m3 of the Rooikoppie gravel resource and 8 million m3 of the suspended and basal gravels. A total of 960 000 m3 of diamondiferous ore will be hauled to the plant, and treated per year. The average expected carat production is 8 640 carats per year. The ore body is considered a single deposit and will be mined according to an overall mining schedule guided by grade, mining costs and commodity price fluctuation.

7.2 Mining methodology

7.2.1 Mineral processing

The orebody consists of diamondiferous alluvial gravels that are mined by means of quarrying, i.e. shallow, open pit mining, by means of a hydraulic shovel and excavator. The excavator has a capacity of 5 tonnes

and articulated trucks, that of 25 to 30 tonnes. For basal gravels, blasting will required. All blasting activities are performed by AECI.

Overburden is stripped where required and the underlying gravels are excavated, screened and treated through a combination of Pan Plants and Bourevestnik X-Ray machines (**Figure 28**). No ore processing reagents are required or used in the treatment of the ore.

Prior to treatment through the plant, the gravel feed is de-sanded at 4.5 mm. Materials of +4.5 mm – 22 mm in size is treated through the 4 Pan Plants. The +22 mm – 50 mm material is treated through a Bourevestnik X-Ray Machine, and the concentrate from the pan plants is also treated through the Bourevestnik X-Ray (**Figure 28**).

7.2.2 Mine residue disposal

The mine residue disposal facility was excavated into the ground. The walls consist of solid calcrete, at least 50 m thick, and up to several hundred meters in places. There is no surface wall, except for a safety berm to prevent vehicles from driving into it. The dam is fenced.

The residue (tailings) from the pan plant is pumped onto two de-watering screens where the remaining -2 mm sand is removed. Only this small amount of – 2mm sand, still left in the gravel after the de-sanding process, is transported by means of pumping and deposition onto the beaches of the mine residue disposal dam. Therefore, all the -4.5 mm material is screened out before the gravel is treated through the plant. The porrel for the plant is supplied through a re-circulating, closed loop system. Only approximately 0.25% of the ROM material is fed to the mine residue disposal dam. The slimes thus consist of muddy water with minimum solids. This resulting slimes dam thus requires a capacity several orders of magnitude smaller than historical slimes dams. **Table 12** provides calculations of the rate of rise of the Mine residue disposal dam. Once the current excavation is full, another similar excavation will be used.

Table 12: Calculations of the rate of rise of the Mine Residue Disposal dam (MRD).

Production	0.25% to MRD	Area of MRD	Volume of MRD	Rise per year	Life of MRD
200 000 T/m (ROM)	500 m^3 / month	6000 m^3	20 000 m^3	1m / yr	3.3 yrs

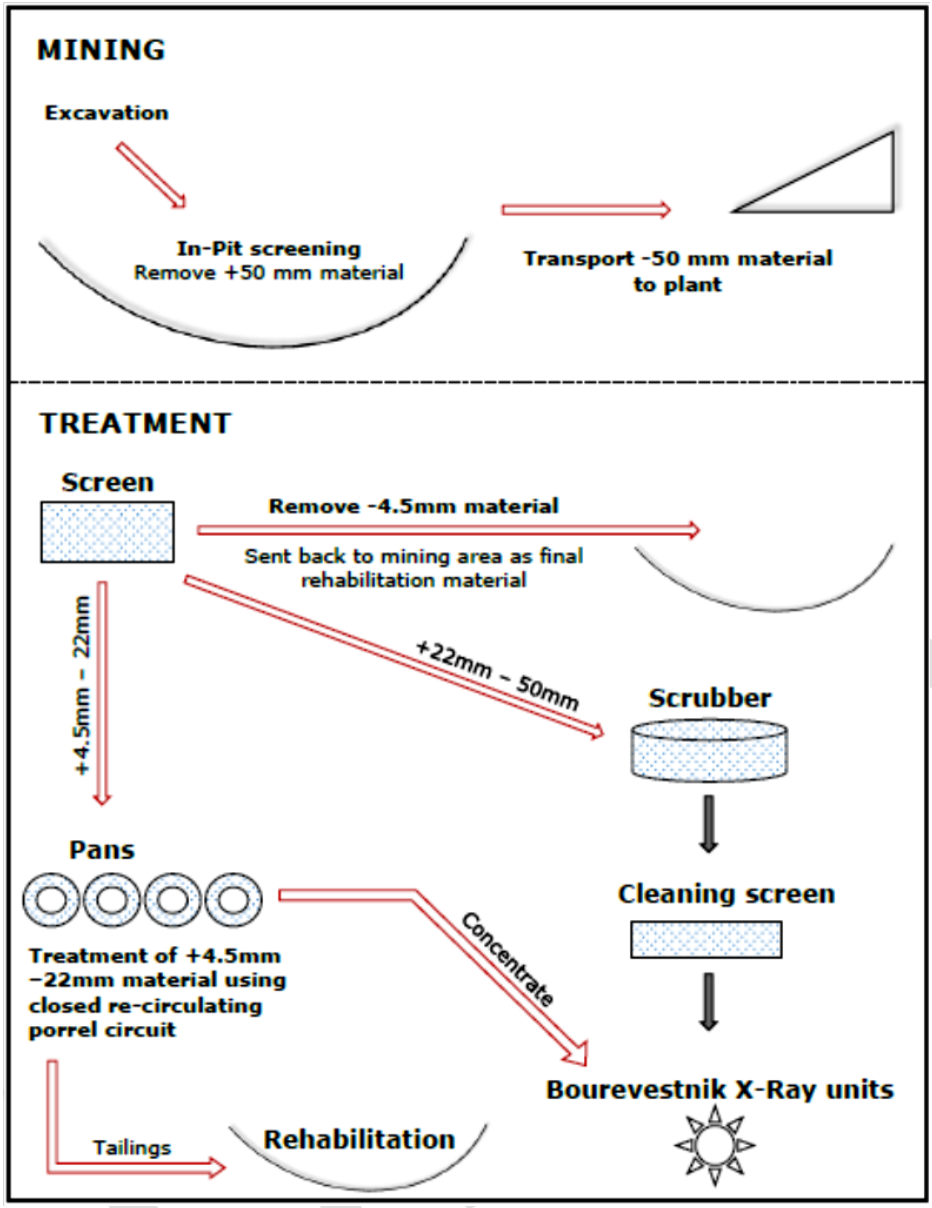

Figure 25: Typical mineral processing procedures at Remhoogte.

7.2.3 Rehabilitation

Rehabilitation strategies were developed to ensure that the visual character of the area is not compromised and that the post mining land use is beneficial to the land owner. The mining method involves a continuous backfilling open cast mining process. Topsoil will be stripped and hauled to already backfilled areas. If there are no backfilled areas available immediately, topsoil be temporarily stockpiled on the surface for later use. No materials will be permanently dumped on the surface. Washed and screened material will be backfilled

into the already mined out areas and will be covered with the overburden and topsoil that has been allocated for this purpose.

7.3 Associated infrastructure

The layout of surface infrastructure at the Remhoogte mining site is shown in **Figure 28**.

7.3.1 Fuel storage

There are three diesel storage facilities at the Remhoogte site. These consist of diesel tanks contained in a bund wall, each with a capacity of 29 m3.

7.3.2 Power

Electricity to the plant site area is supplied by 32 kV Eskom distribution power lines routed from a nearby Eskom substation. An agreement to draw 750 kVa from the power grid has been signed with Eskom. Electrical reticulation will be established from a transformer to the mining infrastructure, as required. A portable generator will be provided on site as a back-up electricity supply.

7.3.3 Water

Mineral processing water will be abstracted from the Orange River by means of a 4.37 km pipeline (**Figure 29**) at 64 000 l/hr using a 37kW pump. The water will be pumped directly to a reservoir; which consists of an old dumper truck bin with the capacity of 28 m3. This reservoir will be used to maintain water routing and requirements on the mining site. From the reservoir water is pumped to where it is required on the plant. Water for re-use on the plant is collected from the mine residue deposit return water dam.

The conceptual water balance diagram is presented in **Figure 26**. Pioneer Minerals have already applied for water use licences from the Department of Water Affairs as required by the National Water Act (Act No. 36 of 1998) for the following:

- Taking water from a water source, according to Section 21 (a) of the Act;
- Storing water, according to Section 21(b) of the Act;
- Waste discharge related water use, according to Section 21 (g) of Act.

The reference number for this application, as provided by DWA is: 27/2/2/D471/1/1/9.

7.3.4 Waste management

A waste inventory is presented in **Table 13**, which includes hazardous waste, general waste and industrial waste generated at the Remhoogte mine.

General domestic waste is disposed at the Municipal facilities in Prieska. Used oil and other products are collected by Oilcol. There are two ablution facilities on site, each with a French drain capacity of 20m3. Two scrap yards are found on the site. The scrap yards are fenced and used for the temporary storage of materials that are salvaged as needed by the mining operation.

No pollution control dams have been established at the Remhoogte mine, because the processing and treatment are a chemical free process. There are no facilities for the treatment of polluted water, other than the mine residue dam, which act as settling dam, and clean water will be pumped back into the process water once the silt has settled out.

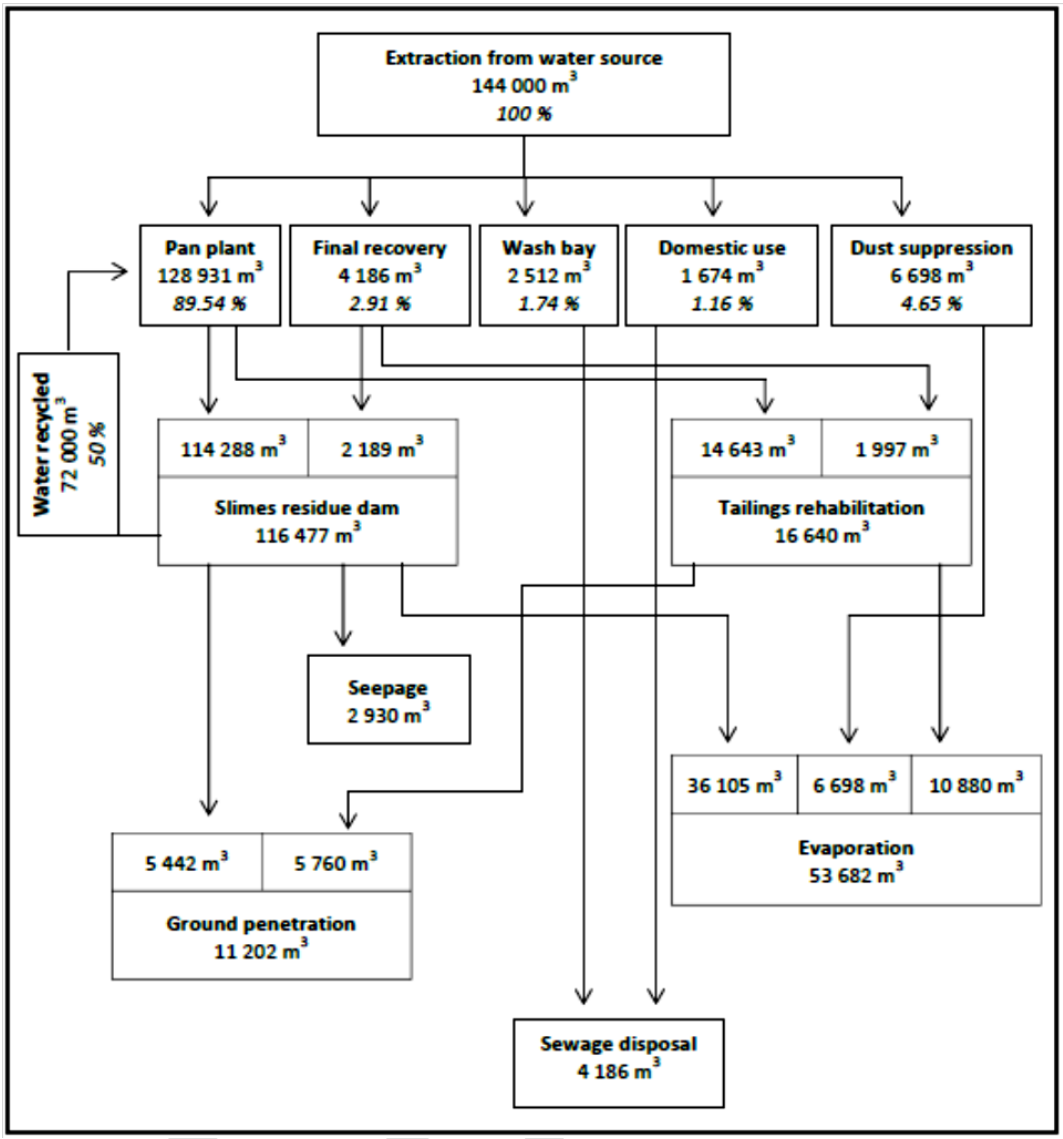

Figure 26: The conceptual water balance diagram for water use at Remhoogte Mine.

Table 13: Waste types identified at the Remhoogte Mine.

Activity area	Waste types																
	Wastewater	Garden waste	Sewage	Food waste	Metal	Plastic/PVC	Rubber	Glass	Wood	Paper/Cardboard	Construction waste	Contaminated rags	Medical waste	Electronic waste	PPE waste	Used oil/filters	Waste rock/gravel
Office			X		X		X	X	X	X	X				X		
Stores			X		X	X	X	X	X	X	X	X	X			X	X
Workshop																X	X
Screening plant				X												X	X
Recovery plant				X								X	X				
Fuel storage				X									X			X	X
Ablutions			X								X				X		
Open areas		X															
Waste storage		X				X	X	X	X	X	X			X	X		
Mining pits																	X

7.3.5 Access roads

The mining site is located in the vicinity of the following existing roads:

Road R357: This provincial road traversing in a north-east and south-west direction in the vicinity of the site. The road links the towns of Prieska in the south-west with Douglas in the north-east.

Muishoek Road: This municipal road traversing in a north-south direction to the west of the site. The road is surfaced from its intersection with the R357 in the south to the Brak River bridge in the north.

Rooisloot/Remhoogte Farm Access Road: This farm access road intersecting with the R357 in the east and Muishoek Road in the west. The road traverses in a north-south direction and bisects the site.
Activities associated with the Remhoogte mine that is expected to make use of these roads include:

- the transportation of mining personnel to and from the site
- delivery of supplies and materials
- the transportation of the rough and uncut diamonds for further beneficiation.
-

These transport operations will make use of passenger vehicles, light delivery vehicles, security/armoured vehicles and mini-busses/busses and very limited heavy vehicles, if any.

7.3.6 Haul roads

Access to the open pits will be obtained by low angle ramps, while access to the plant site, river pump station and slimes dam will be by means of existing roads that were rationalised for the mining operation. Haul roads are approximately 15 m wide.

7.3.7 Mining schedule

The ore body will be mined according to a mine block design (**Figure 27**), which were determined by bulk sampling done on the application area and were defined by utilising property boundaries and geological parameters, i.e. bedrock features, gravel type and thickness, and bedrock elevation. The mining schedule and development phases are provided in **Table 14** and **Table 15** respectively. The overall mining schedule is guided by grade, mining costs and commodity price fluctuation and therefore it may have to be adapted from time to time as determined by these factors.
Expected life of mine for Pioneer Minerals at the Remhoogte Mine, based on the planned scale of operations and production rate, current mining costs and current diamond prices, is 8 years, ending 2019. Further drilling and mining exploration within the farm could bring in additional gravel volume; thereby extending life of mine.

Table 14: The proposed mining schedule for the Remhoogte mining operation.

Year	Ore type	Volume (m^3)
Year 1	Rooikoppie	960 000
Year 2	Rooikoppie, Susupended and basal gravel	960 000
Year 3	Rooikoppie, Susupended and basal gravel	960 000
Year 4	Rooikoppie, Susupended and basal gravel	960 000
Year 5	Rooikoppie, Susupended and basal gravel	960 000
Year 6	Rooikoppie, Susupended and basal gravel	960 000
Year 7	Rooikoppie, Susupended and basal gravel	960 000
Year 8	Rooikoppie, Susupended and basal gravel	960 000
Total		**7 680 000**

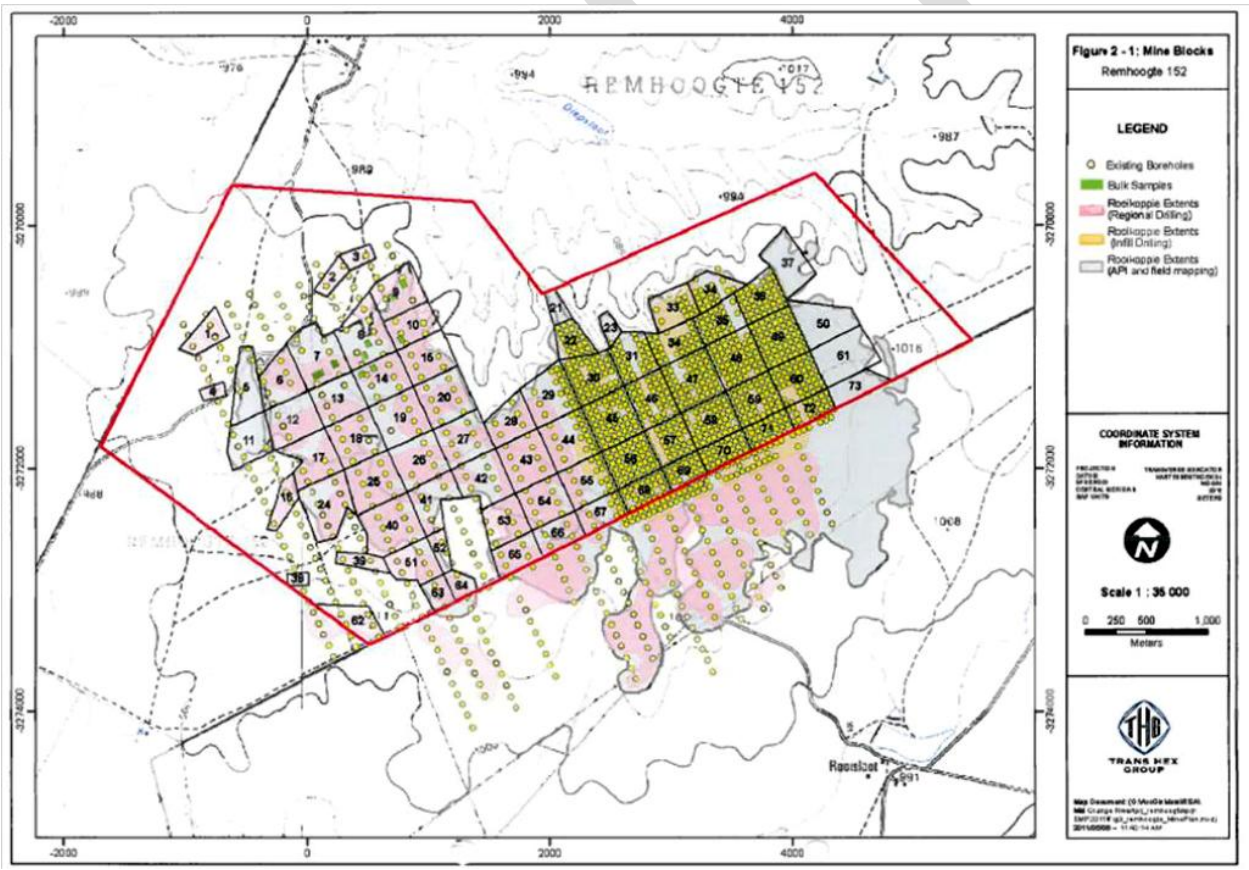

Figure 27: The mine block design for the Remhoogte operation.

Table 15: Development phases for the mining operation at Remhoogte.

Construction Phase		Operational Phase	Decommissioning Phase	Closure and post closure
Clearing of vegetation		Operation of structures	Removal of infrastructure	Ongoing assessment and maintenenace of disturbed areas
Removal and topsoil stockpiling		Monitoring	Rehabilitation of all remaining disturbed areas	Managing post closure / residual impacts
Construction of haul roads		Operation of workshops, diesel facilities, all ancillary infrastructure	Dismantling and reclamation of infrastructure	Monitoring
General and hazardous waste storage facilities		Use of potable water and recycling	Backfilling, shaping, top-soiling	Closure application
Construction of offices water pipelines, sewage structures and workshops, salvage yards and scrap yards		Generation, handling, storage and disposal of waste		
Pump installation		Mine block development		
Plant establishment		Excavation and tramming		
IAP consultation		Blasting		
Rehabilitation of disturbed areas during construction		Infield screening		
Sanitation provision		Ongoing rehabilitation		
Power reticulation		Ongoing watering of roads		
Time frames	**2011 - 2012**	**2012 - 2019**	**2018 - 2019**	**2019**

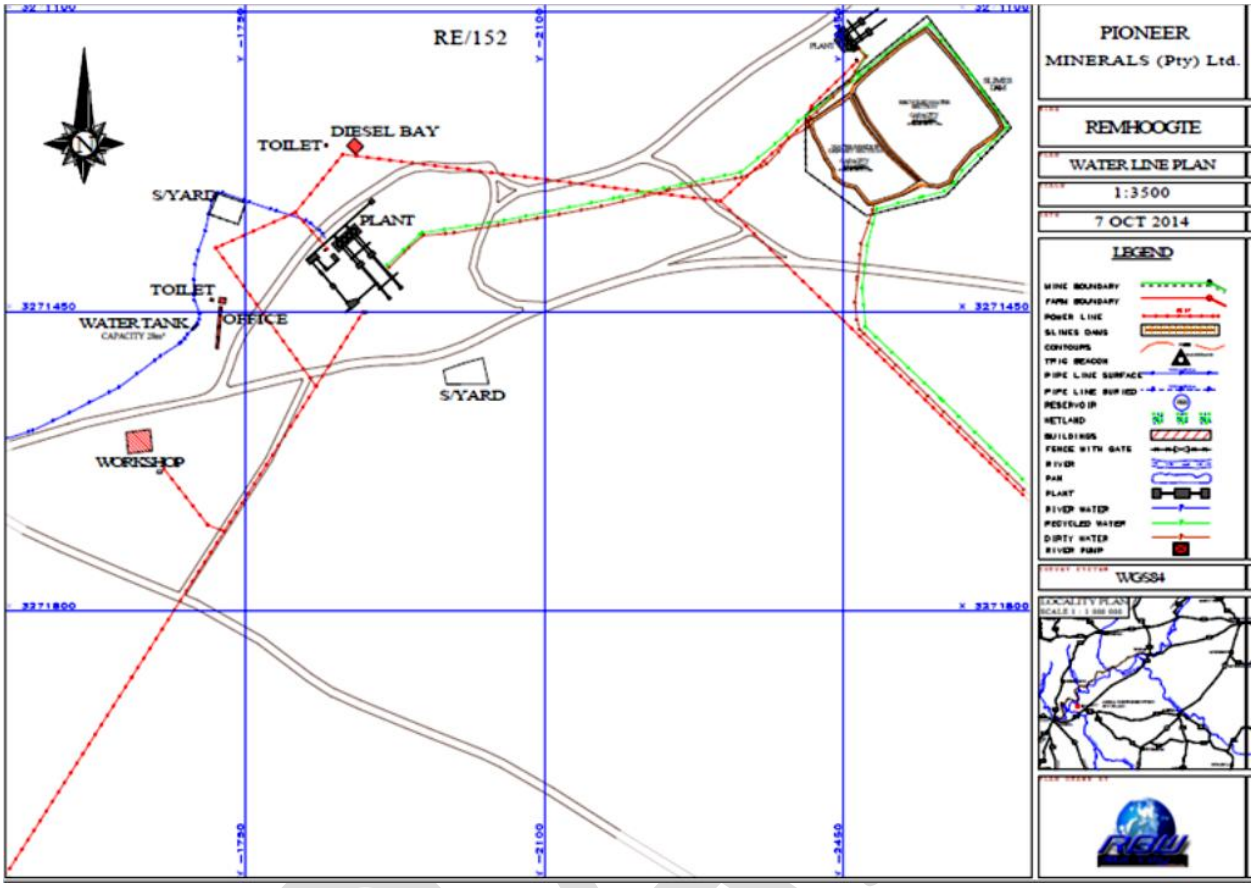

Figure 28: A map indicating the location of mine infrastructure at the Remhoogte mine.

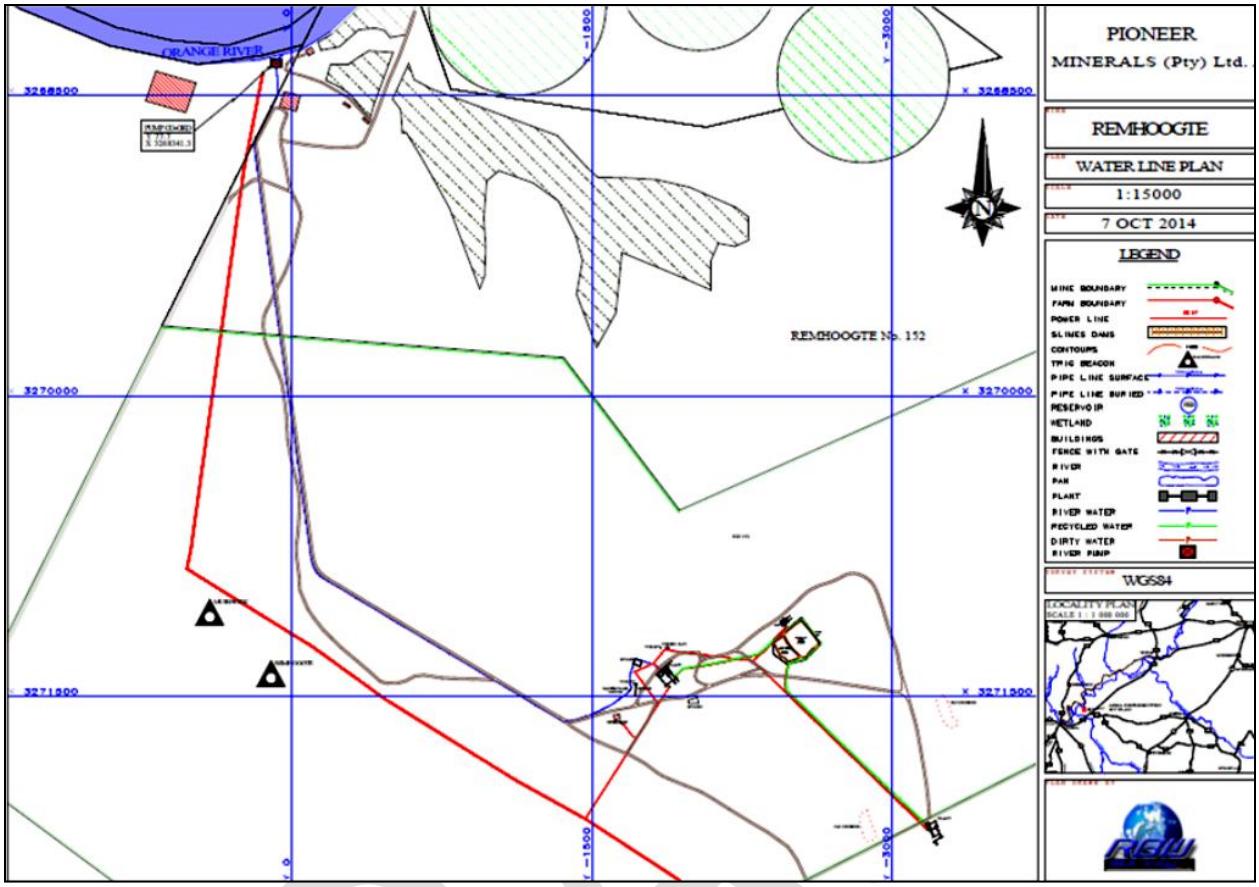

Figure 29: A map indicating the pipeline route (in blue) from the Orange River to the plant site.

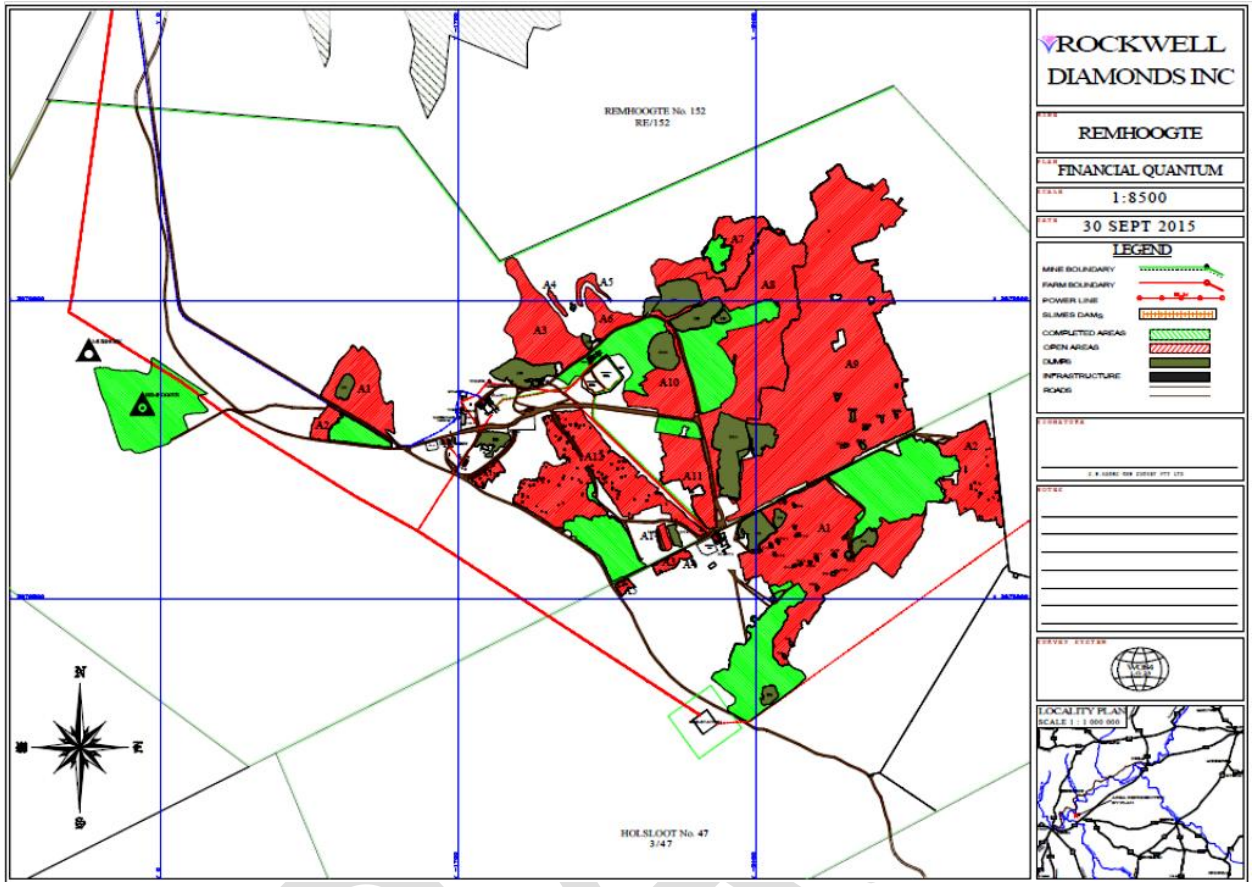

Figure 30: Map indicating the entire mining area and indicates cleared (red) and rehabilitated (green) area.

8 ENVIRONMENTAL IMPACT ASSESSMENT

This section provides a detailed analysis of the impacts associated with the Remhoogte mine. The impacts are assessed in terms of the relevant environmental aspects and each impact is associated with an outline of specific mitigation measures, which with proper implementation, monitoring and auditing, will serve to reduce the significance of the impact.

8.1 Key environmental impacts

A brief overview of the key environmental impacts is listed in **Table 16**.

Table 17: Key potential impacts identified in terms of the Remhoogte mining operation.

Environmental factor	Environmental objective	Potential impacts	Potential management
Physical			
Geology and mineral resource	To ensure efficient extraction of the diamond resource.	Sterilisation of the mineral resource.	Ensure that optimal use is made of the available mineral resource.
Topography	To limit the alteration of the surrounding topography.	Changes to surface topography due to topsoil removal, excavations, blasting, placement of infrastructure and development of mine residue deposits.	Backfill all excavations continuously and employ effective rehabilitation strategies to restore surface topography of excavations and plant site and to stabilise the mine residue deposit.
Soils	To manage and preserve sensitive soil types.	Soil erosion by water and wind on disturbed and exposed soils; potential for dust production and soil microbial degradation; potential contamination of soils due to spillages.	Employ appropriate management strategies to preserve soil resources.
Land capability	To prevent the loss of land capability.	Loss of land capability through topsoil removal, disturbances and loss of soil fertility.	Employ appropriate rehabilitation strategies to restore land capability.
Land use	To ensure the continuation of economically viable land use.	Loss of land use due to poor placement of surface infrastructure and	Carefully plan the placement of infrastructure and employ rehabilitation strategies to restore land capability.

		ineffective rehabilitation.	
Ground water	To ensure that the surrounding ground water resources are not adversely affected to the detriment of the health and welfare of nearby communities; and to ensure suitable quality of ground water resources.	Pollution of underground water sources.	Construction of measures to prevent seepage into the groundwater by biological and engineering means. Implementation of the necessary management programs to ensure the integrity of groundwater resources.
Surface water	To ensure that the surrounding surface water resources are not adversely affected to the detriment of the health and welfare of nearby communities; and to ensure suitable quantity and quality of ground water resources.	Deterioration in water quality through spillages.	Frequent monitoring of surface water resources. Prevention of overspill of mine associated activities into the surrounding streams or rivers. Implementation of the necessary management programs to ensure the integrity of surface water resources.
Storm water	To contain soils and materials within demarcated areas and prevent contamination of storm water runoff.	Erosion of soils and materials during rainfall events; contamination of storm water runoff.	Implementation of the necessary management programs to control storm water runoff.
Indigenous flora	To minimise the loss of natural vegetation.	The clearance of vegetation ; potential loss of floral species with conservation value; potential loss of ecosystem function.	Prevention of overspill of mine associated activities onto the surrounding ecological environment. Employ proper protection and rehabilitation strategies.
Alien invasive plants	To prevent the proliferation of alien invasive plant species.	Proliferation of alien invasive plant species.	Eradicate and control the spread of alien invasive species.
Fauna	To protect the wildlife and bird species.	Displacement of faunal species.	Prevention of overspill of mine associated activities into the surrounding ecological environment. Employ proper protection strategies.
Habitat	To protect the natural habitat of wildlife and bird species.	The loss, damage and fragmentation of floral and faunal habitats; potential loss of ecosystem function.	Prevention of overspill of mine associated activities onto the surrounding ecological environment. Employ proper protection and rehabilitation strategies.
Air quality	To maintain visual integrity;	Sources of atmospheric	Effective soil management,

	and to minimise the extent of the generation of dust in order to minimise the aspect of nuisance and health impacts to sensitive receptors.	emission associated with the mining operation are likely to include fugitive dust from materials handling operations, wind erosion of stockpiles, and vehicle entrainment of road dust.	identification of the required control efficiencies in order to maintain dust generation within acceptable levels.
Social surroundings			
Noise and vibration	To minimise noise and vibration to a level that disturbances felt by the communities are limited.	Increase in continuous noise levels; the disruption of current ambient noise levels; and the disruption of sensitive receptors by means of increased noise and vibration.	Minimise the generation of excessive noise and vibration; Ensure all vehicles and equipment is in a good working order; proper communication and management of blasting activities.
Visual impacts	To reduce the impact on visual quality due to intrusive mine infrastructure, activities and facilities.	Visual impact of the mine infrastructure, excavations, mine residue deposits and waste rock dumps; visibility of dust.	Effective planning of the location of infrastructure and operations to minimise visual impact.
Traffic	To ensure that all traffic generated by the proposed mining development does not negatively impact on existing road networks and infrastructure; to ensure traffic safety.	Potential negative impacts on traffic safety and deterioration of the existing road networks.	Utilise existing access roads, where applicable; implement measures that ensure adherence to traffic rules.
Heritage resources	To preserve the historical and cultural artefacts located on site in compliance with the South African Heritage Resources Act, 1999(Act No 25 of 1999)	The deterioration of sites of cultural and heritage importance.	Preservation of heritage and cultural resources identified within a no go zone; further resources uncovered during mining activities need to be reported to a suitably qualified archaeologists.
Socio-economic	To ensure that the current socio-economic status quo is improved.	**Negative:** Loss of agricultural potential; influx of workers to the area increases health risks and	Application of commitments made in the Social and Labour Plan; implementation of community development programmes.

		loitering (resulting in lack of security and safety); negative impact of employment loss during mine closure. **Positive:** Employment and training opportunities for people in the local community and local contractors; social upliftment and community development programmes, economic benefits.	
Interested and affected parties	To be transparent and practise effective communication; in order to maintain good relationships with all interested and affected parties.	Loos of trust and a good standing relationship between I&AP's and the mining company.	Ensure continuous and transparent communication with I&AP's.

8.2 Assessment methodology

The environmental significance assessment methodology is based on the following determination:

Environmental Significance = Overall Consequence x Overall Likelihood

8.2.1 Determination of Consequence

Consequence analysis is a mixture of quantitative and qualitative information and the outcome can be positive or negative. Several factors can be used to determine consequence. For the purpose of determining the environmental significance in terms of consequence, the following factors were chosen: **Severity/Intensity, Duration and Extent/Spatial Scale.** Each factor is assigned a rating of 1 to 5, as described below and in tables 6, 7, 9 and 10.

Determination of Severity

Severity relates to the nature of the event, aspect or impact to the environment and describes how severe the aspects impact on the biophysical and socio-economic environment.

Table 5**Error! Reference source not found.** will be used to obtain an overall rating for severity, taking into consideration the various criteria.

Table 18: Rating of severity

Type of criteria	Rating				
	1	2	3	4	5
Quantitative	0-20%	21-40%	41-60%	61-80%	81-100%
Qualitative	Insignificant / Non-harmful	Small / Potentially harmful	Significant / Harmful	Great / Very harmful	Disastrous Extremely harmful
Social/ Community response	Acceptable / I&AP satisfied	Slightly tolerable / Possible objections	Intolerable/ Sporadic complaints	Unacceptable / Widespread complaints	Totally unacceptable / Possible legal action
Irreversibility	Very low cost to mitigate/ High potential to mitigate impacts to level of insignificance / Easily reversible	Low cost to mitigate	Substantial cost to mitigate / Potential to mitigate impacts / Potential to reverse impact	High cost to mitigate	Prohibitive cost to mitigate / Little or no mechanism to mitigate impact Irreversible
Biophysical (Air quality, water quantity and quality, waste production, fauna and flora)	Insignificant change / deterioration or disturbance	Moderate change / deterioration or disturbance	Significant change / deterioration or disturbance	Very significant change / deterioration or disturbance	Disastrous change / deterioration or disturbance

Determination of Duration

Duration refers to the amount of time that the environment will be affected by the event, risk or impact, if no intervention e.g. remedial action takes place.

Table 19: Rating of Duration

Rating	Description
1: Low	Almost never / almost impossible
2: Low-Medium	Very seldom / highly unlikely

Rating	Description
3: Medium	Infrequent / unlikely / seldom
4: Medium-High	Often / regularly / likely / possible
5: High	Daily / highly likely / definitely

Determination of Extent/Spatial Scale

Extent refer to the spatial influence of an impact be local (extending only as far as the activity, or will be limited to the site and its immediate surroundings), regional (will have an impact on the region), national (will have an impact on a national scale) or international (impact across international borders).

Table 20: Rating of Extent / Spatial Scale

Rating	Description
1: Low	Immediate, fully contained area
2: Low-Medium	Surrounding area
3: Medium	Within Business Unit area of responsibility
4: Medium-High	Within Mining Boundary area
5: High	Regional, National, International

Determination of Overall Consequence

Overall consequence is determined by adding the factors determined above and summarised below, and then dividing the sum by 4.

Table 21: Example of calculating Overall Consequence

Consequence	Rating
Severity	Example 4
Duration	Example 2
Extent	Example 4
SUBTOTAL	10
TOTAL CONSEQUENCE:(Subtotal divided by 4)	3.3

8.2.2 Likelihood

The determination of likelihood is a combination of Frequency and Probability. Each factor is assigned a rating of 1 to 5, as described below and in Table 9**Error! Reference source not found.** and Table 10.

Determination of Frequency

Frequency refers to how often the specific activity, related to the event, aspect or impact, is undertaken.

Table 22: Rating of frequency

Rating	Description
1: Low	Once a year or once/more during operation/LOM
2: Low-Medium	Once/more in 6 Months
3: Medium	Once/more a Month
4: Medium-High	Once/more a Week
5: High	Daily

Determination of Probability

Probability refers to how often the activity/even or aspect has an impact on the environment.

Table 23: Rating of probability

Rating	Description
1: Low	Almost never / almost impossible
2: Low-Medium	Very seldom / highly unlikely
3: Medium	Infrequent / unlikely / seldom
4: Medium-High	Often / regularly / likely / possible
5: High	Daily / highly likely / definitely

Overall Likelihood

Overall likelihood is calculated by adding the factors determined above and summarised below, and then dividing the sum by 2.

Table 24: Example of calculating the overall likelihood

Consequence	Rating
Frequency	Example 4
Probability	Example 2
SUBTOTAL	6
TOTAL LIKELIHOOD (Subtotal divided by 2)	3

Determination of Overall Environmental Significance

The multiplication of overall consequence with overall likelihood will provide the environmental significance, which is a number that will then fall into a range of LOW, LOW-MEDIUM, MEDIUM, MEDIUM, MEDIUM-HIGH or HIGH, as shown in the table below.

Table 25: Determination of overall environmental significance

Significance or Risk	Low	Low-Moderate	Moderate	Moderate-High	High
Overall Consequence X Overall Likelihood	1 - 4.9	5 - 9.9	10 - 14.9	15 – 19.9	20 - 25

Qualitative description or magnitude of Environmental Significance

This description is qualitative and is an indication of the nature or magnitude of the Environmental Significance. It also guides the prioritisations and decision making process associated with this event, aspect or impact.

Table 26: Description of the environmental significance and the related action required.

Significance	Low	Low-Moderate	Moderate	Moderate-High	High
Impact Magnitude	Impact is of very low order and therefore likely to have very little real effect. Acceptable.	Impact is of low order and therefore likely to have little real effect. Acceptable.	Impact is real, and potentially substantial in relation to other impacts. Can pose a risk to the company	Impact is real and substantial in relation to other impacts. Pose a risk to the company. Unacceptable	Impact is of the highest order possible. Unacceptable. Fatal flaw.
Action Required	Maintain current management measures. Where possible improve.	Maintain current management measures. Implement monitoring and evaluate to determine	Implement monitoring. Investigate mitigation measures and improve management	Improve management measures to reduce risk.	Implement significant mitigation measures or implement alternatives.

		potential increase in risk. Where possible improve	measures to reduce risk, where possible.		

8.3 Environmental Impact Assessment:

8.3.1 Sterilisation of mineral resources

Source of the impact

Construction of infrastructure

Description of the impact

During construction and operation of the mine, there is a possibility of sterilisation of the mineral reserves and resources due to improper placement of infrastructure.

Status of the projected impact

The infrastructure has already been erected on both mining properties. However, care has been taken to establish these on already mined out areas and therefore sterilisation of the mineral resource has not taken place. The impact can therefore be considered as very low.

Significance of the impact

	Severity	Duration	Extent	Consequence	Probability	Frequency	Likelihood	Significance
Before mitigation	2	4	2	2.6	3	2	2.5	6.5
After mitigation	1	4	1	2	1	1	1	2

Mitigation measures:

- Ensure that optimal use is made of the available mineral resource through proper planning.
- The mine blocks should be delineated first and all infrastructure positions should be selected with the main aim of avoiding sterilization of future resources.
- No dumping of materials prior to approval by exploration geologist.

8.3.2 Changes to surface topography

Source of the impact

Development of infrastructure and residue deposits, excavations and blasting.

Description of the impact

The infrastructure and slimes dam will alter the topography by adding features to the landscape. Topsoil removal, excavations and blasting will unearth the natural topography. The impact will be definite.

Status of the projected impact

Large areas has already been excavated for mining purposes. This does alter the topography to some extent. However, excavations are shallow and rehabilitation comprehensive and as a result the alteration to the topography is not considered large. Several areas were also affected by previous mining activities and in these areas topography was already affected before the mining operations by project company. The slimes dam was also already in existing when mining commenced. The impact is considered as moderate.

Significance of the impact

	Severity	Duration	Extent	Consequence	Probability	Frequency	Likelihood	Significance
Before mitigation	4	4	4	4	4	4	4	16
After mitigation	3	4	2	3	3	4	3.5	10.5

Mitigation measures:

- Backfill all excavations continuously.
- Employ effective rehabilitation strategies to restore surface topography of excavations and plant site.
- Stabilise the mine residue deposits.
- All temporary infrastructure will be demolished during closure.

8.3.3 Soil erosion

Source of the impact

Construction of infrastructure; topsoil removal; potential runoff.

Description of the impact

The construction of infrastructure and various facilities in the mining area can result in loss of soil due to erosion. Vegetation will be stripped in preparation for placement of infrastructure and excavations, and therefore the areas will be bare and susceptible to erosion.

The topsoil that is stripped and piled on surrounding areas can be eroded by wind and rain. The soil will be carried away during runoff. The cleared areas will be rehabilitated, but full restoration of soils might only occur over a number of years, subsequent to the re-establishment of vegetation. Therefore the impact will have a moderate severity, throughout the duration of the mine.

Status of the projected impact

Large areas has been cleared of vegetation and topsoil stripped. This leads to a high susceptibility for erosion. However, rehabilitation is done consecutively, the area has a very low rainfall and the mining areas is relatively flat. For these reasons erosion is relatively limited. It must still be taken as a given that a certain amount of erosion (wind or water) is taking place.

Significance of the impact

	Severity	Duration	Extent	Consequence	Probability	Frequency	Likelihood	Significance
Before mitigation	4	3	4	3.6	4	4	4	14.4
After mitigation	3	3	2	2.6	3	4	3.5	9.1

Mitigation measures:

- At no point may plant cover be removed within the no-development zones.
- All attempts must be made to avoid exposure of dispersive soils.
- Re-establishment of plant cover on disturbed areas must take place as soon as possible, once activities in the area have ceased.
- Ground exposure should be minimised in terms of the surface area and duration, wherever possible.

- The mining operation must co-ordinate different activities in order to optimise the utilisation of the excavated trenches and thereby prevent repeated and unnecessary excavations.
- Construction that requires the clearing of large areas of vegetation and excavation should ideally occur during the dry season only.
- Construction during the rainy season (November to March) should be closely monitored and controlled.
- The run-off from the exposed ground should be controlled with the careful placement of flow retarding barriers.
- The soil that is excavated during construction should be stock-piled in layers and protected by berms to prevent erosion.
- All stockpiles must be kept as small as possible, with gentle slopes (18 degrees) in order to avoid excessive erosional induced losses.
- Excavated and stockpiled soil material are to be stored and bermed on the higher lying areas of the footprint area and not in any storm water run-off channels or any other areas where it is likely to cause erosion, or where water would naturally accumulate.
- Stockpiles susceptible to wind erosion are to be covered during windy periods.
- Audits must be carried out at regular intervals to identify areas where erosion is occurring.
- Appropriate remedial action, including the rehabilitation of the eroded areas, must occur.
- Rehabilitation of the erosion channels and gullies.
- The mining operation should avoid land with steep slopes.
- Dust suppression must take place, without compromising the sensitive water balance of the area.
- Linear infrastructure such as roads and pipelines will be inspected at least monthly to check that the associated water management infrastructure is effective in controlling erosion.

8.3.4 Loss of soil fertility

Source of the impact

During the removal of topsoil; stockpiling.

Description of the impact

Improper stockpiling and soil compaction can result in soil sterilisation. Leaching can also occur, resulting in the loss of nutrients.

Status of the projected impact

Currently consecutive rehabilitation is taking place of cleared areas. Topsoil is replaced on backfilled areas. Minimal losses of fertile soil will result from erosion but overall it is anticipated that the impact on the soil fertility will be low.

Significance of the impact

	Severity	Duration	Extent	Consequence	Probability	Frequency	Likelihood	Significance
Before mitigation	3	4	3	3.3	4	4	4	13.2
After mitigation	2	4	3	3	2	3	2.5	7.5

Mitigation measures:

- Topsoil stockpiles must be kept as small as possible in order to prevent compaction and the formation of anaerobic conditions.
- Topsoil must be stockpiled for the shortest possible timeframes in order to ensure that the quality of the topsoil is not impaired.
- Topsoil must not be handled when the moisture content exceeds 12 %.
- Topsoil stockpiles must be kept separate from sub-soils.
- The topsoil should be replaced as soon as possible on to the backfilled areas, thereby allowing for the re-growth of the seed bank contained within the topsoil.

8.3.5 Soil pollution

Source of the impact

Spillage of hazardous material; runoff.

Description of the impact

During the construction and operation of the mine, there is a possibility that equipment might leak oil, thus causing surface spillages. The hydrocarbon soil contamination will render the soil unusual unless they are decontaminated. The storage of fuels on site might have an impact on soil if the tanks that are available on site are not properly monitored and maintained to avoid leakages. Then there is the potential that contaminated soil can be carried through runoff to contaminate water resources and soil stockpiled for rehabilitation. Soil pollution is therefore possible, but through mitigation it can be minimised. The impact will have minimal severity and slight effect on extent.

Status of the projected impact

As a result of mitigation measures on the site this is considered one the lowest and minimal impacts. The likelihood of spills occurring is minimal and should it occur rehabilitation will render the impact minimal.

Significance of the impact

	Severity	Duration	Extent	Consequence	Probability	Frequency	Likelihood	Significance
Before mitigation	4	3	1	2.6	2	2	2	5.2
After mitigation	4	1	1	2	1	1	1	2

Mitigation measures:

- Refuelling must take place in well demarcated areas and over suitable drip trays to prevent soil pollution.
- Spill kits to clean up accidental spills from earthmoving machinery must be well-marked and available on site.
- Workers must undergo induction to ensure that they are prepared for rapid clean-up procedures.
- All facilities where dangerous materials are stored must be contained in a bund wall.
- Vehicles and machinery should be regularly serviced and maintained.

8.3.6 Loss of land capability and land use

Source of the impact

Placement of infrastructure; mining activities.

Description of the impact

The loss of land capability and land use can occur in two ways. Firstly, through topsoil removal, disturbances and loss of soil fertility; and secondly through the improper placement of infrastructure. The site is an historic mining site and has a land capability for grazing. Grazing activities can still be performed in areas not earmarked for mining, and with proper rehabilitation the land capabilities and land use potential can be restored.

Status of the projected impact

Consecutive rehabilitation is undertaken and as long as this is kept to a high standard it is unlikely that land use will be affected. It may just take for rehabilitation to satisfactorily restore the land use and capability.

Significance of the impact

	Severity	Duration	Extent	Consequence	Probability	Frequency	Likelihood	Significance
Before mitigation	4	4	4	4	4	3	3.5	14
After mitigation	4	2	2	2.6	2	2	2	5.2

Mitigation measures:

- Ensure that optimal use is made of the available land through consultation with land owner and proper planning of mining activities.
- Surface agreement to be signed with land owners.
- Employ effective rehabilitation strategies to restore land capability and land use potential of the farm.
- All activities to be restricted within the demarcated areas.
- Ensure that land which is not used during construction is made available for grazing and recreational activities such as in the case of Pan EP1.

8.3.7 Pollution of underground water sources

Source of the impact

Seepage from oil and fuel spillages into the underlying aquifer.

Description of the impact

If oil and fuel spillages occur, then it will seep into the underlying aquifers and contaminate ground water.

Status of the projected impact

As a result of mitigation measures on the site this is considered one the lowest and minimal impacts. The likelihood of spills occurring is minimal and should it occur rehabilitation will render the impact minimal.

Significance of the impact

	Severity	Duration	Extent	Consequence	Probability	Frequency	Likelihood	Significance
Before mitigation	4	3	1	2.6	2	2	2	5.2
After mitigation	4	1	1	2	1	1	1	2

Mitigation measures:

- Refuelling must take place in well demarcated areas and over suitable drip trays to prevent soil pollution.
- Spill kits to clean up accidental spills from earthmoving machinery must be well-marked and available on site.
- Workers must undergo induction to ensure that they are prepared for rapid clean-up procedures.
- All facilities where dangerous materials are stored must be contained in a bund wall.
- Vehicles and machinery should be regularly serviced and maintained.
- Monitor the quality of the boreholes located down-gradient of the mining site.
- Sample according to the sampling method and parameters for analysis as indicated in the Geohydrological study.

8.3.8 Pollution of surface water

Source of the impact

Spillage of hydrocarbon based fuels or lubricants at the pump site near the Orange River; inappropriate ablution facilities; Suspended solids from erosion or disturbed soil.

Description of the impact

Improper handling of hazardous material will cause contamination of nearby surface water resources during runoff episodes. Lack of storm control structures will lead to erosion of stockpiles during heavy rains and runoff will carry suspended solids into the downstream environment. This might cause high silt load and affect stream flow. If no, or inadequate ablution facilities are available then workers might feel the need to use the nearby river or streams for this purpose. A recent water sample analyses done at the water related infrastructure associated to the mining operation did not reveal any pollution potential (Appendix C).

Status of the projected impact

As a result of mitigation measures on the site this is considered one the lowest and minimal impacts. The likelihood of spills occurring is minimal and should it occur rehabilitation will render the impact minimal.

Significance of the impact

	Severity	Duration	Extent	Consequence	Probability	Frequency	Likelihood	Significance
Before mitigation	4	3	1	2.6	2	2	2	5.2
After mitigation	4	1	1	2	1	1	1	2

Mitigation measures:

- Sufficient care must be taken when handling hazardous materials to prevent pollution.
- Under no circumstances may ablutions occur outside of the provided facilities.
- No uncontrolled discharges from the staff camps to any surface water resources shall be permitted.
- If servicing and washing of the vehicles occur on site, there must be specific areas constructed for these activities, which must have concrete foundations, bunding as well as oil traps to contain any spillages.
- A walled concrete platform, dedicated store with adequate flooring or bermed area and ventilation must be used to accommodate chemicals such as fuels, oils, paints, herbicide and insecticides.
- Oil residue shall be treated with oil absorbent and this material removed to an approved waste site.

- Spill kits must be easily accessible and workers must undergo induction regarding the use thereof.
- At all times care should be taken not to contaminate surface water resources.
- Store all litter carefully to prevent it from washing away or blown into any of the water courses within the study area.
- Provide bins for staff at appropriate locations, particularly where food is consumed.
- The mining site should be cleaned daily and litter removed.
- Conduct ongoing staff awareness programmes in order to reinforce the need to avoid littering, which contributes to surface water pollution.

8.3.9 Loss of endorheic pans

Source of the impact

Excavations and blasting.

Description of the impact

To reach the diamondiferous ore, most of the endorheic pans on the property will be destroyed. Although they are seasonal, endorheic pans are classified as wetlands and carry a significant ecological value.

Status of the projected impact

Previous mine owners have mined out many of the existing pans in the study area. However, the project company, Pioneer Minerals (Pty) Ltd has committed to retain all remaining pans and treat these as no-go areas.

Significance of the impact

	Severity	Duration	Extent	Consequence	Probability	Frequency	Likelihood	Significance
Before mitigation	5	5	4	4.6	4	3	3.5	16
After mitigation	4	5	2	3.6	1	1	1	3.6

Mitigation measures:

- No mining should take place on or near the preserved endorheic pan.
- Water Use Licenses in terms of Section 21 (i) of the NWA should be applied for, in order to authorise the disturbance of any pans.

8.3.10 Loss of, and disturbance of indigenous vegetation

Source of the impact

The construction of roads, plant site, as well as other necessary infrastructure; the placement of stockpiles; and the clearing of vegetation for mining, materials storage and topsoil stockpiles; vehicular movement.

Description of the impact

Construction and mining activities on site will reduce the natural habitat for ecological systems to continue their operation. It is not expected that the areas of high ecological function will rehabilitate following disturbance events. Vehicle traffic generates lots of dust which can reduce the growth success and seed dispersal of many small plant species.

Status of the projected impact

Previous mining activities has already caused disturbance of large areas. The current project company has already cleared large areas for mining purposes. However, rehabilitation is comprehensively and consecutively undertaken although it is unlikely that rehabilitation will reinstate the same levels of diversity and species composition.

Significance of the impact

	Severity	Duration	Extent	Consequence	Probability	Frequency	Likelihood	Significance
Before mitigation	5	4	4	4.3	5	3	3.5	15
After mitigation	3	4	4	3.6	3	3	3	10.8

Mitigation measures:

- Minimise the footprint of transformation.
- Encourage proper rehabilitation of mined areas.
- Encourage the growth of natural plant species.
- Ensure measures for the adherence to the speed limit.

8.3.11 Loss of flora with conservation concern

Source of the impact

Removal of vegetation, including conservation important plant taxa during the mining operation.

Description of the impact

It is possible that protected species (e.g. *Boscia albitrunca*) will be destroyed during the mining operation. Furthermore, if the ridges are not protected from mining activities, it is possible that the red listed species (*Phyllobolus amabilis*, classified as rare) will be destroyed.

Status of the projected impact

It is considered likely that several protected species have already been cleared due to mining activities. Measures have been implemented to mitigate this such as search and rescue procedures and replanting of protected tree species.

Significance of the impact

	Severity	Duration	Extent	Consequence	Probability	Frequency	Likelihood	Significance
Before mitigation	3	5	4	4	5	4	4.5	18
After mitigation	2	3	4	3	4	4	4	12

Mitigation measures:

- No mining should take place on the ridges where *Phyllobolus amabilis* occur.
- Footprint areas of the mining activities must be scanned for Red Listed and protected plant species prior to mining.
- It is recommended that these plants are identified and marked prior to mining.
- These plants should, where possible, be incorporated into the design layout and left in situ.
- However, if threatened of destruction by mining, these plants should be removed (with the relevant permits from DAFF and DENC) and relocated if possible.
- A management plan should be implemented to ensure proper establishment of ex situ individuals, and should include a monitoring programme for at least two years after re-establishment in order

to ensure successful translocation.

- All those working on site must be educated about the conservation importance of the fauna and flora occurring on site.

8.3.12 Proliferation of alien vegetation

Source of the impact

Clearing of vegetation; mining activities.

Description of the impact

The extent of alien invasive species in the area shows the high level of past disturbance interference in the natural ecosystem. While general clearing of the area and mining activities destroy natural vegetation, invasive plants can increase due to their opportunistic nature in disturbed areas. If invasive plant establish in disturbed areas, it may cause an impact beyond the boundaries of the mining site. These alien invasive species are thus a threat to surrounding natural vegetation and can result in the decrease of biodiversity and ecological value of the area. Therefore, if alien invasive species are not controlled and managed, their propagation into new areas could have a high impact on the surrounding natural vegetation in the long term. With proper mitigation, the impacts can be substantially reduced.

Status of the projected impact

Previous mining activities has resulting in the establishment of alien species. Current mining activities has also cleared large areas. However, due to the recent nature of the current mining alien species has not yet had time to establish. As long as alien control is implemented continuously until natural vegetation has successfully established the impact should remain low.

Significance of the impact

	Severity	Duration	Extent	Consequence	Probability	Frequency	Likelihood	Significance
Before mitigation	4	5	5	4.6	5	3	4	18.4
After mitigation	1	5	1	2.3	2	1	1.5	3.4

Mitigation measures:

- Minimise the footprint of transformation.

- Encourage proper rehabilitation of mined areas.
- Encourage the growth of natural plant species.
- Mechanical methods (hand-pulling) of control to be implemented extensively.
- Annual follow-up operations to be implemented.

8.3.13 Disturbance and displacement of fauna

Source of the impact

Vegetation clearing; increase in noise and vibration; human and vehicular movement on site resulting from mining activities.

Description of the impact

The transformation of natural habitats to mining and associated infrastructure will result in the loss of habitat affected individual species, and ecological processes. In turn this will result in the displacement of faunal species dependent upon such habitat. Increased noise and vibration due to mining activities will disturb and possibly displace birds and other wildlife. Fast moving vehicles take a heavy toll in the form of road kills of small mammals, birds, reptiles, amphibians and a large number of invertebrates.

Status of the projected impact

Current mining activities has already cleared large areas and is currently operation and it is anticipated that this would already have had an impact on the fauna.

Significance of the impact

	Severity	Duration	Extent	Consequence	Probability	Frequency	Likelihood	Significance
Before mitigation	4	3	4	3.6	5	4	4.5	16.2
After mitigation	3	3	4	3.3	4	3	3.5	11.5

Mitigation measures:

- Careful consideration is required when planning the placement for stockpiling topsoil and the creation of access routes in order to avoid the destruction of pristine habitats and minimise the overall mining footprint.
- The appointment of a full-time ECO must render guidance to the staff and contractors with respect to suitable areas for all related disturbance.

- The extent of the proposed mine should be demarcated on site layout plans, and no construction personnel or vehicles may leave the demarcated area except those authorised to do so. Those areas surrounding the mine site that are not part of the demarcated development area should be considered as a no go zone for employees, machinery or even visitors.
- All those working on site must be educated about the conservation importance of the fauna and flora occurring on site.
- The ECO must ensure that all contractors and workers undergo Environmental Induction prior to commencing with work on site.
- The environmental induction should occur in the appropriate languages for the workers who may require translation.
- Reptiles and amphibians that are exposed during the clearing operations should be captured for later release or translocation by a qualified expert.
- Employ measures that ensure adherence to the speed limit.

8.3.14 Loss, damage and fragmentation of natural habitats

Source of the impact

Clearance of vegetation; mining activities.

Description of the impact

The construction of the mine and associated infrastructure will result in the loss of connectivity and fragmentation of natural habitat. Fragmentation of habitat will lead to the loss of migration corridors, in turn resulting in degeneration of the affected population's genetic make-up. This results in a subsequent loss of genetic variability between meta-populations occurring within the study site. Pockets of fragmented natural habitats hinder the growth and development of populations.

Status of the projected impact

Significant areas have already been cleared and therefore it is likely that this impact has already had some effect on the natural ecosystem. However, as long as rehabilitation is adequately done the connectivity of the ecosystem should be restored to a large degree.

Significance of the impact

	Severity	Duration	Extent	Consequence	Probability	Frequency	Likelihood	Significance
Before mitigation	4	5	3	4	5	3	4	16
After mitigation	3	2	3	2.6	4	3	3.5	9.1

Mitigation measures:

- Mining activities must be planned, where possible in order to encourage faunal dispersal and should minimise dissection or fragmentation of any important faunal habitat type.
- The extent of the mining area should be demarcated on site layout plans (preferably on disturbed areas or those identified with low conservation importance). No construction personnel or vehicles may leave the demarcated area except those authorised to do so.

8.3.15 Dust entrainment and emissions

Source of the impact

Vegetation clearance; topsoil removal; excavating and blasting; road grading; material loading and hauling; stockpiling; bulldozing; vehicular movement.

Description of the impact

During the mining operation the abovementioned activities have potential for dust generation. It is anticipated that the extent of dust emissions would vary substantially from day to day depending on the level of activity and the specific operations. A recent dust fall assessment revealed that dust generated by mining activities are in an acceptable range.

Status of the projected impact

Mining operations are already in progress and dust liberation is an impact requiring mitigation on a daily basis.

Significance of the impact

	Severity	Duration	Extent	Consequence	Probability	Frequency	Likelihood	Significance
Before mitigation	2	3	2	2.3	4	3	3.5	8
After mitigation	1	3	1	1.6	3	3	3	4.8

Mitigation measures:

- Vegetation must be removed when soil stripping is required only. These areas should be limited to include those areas required for mining only, hereby reducing the surface area exposed to wind erosion. Adequate demarcation of these areas should be undertaken.
- Control options pertaining to topsoil removal, loading and dumping are generally limited to wet suppression.
- Where it is logistically possible, control methods for gravel roads should be utilised to reduce the re-suspension of particulates. Feasible methods include wet suppression, avoidance of unnecessary traffic, speed control and avoidance of track-on of material onto paved and treated roads.
- The length of time where open areas are exposed should be restricted. Mining should not be delayed after vegetation has been cleared and topsoil removed.
- Dust suppression methods should, where logistically possible, must be implemented at all areas that may / are exposed for long periods of time.
- Blasting and drilling (if required) should be delayed under unfavourable wind and atmospheric conditions.
- For all mining activities management should undertake to implement health measures in terms of personal dust exposure, for all its employees.

8.3.16 Disruption of ambient noise levels

Source of the impact

All mining activities

Description of the impact

The surface infrastructure of the Remhoogte mine is situated in a rural environment, with typically low levels of noise, dominated by the natural sounds vegetation, wildlife, and man-influenced sounds such as livestock, farming activities, and very occasional remote road and air traffic. The proposed mine will add a

certain amount of noise to the existing noise in the area. However, a recent noise monitoring report revealed that levels of noise generated by mining activities are acceptable (Appendix 8)

Status of the projected impact

Mining operations are already in progress and noise is an impact requiring mitigation on a daily basis.

Significance of the impact

	Severity	Duration	Extent	Consequence	Probability	Frequency	Likelihood	Significance
Before mitigation	1	3	1	1.6	3	2	2.5	4
After mitigation	1	3	1	1.6	1	2	1.5	2.4

Mitigation measures:

- Restrict mining activities to daytime unless agreements are obtained from landowners to do 24 hr operations.
- Systematic maintenance of all forms of equipment, training of personnel to adhere to operational procedures that reduce the occurrence and magnitude of individual noisy events.
- Where possible material stockpiles should be placed so as to protect the boundaries from noise from individual operations.
- Equip vehicles with noise silencers.
- Standardised noise measurements should be carried out on individual equipment at the delivery to site to construct a reference data-base and regular checks carried out to ensure that equipment is not deteriorating and to detect increases which could lead to increase in the noise impact over time and increased complaints.
- Environmental noise monitoring should be carried out at regularly to detect deviations from predicted noise levels and enable corrective measures to be taken where warranted.

8.3.17 Visual impacts

Source of the impact

Removal of existing vegetation cover; mining infrastructure; alteration of the views of the site and intrusion of the views of Karoo landscape.

Description of the impact

The site is screened from viewers along the access roads by vegetation communities with tree species dominating the site.

Status of the projected impact

Mining operations are already in progress and the visual impacts are present although very low.

Significance of the impact

	Severity	Duration	Extent	Consequence	Probability	Frequency	Likelihood	Significance
Before mitigation	1	3	1	1.6	2	2	2	3.2
After mitigation	1	3	1	1.6	1	2	1.5	2.4

Mitigation measures:

- Infrastructure should be placed to optimise the natural screening capacity of the vegetation.
- Where practical, protect existing vegetation clumps during in order to facilitate screening during the mining operation.
- Remove rubble and other building rubbish off site as soon as possible or place it in a container in order to keep the mining site free from additional unsightly elements.
- Locate the staff camps and the material stockpiles outside of the visual field of sensitive visual receptors.
- Dust suppression procedures should be implemented especially on windy days during earth works.
- Rehabilitation should aim to establish a diverse and self-sustaining surface cover that is visually and ecologically representative of naturally occurring vegetation species.
- Implement a management plan for the post-mining site in order to control the invasion of alien vegetation and to manage erosion, until the site is fully rehabilitated.

8.3.18 Impact on traffic and road safety

Source of the impact

Vehicular movement.

Description of the impact

The traffic assessment showed that access roads carry relatively low vehicular traffic during the morning peak hour and that there were no major capacity constraints at the key intersections. The impact of site generated trips on the traffic of these roads is expected to be low. Nevertheless, if road safety is not administered it can have a high impact on the safety of fellow road users.

Status of the projected impact

Mining operations are already in progress and the tarffic impacts are present although very low.

Significance of the impact

	Severity	Duration	Extent	Consequence	Probability	Frequency	Likelihood	Significance
Before mitigation	1	3	1	1.6	2	2	2	3.2
After mitigation	1	3	1	1.6	1	2	1.5	2.4

Mitigation measures:

- Implement measures that ensure the adherence to traffic rules.

8.3.19 Impact on road infrastructure

Source of the impact

Vehicular movement.

Description of the impact

No major roads were planned within the study area in the medium term. A light surface rehabilitation was however undertaken on the R357 in 2011. This surface rehabilitation intended to prolong the road design life to last a further 10 years and to improve the road riding quality. The anticipated site generated vehicle trips are not expected to impact on the structural integrity of the road.

Status of the projected impact

Mining operations are already in progress and the impact on the roads are present although very low.

Significance of the impact

	Severity	Duration	Extent	Consequence	Probability	Frequency	Likelihood	Significance
Before mitigation	1	3	1	1.6	2	2	2	3.2
After mitigation	1	3	1	1.6	1	2	1.5	2.4

Mitigation measures:

- Implement measures that ensure the adherence to traffic rules.

8.3.20 Deterioration or damage of heritage resources

Source of the impact

All mining activities.

Description of the impact

The mining activities on site have the potential to impact upon heritage resources. Heritage sites are fixed features in the environment, occurring within specific spatial confines. Any impact upon these resources will be permanent and irreversible. Any movement of vehicles, equipment or personnel through areas containing these artefacts could result in the permanent destruction of the artefacts and loss of heritage resources. The impacts of the mining activities are however anticipated to be low, because the highest density of heritage resources was found to be outside the area earmarked for mining. Nevertheless, if any impact should occur, it would be of national significance and definite. Furthermore, a buffer of 10 m will be establishment along the boundary zone a representative sample of surface occurrences outside the buffer zone has also been mapped recorded and photographed for safekeeping.

Status of the projected impact

Mining operations are in progress however the existing heritage and archaeological area which are considered sensitive has been identified and is excluded from mining activities. The likelihood still remains that heritage areas underground may be impacted on during excavations.

Significance of the impact

	Severity	Duration	Extent	Consequence	Probability	Frequency	Likelihood	Significance
Before mitigation	3	5	2	3.3	4	2	3	9.9
After mitigation	1	5	1	2.3	1	2	1.5	3.45

Mitigation measures:

- The heritage and cultural resources must be protected and preserved by the delineation of a no go zone.

8.3.21 Loitering of people causing security risks

Source of the impact

Influx of people, especially unemployed job-seekers to the mine and surrounding areas.

Description of the impact

The mining operation, especially during construction, will create a number of new employment opportunities. The magnitude of this impact will depend on the number of people that will be employed and the number of contractors sourced. An influx of people into the rural area will possibly impact on safety and security of local residents.

Status of the projected impact

Mining operations are in progress and due to the isolated mining area and high levels of security at the gate and on the premises loitering of people in the area is not taking place.

Significance of the impact

	Severity	Duration	Extent	Consequence	Probability	Frequency	Likelihood	Significance
Before mitigation	2	3	1	2	3	2	2.5	5
After mitigation	1	3	1	1.6	1	1	1	1.6

Mitigation measures:

- The mine must ensure that false expectations are not created regarding job creation.
- Jobs must be allocated as advertised and in so far as is possible to local inhabitants.
- Contractors and employees should not be permitted to wander outside the mining area.
- Uncontrolled settlement of contractors and workers outside of the site will be prevented.

8.3.22 Loss of jobs and income

Source of the impact

Mine closure

Description of the impact

During the decommissioning and at closure of the mine, staff will most likely be retrenched. This can potentially flood the job market, resulting in people being unable to find new employment for a long period of time. It is normally more difficult for people with highly specialised skills to find employment immediately. Those with fewer skills have more flexibility in the job market.

Economic slump of the local towns after mine closure is an associated potential impact. Income streams from wage bills as well as goods and services contracts (at all geographical levels) will come to an end, reducing the monetary income of individuals and mine-related businesses. People who have derived income directly or indirectly from the project may be inclined to leave the region in search of employment or business opportunities. This could result in further decline of the economy of the region as well as the abandonment of infrastructure. The loss of mine workforce income will also impact upon non-mine related industries within the local and regional areas, particularly the rental property market and retail and service industries who would have received income during the life of mine from the salaried workforce.

It is likely, however that there will be residual positive economic impacts that are not fully reversed with the closure of the mine, and that the economy will not decline to its original level prior to the development of this project. This is because the mine will generate substantial income for the regional and local economy, both directly and indirectly, during its life.

It is difficult to predict the actual impact of the mine closure in advance, but it is acceptable to assume that the mine closure will have a negative impact on the local and regional economy with a high probability of occurrence, a high severity and a high significance.

Status of the projected impact

This impact will only become evident during the closure of the mine.

Significance of the impact

	Severity	Duration	Extent	Consequence	Probability	Frequency	Likelihood	Significance
Before mitigation	4	3	3	3.3	4	4	4	13.2
After mitigation	3	3	3	3	4	4	4	12

Mitigation measures:

- The expectations of what benefits can accrue to the community must be managed from the initiation of the project.
- Commitments as set out in the SLP must be attained.

8.3.23 Loss of IAP relationship and trust

Source of the impact

All mining activities

Description of the impact

The lack of transparent and efficient communication with IAPs will cause the IAP to lose trust in the mining company. This will cause the relationship between the parties to deteriorate and might have an impact on the mining activity itself, as well as create a possible stigma about mining activities in the area, preventing possible future ventures.

Status of the projected impact

Although the mining operation is in progress the relationship with I&AP's are still in good order.

Significance of the impact

	Severity	Duration	Extent	Consequence	Probability	Frequency	Likelihood	Significance
Before mitigation	3	2	2	2.3	3	2	2.5	5.75
After mitigation	1	2	2	1.6	2	2	2	3.2

Mitigation measures:

- Maintain active communication with IAPs.
- Ensure transparent communication with IAPs at all times.
- IAPs must be kept up to date on any changes in the mining operation.
- A complaints management system should be maintained by the mine to ensure that all issues raised by community members are followed up and addressed appropriately.

8.4 Cumulative impact assessment

8.4.1 Disturbance of soils

The application area is used for mining as well as grazing. Grazing exposes soils and can lead to erosion. The historic mining has also caused loss of soils, even though the soils of the application areas are generally shallow. There are Rooikoppie gravel dumps due to historic diggings that have impacted on the topsoil layers. The current mining activities planned on Remhoogte will have a cumulative impact on the soil. Due to previous mining activities the impact will not be as pronounced. The cumulative impact of soil disturbance is considered as low.

8.4.2 Loss of land capability

The mining activities will cumulatively impact on land capability. The soils within the application area already have a low agricultural potential. Rehabilitation will assist in restoring land capability, with grazing potential in areas that have been mined. In areas that will not be mined, the land capability will be maintained. The loss of land capability has a low probability, but a severe impact if it occurs. The impact rating is considered to be medium.

8.4.3 Degradation and loss of natural vegetation

The study area falls within the Griqualand West Centre of Endemism. A significant amount of mining is taking place here, but not enough research has been done here and therefore the centre is not well understood. This is a cause of concern, because vital aspects might be lost or disturbed. The cumulative effect of mining in this area exacerbates the potential risk of losing information and/or ecosystem function.

The vegetation clearing for mining activities will cumulatively add to the loss of vegetation due to clearing for crop production or loss of vegetation due to grazing. Even though grazing stimulates vegetation succession, overgrazing can impact negatively on growth and promote alien invasive species. The cumulative impact is considered to be medium.

8.4.4 Disturbance of heritage sites

Other farming and historic mining activities in the area have already impacted on the heritage sites. The mining activities will cumulatively add to this impact. However, heritage impact studies conducted prior to mining activities are a key source of research for understanding our National Heritage. The identification of grave sites are recorded by SAHRA and subsequently preserved.

8.4.5 Mitigation measures for cumulative impacts

Mitigation measures presented in section 9.3., are also applicable for the cumulative environmental impacts. Therefore, if these measures are employed, it will prevent cumulative environmental impacts on the surrounding environment.

8.5 Conclusion

The impacts as identified and rated are as follows:

Identified impacts	Impact rating	
	Before mitigation	After mitigation
Sterilisation of mineral resources	Low-Moderate	Low
Changes to surface topography	Moderate-High	Moderate
Soil erosion	Moderate	Low-Moderate
Loss of soil fertility	Moderate	Low-Moderate
Soil pollution	Low-Moderate	Low
Loss of land capability and land use	Moderate	Low-Moderate
Pollution of underground water sources	Low-Moderate	Low
Pollution of surface water	Low-Moderate	Low
Loss of endeorheic pans	Moderate-High	Low
Loss of, and disturbance to	Moderate-High	Moderate

indigenous vegetation		
Loss of flora with conservation concern	Moderate-High	Moderate
Proliferation of alien vegetation	Moderate-High	Low
Disturbance and displacement of fauna	Moderate-High	Moderate
Loss, damage and fragmentation of natural habitats	Moderate-High	Low-Moderate
Dust entrainment and emissions	Low-Moderate	Low
Disruption of ambient noise levels	Low	Low
Visual impacts	Low	Low
Impact on traffic and road safety	Low	Low
Impact on road infrastructure	Low	Low
Deterioration or damage of heritage resources	Low-Moderate	Low
Loitering of people causing security risks	Low-Moderate	Low
Loss of jobs and income	Moderate	Moderate
Loss of IAP relationship and trust	Low-Moderate	Low

9 ENVIRONMENTAL MANAGEMENT PROGRAMME

9.1 Introduction

The following Environmental Management Programme (EMP) is structured in order to provide a basis for an Environmental Management System (EMS) for the life of the Remhoogte mine. Furthermore, it should be noted that the proposed EMP is not static, as allowances were made for its evolution through the life of the mine, which is important as key factors and processes may change based on changes to the project plan and technological advancements. It is therefore necessary to alter proposed mitigation and monitoring methodologies in order to determine the best approach to deal with such changes. The EMP was developed with the intention that it conforms to the following criteria:

- Identifies specific quantifiable monitoring regimes;
- Delineates key lines of accountability;
- Associates mitigation and monitoring tasks to specific impacts;
- Where practically possible, identifies key indicators, which can be utilised for environmental performance monitoring;
- Ensures flexibility to enable the incorporation of additional monitoring and mitigation techniques as deemed necessary throughout the life of the mine;
- Conforms to best practice principles by acknowledging (through its strong relationship with the EIA) the existence of both long-term and immediate impacts and the necessary mitigation measures; and
- Identifies key corporate commitments, made by Pioneer Minerals with regards to its environmental performance.

9.2 General project description

The mining operation is based on alluvial diamond mine reserves which will be mined by means of an opencast method using heavy earthmoving machinery and occasional blasting. The ore will be treated through a 4 pan plant and will undergo on-site screening, scrubbing, crushing and processing, which do not require the use of any processing reagents. The rough diamond product

will then be removed from site for further beneficiation. The estimated production is 80 000 m3 per month and the expected lifespan of the mine is 8 years.

9.3 Roles and responsibilities

9.3.1 The applicant

The applicant remains ultimately responsible for ensuring that the mining operation is implemented according to the requirements of the EMP. The applicant may appoint specific role players to perform functions on their behalf, but the responsibility rests on the applicant to ensure that these role players adhere to the requirements in the EMP. The applicant is ultimately responsible for ensuring that sufficient resources (time, financial, capacity, equipment) are available to all role players in order to efficiently perform their tasks in terms of the EMP.

9.3.2 Contractors

The contractors, as the applicant's implementing agents on site, are bound to the conditions as stipulated in the EMP through contractual agreements and are therefore responsible for ensuring that they adhere to all the conditions of the EMP. The contractors must thoroughly familiarise themselves with the EMP requirements prior to commencing with work on site. Furthermore, the contractors must request clarification on any aspect of the EMP, where required. The contractors must ensure that all workers undergo an environmental induction in terms of the EMP. The contractors must ensure that they provide sufficient budget for complying with all the EMP conditions at the tender stage.

9.3.3 Safety, Health, Environment and Quality (SHEQ)

A SHEQ will be employed by Pioneer Minerals and will form part of the management team at the Remhoogte mine, in order to address all of the environmental and safety aspects.

9.3.4 Environmental Control Officer

A fulltime ECO will be appointed at the Remhoogte mine if the responsibilities of the ECO cannot be fulfilled by the SHEQ. The ECO must attend relevant project meetings, conduct inspections to assess compliance with the EMP and be responsible for providing feedback on potential

environmental problems associated with the mining operation. In addition, the ECO is responsible for:

- Liaison with relevant authorities;
- Liaison with contractors regarding environmental management; and
- Undertake routine monitoring.

9.4 Phases of mining operation

The EMP addresses all four phases of the mining project, i.e. planning and designing; construction; operation; decommissioning.

9.4.1 Planning and design

The EMP offers an ideal opportunity to incorporate pro-active environmental management measures with the goal of attaining sustainable mining. Proactive environmental measures minimise the chance of impacts occurring during the construction and operation phase. Nevertheless, there remains a chance of accidental impacts taking place. However, through the incorporation of contingency plans (e.g. this EMP) during the planning phase, the necessary actions can be taken to further limit potential impacts.

9.4.2 Construction

Continuous monitoring will allow for the identification of impacts as the impacts occur. The impacts can then be mitigated with a commitment to sound environmental management on the part of the engineering team and the contractor as well as the applicant.

9.4.3 Decommissioning

Decommissioning and closure of the mine is a process that starts at the beginning of a mining project. Closure objectives must be defined prior to the commencement of construction.

9.5 Environmental management programme

A list of potential environmental impacts and the appropriate mitigation measures that must be taken into account during the four different phases of the Remhoogte Mine is shown in **Table 19**.

Table 26: Potential environmental impacts and their appropriate mitigation measures.

Activity	Potential Impact	Objective	Mitigation or Control Measure
Environmental Impacts			
Construction activities	Geology Sterilisation of mineral resources	• Avoid the sterilisation of future resources	- No dumping of materials prior to approval by exploration geologist; - Proper planning of excavations
	Topography Changes to surface topography due to placement of infrastructure and development of residue deposits	• Minimise the impact of topographically impacting features	- Prominent natural features will not be disturbed such as EP 1 and grave sites; - All temporary infrastructure will be demolished during closure; - Waste will be disposed of at Municipal waste disposal site; - All disturbed areas will be rehabilitated
	Soils Loss of soils resources due to erosion Soil contamination due to hydrocarbon spillages	• To avoid and where not possible, minimise the loss/disturbance of soil; • To store and handle soils as to prevent contamination and erosion and to maximise use in rehabilitation	- All temporary infrastructures will be demolished during closure; - Waste will be disposed of at Municipal waste disposal site; - Agreement to use this site will be sought from the municipality; - All disturbed areas will be cleaned and rehabilitated; - Topsoil will be stripped prior to placement of infrastructure, as well as excavating mine pits. - Topsoil will be stripped according the soil type and the available soil depth in the areas to be disturbed (up to 150mm) as per soil analysis of the area. - Soil will be stockpiled in windrows not higher than 2m with as little compaction as possible. - Stockpiling will be done as close as possible to areas where the soils will be replaced and single handling practiced.

Activity	Potential Impact	Objective	Mitigation or Control Measure
			- Soil stockpiles will be kept in a weed-free condition. - Stockpiled soil will be used in ongoing rehabilitation of disturbed areas. - Rehabilitation will include: ✓ removing of all debris, ✓ replacement of soil with as little compaction as possible, ✓ reshaping, ploughing or ripping to break compaction, and ✓ introduction of organic matter as necessary; - Soil contamination will be prevented through: ✓ bunding of all above-ground storage facilities ✓ Construction on impervious floors for hazardous substances such as diesel, oil and chemicals; and ✓ regular inspection of equipment and vehicles for leaks. - Spillages of oil, grease and hydraulic fluids will be reported. The spillages will be cleaned up by removing the soil and disposing such soil in a waste receptacle called soil farm. A dedicated engineer will be appointed to oversee the soil farm. - Contaminated soil will be removed taken to this soil farm, where it will be treated with decontaminant. The treated soil samples will be taken to the laboratory to determine if this soil is suitable for taking back to rehabilitation areas. - Contractors, staff and drivers will be trained on how to deal with spillage of hydrocarbons and other potential

Activity	Potential Impact	Objective	Mitigation or Control Measure
			contaminants. - All domestic and industrial waste generated on site will be contained in skips and appropriate receptacles, collected and if required sorted by the approved contractor, and removed to approved waste disposal site. - Linear infrastructure such as roads and pipelines will be inspected at least monthly to check that the associated water management infrastructure is effective in controlling erosion. - All surface water management infrastructure constructed from soil (berms, canals and bunds) will be inspected at least monthly, with more frequent inspections during periods of high rainfall and after major rainfall events. - The disturbed areas will be rehabilitated to grazing potential and appropriate erosion control measures will be implemented. After the overburden have been placed back in the mined open pits, the topsoil/subsoil dumps will be replaced for rehabilitation and re-vegetation purposes. Clovely soils will be used for topsoiling. - Any excavation of topsoils will be done such that the cleared area is also ripped and allow to re-vegetate

Activity	Potential Impact	Objective	Mitigation or Control Measure
	Land capability Loss of land capability	• To minimise the negative impacts on land capability	- All construction activities to be restricted within the demarcated areas - Surface agreement to be signed with land owners - Check, service and maintain construction vehicles and equipment to minimise the risk of hydrocarbon and chemical leakages and spillages
	Land use Fragmentation of farm land	• To reduce negative impacts on land use	- Restrict construction activities to demarcated areas and consider all other areas as no-go areas to minimise loss of grazing land - Do not disturb Pan - EP 1 - Do not disturb grave sites - Ensure that land which is not used during construction is made available for grazing and recreational activities such as in the case of Pan - EP1.
	Fauna and Flora Loss of habitat	• To mitigate negative impacts on faunal species	- Service and maintain construction vehicles in order to reduce noise emissions - Advise persons entering the site not to disturb or harm animals - Implement a biodiversity action plan that is available as part of the Biodiversity specialist report - Avoid sensitive areas, such as pans and streams banks-no infrastructure within 100 m of any road or water course
	Pans and wetlands Loss or disturbance of habitat through encroachment of mining related activities	• To avoid disturbance of delineated Pans • Ensure healthy functioning and maintenance of pans	- Educate employees, contractors and visitors on biodiversity and land management principles - The pan is classified as a water system according to GN 704. No water system will be mined before an authorization (either

Activity	Potential Impact	Objective	Mitigation or Control Measure
			as the General Authorisation or a Water Use Licence) is obtained from the Department of Water Affairs. Exemption in line with Regulation 3 of GN 704 to mine out the Endorheic/seasonal pans identified on site will be applied for. In terms of the linkages of GN 704 with other requirements of the National Water Act, it is stated in Best Practice Guidelines that should an exemption from any requirements of GN 704 imply the necessity for a water use licence, the person in control of the mine or activity need only apply for a licence. The licence has higher authority than the GN704. This principle will be observed during the development. - A 30m buffer is required, however, it is strongly recommended that 100m buffer around delineated EP1 is implemented. - Reconstruct drainage around EP1. - Re-drill a collapsed borehole as per farmers request - Planning & Surveying Department to be provided with relevant buffer areas to incorporate in future planning. - Applicable Water Use Licenses should be applied for disturbance of any pans
	Alien Species Contamination by chemical control agents (users need to be registered and certified for use of dangerous products) Large areas denuded of vegetation (small-scale	• Removal of Priority Group 1 Species. • Removal of Priority Group 2 Species (large woody species) • Reduction of Priority Group 3,4 and 5 Species	- Mechanical and chemical methods will be implemented initially to bring about a quick reduction in these species that pose the greatest invasive threat to the area. - Mechanical (tree-felling) and chemical (stump treatment) methods to be implemented. Market for harvested wood to be investigated. - Mechanical methods (hand-pulling) of control to be

Activity	Potential Impact	Objective	Mitigation or Control Measure
	rehabilitation of denuded areas to be implemented)	• Reduction of remaining Priority Groups	implemented extensively in the early stages of establishment of the mine. - Annual follow-up operations to be implemented. - Control measures to be implemented on an opportunistic basis. - Landscaping and gardening to be based on the use of indigenous plants only. Alien plants are to be removed whenever possible.
	Biodiversity Loss of biodiversity	• Avoid the loss of biodiversity • Contain the footprint of mine and mine related operations to within an accepted area, and outside of sensitive areas. • Re-establishment of *B. abitrunca* species • Raise awareness of biodiversity related issues among staff and contractors • Rehabilitate areas in a manner that promotes the recovery of biodiversity. • Protection of large established trees	- Research and information gathering regarding the establishment of *B. albitrunca* trees. - Establish a nursery on site - Grow seedlings at the nursery - Monitor success rate for the establishment of seedlings - Conduct rehabilitation - Provide training in the identification of protected species - Re-vegetate using mix of indigenous locally occurring species - Re-establish tree species on the field away from the mining areas - Set up fixed point monitoring sites to check progress of rehabilitation - Fence off newly rehabilitated areas and protect from grazing until well established. - Apply for a licence for removal of *B. albitrunca* trees in terms of the National Forest Act.
	Ground water Contamination of ground water	• Avoid contamination of underground water resources	- Implement waste management plan for handling hazardous waste b) Conduct ground water monitoring as per the

Activity	Potential Impact	Objective	Mitigation or Control Measure
			monitoring plan
	Air quality Deterioration of air quality	• To reduce deterioration of ambient air quality	- Rehabilitate and maintain disturbed surfaces that are not going to be utilised after construction; - Promote use of PPE such as dust masks
	Noise Increase in ambient noise level	• To minimise increases in ambient noise levels	- Restrict construction activities to daytime unless agreements are obtained from landowners to do 24 hr operation; - Service construction vehicles and equipment on a regular basis to ensure noise suppression mechanisms are functioning; - Construct enclosures/bunds and berms for pumps, generators and other noise generating equipment; - Equip vehicles with noise silencers; - Switch equipment off when not in use; - Demarcate and clearly mark noise zones; - Adhere to occupation health and safety noise limits; - Maintain occupational noise monitoring to determine noise levels from equipment as increased noise may indicate other issues. A noise monitoring programme and grievance procedure must be implemented;
	Visual Visual intrusion	• To minimise visual impacts	- Use natural colour tones for structures, roofs of buildings will be angled so as to not reflect sunlight and night lighting will be minimised; - Carry adjustments to the siting and design of the project, the careful selection of finishes and colours, the use of earthworks (such as berms) and planting to provide visual screening, as well as dust control where required. Penalties for non-

Activity	Potential Impact	Objective	Mitigation or Control Measure
			compliance should be considered; - Screen the site from the surrounding areas by planting fast growing indigenous trees; - Turn lights off using a timer or occupancy sensor or manually when not needed. - Both on-site and off-site landscape rehabilitation of areas affected by the project should be considered. This may include re-instating landforms and natural vegetation, provision of landscaped open space, or other agreed upon facilities.
	Sensitive areas Destruction of sensitive areas	• To minimise negative impacts on sensitive areas	- Avoid all identified wetlands and ensure that no activities take place within wetland areas; - Construct catchment dams in areas that drain towards streams and wetlands, in order to contain dirty water and reduce impacts on wetlands; - Conduct monitoring programme for water, soil and biodiversity; - Introduce a hydrocarbon management system to ensure that hydrocarbon pollution is minimised; - Commence with construction during the low flow or during low rainfall in the - wet season; - Ensure that infrastructure is constructed outside the 100 year flood line and or within 100 m from streams and pans in order to minimise impacts on water courses; - Comply with Regulation 704 of the National Water Act of 1998 for all designs of mine residue disposal infrastructure; - Minimise the removal of vegetation during stripping.

Activity	Potential Impact	Objective	Mitigation or Control Measure
	Traffic and safety	• To reduce negative impacts of increased traffic on and around the site	- Allocate and adhere to speed limits; - To reduce negative impacts of increased traffic on and around the site; - Restrict traffic to demarcated areas; - Public to be given right of way on public roads and truck contractors shall make use of approved methods to control the movement of vehicles so as not to constitute a road hazard; - Erect safety signs in the local languages to warn people of the danger on roads; - Keep in constant liaison with the local Department of Roads who will need to be aware of any proposed road plans and who may be able to assist in terms of making recommendations and road maintenance; - Ensure that site access points are clearly visible from the main road; - Ensure that all drivers employed are certified with appropriate training levels for the required vehicle; - Ensure that all vehicles entering and leaving the site use demarcated routes.
	Surface Water Contamination of surface water resources	• Contamination of surface water resources • Diversion of clean runoff and interception of dirty water	- Clean surface water or runoff will be prevented from entering dirty areas by diverting it around these areas; - The discharge positions might also require additional reinforcement in the form of a suitably designed gabion or similar structure to prevent erosion at the discharge positions.
	Fauna and flora Loss of natural vegetation and	• To minimise species loss and faunal habitat loss	- Ensure that vegetation is not unnecessarily removed; - Remove with care and relocate Red Data List species to avoid

Activity	Potential Impact	Objective	Mitigation or Control Measure
	species of conservation value		destruction; - Manage and control plant species declared as invasive and declared weeds.
Opertaional activities	Air quality Deterioration in air quality	• To minimise negative impacts on air quality	- Minimise the removal of vegetation in order to reduce the possibility of dust pollution; - Vegetate topsoil stockpiles as soon as possible to reduce dust and particulate emissions; - Locate topsoil stockpiles in order to reduce its exposure to wind, thereby reducing the likelihood of particle entrainment. - Spray road surfaces with water and treat it with a dust binding agent to minimise emissions of fugitive dust. The type of dust-binding agent should determine the amount of watering.
	Topography Change in surface topography	• To reduce negative impacts on soil resources	- Engineer and environmental consultant should supervise vegetation and rehabilitation activities in accordance with post mining topographical plan.
	Land capability Loss of land capability	• To minimise the negative impacts on land capability	- Plan all construction activities to prevent the incorrect stripping of topsoil which leads to the reduction in land capability; - Restrict all construction activities to demarcated areas.
	Soils Loss of soil fertility	• To minimise negative impacts on soil resources	- Vegetate soil stockpiles and berms to minimise the risk of erosion; - Implement erosion control measures, such as contour banks in area prone to erosion, including slopes and uneven ground; c) Vegetate preferential flow paths of storm water runoff; - Remove soils in dryer months, due to their increased susceptibility to compaction and erosion during rains;

Activity	Potential Impact	Objective	Mitigation or Control Measure
			- Separate topsoil (A horixon) and sub-soils (B horizon) where possible and stockpile separately; - Construct berms around soil stockpiles in order to divert water away from the stockpile to prevent erosion; - Restrict stockpile height to less than 3m and shape to reduce soil compaction; - Minimise the removal of topsoil in order to reduce dust and particulate emissions.
	Surface water Deterioration in water quality	• To minimise negative impacts on surface water quality	- Ensure that construction activities are at least 100m from wetlands and floodlines; - Stabilise soil stockpiles with vegetation in order to reduce exposure to erosion and minimise the effects of silt loading of surface water running over exposed soil
	Surface water Deterioration of a water resource	• To minimise water use • To prevent pollution	- Measures to reduce the pressure on water resources include actions such as: ✓ Optimising the recycling and re-use of water, and ✓ Minimising losses - These can be accomplished in many ways, but with the following aspects being recommended for this site: ✓ Maximum re-use of water from the return water dam. - Dispose of domestic and hazardous waste originating from temporary and permanent offices and workshops at an authorised landfill facility to minimise the risk of surface water pollution; - Dispose of hazardous waste and effluent at an authorised landfill facility.

Activity	Potential Impact	Objective	Mitigation or Control Measure
	Groundwater Contamination of ground water	• To minimise negative impacts on groundwater quality	- Check, service and maintain construction vehicles and equipment used during infrastructure construction to reduce the risk of hydrocarbon and chemical leakages and spillages; - Contain and remediate hydrocarbon or chemical leakages and spillages to prevent leaching into the groundwater; - Develop an emergency spill response plan and train all construction contractors in the emergency spill response procedure;
	Fauna and flora Loss of natural vegetation and species of conservation value	• To minimise species loss and faunal habitat loss	- Plan and construct strip areas carefully to minimise the impact on flora species; - Avoid the unnecessary removal of vegetation; - Set and enforce speed limits to prevent accidental injury or death to animals. - Restrict vehicles to road and demarcated areas to prevent damage to vegetation. - Prevent disposal of waste in non-designated areas and the reputable clearing and disposal of any such waste, as these can cause harm to animals, particularly poisonous wastes and plastics.
	Noise Noise disturbance	• To reduce noise disturbance	- Restrict operational activities to normal working hours; - Service vehicles and equipment on a regular basis to ensure noise suppression mechanisms are functioning; - Limit the speed of vehicles to 40km/h; - Train workers in safety and the use of personal protective equipment to prevent damage to their hearing

Activity	Potential Impact	Objective	Mitigation or Control Measure
Construction, operational and decommissioning	Socio-Economic Negative impacts on employment and loitering of people in the area resulting in a lack of security and safety	• To minimise negative, and enhance positive impacts on employment • To bring positive change to local infrastructure requirements • To minimise negative impacts on safety of residents	- Where possible local service providers and workers will be recruited from the local area to increase employment opportunities during the construction phase; - Ad-hoc, informal recruitment at the gate or through other unapproved channels by setting up recruitment stands in built up areas will be prohibited; - A skills audit should also be undertaken to determine local skills available; - HIV/AIDS awareness programmes/ Voluntary Counselling & Testing Program will be introduced; - Relationships with local government through LED programmes should be developed - Stakeholder database will be established to identify partners and develop collaborative networks; - Uncontrolled settlement of contractors outside of the site will be prevented; - The recruitment selection process to promote gender equality and the employment of women wherever possible - SLP commitments will be implemented - Reach agreement with the municipality regarding mandates and responsibility for issues relating
	Interested and affected parties Lack of communication with stakeholders and loss of trust	• To manage IAPs comments and concerns	- Implementation of EMP recommendations, involvement of communities in LED initiatives, ongoing communication to provide feedback and updates; - IAPs must be kept up to date on any changes to transport routes and increase in truck frequency or of alternative routes;

Activity	Potential Impact	Objective	Mitigation or Control Measure
			- A complaints management system should be maintained by the mine to ensure that all issues raised by community members are followed up and addressed appropriately.
	Heritage resources Destruction of heritage resources	• To prevent and minimise damage to heritage resources	- In the event that any major feature such as a burial or cache of ostrich eggshell flasks is uncovered during mining operation, an archaeologist should be called in to evaluate the finds. - A buffer zone from all graves and grave yards close to construction activities will be established. - The mine will not hinder easy and safe access for relatives to the grave yards. - In the event of an archaeological artefact being unearthed, an accredited archaeologist will inspect the site and make recommendations; - Promote archaeological awareness and investigate sustainable initiatives with communities to promote the local culture.
	Land Use Loss of land use Proliferation of alien invasive species	• To reduce negative impacts on land use	- Incorporate an alien invasive eradication and control programme into the rehabilitation efforts. This programme should be formulated according to relevant legislation; - All temporary infrastructure will be demolished during closure
	Employment Loss of jobs and employment	•	- Opportunities for additional resources and redeployment, integration of employees and communities into sustainable LED projects, equip suppliers through mentorship and training; - Increased employment opportunities during decommissioning for local contractors; - Where short term employment opportunities exist during decommissioning, local contractors and jobs seekers will

Activity	Potential Impact	Objective	Mitigation or Control Measure
			receive preference; - The workforce should undergo multiple skills training during the operation of the mine so that they can be productively absorbed into the local economy after mine closure; - Where retrenchments are unavoidable, they will be managed humanely according to legislative requirements; - There should be adherence to the objectives and management measures stated with the Social and Labour Plan; - The workforce should be empowered to develop skills that will equip them to obtain employment in other sectors of the economy; - The LED plan should be implemented to assist local business development; - Local partners should be supported to diversify economy and decrease dependence on mining; - A strategy for saving jobs and management of downscaling and/or retrenchment should be implemented; - Assistance should be given for help with redeployment of retrenchees in other operations or assistance with alternative livelihood strategies; - Identify and implement training needs and training programmes for decommissioning and closure; - Consultation with communities and local government on future uses for the infrastructure and facilities should be implemented.

9.6 Action Plan

The personnel responsible for the roles highlighted under the management commitments in section 9.5., are outlined in **Table 27**. Their responsibilities entail the implementation of all the management measures under each of the environmental components affected during the impacts caused by the mine activities. All divisional managers will be allocated budgets as part of the operation costs, in order to implement the activities which fall under their area of responsibilities.

Table 27: Roles and responsibilities of personnel at Remhoogte/Holsloot Mine.

Environmental component	Responsible person	Time frame
Topography	Operations Mine Manager and ECO	Construction, operation and decommissioning
Soils	Operations Mine Manager, Earth Moving Manager, ECO, Plant and Maintenance Superintendant, and Mechanics	Ongoing
Land capability	Operations Mine Manager	Operation and decommissioning
Ecology	ECO, Operations Mine Manager	Construction, operation and decommissioning
Ground water	Operations Mine Manager, Metallurgist	Ongoing
Surface water	Engineering services, Metallurgist, SHEQ	Ongoing
Air quality	SHEQ	Ongoing
Noise	SHEQ	Ongoing
Visual	Operations Mine Manager, Exploration Manager	Construction, operation and decommissioning
Archaeology	Operations Mine Manager	Ongoing
Socio-Economic	Operations Mine Manager, Human Resources Manager, Stakeholder Liaison Manager	Ongoing

9.7 Environmental Awareness Plan

The objective of the environmental awareness plan is to ensure that:

- Training needs are identified and all personnel whose work may create a significant impact upon the environment have received appropriate training;
- All employees are aware of the impact of their activities
- Procedures are established and maintained to make appropriate employees aware of:
  - The significant environmental impacts (actual or potential) of their work activities and environmental benefits of improved personal performance,

- Their roles and responsibilities in achieving conformance with environmental policies, procedures, and any implementation measures,
- The potential consequences of departure from specified operating procedures.

- Personnel performing tasks, which can cause significant environmental impacts, are competent in terms of appropriate education, training and / or experience.

Environmental awareness will be part of the existing training and development plan. Key personnel with environmental responsibilities will be identified and the following principles will apply:

- Procedures will be developed to facilitate training of employees, on-site service providers and contractors;
- Environmental awareness will focus on means to enhance the ability of personnel and ensure compliance with the environmental requirements;
- Top management will build awareness and motivate and reward employees for achieve environmental objectives;
- Environmental policies will be availed to contractors;
- Environmental inductions will be conducted for employees, contractors and visitors;
- There will be an ongoing system of identifying training needs.

General environmental awareness training as part of the induction at Remhoogte should focus on the following:

- General environmental awareness
- The mine policies and vision concerning environmental management
- Legal requirements
- Mine activities and their potential impacts
- Different management measures to manage identified impacts
- Mine personnel's role in implementing environmental management objectives and targets

9.8 Emergency Plan

9.8.1 Terms and objectives

An emergency is defined as an unplanned situation or event resulting in involvement of the emergency services, police, fire, paramedic or the regulatory authorities; and includes accidents and emergency incidents.

The objective of an emergency plan is to ensure that all environmental emergencies are identified and linked to the identified significant risks; that they are made known to employees and surrounding communities; and to ensure that proper response actions are in place and that the latter is communicated to those who might encounter such emergencies.

An emergency plan will be developed for each potential emergency situation. Each plan should ideally provide easy reference to relevant basic information for handling the situation. The emergency plan is not intended to be a comprehensive instruction for handling the emergency. This can only be achieved through training and regular practise drills. Actual emergencies will be reported and followed up by means of the Safety, Health and Environment Management Procedures for Non-conformity, corrective action and preventative action procedures. Relevant government authorities will be contacted in case of the occurrence of an emergency as per legislative requirements.

Information relative to a particular emergency is documented in the respective emergency plan, and should include the following:

- Description of the emergency;
- Reference to relevant material safety data sheets;
- Responsibilities for management of emergencies;
- Contact telephone numbers (on- and off-site);
- Equipment required (including locations)
- Site plan where applicable.

Pioneer Minerals will commit to establishing and maintaining procedures to identify potential emergency situations, including responding to such emergencies and to mitigate any resulting safety, health and environmental impacts. In addition, the applicant will review its emergency procedures after each incident or annually. The following procedures will be developed:

- Handling of hazardous substance spills;
- Dealing with failure of mine residue disposal facilities;
- Identify potential for accidents;
- Respond to accidents and emergency situations;
- Prevent and mitigate environmental impacts.

9.8.2 Identification of potential environmental emergencies

Significant environmental aspects and their associated environmental impacts will be identified for all operation areas at Remhoogte. In formulating the emergency plan, the following factors were taken into consideration:

- All significant environmental aspects likely to result in emergency conditions;
- Fuel, oils and other materials used on site;
- Activities of contractors;
- Concerns of communities and authorities;
- Proximity to sensitive area such as residential facilities, schools, wetlands, rivers;
- Availability of local emergency services;
- Availability of trained, on-site personnel for emergency situations.

The potential emergency situations identified for the Remhoogte mine will include petrochemical/chemical spillages, hazardous material spillages, fires, slimes failure, explosions, natural disasters, and electrical failure. Emergency plans will be documented for each of these stipulated emergencies, which include responsibilities in emergency situations, corrective and preventative actions, and the reporting of such emergencies.

The applicant will address the following:

- Identification of emergency routes;
- Identification of fire extinguishers;
- Identification of spill containment equipment;
- Effluent drains, storm water channels, sewage treatment and other water systems;
- Site infrastructure such as bulk storage facilities;
- Prevailing wind conditions and neighbouring communities and facilities; and
- Emergency generators.

All employees and contractors working on the Remhoogte mining site are responsible for reporting any accident or emergency to their supervisor immediately. An emergency response team will be identified. The SHEQ is responsible for the annual reviewing of the applicable emergency response procedures in conjunction with the emergency response team.

9.8.3 Emergency response team

Personnel nominated as emergency response team members will receive appropriate training to manage emergencies. All other personnel will be made aware of potential emergencies and trained in evacuation and call out procedures. Where practical, personnel will participate in regular practise drills to test the effectiveness of the procedures and plans. Emergency plans should be reviewed and tested through practise drills at least once a year. The result of drills are reviewed and documented including any amendments to training, changes to procedures, plans or equipment.

Equipment associated with the identified emergencies will be maintained in the following manner:

- Each working area is responsible for the maintenance of fire extinguishers, fire hydrants, fire hose reels and first aid boxes;
- Machinery should be services and maintained on a regular basis and as required by the resident mechanic;
- The emergency response team will maintain all emergency equipment.

Emergencies will be reported within 24 hours by telephone or fax, to the relevant government authorities. In addition, a report is to be submitted to the Director-General of DENC within 14 days of the incident, and should include the following information:

- Contact person and contact details;
- Date and time of incident;
- Reference to Section 28 and 30 of NEMA
- Reference to Section 20 of the NWA
- The nature of the incident
- The substance involved and an estimation of the quantity released, along with the possible acute effect on persons and the environment, as well as the time needed to assess these effects;
- Initial measures taken to minimise impacts;
- Causes of the incident (direct or indirect), including equipment, technology, system or management failure; and
- Measures taken and to be taken to avoid a recurrence of such incidents.

9.9 Monitoring measures

A monitoring plan for all general monitoring purposes at the Remhoogte mine is provided in **Table 28**. In addition to this, specific criteria pertaining to the monitoring of water quality and air quality are discussed below.

Table 28: Monitoring plan for the Remhoogte mine.

Action	Frequency	Method
Monitoring of perimeter fences and all other fences on the mining site	Monthly and following any heavy rainfalls, until closure	Foot or vehicle patrol
Monitoring the re-vegetation of: • Mined out and rehabilitated areas • Levelled and rehabilitated dumps • Old roads • Rehabilitation plots • *Boscia albitrunca* • *Cleared areas*	Every 6 months, until closure	Foot inspection
Monitoring of erosion at: • Roads • Mine residue dam • Rehabilitated mined out areas • Dumps • Pumps and pipelines • Any other area where erosion occurs	Every 6 months and following heavy rainfall, until closure	• Visual inspection • Walk over rehabilitated areas • Drive along roads • Check pipelines and pumps, mine residue dam and dumps • Photographic records
Monitoring of alien invasive plants	On-going until under control, and thereafter every 6 months, until closure	• Visual inspection on foot • Map presence of invasive plants • Plan removal and document area covered on a monthly basis • Photographic records
Monitoring of water quality from selected points	Every 6 months, until closure	• Chemical and bacteriological tests at identified points • Build up database and graph the results • Compare with limits and take

		action on non-conformance
Monitoring of all rehabilitated areas	Every 6 months, until closure	Survey and map new rehabilitated areas
Evaluate compliance with gradients and variation in topography	Annually, until closure	Plot, map and calculate areas treated
Monitor the stability of the mine residue deposit and water storage facilities	Monthly, and summarise every 6 months, until closure	• Record each load sent off • Give used oils to oil recycling companies • Ensure safe disposal certificates are obtained from suppliers if the materials are given back to them
Monitoring of maintenance of general waste disposal	All loads of waste to be recorded, along with their quantities, until closure	Running total of loads of waste taken to the Prieska waste disposal site
Monitoring of conditions of the septic tanks/sewage works	Every 6 months, until closure	• Visual inspection • Record conditions
Monitoring of conditions of bunded areas around diesel fuel tanks, refuelling areas, old oil tanks, storm water facilities	Every 6 months, until closure	Visual inspections
Monitoring of water use related activities in terms of Section 21 of the NWA	Monthly, until closure	• Record total water use by recording flow meters • Ensure compliance with licenses
Ground water monitoring	Bi-annually, until closure	Testing ground water quality of existing boreholes

9.9.1 Water monitoring

The purpose of adhering to the monitoring program is to provide timely and accurate water quality data to the Department of Water Affairs and to manage impacts caused by the mining activities. The specific objectives of the water quality monitoring program are as follow:

- Determine whether water quality at sampling points exceed water quality standards;
- Assess the status of water quality in the surrounding areas;
- Provide analytical water quality information that describe present conditions and changes;
- Provide timely data for other users;
- Numerical water quality objectives

The numerical water quality objectives aim to limit the adverse effect of pollutants in the water resources. The setting of in-stream Resource Water Quality Objectives (RWQO) is based on South African Water Quality Guidelines and the water users in the study area. The RWQO were only developed for the priority catchments to protect the users within the catchment. Therefore, no RWQOs are currently available for the Orange River (Upper and Lower). Nevertheless, the preliminary RWQOs for the Prieska – Lower Orange Water Management Area are used to evaluate water results, as seen below:

Variable group	Variable	Units	Present State	Ref. value	RWQO Model	User	RWQO New	Reason	Alloc Value
Physical variables	Hardness	mg/l	118	–	200	Dom In3	200	–	82
	EC	mS/m	33	38	70	Dom In3	55	Eco-A	22
	pH 5th		-	-	6.5	Alr In3	7.2	5 % dev	0.4
	pH 95th		8.3	-	8.0	In3	8.4	Alr	0.1
	TSS	mg/l	29.3	221	5	In3	50	Alr-I	20.7
Chemical variables	Alkalinity	mg/l	103	146	300	In3-I	300	-	197
	Ammonia	µg/l	15	–	15	Eco-I	58	Eco-A	43
	Calcium	mg/l	26.7	43.5	10	Dom-I	80	BHN	53.3
	Chloride	mg/l	24.7	26.1	100	Dom Air	100	–	75.3
	Fluoride	mg/l	0.19	0.46	0.7	Dom-I	0.7	–	0.51
	Magnesium	mg/l	12.4	18.7	70	Dom-I	70	Dom-I	57.6
	Potassium	mg/l	2.23	3.8	25	Dom-I	25	Dom-I	22.7
	SAR	mmol/l	1.1	0.91	2	Alr-I	2.0	-	0.9
	Sodium	mg/l	27.0	29.7	70	Alr-I	70	–	43
	Sulphate	mg/l	36.2	59.7	200	Dom In3	100	Rec d/s	63.8
	TDS	mg/l	238.4	336	260	Air	360	Eco-A	121.6
Chemical micro & metals	Al	µg/l	95	–	20	Air	150	Eco-T	55
	Cd	µg/l	<1	–	0.000	Dom-I	3	Dom-I Alr	2
	Cu	µg/l	4	–	0.000	Air	10	Prop-Pr	6
	Fe	µg/l	92	–	300	In3	100	Dom-I	8
	Mn	µg/l	9	–	20	Air	20	Dom-I	11
	Pb	µg/l	<10	–	0.000	ASw	50	Dom-A	40
	V	µg/l	8	–	100	Alr-I	100	-	92
	Zn	µg/l	7	–	1000	Alr-I	36	Eco-Rec	29
Nutrients	PO_4-P	µg/l	25	11	10	Eco	30	Eco-A	5
	NO_3&NO_2-N	mg/l	0.30	0.11	6.0	Dom	0.40	Eco-Rec	0.10
	DIN	mg/l	0.46	0.17	0.25	Eco-N	0.50	Eco-A; Rec	0.04
	Si	mg/l	5.6	8.9	20	In3	20	–	14.4
Response variable	Chl-a	µg/l	18	–	15	RFull	20	Eco-T	2
	Diatoms*	SPI	12.2	–	–	–	9 – 13	Mod qual	-
	E. coli	/100ml	52	–	–	–	130	RFull	78

* Snapshot values; AAq: Agriculture – Aquaculture; A: Acceptable; Alloc: Allocatable; Alr: Agriculture – Irrigation; ASw: Agriculture – Stock watering; BHN: Basic Human Needs; Dom: Domestic; d/s: downstream users; Eco: Ecosystem requirement; I: Ideal; In3: Industrial – Category 3; Nat: Natural; N-lim: Nitrogen limitation; Rec: recommended value; Ref: Reference value; RFull: Recreation – Full contact; T: Tolerable.

Four water quality monitoring points are recommended, in line with the requirements of the Best Practice Guidelines in order to indicate upstream and downstream water quality. An additional three water quality monitoring points are recommended, in order to indicate water quality of water use at the site. These seven monitoring points are located as follow:

Monitoring point 1 - Located on the confluence of the unknown tributary with the Diepsloot stream

Monitoring point 2 - Located downstream of the site before the confluence with the Orange River

Monitoring point 3 - Located on the western tributary of the Orange River

Monitoring point 4 - Located upstream of the Remhoogte mine

Monitoring point 5 - Located at the pump site in the Orange River

Monitoring point 6 - Located at the return water dam on site

Monitoring point 7 - Located at the slimes dam on site

9.9.2 Air quality

To assist the mine in complying with the National Environmental Management: Air Quality Act 39 of 2004, monitoring of air quality should be undertaken. This monitoring will be by means of assessing fallout dust impact generated by the mining activities. A specialist consultant will be appointed to conduct these tests. Specific objectives for air quality monitoring include:

- Determine whether air quality impacts generated by the mine exceed air quality standards;
- Provide analytical air quality information that describe present conditions and changes;

The methodology used for these assessments is known as the "Standard Test Method for Collection and Measurement of Dust fall (Settleable Particulate Matter) D1739 – 98" and include the following procedure:

Four x 2 m high single bucket receptors are placed at strategically positioned locations to accommodate the prevailing wind directions in relation to dust generating sources on the mine. The following locations are used in order to ensure consistent and comprehensive measurement of environmental impact on the surrounding area:

Location 1 - South west

Location 2 - Gate

Location 3 - Windpump

Location 4 - Plant

The criteria and thresholds used to evaluate dust fall on the mine is shown in **Table 29**.

Table 29: Criteria to evaluate dust fallout on Remhoogte/Holsloot

Four band scale evaluation criteria			
Band number	**Band description label**	**Dust fall rate (D) (mg/m²/day; 30 day average)**	**Comment**
1	Residential	D < 600	Permissible for residential and light commercial
2	Industrial	800 < D < 1200	Permissible for heavy commercial and industrial
3	Action	1200 < D < 2400	Requires investigation and remediation if two subsequent months lie in this band, or if more than three occur in one year
4	Alert	2400 < D	Immediate action and remediation required following the first incidence of dust fall rate being exceeded, incident report to be submitted to relevant authorities.
Dustfall standards, targets, actions and alert thresholds for dust deposition			
Level	**Dust fall rate (mg/m²/day)**	**Permitted frequency of exceeding**	
Target	300	-	
Action residential	600	Three within any year, no two sequential months	
Action industrial	1200	Three within any year, not sequential months	
Alert threshold	2400	None. First exceeding requires remediation and compulsory report to authorities	

9.10 Environmental objectives and goals for mine closure

9.10.1 Rehabilitation of infrastructure areas

The objectives for the removal of infrastructure and the subsequent rehabilitation of the areas they occupied include:

- To ensure that infrastructure identified for removal is successfully demolished and removed.
- To ensure that infrastructure identified to remain after mine closure is maintained until the issue of a closure certificate.

The removal, decommissioning and disposal of all mining infrastructure, will comply with all conditions contained in the MPRDA. To this end, decommissioning and rehabilitation of all infrastructure areas will follow the following principles:

- The plant and associated disused infrastructure will be dismantled or demolished. Any building foundations will be removed and land exposed to the demolition and dismantling of infrastructure and all other disturbed land will be rehabilitated.
- Rubble will be disposed of at a suitable site. The site will be selected in consultation with DENC.
- Any surface water management infrastructure will be maintained to ensure they are stable and functional.
- Just before closure, when disturbed land has been rehabilitated and erosion is controlled by vegetation cover, all disused surface water management facilities will be decommissioned.

9.10.2 Mine residue deposits

The mine residue deposits comprise of a slimes dam. The objectives pertaining to the effective management and rehabilitation of the slimes dam included:

- To ensure that the mine residue deposits are stable and that there is an acceptably low risk of failure of these deposits during the decommissioning phase and following mine closure;
- To establish self-sustainable vegetation cover on the slimes dam so that the visual impact of the slimes dam is improves and in order to prevent erosion.

Management principle pertaining to the slimes dam includes:

- The slimes dam/s will continuously be inspected by a suitable qualified professional engineer to ensure their stability. If they are unstable, the appropriate remedial measures will be implemented.
- Inspection and monitoring should continue until a suitable qualified profession engineer has confirmed the long-term stability of the slimes dam.

- Any infrastructure or facilities that serve the slimes dam will be maintained to ensure that they are both stable and functional.

9.10.3 Maintenance

The necessary agreements and arrangement will be made by Pioneer Minerals to ensure that all natural physical, chemical and biological processes for which a closure condition were specified are monitored until they reach a steady state or for three (3) years after closure or as long as deemed necessary at the time.

- Such processes include erosion of the slimes dams, rehabilitated surfaces, surface water drainage, air quality, surface water quality, ground water quality, vegetative re-growth, weed encroachment.
- The closure plan will be reviewed yearly.
- Rehabilitation of the land will be maintained until a closure certificate is granted or until the land use is regarded as sustainable.
- All rehabilitated areas will be monitored and maintained until such time as required to enable the mine to apply for closure of these different areas.

9.10.4 Performance assessments

As per the MPRDA and associated Regulations, this Environmental Management Programme will be continually assessed in terms of its appropriateness and adequacy. In order to achieve this, Pioneer Minerals will undertake the following:

- Implement the necessary monitoring programmes, as discussed as part of this EMPR;
- Conduct performance assessments of this EMPR as required by the MPRDA and associated Regulations; and
- Compile and submit the afore-mentioned performance assessment reports to the DMR. The frequency of the performance assessments will occur every year. An independent and competent person will undertake all performance assessments.

9.10.5 Performance assessments

The key aim decommissioning and closure is to ensure that all the significant impacts are ameliorated. All rehabilitated areas will be left in a stable, self-sustainable state. Proof of this will be submitted at closure. Specific objectives include:

- To identify potential post-closure land uses in consultation with the surrounding land owners and land users. This should be done during the operational phase of the mine.
- Rehabilitate disturbed land to a state that is suitable for its post-closure uses;
- Rehabilitate disturbed land and mine residue deposits to a state that facilitates compliance with applicable environmental quality objectives.
- Limit the impact on staff whose positions become redundant at the time of mine closure, as addressed in the SLP.
- Keep relevant authorities informed of the progress of the decommissioning phase;
- Submit monitoring data to the relevant authorities;
- Maintain required pollution control facilities and rehabilitated land until closure;
- Maintenance of the protected endorheic pan, if needed reconstruct the drainage around this pan.

9.10.6 Negative economic impacts

The objective is to alleviate the negative socio-economic impacts that will result from mine closure. Management principles to achieve this include:

- Pioneer minerals will undertake a carefully planned step-wise decommissioning process.
- Closure planning will form an integral part of mine planning.
- Strategies for sustainable development of surrounding towns have been and will continue to be developed by the project in collaboration with district and local authorities, local businesses and other interested parties. Early warning of impending closure will be given to IAPs.
- In conjunction with long-term closure planning, the mine will actively participate in regional and local planning to enhance the economic benefits of the project through development of alternative forms of income generation.

- Pioneer Minerals will initiate and participate in regional planning exercises that will mitigate the impacts of closure of the Remhoogte/Holsloot mine, the local and regional economies and associated abandonment of community infrastructures surrounding the mine.
- The mine will fulfil the requirements for closure and the management of downscaling as contained in the SLP.

10 CLOSURE QUANTUM

Financial provision is mandatory in guaranteeing the availability of sufficient funds to provide for the final requirements during closure of the Remhoogte mine. The operation and associated infrastructure is assessed, and funds are transferred to a rehabilitation trust fund on a yearly basis for this purpose.

10.1 Infrastructure

10.1.1 Dismantling of processing plant and related structures

A total of four sorting pans are utilised for the purpose of the Remhoogte mining activity, which overall occupies a volume of 3550 m².

10.1.2 Rehabilitation of access roads

Access roads created at the Remhoogte mining area that will need to be rehabilitated amounts to a total of 23.71 Ha.

10.2 Excavations

10.2.1 Opencast rehabilitation

Opencasts on the Remhoogte mining area occur in the form of mine pits. Rehabilitation takes place concurrent to the mining operation and a total area of approximately 228.18 ha will be in need of rehabilitation during mine closure.

10.2.2 Rehabilitation of overburden and spoils

The overburden and spoils at the Remhoogte mining area covers an area of approximately 29 ha.

10.2.3 Rehabilitation of slimes dam

The slimes dam utilised for slimes generated by the Remhoogte mining operation has no polluting potential and covers an area of 1.21 ha.

10.2.4 General surface rehabilitation

General surface rehabilitation includes the removal of temporary fences, power lines and the water pipe. It also includes possible areas contaminated with soil, diesel, etc. The total area expected to receive general surface rehabilitation amount to a total of approximately 5 ha.

10.2.5 Environmental liabilities not applicable to the mining operation

Due to the transient nature of an alluvial diamond mining operation, the Remhoogte operation will not establish any steel buildings, reinforced concrete buildings, or structures. Neither will permanent housing or administration facilities be established. No railway lines will be needed for the Remhoogte mining operation and no permanent fences will be erected. There will also be no river diversions either.

Due to the low pollution hazard of an alluvial diamond mining operation, it is not expected that water management or specialist studies will be needed at mine closure. The transient nature of the operation also limits the need for maintenance and aftercare of the mining site.

11 CONCLUSION AND CURRENT IMPACTS

The proposed development was conducted in accordance with the Environmental Impact Assessments Regulations of 18 June 2010 in terms of the National Environmental Management Act (NEMA), 1998 (Act 107 of 1998). The Environmental Impact Assessment (EIA) process consisted of several phases:

- The notification stage in which directly affected landowners, neighbouring landowners, stakeholders, communities, interested parties, key stakeholders as well as authorities were notified of the proposed development. Initial information in the form of a Background Information Document was also supplied to these parties. A communication channel was initiated with these parties to obtain queries and concerns and also to provide information to these parties.
- The EIA stage wherein the specialist input is incorporated and the likely impacts arising from these are considered in respect of the proposed development. The phase includes the development of mitigation measures and the development of an Environmental Management Program (EMPr).

The diamond industry is an international trade and one that involves a number of processes between the mining and extraction of the rough product, through to the polished diamond jewellery of the retail sector. The value of the industry is primarily dependent on the consumers' demand.

The production from Remhoogte has an average stone size in excess of two carats, which being predominantly made of gem and near-gem quality, will likely have a current average value of more than USD 2 000 per carat. The mining project will employ a total of 185 people and invest a total of R 475 000 in Human Resource development, R 600 000 in Infrastructure Development Projects, R 100 000 in Sustainable local economic development and R 220 000 in the creation of Small and Medium Enterprises.

Several alternatives has been considered for the mining operations as follows:

Land use

An alternative land use other than mining. A soil and land capability evaluation determined that the mining area has low agricultural potential. The size and depth of the deposit has been determined by means of an extensive exploration programme over a period of years. Therefore mining land

has been determined as the most feasible alternative. Furthermore, historical diggings have deteriorated the grazing potential and the carrying capacity.

Infrastructure placement

The location of mining infrastructure has been specifically chosen in relation to the proximity to the access roads, proximity to the areas earmarked for mining and limited additional impact on the environment. This renders the consideration of further alternative locations in terms of the mine site location, other than the mine residue deposits, unnecessary.

Fuel storage

Alternatives considered for fuel storage included surface storage, underground storage and the storage of fuel in mobile tanks with a metal bund wall. Underground storage has an adverse negative pollution potential, because it is not easy to monitor leakages. Remediation measures are also not as effective as compared to surface storage tanks. Mobile tanks are the most viable option for infield screening activities.

Water use

The temporary transfer of agricultural water from the farm Middelwater was considered as an alternative water use. However, a pipeline was considered to be the best long term option. Therefore, a pipeline route was designed based on the principle of minimum impacts to the environment and to avoid the disturbance of graves (**Figure 25**). This pipeline utilises the current road reserve and thereby minimises the footprint of the operation.

Mine residue dam

Two alternative localities were considered for the mine residue dam and a risk assessment was completed following the SIMRAC Guidelines. An area east of the mining offices complex was deemed undesirable, mainly because it lies in close proximity to the farm workers' accommodation; thereby endangers wandering people. The current locality of the mine residue dam was found to be most beneficial with the lowest impact.

No-Go

The No-Go option would entail a loss of a total of 185 job opportunities. The non-approval if this mining operation would impact negatively on the employment rate for the region and the families who are likely to benefit from the positive employment opportunities. Simultaneously, it may have a negative effect on the economy of South Africa and the diamond industry as a whole.

The implementation of the Remhoogte mine will have a potential impact on the biodiversity through removal of indigenous vegetation and destruction of habitats. If no mining activities were to continue, the status quo would apply and no damage would accrue to the environment. It must be added, however, that the mine intends to conduct continuous rehabilitation on all areas where vegetation is cleared, as well as on mine residue deposits.

Likely impacts caused by current mining operations

Current mining and excavation is likely to have impacted moderately on surface topography. Although the mining area contains a relatively flat topography the excavation of material will have an impact on topography as it will be unlikely to re-instate the topography to exactly the natural condition. Furthermore, previous mining activities has already impacted on topography which makes the establishment of the natural topography in these areas impossible.

The impact on soil erosion is not clearly evident as a result of current mining and is therefore not considered pronounced. However, clearing of vegetation is likely to cause some level of erosion and it is considered likely that a low amount of erosion is occurring.

Together with limited erosion, excavation and some alteration in topography an amount of loss in soil fertility is inevitable.

It is considered unlikely that any pronounced pollution or impact on surface and ground water has been caused by current mining activities.

Previous mining activities has caused damage to some of the endeorheic pans on the site. However, current mining has had a low impact due to the exclusion of these pans from the mining area.

Current mining has had a significant impact on the loss of natural vegetation. Through the excavation of material it is required to clear the vegetation layer and although rehabilitation seems to be adequate the re-establishment of an exact natural vegetation layer of similar species composition is unlikely. Together with this a low amount of protected species will also be removed. Although transplanting and re-establishment of protected species is taking place the success rate will never be 100%. Due to clearing of vegetation and disturbance of the soil profile the area is also susceptible to alien vegetation establishment. Currently no pronounced infestation is evident in mining areas although this will have to continually monitored.

The impact on fauna due to current mining is also considered to be significant as the clearing of vegetation will lead to the loss of habitat and the displacement of fauna.

The loss, damage and fragmentation of habitat is considered to have a low-moderate impact due to current mining activities. The scale of the mining area is not extensive and as long as rehabilitation is adequate it will not lead to fragmentation of habitats.

Dust emissions and noise pollution is considered a low impact due to the current mining activities. Constant monitoring and mitigation will keep these impacts low.

Due to the isolated location of the mine the visual impact is relatively low. Infrastructure and spoil heap height is not such that it negatively impacts on the visual aesthetics.

The impact on road traffic and safety and the deterioration of the road infrastructure is relatively low. Traffic on the public roads remain low and as a result deterioration of the public road is also low. Roads are being maintained in good order.

Current mining activities has excluded all sensitive heritage areas and consequently the impact on heritage resources is relatively low.

Security at the mining site is at a high level and consequently security risks and increase in crime is highly unlikely.

The relationship with I&AP's is currently still on a good standing.

APPENDIX: A

Specialist Reports

APPENDIX: A1

Soil specialist report

APPENDIX: A2

Geohydrological assessment report

APPENDIX: A3

Stormwater and wetland assessment report

APPENDIX: A4

Botanical specialist report

APPENDIX: A5

Traffic assessment report

APPENDIX: A6

Hertiage impact assessment report

APPENDIX: B

Public participation process

APPENDIX: C

Recent monitoring results