ENVIRONMENTAL IMPACT ASSESSMENT
ENVIRONMENTAL MANAGEMENT PLAN
VAAL SAND – BANKFONTEIN OPERATION

COPPER SUNSET TRADING 324 (PTY) LTD.

TRADING AS:

VAAL SAND

DECEMBER 2007

Prepared By:
Digby Wells & Associates
Environmental Solutions Provider
Private Bag X10046,
Randburg, 2125,
South Africa
Tel: +27 (11) 789-9495
Fax: +27 (11) 789-9498
E-Mail: info@digbywells.co.za

Environmental Solutions Provider

EXECUTIVE SUMMARY

Digby Wells and Associates (DWA) has been appointed by Vaal Sand as independent environmental consultants to undertake the social and environmental studies related to a mining right application as well as for the compilation of the relevant documentation.

Vaal Sand is applying for a Mining Right to mine General Sand on the farm Bankfontein 9 near the town of Vereeniging. Bankfontein is located in the Free State Province approximately 10 km from the border with Gauteng.

In order to comply with the requirements of the Minerals and Petroleum Resources Development Act, 2002 (Act 28 of 2002) ("the MPRDA"), an environmental Scoping Report was compiled and submitted to the Regional Manager of the Department of Minerals and Energy (DME), Free State.

Project Description

The Bankfontein 9 farm is located 11 km south of Vereeniging and 13 km north east of Sasolburg and falls within the Fezile Dabi District Municipality and the Metsimaholo Local Municipality of the Free State Province.

The deposit extends over an area of approximately 600 ha, with an estimated thickness of between 2.0 m and 2.5 m. Exploitable sand lies between 0.35m and 0.5m below the surface. The total deposit is thus of the order of 7 million bulk cubic meters (BCMs); assuming a yield of 85% and average monthly sales of 30 000 BCMs, the economic life of the mine is approximately 15-20 years.

The mining method will be strip mining and dozers and trucks will be used to mine the sand. The sand will be removed in strips of 50 m by 200 m and approximately 2.5 m to 3.0 m deep. As each strip is excavated, the overburden will be placed in the excavation previously mined.

Pre Mining Environment

Aspects that were investigated during the execution of the project included the climate, topography, geology, soil, surface and groundwater, land capability, land use, air quality, noise, natural vegetation, animal life, sites of archaeological and cultural interest, sensitive landscapes, visual aspects, traffic and safety, the regional socio-economic structure and interested and affected parties. The various specialist reports that were compiled are appended to the Environmental Impact Assessment/Environmental Management Programme (EIA/EMP) Report where relevant.

Environmental Impact Assessment Methodology

The Environmental Impact Assessment (EIA) uses a rigorous, numerical environmental significance rating process to determine the significance, frequency and severity of an impact. The impact rating process is designed to provide a numerical rating of the various environmental impacts identified by use of the "Input-Output" model. The process is based on the accepted impact assessment methodology that uses the probability of an event occurring and the severity of the impact, should an event occur, as factors to determine the significance of a particular environmental risk.

In order to determine the severity of any potential environmental impact, the criteria that are taken into consideration are the spatial extent of the impact, the duration of the impact and the severity of the impact. The probability of an impact occurring is determined by the frequency at which the activity takes place and by how often the type of impact in question has taken place or takes place in similar circumstances. The values assigned to these factors (weighting) are discussed as part of the EIA.

Some of the key findings that were identified during the impact assessment include the following:

- The permanent loss of soil;
- Loss of fauna flora during the operational phase of the operation;

- A possible increase in vehicle and pedestrian accidents due to an increase in vehicle movement on and around the proposed mining area;
- Change in topography due to the removal of the sand;
- Employment opportunities; and
- An increase in economic activities in the surrounding area.

Public Participation Process

The Public Participation Process (PPP) for Vaal Sand attempted to ensure that all Interested and Affected Parties (IAPs) were adequately involved in the project. IAPs were afforded the opportunity to participate in and contribute to the EIA/EMP studies. Stakeholders were presented with detailed and up-to-date information regarding the Vaal Sand Mining Rights Application to ensure that all feedback was relevant and well-informed.

A number of significant issues and findings were uncovered. The most pertinent positive project impact was identified as being the continuation of existing employment opportunities, and with this a few families' lives would be enhanced. Negative impacts, such as water, dust and roads were of concern to stakeholders. Most concerns were raised by authorities who attended the meetings.

Management and Monitoring

The management plan should be used to address impacts that were identified during the impact assessment. Monitoring is required in order to check compliance with agreed upon standards or objectives and targets. During pre-construction, construction, decommissioning and closure monitoring would be used to check compliance with regulations while post closure monitoring is to ensure aftercare and maintenance of post closure objectives.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLANS

LIST OF APPENDICES

1 INTRODUCTION

Vaal Sand has applied for a Mining Right to mine General Sand on the farm Bankfontein 9 near the town of Vereeniging. Bankfontein is located in the Free State Province approximately 10 km from the border with Gauteng.

In order to comply with the requirements of the Minerals and Petroleum Resources Development Act, 2002 (Act 28 of 2002) ("the MPRDA"), an environmental Scoping Report was compiled and submitted to the Regional Manager of the Department of Minerals and Energy (DME), Free State.

The Scoping Report was used as a guide for compilation of the Environmental Impact Assessment Report (EIA), and the Environmental Management Programme (EMP). These documents provide detail on the proposed project, the methodology which was used for conducting the EIA, the current state of the environment, the various environmental impacts that are likely to occur during all phases of the project and the mitigation measures that are proposed for implementation.

Digby Wells and Associates (DWA) has been appointed by Vaal Sand as an independent environmental consultant to undertake the submission of a Mining Right application and the relevant social and environmental reports associated with such an application.

2 METHODOLOGY

2.1 Scoping

DWA has been appointed to investigate the social and environmental aspects of the proposed mining site. The investigation included the bio-physical and socio-economic aspects and gave a general evaluation of the current environment.

The scoping phase was necessary in order to identify potential issues that might be associated with the project, as well as facilitate the process of compiling the Environmental Impact Assessment/Environmental Management Programme (EIA/EMP) and thus is a critical stage in the environmental management process. This scoping report was compiled

through information obtained from the client, site visits, interviews, literature reviews, and reference documentation.

During the scoping phase the public were informed of the proposed project through an extensive consultation exercise. The Public Participation Process (PPP) is of great importance as those stakeholders affected by the project are given an opportunity to identify issues, while ensuring that local knowledge and values are understood and utilised. The views that were uncovered during this phase have been taken into account when deciding between alternative actions, in exploring the importance of issues, and in framing mitigating measures, compensation provisions and management plans.

The final process for the scoping phase was the description of the nature and extent of further investigations required in the impact assessment. This included issues identified that required more in-depth investigation to gather the information needed to compile an appropriate mitigation plan.

2.2 Environmental Impact Assessment

As was indicated in the assessment of the significance of potential environmental impacts in the Scoping Report, the EIA uses a more rigorous, numerical environmental significance rating process than was used in the Scoping Report. Both processes are based on the accepted impact assessment methodology that uses the probability of an event occurring and the severity of the impact, should an event occur, as factors to determine the significance of a particular environmental risk.

In order to determine the severity of any potential environmental impact, the criteria that are taken into consideration are the spatial extent of the impact, the duration of the impact and the severity of the impact. The probability of an impact occurring is determined by the frequency at which the activity takes place and by how often the type of impact in question has taken place or takes place in similar circumstances. The values assigned to these factors (weighting) are discussed as part of the EIA (Section 6).

In order to clarify the purpose and limitations of the impact assessment methodology, it is necessary to address the issue of subjectivity in the assessment of the significance of environmental impacts. Even though DWA, and the majority of Environmental Assessment

Practitioners (EAPs), propose a numerical methodology for impact assessment, one has to accept that the process of environmental significance determination is inherently subjective. The weight assigned to each factor of a potential impact, and also the design of the rating process itself, is based on the values and perception of risk of members of the assessment team, as well as that of the Interested and Affected Parties (IAPs) and authorities who provide input into the process. Whereas the determination of the spatial scale and the duration of impacts are to some extent amenable to scientific enquiry, the severity value assigned to impacts is highly dependent on the perceptions and values of all involved. It is for this reason that it is crucial that all EIAs make reference to the environmental and socio-economic context of the proposed activity in order to reach an acceptable rating of the significance of impacts. Similarly, the perception of the probability of an impact occurring is dependent on perceptions, aversion to risk and availability of information.

It has to be stressed that the purpose of the EIA process is not to provide an incontrovertible rating of the significance of various aspects, but rather to provide a structured, traceable and defendable methodology of rating the relative significance of impacts in a specific context.

The EIA assesses environmental and social impacts according to different stages of the proposed project, namely: the construction, operational, decommissioning and post closure phases. Impact and benefit significance are assessed before and after the application of any mitigation measures and refer to effects on both the ecological and social environment.

Lastly, the cumulative impacts of the proposed operation on the environment, with reference to similar operations and activities in the area are discussed.

2.3 Environmental Management Programme

This document aims to address all environmental impacts likely to occur during the execution of the project and to give a description of the general environment.

As the EIA indicates the relative significance of the various environmental impacts associated with mining activities, it serves to focus the allocation of resources on environmental aspects and specific impacts requiring mitigation. The aim of the mitigation measures is to minimise the negative impacts and enhance the positive aspects of the project, as well as to inform, involve and improve the local communities in the process. In

terms of Section 39 (1) of the Minerals and Petroleum Resource Development Act (MPRDA), an EMP must describe the manner in which the applicant intends to:

- Modify, remedy, control or stop any action, activity or process which causes pollution or environmental degradation;
- Contain or remedy the cause of pollution or degradation and migration of pollutants; and
- Comply with any prescribed waste standard or management standards or practices.

The EMP section is divided into setting objectives and planning of management measures. The monitoring and performance assessment section of the EMP details the annual monitoring and audits that will be implemented to ensure the effectiveness of mitigation measures.

2.4 Submission of Information

In terms of the MPRDA regulations, the sequence of submission of information includes:

- Application for a Mining Right which includes, amongst others, a Mining Work Programme and a Social and Labour Plan;
- Submission of a Scoping Report as contemplated in regulation 49 of the MRPDA regulations; and
- Submission of an Environmental Impact Assessment and Environmental Management Programme as contemplated in regulation 50 and 51 of the MPRDA regulations.

The Scoping Report was submitted to the Department of Minerals and Energy's (DME's) Bloemfontein Regional Office. This report is, therefore, the final step in the submission of information to complete the Vaal Sand EIA/EMP.

3 PROJECT DESCRIPTION

3.1 Project Introduction

Vaal Sand is applying for a mining right to mine general sand from Bankfontein 9. The deposit extends over approximately 600 ha and contains around 7 million Bulk Cubic Meters (BCMs). Strip mining will be used to remove the sand. Sand will be transported to the different clients with trucks ranging in volume from 6 m^3 to 30 m^3. The expected life of mine based on current estimations is 15-20 years.

3.2 Project Processes

The project processes followed for the proposed Vaal Sand EIA/EMP have been in accordance with the MPRDA Regulations of April 2004. The following processes have been followed:

- Compilation of an environmental Scoping Report – done in accordance with regulation 49 of GN R527 of April 2004;
- Compilation of an Environmental Impact Assessment – done in accordance with regulation 50 of GN R527 of April 2004; and
- Compilation of an Environmental Management Programme - done in accordance with regulation 51 of GN R527 of April 2004.

3.3 Applicant Details

Name of Applicant	Copper Sunset Trading 324 (Pty) Ltd. Trading as Vaal Sand
Person Responsible	Gert Kappler / Rudi Wolter
Postal Address	P.O. Box 413712, Craighall, 2024
Telephone No.	011 787 9274
Fax No.	011 326 4647

A declaration that the applicant is conversant with the mine health and safety act has been attached in **Appendix A**.

3.4 Regional Setting

The Bankfontein 9 farm is located 11 km south of Vereeniging and 13 km north east of Sasolburg and falls within the Fezile Dabi District Municipality and the Metsimaholo Local Municipality of the Free State Province (Plan 1, **Appendix B**).

3.5 Description of the Project

3.5.1 Deposit

The deposit extends over an area of approximately 600 ha, with an estimated thickness of between 2.0 m and 2.5 m. Exploitable sand lies between 0.35 m and 0.5 m below the surface. The total deposit is thus of the order of 7 million BCMs; assuming a yield of 85% and average monthly sales of 30 000 BCMs, the economic life of the mine is approximately 15-20 years.

The deposit lies adjacent to the Lethabo Power Station and was previously undermined by Anglo Coal.

Plan 2 indicates the boundaries of the proposed mining area.

3.5.2 Mining method

Top soil, up to 350 mm, will be removed with a bulldozer and stored separately in a stockpile which will act as a berm. The mining method will be strip mining and dozers and trucks will be used to mine the sand. The sand will be removed in strips of 50 m by 200 m and approximately 2.5 m to 3.0 m deep. As each strip is excavated, the overburden will be placed in the excavation previously mined.

Raw sand will be screened in the process plant to remove impurities. Discard from the screening process will be disposed of in the pit. The discard will only consist of plant roots and other larger particles that exist in the soil before it is mined. The discard will have no impact on the environment as thus can be safely disposed of in the pits. The clean sand will be conveyed to an off take stockpile from where it will be loaded on trucks and delivered to clients.

The operation requires approximately 24 skilled or multi-skilled employees.

3.5.3 Mine products

General Sand, which comprises 90% plaster sand and 10% building sand, will be mined at Bankfontein. Vaal Sand intends to supply a number of clients who will most likely use the sand in the construction industry in the rapidly growing Northern Free State and Gauteng area.

3.6 Servitudes and Infrastructure

Vaal Sand will attempt to hire the necessary buildings from the existing Bertha Village for the proposed operation. These buildings include offices, toilets, a kitchen, store-room, and a workshop. The existing sewage systems will be used and thus no pollution will occur. If there are no buildings available in close proximity to the proposed mining area then these buildings will have to be constructed.

There are several ESKOM power transmission lines that traverse the site, south east of the Bertha Village. There is currently one access road on the southern boundary of the proposed mining area, which extends to the north of the site. An access road on the northern boundary of the Bertha Village also exists and will be used as the main access to the sand operation.

3.7 Waste Management

The only industrial waste will be from the material screened from the sand and left in the pits. Domestic waste will be transported and dumped at the Sasolburg Municipal dumping site. Permission to do so was granted by the municipality (**Appendix C**)

All used oil is currently stored in plastic drums and is collected by Nora Oil Recycling (Pty) Ltd on a monthly basis this will continue to occur at the new mining site. All new and used oil will be stored in a concrete bunded area where no seepage can occur into the groundwater.

3.8 Management of Stockpiles

Topsoil will be stockpiled in a berm of 200 m and the height will not exceed 3 m. The overburden of the first few pits will be stockpiled such that they can be used to close the last open strips.

Due to the lack of watercourses on the site there is no risk of sedimentation occurring should erosion from the stockpiles occur.

3.9 Water Use and Resources

Water for domestic use will be obtained from the reservoir in the Bertha Village. Water form this reservoir will also be used for dust suppression.

4 DESCRIPTION OF AFFECTED ENVIRONMENT

4.1 Climate

4.1.1 Description of regional climate

This area falls under the Moist Highveld Grassland climatic zone (Kruger, A. C. 2004). This region is characterised by cold, dry winters, lasting from April to September, and warm, wet, summers (Schulze, et al. 1997).

4.1.2 Mean annual rainfall and precipitation

The Mean Annual Precipitation (MAP) for this area is approximately 585 mm with the highest concentrations coming between October and March. The winter months (June – August) contribute very little (4%) to the annual rainfall for this area, with the summer months (December – February) contributing the greatest amount (44%), (See Figure 4.1).

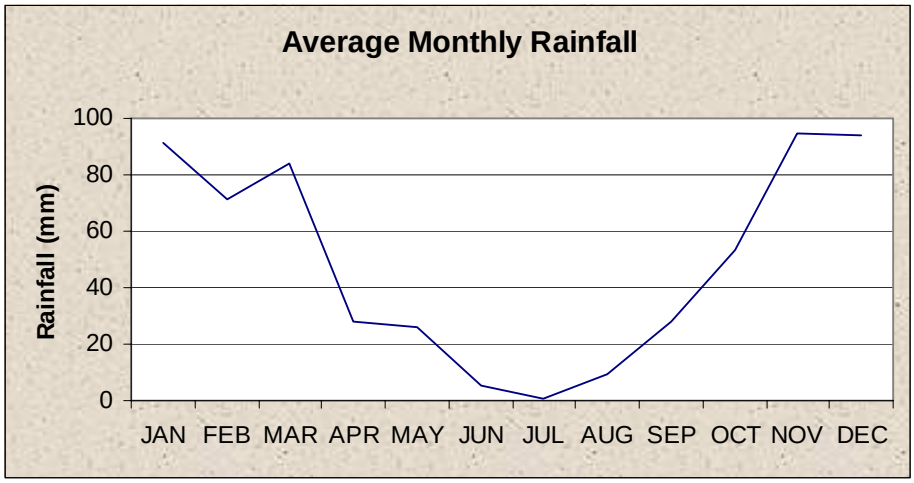


Figure 4.1: Mean Annual rainfall for Vereeniging (climate station number 04387843) for the period between 1997 and 2007.

4.1.3 Mean monthly maximum and minimum temperatures

Temperatures for this area are typical of the Northern Free State climatic zone, with warm summers and cool dry winters. Average temperatures vary from 28ºC in the summer to as low as -1ºC in the winter. Figure 4.2 illustrates the mean annual temperatures.

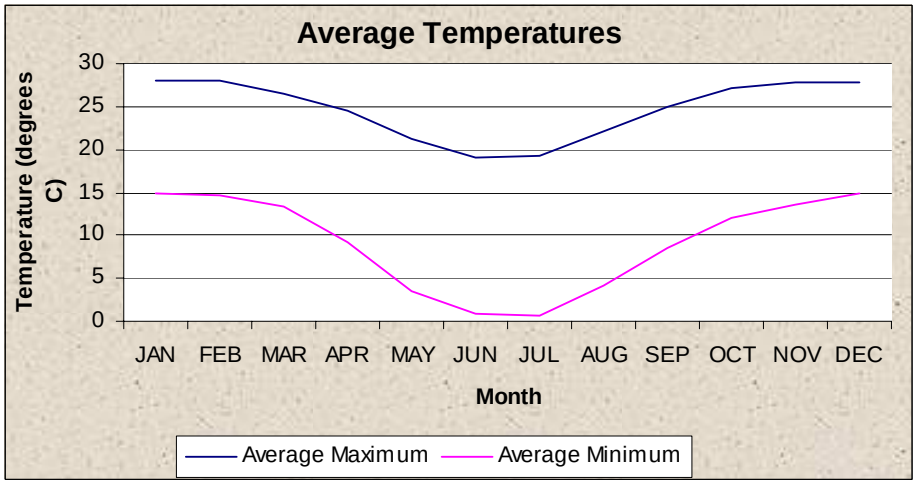


Figure 4.2: Mean maximum and minimum temperature for Vereeniging (climate station number 04387843) for the period between 1997 and 2007.

4.1.4 Mean monthly wind direction

Figure 4.3, represents the annual wind frequency distribution for the Vereeniging station taking in all four seasonal fluctuations. The graph shows that the wind predominantly comes from a north-westerly direction.

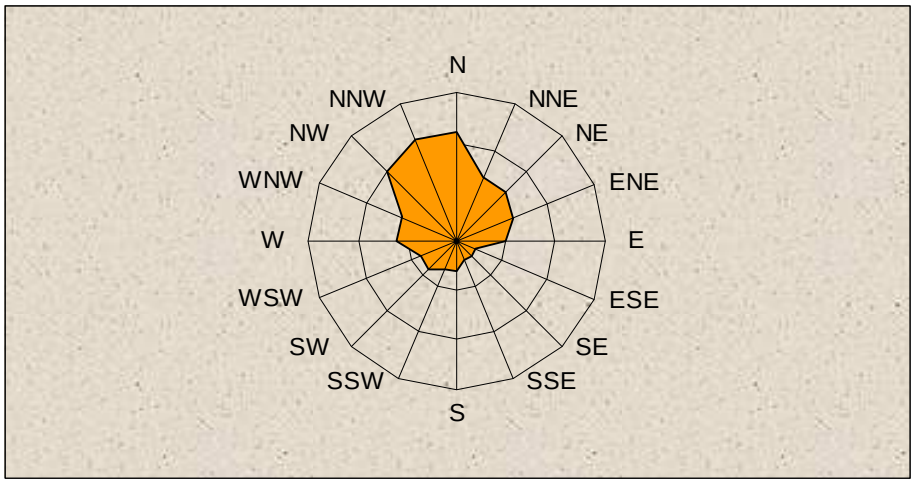


Figure 4.3: Graphic representation of the wind direction frequency.

Table 4.1 represents the average wind speeds during each month in meters per second (m/s). The results are represented as a percentage with the most frequent wind speeds in the area being from 1.6 – 3.5 m/s.

Table 4.1: Annual average, wind speeds (m/s) recorded at the Vereeniging Climate Station.

	0 -1.0	1.1-1.5	1.6-3.5	3.6-5.5	5.6-8.0	> 8.0
JAN	7.2	9.7	51.6	24.9	6.1	0.5
FEB	9.7	11.2	52.7	22.1	4.2	0.1
MAR	11.8	14.1	52.6	17.6	3.9	0.1
APR	15.1	14.7	51.6	13.8	4.5	0.3
MAY	15.7	13.6	53.2	13.1	3.8	0.6
JUN	17.5	13.2	50.2	14	4.8	0.4
JUL	16.3	13.3	51.3	13.5	4.8	0.7
AUG	11.5	10.6	47.4	18.5	9.3	2.7
SEP	8.1	8.6	44.6	22.7	12.2	3.8
OCT	6.2	7	42.8	26.4	14.6	3.1
NOV	6.2	8.2	41.7	27.9	14	2
DEC	6	7.8	42.8	29.4	12.9	1.1
YEAR	10.9	11	48.5	20.3	7.9	1.3

4.2 Topography

With reference to the topography map (Plan 3), it appears that the site is located on a slight hill as the area is of higher elevation relative to the surrounding areas. The elevation on the site ranges from approximately 1500 m to 1460 m (above sea level - asl) deriving an elevation range of approximately 40 m over a distance of 3 km (average gradient ±1.3%). The relief of the site and surrounding areas can therefore be accepted as level.

4.3 Geology

Bankfontein lies within the Vryheid Formation that forms part of the Ecca Group which is part of the Karoo Supergroup. The Vryheid Formation consists predominantly of thick beds of yellowish to white cross-bedded sandstone and grit alternating with beds of soft sandy shale. This unit also contains the coal seams that support the coal mining activities (Barnard, 2000). Dolerite sheets and dykes have intruded the sedimentary rocks extensively in the formation. Refer to Plan 4.

4.4 Soils

A soil study was done by Envirosoil Consulting. The full report is attached in **Appendix D**.

4.4.1 General soil description

The Land Type Map of the area (2626 West Rand, Land Type Survey Staff, 1984) describes the soils as part of a plinthic catena where upland duplex or margalitic soils are common. As the general terrain is very flat, the position of the soil in the catena only plays a small role in soil formation. The soils are derived from aeolian sand moved in over local colluvium derived from Ecca sandstone.

Upland soils

The gentle upper slopes tend to be occupied by Glencoe and Avalon form soils which consist of sandy topsoil over medium sandy subsoil. Both soft and hard plinthite is found where iron and manganese oxides have accumulated at 1 – 2 m depths, mainly at the upper end of the site.

Midslope soils

The lower mid-slope positions are occupied by the Clovelly and Longlands form soils where drainage is somewhat restricted. These soils are very sandy with low fertility.

4.4.2 Soils of the area

The soil boundaries were established by augering the area on a grid of 200 x 200 m with a hand held soil auger to a depth of 1.2 m (or shallower if a limiting layer was encountered).

At each observation point the more important soil physical characteristics used to identify the soil i.e. depth, colour, texture and structure were noted.

Soils were classified according to the Taxonomic System for South Africa (Soil Classification Working Group, 1991)

On completion of the soil map of the area, six main soil units were identified , **Cv** (Clovelly), **Gc** (Glencoe), **Lo** (Longlands), **Av**(Avalon). The **Soils Legend** (Table 4.2) below describes these soil units in more detail.

Table 4.2: Soils Legend

Soil Unit	Dominant Soil Form and Family	Other Soils Forms	Average Depth (mm)	Land Capability	Summarized Description of Dominant Soil Form
Cv(sa)	Clovelly 2100	Glencoe, Avalon	1200+	Poor grazing	Deep, pale yellow with bleached layer 800 - 1000mm, very sandy with no structure.
Gc	Glencoe 3100	Avalon, Wasbank	800 - 1000	Arable	Moderately deep, strong brown to yellowish brown, sandy with no structure, underlain by hard plinthite.
Lo	Longlands 1000	Clovelly, Avalon	1200+	Poor grazing	Deep, pale yellow with bleached layer 800 - 1000mm, sandy with no structure; underlain by soft plinthite.
Av(sa)	Avalon 3100	Clovelly, Longlands	800 - 1000	Poor grazing	Moderately deep, strong brown to pale brown, very sandy with no structure, underlain by soft plinthite.

All the soil units had a high potential for soil erosion they had a very high sand fraction (80 – 90%), low silt (2-3%) and clay <5%. Due to the flat topography and high infiltration rate, however, erosion should not be a problem.

The areas and percentages covered by the soil units are found in Table 4.3 below.

Refer to the soil map Plan 5 for more detail.

Table 4.3: Areas and percentages covered by the soil units

Soil Unit	Area (ha)	Area (%)
Cv(sa)	200.1	10.7
Cv/Av	27.9	5.7
Gc	118.4	32.7
Gc/Av	26.4	4.6
Lo	69.1	11.4
Av(sa)	65.3	19.3
Av/Wa	35.1	4.3
Disturbed area	70.0	11.3
Total	**612.3**	**100.00**

4.4.3 Soil analysis

Soil samples were taken of the upper soil layer (0 – 600 mm) of the dominant soil forms at three positions in the proposed sand mining area. The sampling points are shown on the detailed soil map (Plan 5).

The samples were analysed by the Inst. Soil Climate & Water (ISCW), using standard acceptable methods for pH, Cation Exchange Capacity (CEC), particle size distribution (7-Fraction) and Phosphate (P).

Table 4.4: Vaal Sand soil analysis

Analytical Data			
Sample No	**1**	**2**	**3**
Depth(mm)	0 - 600	0 - 600	0 - 600
Texture	Sa	Sa	Sa
Net extractable cations (me/100g soil)			
Na	0.067	0.061	0.053
K	0.068	0.139	0.053
Ca	1.162	1.415	0.490
Mg	0.281	0.401	0.137
S value	1.577	2.016	0.733
T value(CEC)	3.965	4.742	4.718
Other analyses			
Clay (%)	3.20	4.00	3.50
CEC clay	49.28	50.40	20.94
pH water	6.94	6.76	5.47
P (mg/kg)	4.55	2.08	10.06
K (mg/kg)	26.59	54.35	20.72

In general the soils in the Vaal Sand study area are highly leached and thus have a low base status. Soil pH values are between 5.5 and 6.9; and soils have a low fertility status.

Topsoil Phosphate (P) values are low (2.1 –10.1 mg/kg), while Potassium (K) values vary from 20.7 mg/kg (low) to 54.4 mg/kg (fairly low).

4.5 Surface Water

There are no rivers or streams found on or near the proposed mining area. The closest river is the Vaal River, which is approximately 4 km from the site. The 1:50 year flood line is situated on the 1434m asl contour line and the proposed area to mined is at an altitude 1460 m to 1500m asl. The operations are, therefore, well outside the 1:50 year floodline as determined by Randwater.

4.5.1 Surface water quantity

4.5.1.1 Catchment boundaries

The mine is located in the Vaal River catchment (tertiary catchment C22F).

4.5.1.2 Drainage

As the site is on a slight hill, it can be expected that any surface water runoff will flow away from the site in the following directions:

- West: towards the Taaibosspruit, which flows into the Vaal River;
- North-west, north-east and east: towards the Vaal River.

4.5.2 Surface water quality

No water samples were taken due to the lack of water on the site. As there is no surface water present on the site and none in the vicinity, the establishment of baseline surface water quality is not applicable to the EIA/EMP.

4.5.3 Surface water use

There is no surface water on site.

4.5.4 Water authority

The water authority for this region is the Free State Department of Water Affairs and Forestry (DWAF) which is situated in Bloemfontein.

4.5.5 Wetlands

There are no wetlands present on the proposed site.

4.6 Groundwater

Two aquifer types occur in the Vryheid formation. The first is the upper weathered aquifer which consists of transported or in-situ weathered material and is generally between 5 and 12 m thick. Highly variable recharge occurs over the area but generally values are between 1 and 3 % of Mean Annual Precipitation (MAP) (Hodgson and Krantz, 1998).

The second is the lower fractured Karoo aquifer which includes the underlying Ecca sediments. Water movement is along secondary structures as the pores are generally too well cemented to allow the permeation of water. The later intrusions of dolerite dykes and sills are important in characterising the flow system active within this aquifer as the cooling joints act as conduits. Intrusions are associated with existing structural features and in this case the dykes/sills act as impermeable boundaries. This aquifer is generally recharged by interflow from the weathered aquifer (Hodgson and Krantz, 1998).

4.6.1 Water level

The regional groundwater levels in the area vary from approximately 5 m below surface in the topographically lower lying areas to a maximum of approximately 22 m below natural ground level.

4.6.2 Presence of boreholes and springs and their estimated yields

Groundwater yield is classed as low, with 83% of boreholes on record producing less than 2 l/s in the Vryheid Formation. (Harvest Potential Map, Vegter, 1996)

4.6.3 Groundwater quality

According to the regional analysis (Barnard, 2000) the quality of groundwater is indicated by the average EC value of 57 mS/m and the mean pH of 7.5. There is however a significant variation in the concentration of sodium, chloride and sulphate which indicates contamination by the coal mining activities already present in the area.

Anglo Operations Limited has been monitoring the borehole (BH2) on site for a number of years. Water quality data collected during the period April 2005 to April 2007 have been analysed visually by using Hydrochemical Software. A Piper plot (From the diagram it is evident that most of the samples fall within the sulphate dominant quarter (top quarter) while the remaining samples plotted in the sodium chloride dominant quarter (right quarter). Water quality appears to be relatively constant over the two year period with only minor fluctuation in alkalinity at the end of the data set; this fluctuation is causing the water quality to plot in the upper levels of the top quarter resulting in higher sulphur levels. Alkalinity is defined as the capacity of water to neutralise acid, thus the decrease of the total alkalinity will lower the pH and the water samples will become more acidic and sulphur dominated.

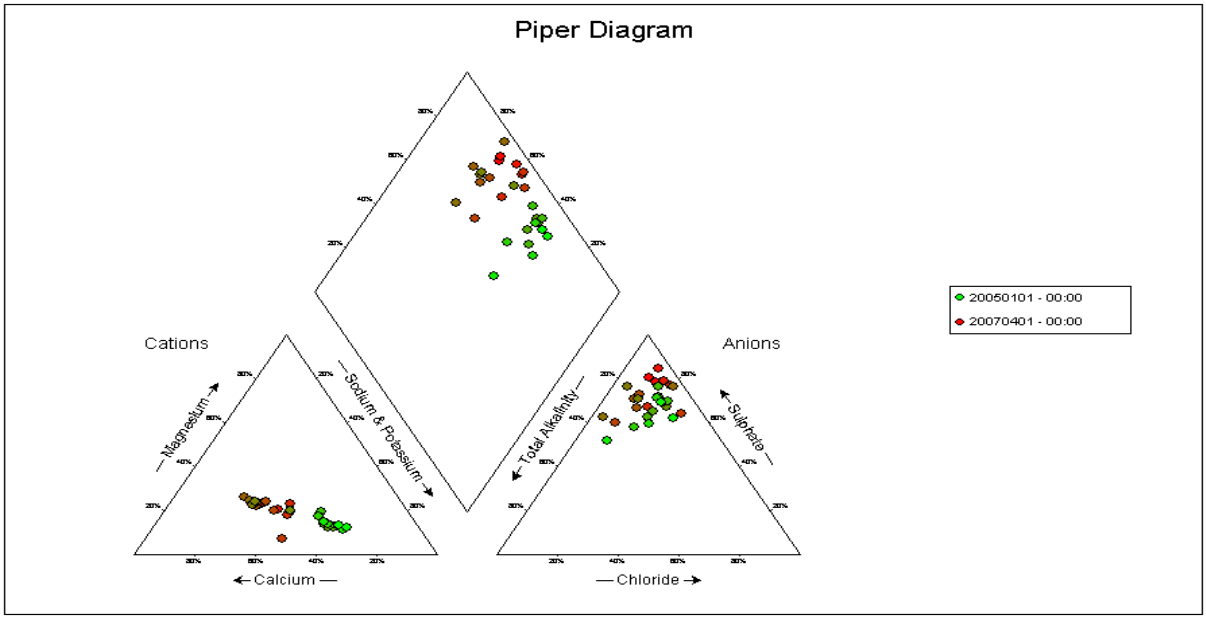
Figure 4.4) of the available data was utilised to distinguish any specific water types on the property. It is also utilised to characterise water types in a graphical manner. The position of the water sample on the plot is based on the ratio of the various constituents in equivalence and is not an indication of the absolute water quality or the suitability thereof for domestic consumption. The highlighted sample points indicate samples that are selected in the sample group. The Trapezium diagram above the cations and anion triangles is used to present both anion and cation groups as a percentage of the sample. The point is found by extending the cation point parallel with the magnesium into the upper diagram. Similarly, another extension is made from the point in the anion triangle parallel with the sulphate in to the upper trapezium. The point indicates the relative composition of the water sample in regard to the cation-anion pairs that correspond to the four sides of the trapezium area (Fletcher G. Driscoll, 1986). The major anions are Bicarbonate Alkalinity, Sulphate, Chloride and to a lesser extent Nitrate with the major cations being Calcium, Sodium, Magnesium and Potassium.

The diagram was quartered to simplify this process. The water samples can be grouped into the calcium-magnesium-bicarbonate dominant (left quarter), sodium bicarbonate dominant (bottom quarter), sodium chloride dominant (right quarter) and sulphate dominant (top quarter). Within the South African coal fields, the calcium-magnesium-bicarbonate dominant (left quarter) of the Piper plot is characterised by freshly recharged water. The sodium bicarbonate dominant (bottom quarter) is typical of dynamic groundwater flow within the aquifers with the sodium replacing calcium and magnesium in solution. The

sodium chloride dominant (right quarter) is associated with stagnant or slow moving groundwater with little or no recharge. The sulphate dominant (top quarter) is typically of water impacted by the oxidation of pyrites which is commonly associated with coal mining activities.

From the diagram it is evident that most of the samples fall within the sulphate dominant quarter (top quarter) while the remaining samples plotted in the sodium chloride dominant quarter (right quarter). Water quality appears to be relatively constant over the two year period with only minor fluctuation in alkalinity at the end of the data set; this fluctuation is causing the water quality to plot in the upper levels of the top quarter resulting in higher sulphur levels. Alkalinity is defined as the capacity of water to neutralise acid, thus the decrease of the total alkalinity will lower the pH and the water samples will become more acidic and sulphur dominated.

Figure 4.4: Piper diagram showing the chemical results from the water quality



4.6.4 Groundwater use

Use of groundwater in the area is mostly for mining purposes. No schedule 1 water users were identified during the field visit.

4.7 Pre-mining Land Capability

The land capability of the proposed mining area was assessed using the Chamber of Mines of SA Guidelines for Rehabilitation of land disturbed by surface coal mining in SA.

The criteria were applied in order to classify the soil units in soils Plan 5 into three land capability classes; arable and, grazing land and "disturbed area" (wilderness). The area and percentage of each land capability class is given in Table 4.5 below.

Table 4.5: Area percentage of each land capability class

Land capability class	Area (ha)	Area (%)
Arable	144.8	23.6
Grazing	62.9	10.3
Grazing(poor)	334.5	54.6
Disturbed Area(wilderness)	70.0	11.4
Total	**612.3**	**100.0**

4.8 Land Use

4.8.1 Pre-mining land use

Most of the area was not previously utilised for agricultural purposes; however there is some evidence that the upper areas were planted with maize and also cultivated pastures.

4.9 Air Quality

Assessment Categories

The South African National Standard four-band scale below is useful for illustrating the various acceptable limits according to the industry in African conditions. The four band scale is given in Table 4.6 below. For the purposes of this study a band threshold of 2 will be considered as the limits for the levels of fall-out material on site.

Table 4.6: Four-band scale evaluation criteria for dust deposition (SANS 1929:200x)

Band number	Band description label	Dust fall rate (D) ($mg/m^2/day$, 30-day average)	Comment
1	Residential	D < 600	Permissible for residential and light commercial
2	Industrial	600 < D < 1 200	Permissible for heavy commercial and industrial
3	Action	1 200 < D < 2 400	Requires investigation and remediation if two sequential months lie in this band, or more than three occur in a year.
4	Alert	2 400 < D	Immediate action and remediation required after first incidence of dust fall rate being exceeded. Incident report to be submitted to relevant authority.

If dust levels can be shown to be high as a result of extreme weather conditions, then dust counts for that month can be discounted. Heavy and very heavy dust falls are considered to be action levels and will need mitigation measures.

Table 4.7: World Bank dust fall, target, action and alert thresholds for dust deposition (SANS 1929:200x)

Level	Dust fall Rate ($mg/m^2/day$)	Permitted Frequency of Exceedances
Target	300	
Action residential	600	Three within any year, no two sequential months.
Action industrial	1 200	Three within any year not sequential months.
Alert threshold	2 400	None. First exceedance requires remediation and compulsory report to authorities.

Assessment of Results

The samples were sent to the mine's laboratory for analysis. The results were then placed into a series of graphs and tables that best represent the data collected.

Table 4.8: Total dust fall recorded for each sampler

Station 1	**mg**	**mg/m^2/day**
North	18	54
East	20	60
South	15	43
West	18	54
Total	**71**	**211**
Station 2	**mg**	**mg/m^2/day**
North	20	59
East	26	77
South	30	89
West	24	69
Total	**100**	**294**

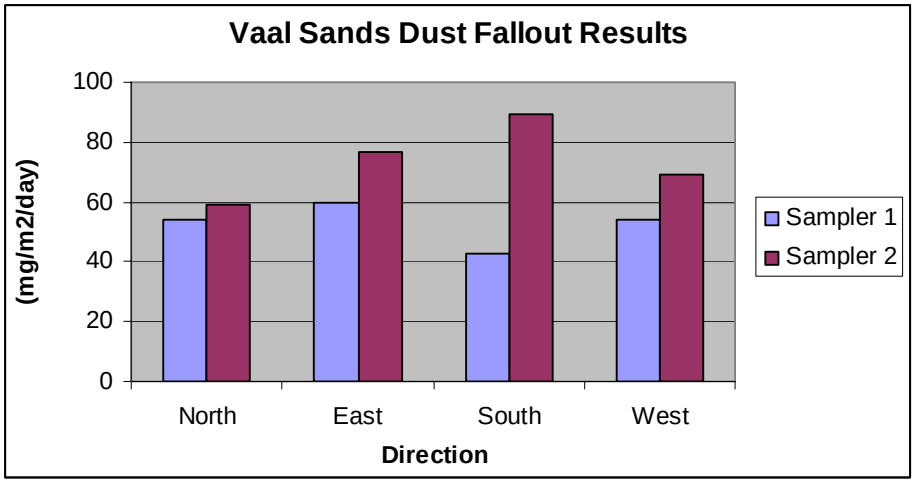


Figure 4.5: Total dust fall recorded for each sampler

Table 4.8 shows the total fallout dust recorded from each sampler over the 14 day sampling period. The results obtained during this period were well within the recommended levels for industrial activity as shown in Table 4.7 above.

Station 2 recorded the highest levels of fallout material during this sampling run. Several factors may have contributed to this including the amount of rainfall that occurred during this period. Station 2 was located in the northern side of the potential site and recorded levels of 294 mg/m²/day which are below the target level. Station 1 recorded slightly lower levels of 211 mg/m²/day (refer to Table 4.8).

It is recommended that a sampling programme is set up on site to ensure that the levels of fallout material are kept to a minimum. It is important that the programme takes in both the dry and wet seasons as the dry season typically accounts for the highest levels of dust on any industrial site. This will allow the correct management procedures to be put in place, and the impact to be minimised.

4.10 Noise

4.10.1 Methodology

A calibrated Quest (Model 2500) impulse and precision integrating sound level meter (serial number: QM0010020, 12723) was used for the measurements. The instrument was calibrated by De Beer calibration services on 3 May 2007. A short duration measurement of two hours was performed on the 14 September 2007 at the proposed mining site, which started at 11:10am. Six different measurement points were selected beforehand in order to have a good representation of the site. One measurement at every point was taken at 10 minute intervals, until all six points were covered. This process was then repeated again one hour later for all six points.

4.10.2 Results

The Table 4.9 is a summary of the results that were obtained from the measurements:

Table 4.9: Summary of results

Measurement point	Period	SANS 10103	L_{Aeq} (dBA)	Remarks
1	Day	70	40.0	Wind blowing. Quiet.
	Day	70	42.1	Birdsong. Wind blowing.
2	Day	70	40.5	Quiet. Wind blowing.
	Day	70	40.9	Quiet.
3	Day	70	40.9	Quiet. Wind blowing.

Measurement point	Period	SANS 10103	L_{Aeq} (dBA)	Remarks
	Day	70	41.2	Bird song. Quiet.
4	Day	70	42.6	Quiet. Wind blowing.
	Day	70	43.8	Wind blowing.
5	Day	70	41.6	Quiet.
	Day	70	41.1	Quiet. Voices of people in distance.
6	Day	70	51.9	Car passes measurement point.
	Day	70	43.9	Voices of people in distance, otherwise quiet.

4.11 Natural Vegetation / Plant Life

4.11.1 General Description of the Vegetation in the Region

4.11.1.1 Description of biome

The area falls in the Grassland Biome of South Africa (Rutherford & Westfall, 1986). The Grassland Biome is found on the high central plateau of South Africa, and the inland areas of Kwazulu-Natal and the Eastern Cape. The topography is mainly flat and rolling, but includes the escarpment itself. The altitude covered by this biome varies from near sea level to 2 850 m above sea level.

Grasslands are dominated by a single layer of grasses (Rutherford & Westfall, 1986), (Endangered Wildlife Trust 2004). The amount of cover depends on rainfall and the degree of grazing. Trees are absent, except in a few localised habitats. Geophytes are often abundant. Frost, fire and grazing maintain the grass dominance and prevent the establishment of trees (Rutherford & Westfall, 1986).

4.11.1.2 Description of vegetation type

The specific veld type is known as *Cymbopogon-Themeda* veld (Type nr.48). Two variations are recognised, namely southern variation in the Free-state and North Eastern Cape and the northern variation in Gauteng. The project falls within the northern variation.

A more recent classification of the South African vegetation types by Low and Rebelo (1996) calls this the Moist cool highveld Grassland (Type 39), with *Cymbopogon-Themeda* veld (Type no.48), and *Themeda triandra – Eragrostis curvula* listed as synonyms.

Grasses can be divided into two broad categories, namely: sweet grasses with low fibre content and sour grasses with a higher fibre content that tend to withdraw their nutrients from the leaves during the winter so that they are unpalatable to livestock. Sour grasses prevail with higher rainfall and on more acidic soils (Low & Rebelo, 1996). The area of concern is dominated by sour grass, which is evident in the winter die back that the area, and the entire highveld, experiences. Of potential concern is the characteristic of sourveld to recover slower after disturbance than sweet veld. Reseeding of affected areas will yield better results than allowing natural progression to re-vegetate.

4.11.2 Site-specific vegetation description

4.11.2.1 General description of the vegetation at the site

Natural grassland occurs at the site, with patches of trees occurring on the boundaries, and one large clump in the middle of the southern part of the site. The vegetation at the site has not fully developed beyond the grassland stage into forest, which is due to limiting factors such as available nutrients, climate and fire (Meffe & Carrol 1997). Yet on some plots clumps of mostly alien trees were observed. The grassland in this region is considered to be sourveld, primarily due to high rainfall (>625 mm per annum), cold winters, and slightly acidic soils. The soil in the area is generally poor and acidic due to leaching of nutrients, resulting in plants that are of low nutritional value and unpalatable. In order for these grasses to survive severe winters they withdraw the nutrients from the leaves and store them in the roots. These stored nutrients are used in spring to start the growing process again. As such, these grasses are particularly unpalatable in winter with a low nutritional value (Low & Rebelo, 1996). The area of concern is almost completely surrounded by roads, train tracks or housing, which creates a large edge effect and subsequently very small areas of

natural vegetation. This is exacerbated by the dumping of refuse on these natural areas. Variation within the northern section was very limited due to dumping, grazing and unplanned fires; therefore the one sample site within this area was adequate. Within the southern section the area seemed to be more heterogeneous, with old farm lands, open fields and a large burnt area necessitating more sample sites.

Table 4.10: Location and description of sample plots (Plan 7)

Site No.	Latitude	Longitude	Site Description
1	S 26° 45' 53.4"	E027° 58' 08.7"	In clump of trees
2	S 26° 45' 29.0"	E027° 57' 56.6"	Burnt area, mostly grassland, no trees
3	S 26° 46' 41.3"	E027° 58' 03.5"	Clump of trees surrounding uniform grassland
4	S 26° 45' 39.1"	E027° 57' 06.1"	Grassland used for dumping
5	S 26° 46' 20.7"	E027° 58' 15.5"	Uniform, old cultivated field
6	S 26° 45' 09.3"	E027° 56' 03.3"	Overgrazed grassland, dumping being done

4.11.3 Vegetation types identified during surveys

A total of six sample plots were surveyed during the vegetation survey, using the relevant aerial photograph to delineate homogenous units (Plan 7). The Braun Blanquet method was used to determine the vegetation composition, the dominant species and exotic and/or invader species.

The GPS position and description of the sample plots are given in Table 4.10.

Mismanagement can have an influence on species presence and species composition; therefore areas disturbed were also identified on site and sample plots were sampled within these disturbed areas.

The main vegetation type identified during the data analysis of the vegetation survey was plains grassland (Hannekens 1996). A detailed list of the plant species identified is included as **Appendix E**.

Table 4.11: Main plant species found during the survey

Species	Common name	Ecological status	Status
Cynodon dactylon	Couch Grass	Increaser 2	Diagnostic
Hyparrhenia hirta	Common Thatching Grass	Increaser 1	Diagnostic
Monocimbian cyrisiforme	Boat grass	Climax decreaser	Dominant
Sporobolus africanus	Ratstail dropseed	Increaser 3	Dominant
Tagetes minuta	Tall Khaki Weed	Alien Invasive	Prominent

Table 4.11 lists the main plant species found. Diagnostic species included *Cynodon dactylon, which* was the most common species found and occurring in all the sample plots, and *Hyparrhenia hirta*, which was found mostly close to unused dirt roads, within the sample areas. This species thrives in mismanaged veld, and was common in disturbed areas.

The majority of the grass species found were increaser species, which are predominantly pioneer or sub-climax species. This means they are the first or second category in plant succession making them hardy species, usually unpalatable in nature (Tainton, 1999). This is to be expected with untimely disturbances, as the grass sword does not have time to regenerate and progress beyond these initial succession stages.

The vegetation in the area is a direct result of the underlying soil forms present in the area. In general the status of the soils in the area is very poor; this is due to a number of factors that have taken place over time, which include:

- Dumping of subsoil, ash and building rubble and refuse in certain areas over the site.
- Erosion due to ploughing up of unsuitable soils, which has resulted in poor vegetation cover and species composition.

4.11.4 Exotic and invasive plant species recorded.

The Conservation of Agricultural Resources Act regards weeds as alien plants with no known useful economic purpose that should be eradicated. Invader plants, also considered

by the Act, are also of alien origin but may serve useful purposes as ornamentals, as sources of timber, or may have other benefits. These plants need to be managed in order to prevent them from spreading.

Category 1 plants are weeds that serve no useful economic purpose and possess characteristics that are harmful to humans, animals or the environment. These plants need to be eradicated using the control methods stipulated in regulation 15.D of the Conservation of Agricultural Resources Act. Category 2 plants are plants that are useful for commercial plant production purposes but are proven plant invaders under uncontrolled conditions outside demarcated areas. Category 3 plants are mainly used for ornamental purposes in demarcated areas but are proven plant invaders under uncontrolled conditions outside demarcated areas. The planting of Category 2 and 3 plants should be confined to demarcated areas under controlled conditions of cultivation. Table 4.12 lists the exotic and alien invasive species found on the site; some are not listed as alien invasive but are still considered weeds in South Africa. This means they are not aggressive invaders but nuisance plants.

Table 4.12: Exotic and invasive species recorded during the survey

Species	Common name	Ecological status	Growth form
Bidens pilosa	Common Black-jack	Not Listed	Herb
Eucalyptus camaldulensis	Red River Gum	Cat. 2	Tree
Tagetes minuta	Tall Khaki Weed	Not Listed	Herb
Cotoneaster lacteus	Showberry	Not Listed	Shrub
Opuntia ficus-indica	Sweet Prickly pear	Cat. 1	Succulent shrub
Pinus patula	Patula pine	Cat. 2	Tree
Populus x canscens	Grey poplar	Cat. 3	Tree
Conyza bonariensis	Horseweed	Not Listed	Herb

4.11.5 Cultural and medicinal plant species

During the vegetation survey no medicinal plant species were encountered, which is not surprising as the overall natural environment is not in prime condition. The Sweet Prickly pear, however, was found in sample area 1 and this species' fruit is edible (Mahindapala, 2004).

4.11.6 Red data plant species

No red data plant species was recorded during the survey.

4.12 Animal Life

4.12.1 Mammals observed and recorded in the area

Signs of three mammal species, *Lepus saxatilis* (shrub / savanah hare), a Mongoose species and a Steenbok (*Raphicerus campestris*) were recorded during the field survey. Due to the disturbance of natural vegetation and the large amount of human activity on and around the site, it is not expected that any of the primates, larger carnivores or Artiodactyla will be present.

4.12.1.1 Red Data mammals

No red data mammal species were recorded during the survey. Given the anthropogenic activities surrounding the site, which includes housing, roads and agricultural land, the presence of these animals is highly unlikely.

4.12.2 Birds

A total of 10 birds were recorded during the survey (Roberts 2003). All birds observed and recorded during the survey are listed in Table 4.13. The mobility of birds and their large home ranges means the actual observed species are not the only bird species that could occur in the area. Furthermore the timing of the survey, which was in the late dry season, means food items for these birds would have been scarce forcing them to forage over a larger area and making sightings more difficult.

Table 4.13: Bird species observed

Scientific name	Common name	Status	Plot found
Vanellus armatus	Blacksmith Plover	Common resident	1
Euplectes orix	Red Bishop	Common resident	1
Vanellus coronatus	Crowned Plover	Common resident	1
Euplectes progne	Long-tailed Widowbird	Resident	3
Colius striatus	Mouse bird	Common resident	2
Bubulcus ibis	Cattle egret	Common resident	1
Acridotheres tristis	Indian myna	Common resident	2
Streptopelia capicola	Cape Turtle-Dove	Common resident	5

4.12.2.1 Red data birds

No red data or endangered bird species were observed during the survey. The fact that common resident species were scarce indicates that rare species will be very unlikely to occur here (Barnes, 2000).

4.12.3 Reptiles

The presence of reptiles in the area, specifically snakes, was confirmed, some visually and others through indicators such as shedded snake skin. A Mozambican spitting cobra (*Naja mossambica*) was observed by a soil scientist in the area. Human presence has meant an increase in the rodent population. These rodents, being a cornerstone in the cobra diet, would have meant a steady food supply to the snakes. Other snakes could also occur on the site for the same reason, if habitat requirements permit. During the survey one snake was seen that could possibly have been a Brown House snake (*Lamprophis fuliginosus*) although it could not be positively identified (Branch, 2000).

4.12.4 Frogs

No frogs were sighted or heard during the animal survey.

4.12.4.1 Red Data frogs

No Red Data frogs were sighted or heard during the animal survey.

4.13 Sites of Archaeological and Cultural Interest

A Heritage Impact Assessment (HIA) was conducted by *Matakoma – ARM Heritage Contracts Unit* in June 2007 to evaluate archaeological and heritage resources potentially impacted by the proposed development (**Appendix F**). This assessment forms part of the EIA/EMP for the proposed Vaal Sand mining operation on portions of the farm Bankfontein 9, Viljoensdrif, Free State Province.

In accordance with the National Heritage Resources Act (Act 25 of 1999 – NHRA), a HIA comprises of archival, historical and cartographic data, representing valuable supporting tools in discovering and identifying significant archaeological and heritage resources (Matakoma, 2006). Cultural elements include historical and pre-historical sites of human occupation, artefacts and buildings, as well as graves and shipwrecks. Natural heritage includes elements from the biophysical and ecological environment, such as sacred forests, rivers, mountains and caves of significance. Natural and cultural heritage resources also include palaeontological phenomena, archaeological artefacts and fossil remains from ancient plants and creatures.

During the archaeological and heritage survey, three sites of archaeological and heritage significance were found within the footprint of the proposed mining area. Of these, only **MHC003** will require further work in the form of further evaluation in low vegetation conditions. All sites identified during the survey are mapped on the plan provided in Annexure A and B of the HIA report (**Appendix F**). According to the current mining plans for the proposed project, site **MHC003** will be protected from mining related developments. If this option is not viable, it is recommended that site **MHC003** be re-evaluated when vegetation conditions makes it possible for better visibility of the area.

The following table briefly outlines the most significant site in the proposed project area. For a detailed description of other findings in the area, refer to the archaeological and heritage assessment in **Appendix F**.

Table 4.14: Summary of potential significant site MHC 003 (Possible cemetery)

Details of Site:					
Site Number	2627DD-MHC003				
Garmin 38, WGS 84	E27.9687641	S26.7647490			
Site Data	***Description***				
Type of site *(e.g. open scatter; shell midden, cave /shelter);*	Possible cemetery				
Photographs and diagrams *(Illustration: Tree lined area)*					
Statement of Significance *(Heritage Value)*	The site is of **possible high** heritage significance				
Field Rating *(Recommended grading or field significance)* of the site:	Generally protected (GP.A)				
Impact Evaluation *of development on site*	Impact on site is seen as possible negative, through possible destruction of site				
Recommendations *including:*	It is recommended that the site be re-evaluated during the stage where vegetation cover has reduced to confirm the presence of graves.				
Field Rating	**Impact**	**Impact Significance**	**Certainty**	**Duration**	**Mitigation**
Grade GP.A	Negative	High	Possible	Long term	B

4.14 Sensitive Landscapes

There are no sensitive areas around the proposed mining area.

4.15 Visual Aspects

Visually, the area of interest consists of an open field with grass and trees. There is currently no infrastructure on the proposed site. There is however, the Bertha Village that lies to the west of the site, which houses employees from the Anglo coal mine as well as the ESKOM power station. Large ESKOM power lines run through the centre of the proposed area, north of the Bertha Village and are clearly visible on site.

4.16 Traffic and Safety

The R82 and the R716 are the main routes in the vicinity of the proposed mine. The R716 links up with the R82 which is linked to Vereeniging. It is expected that approximately 100 – 200 trucks will be leaving the mining site daily. These trucks will vary in size from $6m^3$ – $30m^3$.

4.17 Regional Socio-economic Structure

4.17.1 Population density, growth and location

Within the Metsimaholo municipality, the total population was estimated at 177 500 in 2001. Population influxes have tended to occur in the Sasolburg and Denysville areas due to the presence of mining activities and perceived job opportunities. In terms of racial population distribution, the following figure shows that Black people form the majority of the population within Metsimaholo, being followed by White people and minimal Asian and Coloured populations.

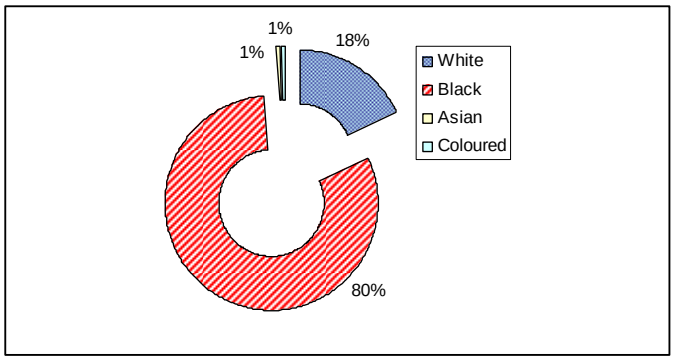


Figure 4.6: Population composition within Metsimaholo, 2001

4.17.2 Major economic activities and sources of employment

While mining and industry dominate the Sasolburg and Denysville area of the municipality, agricultural activities tend to dominate the remainder of the region. A fairly significant portion of the area is currently under cultivation, with this being attributed to the relative availability of water for irrigation purposes. Stock farming dominates this sector (46%), focusing primarily on grazing and dairy farming. In terms of plant products, maize, sunflowers and sorghum tend to be the most popular crops.

4.17.3 Unemployment estimate for the area

Unemployment rates within the local municipality vary greatly, depending on the exact location and its proximity to the industrial and mining hubs of the area. Sasolburg, for example, experiences unemployment of less than 20%, while areas such as Zamdela and Metsimoholo experience between 58 – 70% unemployment. Rural areas tend to be isolated from access to employment opportunities, thus these households generally display lower income levels and higher levels of poverty.

4.17.4 Housing – demand and availability

The figure below provides a depiction of the type of housing available within the Metsimaholo municipal area as a whole:

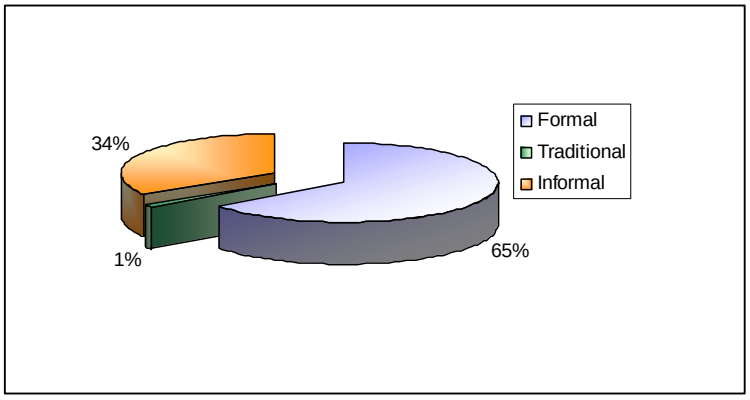


Figure 4.7: Housing availability within Metsimaholo, 2001

It can be seen that the majority of the population has access to formal housing in the municipality (approximately 65%). It should be noted, however, that 1% of the population is still occupying traditional housing structures, and that 34% are living informally in dwellings of which the construction varies from wood or iron shacks to cardboard and plastic structures.

4.17.5 Social infrastructure

The Metsimaholo area is equipped with 21 Primary Schools and 9 Secondary Schools. In general, the teacher:learner ratio within these facilities is regarded to be acceptable, although the quality of school buildings and relevant equipment is seen to be problematic.

There is currently one hospital situated within the Metsimaholo local region, namely the Sasolburg Hospital. Eight fixed clinics are also situated in the area, as well as one community health centre. This provision is not sufficient when one considers the total population of the area. Community members have prioritised the provision of an HIV/AIDS centre for orphans, as well as increased HIV/AIDS awareness programmes within communities.

Within the existing health facilities, a lack of equipment and low maintenance of infrastructure have been identified as challenges, as has the under-resourcing of facilities in terms of available staff members.

4.17.6 Water supply

The diagram below provides a depiction of the level of water provision available within Metsimaholo:

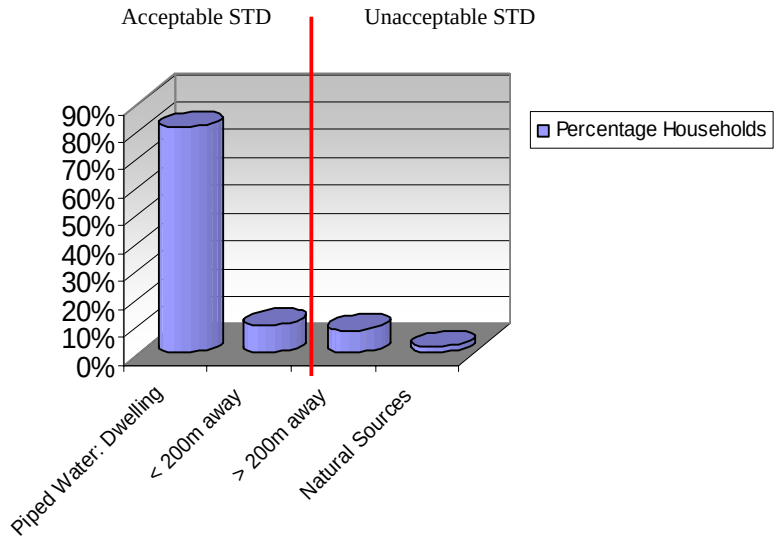


Figure 4.8: Level of water provision within Metsimaholo, 2001

It can be seen from the above that the regional population generally has access to good quality piped water within their households. Only approximately 10% of people receive a water supply which is considered to be below Reconstruction and Development Programme (RDP) standards.

4.17.7 Power supply

It can be seen from the figure below that the majority of households within Metsimaholo have access to electricity for lighting purposes, while 21% still rely on the use of candles for this purpose:

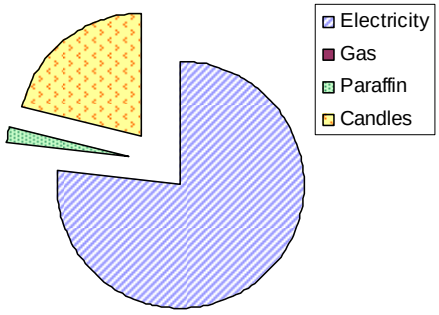


Figure 4.9: Electricity provision within Metsimaholo, 2001

Current electricity shortages within the country as a whole have meant that the local IDP document prioritises electricity-use awareness campaigns to encourage the conservative use of this resource. Communities have also cited the provision of electricity to rural areas as being a challenge, as well as the provision of adequate street- and area lighting. The upgrading of the existing system is important in the immediate area of Bankfontein's operation

4.18 Interested and Affected Parties

The following organisations and individuals are considered to be the key stakeholders for Vaal Sand's operation; however a full Interested and Affected Party (IAP) register is included in the Public Participation Process (PPP) Report (**Appendix G**).

- The Department of Mineral & Energy;
- The Department of Water Affairs and Forestry;
- The Department of Environment Affairs and Tourism;
- The Department of Health;
- Fezile Dabi Municipality;
- Metsimaholo Municipality;
- Community and Social Development;
- Sasolburg Chamber of Commerce;
- Save the Vaal;

- Community Health Clinic;
- Mine Workers Union; and
- Vaalpark Residents Association.

5 ASSESSMENT OF ENVIRONMENTAL IMPACTS RESULTING FROM IDENTIFIED ALTERNATIVE LAND USE AND DEVELOPMENTS

In accordance with the MPRDA, alternative land uses in the area must be identified and their potential impacts on the environment identified.

5.1 Identified Alternative Land Use and Developments

Potential alternative land use and development opportunities for the mine site include the following:

- Agricultural, which includes small and large scale farming of crops and animals.
- Residential, which could involve both farmers and workers living on the property or high density housing.

Both of these activities currently exist in the area and, although the potential for significant expansion in the short term is limited due to the numerous and extensive mining activities in the area, these activities are a viable alternative to mining. The degraded status of the current environment (e.g. soils and vegetation) could limit the agricultural potential of this site.

5.2 Comparative Impact Assessment

For purposes of the comparative assessment, the rating process that is followed to provide a relative indication of the environmental significance of anticipated impacts for agriculture and housing is not as rigorous as the numerical process that is followed for mining impacts below, but is still based on the accepted risk assessment methodology of “Risk = Probability x Consequence”. The environmental significance indicated for each aspect for mining is obtained from the post-mitigation significance rating obtained from the EIA in section 6, below. The methodology followed for the rating of agricultural and housing impacts is the same as the methodology that was followed for the EIA.

	Mining **(mitigated)**	**Agriculture** **(stock & crop)**	**Housing**
Topography	Issue: Topography will have to be reshaped. Permanent, negative impact of moderate severity. Medium-low significance.	Negligible or no impact.	Negligible or no impact.
Geology	Negligible or no impact	Negligible or no impact.	Negligible or no impact.
Soil	Issue: Loss of soil through mining, soil disturbance and erosion. Possible medium term, negative impact of moderate severity. Medium-low significance.	Issue: Grazing and crop farming may cause loss of soil through erosion and compaction of soil as well as nutrient depletion. Possible medium-short term, site specific, negative impact of moderate severity. Medium-low significance.	Issue: Soil loss through compaction, erosion and the construction of houses and roads may occur. Possible medium-long term, site specific, negative impact of moderate severity. Medium-low significance.
Surface water	Issue: Contamination through hydrocarbon spillages. Possible medium term, negative impact of moderate severity. Medium-low significance.	Issue: Fertiliser, pesticides and animal waste in surface water. Possible medium-short term, local, negative impact of moderate severity. Medium-low significance.	Issue: Domestic waste/effluent and household chemical compounds in surface water. Possible long term, site specific, negative impact of moderate severity. Medium-low significance.

	Mining (mitigated)	**Agriculture (stock & crop)**	**Housing**
Groundwater	Issue: Contamination of groundwater through hydrocarbon spillages, incorrect disposal of the different waste streams. Short term, negative impact of moderate severity. Low significance.	Issue: Fertiliser, pesticides and animal waste in groundwater. Possible medium term, local, negative impact of moderate severity. Medium-low significance.	Issue: Domestic waste/effluent and household chemical compounds in groundwater. Possible medium term, site specific, negative impact of moderate severity. Low significance.
Land Capability	Negligible or no impact.	Issue: Poor farming practices may decrease land capability through erosion and nutrient reduction. Possible medium-short term, site specific, negative impact of moderate severity. Low significance.	Issue: Production land will be reduced. Possible permanent, local, long term negative impact that will cause serious impairment of the ecosystems. High significance.
Land use	Negligible or no impact.	Negligible or no impact.	Issue: Land use will be permanently changed and farm land will be reduced. Possible permanent, local, long term negative impact that will cause serious impairment of the ecosystems.

	Mining (mitigated)	Agriculture (stock & crop)	Housing
			High significance.
Air quality	Issue: Dust will be generated by earth moving equipment. Possible short term, negative impact. Low significance.	Issue: The use of agricultural implements e.g. ploughing will increase dust levels. Possible medium-short term, site specific, negative impact. Low significance.	Issue: Construction of houses may cause a temporary increase in dust levels. Possible short term, insignificant site specific, negative impact. Low significance.
Noise	Issue: Increase in noise levels could lead to species migration. Impact is expected to be short term and moderately negative. Medium-low significance.	Issue: Noise levels will increase with the use of farming implements. Possible short term, site specific, insignificant, negative impact. Low significance.	Issue: Noise associated with human habitation. Possible permanent, local, negative impact. Medium-low significance.
Animal life	Issue: Mining and rehabilitation activities. Possible medium-short term, negative impact of minor severity. Medium-low significance.	Issue: Farming activities may cause a decrease in habitat due to grazing/lands. Possible medium term, site specific, negative impact of moderate severity. Medium-low	Issue: Expansion of housing may cause a reduction in habitat. Possible permanent, site specific, negative impact of moderate severity. High significance.

	Mining (mitigated)	Agriculture (stock & crop)	Housing
		significance.	
Vegetation	Issue: Mining and rehabilitation activities. Possible medium-short term, negative impact of minor severity. Medium-low significance.	Issue: Farming activities may cause a reduction of indigenous plant species due to grazing/lands. Possible medium term, site specific, negative impact. Medium-low significance.	Issue: Expansion of housing may cause reduction in indigenous plant species. Possible permanent, site specific, negative impact of moderate severity. High significance.
Sensitive Landscapes	There are no sensitive landscapes present	There are no sensitive landscapes present	There are no sensitive landscapes present
Regional socio-economic structure	Issue: If the mine closes employees will be at risk of losing their jobs Negative impact of medium-high significance	Issue: No change expected	Issue: No change expected

6 ENVIRONMENTAL IMPACT ASSESSMENT

6.1 Impact Identification

Impact identification is performed by use of an “Input –Output Block Diagram” model which serves to guide the assessor in assessing all the potential instances of ecological and socio-economic change, pollution and resource consumption that may be associated with the activities required during the construction, operational, closure and post-closure phases

of the project. Inputs include personnel and machines, resources such as fuels, lubricants, explosives, chemicals, electricity and water.

Outputs may generally be described as any changes to the biophysical and socio-economic environments, both positive and negative in nature, and may also include the product produced by the activity, where such product(s) may cause environmental impacts. Negative outputs typically include gases, effluents, dust, noise, vibration, other pollution and changes to the bio-physical environment such as damage to habitats or reduction in surface water quantity. Positive impacts may include the removal of invasive vegetation or benefits to the socio-economic environment.

During the determination of outputs, the effect of outputs on the various components of the environment, e.g. topography, water quality, is considered.

The Impact Assessment for the various phases of the project is attached in **Appendix H**.

6.2 Impact Rating

The impact rating process is designed to provide a numerical rating of the various environmental impacts identified by use of the "Input-Output" model. As discussed in Paragraph 2.2 above, it has to be stressed that the purpose of the EIA process is not to provide an incontrovertible rating of the significance of various aspects, but rather to provide a structured, traceable and defendable methodology of rating the relative significance of impacts in a specific context.

The significance rating process follows the established impact/risk assessment formula:

"Significance = Consequence x Probability"

Where:

"Consequence" = Severity + Spatial Scale + Duration"

And

"*Probability*" is determined with reference to industry knowledge and instances of impacts happening in similar or same circumstances

The weight assigned to the various parameters for positive and negative impacts in the formula is presented in the tables below:

Severity (Positive and Negative Impacts)

	Severity - Environmental	Severity - Social/Cultural/Heritage
5	Very significant impact/total destruction of a highly valued species, habitat or ecosystem or Extremely positive impact over baseline environmental condition*	Irreparable damage to/destruction of highly valued items of great cultural significance or complete breakdown of social order or Extremely positive impact on social, economic and cultural environment.
4	Serious impairment of ecosystem function or Greatly positive impact over baseline environmental condition	Serious social issues/Permanent damage to items of cultural significance or Greatly positive impact on social, economic and cultural environment.
3	Moderate negative alteration of ecosystem functioning or Moderately positive impact over baseline environmental condition	Moderately important social issues and/or moderately significant damage to items of cultural significance or Moderately positive impact on social, economic and cultural environment.
2	Minor effects not affecting ecosystem functioning or Slightly positive impact over baseline environmental condition	Minor Impacts on the local population, repairable over time. Temporary impairment of the availability of items of cultural significance or Minor positive impact on social, economic and cultural environment
1	Insignificant effects on the biophysical environment or Insignificantly positive impact over baseline environmental condition	Insignificant social issues / low-level repairable damage to commonplace structures. positive impact on social, economic and cultural environment or Insignificant positive impact on social, economic and cultural environment

* I.e. Positive impacts over baseline conditions only and not e.g. positive improvements due to rehabilitation.

Spatial Scale

5	National/International
4	Provincial/Regional
3	Regional (substantially beyond site boundary)
2	Local (beyond site boundary and affects neighbours
1	Site (does not extend beyond site boundary)

Duration

5	Permanent/Irreversible (more than 50 years)
4	Long Term (25 to 50 years or beyond closure)
3	Medium Term (5-25 years)
2	Medium-Short Term (1-5 years)
1	Short term (Less than a year)

Probability

5	Certain/ Normally happens in cases of this nature (80-100% chance of happening
4	Will more than likely happen (60-80% chance)
3	Could happen and has happened here or elsewhere (40-60% chance)
2	Has not happened yet, but could (20-40% chance)
1	Conceivable, but only in a set of very specific and extreme circumstances (0-20% chance)

* For purposes of the post-mitigation impact significance rating the duration of the impact is assumed to be the same as for the pre-mitigation assessment.

Impacts are rated prior to mitigation and again after consideration of the mitigation measure proposed in the EMP. The significance of an impact is one of four broad categories, as indicated in the table, below:

Significance Threshold Limits (%)		
High	**76 %- 100%**	
Medium – High	**51% – 75%**	
Medium – Low	**26% – 50%**	
Low	**0% - 25%**	

In accordance with Regulation 51 of the MPRDA, management actions will be assigned for all impacts, irrespective of significance, but the scale of significance serves to focus attention and resources on critical environmental impacts

For the impact assessment related to the impact of each activity on a specific environmental parameter, refer to **Appendix H**. The paragraph number of each environmental parameter is cross-referenced in the Impact Assessment table in the column marked "EIA Reference".

6.3 Construction Phase

During this phase the offices, workshop and wash bay will be built if there are no buildings available in the area to rent. This will entail an increase in movement to and from the proposed site as well as an increase in people on the site and in the area.

6.3.1 Topography

The construction of buildings will cause an alteration of the natural drainage pattern of the area and erosion could also increase. This negative impact is expected to be of medium-low significance (37/100). Mitigation measures will have to be implemented during construction.

6.3.2 Geology

No impacts are expected.

6.3.3 Soil

Topsoil will be disturbed during the clearing and stockpiling of vegetation and topsoil for the construction sites. This negative impact is expected to be of medium-low significance (47/100). Mitigation measures should be implemented to minimise the impacts.

The possibility exists that heavy machinery and trucks that will be used to clear sites, will spill hydrocarbons. This will cause soil contamination. The impact is expected to be of medium-low significance (32/100). Mitigation measures should be put in place to prevent major spillages.

6.3.4 Surface water

No impacts are expected.

6.3.5 Ground water

6.3.5.1 Ground water quality

The potential spillage of hydrocarbons from construction machines during the construction of infrastructure, topsoil and overburden stripping and haul road construction has the potential to cause the pollution of ground water resources. This impact is of medium-low significance with a significance score of 27/100 for each of the activities.

The operation of the fuel and lubricants storage facility has the potential for causing contamination of surface water due to an infrastructure failure (emergency), leakage or spillages during normal operation. Included in normal operation is the potential for the incorrect disposal of spill absorbing material. The potential impact is of medium-low significance with a score of 43/100.

The operation of the offices, ablutions and maintenance workshops has the potential for the contamination of ground water due to incorrect disposal of domestic and hazardous wastes, incorrect handling of workshop effluent spills and leaks. This impact is of low significance with a significance score of 24/100.

6.3.5.2 Ground water quantity

The establishment of hard paved areas during infrastructure construction reduces the recharge of aquifers. This impact has a low significance rating with a score of 20/100.

The establishment of dirty water areas, such as at workshops and storage areas reduces the amount of run-off and, consequently, the catchment yield. This impact has a low significance rating with a score of 20/100.

The removal of vegetation during topsoil and overburden stripping and haul road construction reduces the recharge of aquifers due to increased surface run-off. This impact has a medium-low significance rating with a score of 33/100.

6.3.6 Land capability

Soil degradation during the construction phase will cause deterioration of the land capability. The impact is expected to have medium-low significance (37/100). Mitigation will be required.

6.3.7 Air quality

Dust levels on site will be raised during the construction phase due to the increase in activity. The area is very dry during the winter months and this increases the ability for dust particles to become airborne. Construction vehicles and machinery will be transporting equipment around the site and will cause a major increase in fallout dust levels on site. Dust suppression measures should be put in place to minimise this impact.

The impact will be of medium-high significance due to the risk to human health both on site and offsite in the surrounding communities. A dust management programme will decrease the significance of the impact to medium-low.

The clearing of vegetation and stripping of any topsoils during this phase will result in dust generation. These impacts will be minimised if the management and action plan is followed.

6.3.8 Noise

Noise levels will increase during the construction phase. The increase will only occur during the daylight hours when construction occurs. There will be no construction during the night. The significance of the impact will be medium-low (33/100).

6.3.9 Natural vegetation

Construction of infrastructure and the offices, workshop and wash bay, all involve the removal of vegetation. The impact is of medium-low significance with a score of 47/100 for both activities.

Topsoil stripping for establishment of opencast pit will cause the destruction of vegetation. In both cases the impacts are of medium high significance with a score of 67/100.

Construction of the haul road involves the removal of natural vegetation. The impact is of medium significance with a score of 47/100.

Pollution of water and soil which can cause harm to vegetation, this impact scores 28/100.

6.3.10 Animal life

Noise created during construction will have a negative effect on fauna, causing them to move away from the affected areas. The impact is of medium-low significance with a score of 32/100.

Removal of natural vegetation destroys the natural habitat of mammals, causing them to move away. Due to the very limited number of mammals observed on the property, the impact is of medium-low significance with a score of 37/100.

Removal of natural vegetation destroys the natural habitat of birds, causing them to move away. The impact is expected to be of medium low-significance with a score of 33/100.

Removal of natural vegetation destroys the natural habitat of reptiles and amphibians, causing them to perish or move away. The impact is expected to be of medium-low significance with a score of 33/100.

Removal of natural vegetation destroys the natural habitat of terrestrial invertebrates, causing them to perish or move away. No Red Data species were observed during site visits; the impact is therefore of medium-low significance with a score of 33/100.

6.3.11 Sites of archaeological and cultural interest

During the construction phase, impacts on archaeological and heritage sites will be localised to areas affected by the development of mining infrastructure and areas prepared for mining. The best option would be to preserve sites of archaeological and cultural significance according to the NHRA regulations.

Current mining plans for the proposed project indicate that site **MHC003** will be protected from mining related developments. If this option is not viable, it is recommended that site **MHC003** be re-evaluated when vegetation conditions make it possible for better visibility of the area. If it is identified that the area is a cemetery, the best option would be the preservation of the cemetery *in situ*. Subsequently, the area will have to be fenced off and provided with a gate for access by family members. A buffer zone of at least 20 m will have to be kept around the cemetery, to facilitate the protection of the site during development. In the instance that the site will be adversely impacted by development, the cemetery needs to be relocated in accordance with all legal requirements, as well as along with the undertaking of an extensive social consultation process. It is well advised that a company with a proven record of accomplishment be used to manage and complete such a project.

6.3.12 Sensitive landscapes

There are no sensitive landscapes in the area. No impacts are expected.

6.3.13 Visual aspects

The construction of buildings will have a moderately negative impact locally. The impact on the visual aspect of the area is expected to be of medium-low significance (47/100). Mitigation will be required to lower the significance of the impact.

6.3.14 Traffic and safety

Heavy machinery and trucks used during construction poses a safety risk on site. The impact is expected to be of medium-high significance (53/100). Mitigation measures should be put in place to prevent accidents.

6.3.15 Regional socio-economic structure

During the construction phase a slight increase in employment opportunities may result for construction contractors situated in the region. Due to the fact that only a small amount of infrastructure will be constructed on site, and the small scale of the operations, the total benefit of the construction phase will not be highly significant. This positive impact is of medium-low significance and has a score of 32/100.

6.3.16 Interested and affected parties

Activities related to construction, such as the erection of offices and administrative facilities, will likely cause increases in the amount of dust and noise in the directly adjacent areas. This will slightly affect nearby stakeholders in as far as the enjoyment of their properties is concerned and dust may also have impacts where crop production is concerned. However, this impact will be extremely limited in nature due to the isolation of the proposed construction site as well as the low level of human activity in the nearby area. The impact is expected to be of low significance with a score of 20/100.

The presence of contractors during the construction phase of the project is expected to slightly affect IAPs with regard to trespassing and security issues. The impact is expected to be of low significance with a score of 13/100.

6.4 Operational Phase

The topsoil will be removed and stored separately to expose the sand that will be mined. Strip mining will be used to mine the sand in strips of 50 m by 200 m. Trucks and loaders will be used to mine the sand and transport it to the process plant to remove the impurities. Domestic waste will also be produced during this phase.

6.4.1 Topography

The topography will be changed due to the removal of the topsoil and the permanent removal of the sand. Drainage will be changed and the erosion risk is higher. The impact is expected to be of medium-high significance (53/100). Mitigation is required.

6.4.2 Geology

No impacts are expected.

6.4.3 Soil

The loss of soil is expected to be a medium-high significant, negative impact (67/100). Mitigation measures should be put in place to minimise the significance of the impact.

Heavy machinery and trucks will compact the soil and hydrocarbon spillages is expected to occur. These negative impacts are expected to be of medium-low significance (47/100). Mitigation measures should be put in place.

6.4.4 Surface water

The removal of soil and vegetation will increase the amount of surface water runoff during rain events and will alter the surface water flow dynamics. It is expected that this negative impact will have medium-high significance (60/100).

It is possible that hydrocarbon spillages might occur on site due to the storage of hydrocarbons and vehicle activity on the mine. This could have a negative impact on surface water quality in the vicinity of the mine. This impact will have medium-low significance (43/100) and mitigation will be required.

The incorrect handling of industrial, domestic and hazardous waste as well as sewerage will degrade the surface water quality. The impact is will have medium-low significance (32/100) and mitigation will be required to minimise pollution.

6.4.5 Ground water

6.4.5.1 Ground Water Quality

During the performance of all mining activities the potential exists for the contamination of ground water due to the spillage of hydrocarbons by mining machines. The impact is of medium-low significance and has a score of 27/100.

The operation of the fuel and lubricants storage facility has the potential for causing contamination of ground water due to either an infrastructure failure (emergency) or spillages during normal operations. Included in normal operations is the potential for the incorrect disposal of spill absorbing material. The potential impact is of medium-low significance with a score of 32/100.

The potential incorrect disposal of domestic waste at the offices and ablutions may have an impact on ground water quality. The impact is expected to be of medium-low significance with a score of 28/100.

The potential incorrect handling of sewerage at the offices and ablutions may have an impact on ground water quality. The impact is expected to be of medium-low significance with a score of 28/100.

The potential incorrect disposal of hazardous wastes, workshop effluent as well as spills and leaks at the maintenance workshops may have an impact on ground water. The impact is expected to be of medium-low significance with a score of 32/100.

6.4.5.2 Ground Water quantity

The establishment of hard paved areas at workshops, storage areas, offices and ablutions has a negative effect on recharge to ground water. The impact is of low significance with a score of 20/100.

The removal of vegetation during topsoil and overburden pre-stripping reduces the recharge of rain water to aquifers due to increased run-off. The impact is of medium-high significance with a score of 53/100.

6.4.6 Land capability

The removal of the soil will cause a deterioration of the land capability. This impact is expected to be negative and of medium-low significance (47/100). Mitigation measures should be put in place to minimise the impacts.

6.4.7 Air quality

During the operational phase the most dust will be produced by vehicle and machinery movement around the site. Target areas for dust suppression should be on the haul roads and tipping areas as these are the areas of most activity and the areas most prone to producing fallout dust. Good dust suppression measures should be in place. The impact is expected to have medium-low significance (37/100).

With a proper air quality management plan to monitor and limit emissions the significance of the impact could be low.

6.4.8 Noise

During the operational phase the noise levels will increase due to the use of machinery and trucks. The noise will be restricted to the daylight hours as no mining will take place after dark. The impact is expected to be of medium-low significance (37/100).

6.4.9 Natural vegetation

Topsoil stripping during mining of areas will cause the destruction of vegetation. The impact is of medium-high significance and has a score of 67/100.

Dust created during all opencast mining activities may have a negative effect on vegetation due to dust deposition on leaves, which affects transpiration and photosynthesis. The impact is of medium low significance with a score of 27/100.

Pollution of soil water and vegetation is a real possibility and could have a negative effect on future land capability. This impact scores 32/100.

Invasion of exotic and weed species into un-mined or rehabilitated areas. This impact scores 24/100.

6.4.10 Animal life

Removal of natural vegetation destroys the natural habitat of mammals, causing them to move away. Largely due to the extensive agricultural disturbance of the area, few mammals are present and the impact is expected to be of medium low significance with a score of 32/100.

Removal of natural vegetation destroys the natural habitat of birds, causing them to move away. The impact is of medium-low significance with a score of 47/100.

Noise created during operation will cause animals to avoid the site as far as possible. The impact is of medium-low significance with a score of 32/100.

Removal of natural vegetation destroys the natural habitat of reptiles and amphibians, causing them to perish or move away. The impact is of medium-high significance with a score of 53/100.

Removal of natural vegetation destroys the natural habitat of terrestrial invertebrates, causing them to perish or move away. The impact is of low significance with a score of 24/100.

6.4.11 Sites of archaeological and cultural interest

The operational phase is not expected to increase negative impacts on identified sites of archaeological and/or heritage significance if the necessary management measures have been implemented in the construction and pre-construction phase. During the operational phase impacts on archaeological sites could, however, be high, depending on the quantity and location of sites identified in the archaeological assessment report. In this case, three sites of archaeological and heritage significance were found within the footprint of the proposed mining area. Of these, only **MHC003** will require further work in the form of further evaluation in low vegetation conditions.

Due to the nature of cultural remains that occur, in most cases, below surface, the possibility remains that some cultural relics may not have been discovered during the survey. Although Matakoma Heritage consultants surveyed the area as thoroughly as possible, it is incumbent upon the developer to inform the relevant heritage agency should further cultural remains be unearthed or laid open during the operational phase of development. If during construction or operation any possible finds are made, the process must be stopped and a qualified archaeologist be contacted for an assessment of the find. Impacts would be of low significance (21/100) as long as site **MHC003** is not affected by activities resulting from mining activities. Should preservation not be a viable option, these sites should be properly documented and assessed by relevant experts. With regard to cemeteries, relocation would have a severe impact and would need to be dealt with accordingly.

6.4.12 Sensitive landscapes

There are no sensitive landscapes in the area. No impacts are expected.

6.4.13 Visual aspects

The area will be changed from vegetation to mining. The removal of the vegetation and removal the sand will have a moderately negative impact locally. The impact on the visual aspect of the area is expected to be of medium-high significance (53/100). Mitigation will be required to lower the significance of the impact.

6.4.14 Traffic and safety

Heavy machinery and trucks used during the operational phase poses a safety risk on site. The impact is expected to be of medium-high significance (53/100). Mitigation measures should be put in place to prevent accidents.

Big trucks that will be used for the transport of the sand to different clients will increase the risk of road and pedestrian accidents in the area around the mine. The impact is expected to have medium-high significance (60/100). Mitigation will be required to minimise or prevent any road and pedestrian accidents.

6.4.15 Regional socio-economic structure

During the operational phase of Bankfontein, the existing 24 employment opportunities at Vaal Sand will be continued for a further period of time. This is an important impact for those local individuals that receive employment from the company, and will have a resultant impact on the income earning potential of the affected households. Considering a multiplier effect of 1:6, it is likely that approximately 144 people's lives will be positively affected by these opportunities. This positive impact is of medium-high significance and has a score of 60/100.

6.4.16 Interested and affected parties

The strip mining methods that will be associated with the Bankfontein operation will likely cause increases in the amount of dust and noise in the directly adjacent areas. Depending on the season and the strength of the wind, dust may cause a further reaching impact into the general region. This will likely affect nearby stakeholders in as far as the enjoyment of their properties is concerned and dust may also have impacts where crop production is concerned. The impact is expected to be of low significance with a score of 19/100.

The presence of mining workers on site during operations is expected to slightly affect IAPs with regard to trespassing and security issues. The impact is expected to be of medium-low significance with a score of 32/100.

6.5 Decommissioning Phase

Rehabilitation will be an ongoing process as the mine progresses. During the decommissioning phase all the buildings will be removed and rehabilitation of the area will be completed.

6.5.1 Topography

The reshaping and re-vegetating of the area will have a moderately positive impact. The impact is expected to be of medium-low significance (33/100) but could be higher if rehabilitation is done effectively.

6.5.2 Geology

No impacts are expected.

6.5.3 Soil

The possibility exists that soil could be further degraded and could also be subject to erosion if mitigation is not done effectively. The impact is expected to have medium-low significance (37/100). Mitigation measures should be put in place to ensure that rehabilitation is done effectively.

6.5.4 Surface water

Heavy vehicles and machinery used during decommissioning could cause surface water contamination through hydrocarbon spillages. It is expected that the impact will have medium-low significance (32/100). Mitigation will be required.

6.5.5 Ground water

6.5.5.1 Ground Water Quality

During the decommissioning of all mining activities, the potential exists for the contamination of ground water due to the spillage of hydrocarbons by mining machines. The impact is of medium-low significance and has a score of 27/100.

The operation of the fuel and lubricants storage facility has the potential for causing contamination of ground water due to either an infrastructure failure (emergency) or spillages during normal operation. Included in normal operation is the potential for the incorrect disposal of spill absorbing material. The potential impact is of medium-low significance with a score of 32/100.

The potential incorrect disposal of domestic waste at the offices and ablutions may have an impact on ground water quality. The impact is expected to be of medium-low significance with a score of 28/100.

The potential incorrect handling of sewerage at the offices and ablutions may have an impact on ground water quality. The impact is expected to be of medium-low significance with a score of 28/100.

The potential incorrect disposal of hazardous wastes, workshop effluent as well as spills and leaks at the maintenance workshops may have an impact on ground water. The impact is expected to be of medium-low significance with a score of 32/100.

6.5.5.2 Ground Water Quantity

No impacts are expected to influence the groundwater quantity during the decommissioning state.

6.5.6 Land capability

No further impacts are expected during the decommissioning phase.

6.5.7 Air quality

During decommissioning the mine's infrastructure will be removed and there will be a temporary increase in the amount of activity on site. This will increase the potential for the creation of fallout dust on site. The rehabilitation activities will also increase the dust levels as soil stockpiles are dug up and replaced over disturbed areas. Whilst these rehabilitated areas are still being vegetated, the risk for dust creation during strong winds will be high and this will need to be managed.

The impacts from the dust on the fauna and flora and the people in the area are expected to be medium to low (27/100) as it will be for a short period of time. Once the infrastructure has been removed from the site, the potential impacts of dust creation will be insignificant.

6.5.8 Noise

Heavy vehicles and machinery used during decommissioning will have an impact on the noise levels of the area. The significance of the impact is seen to be low to medium (27/100).

6.5.9 Natural vegetation

Although natural vegetation will be improved during the decommissioning, the actions performed are classed as mitigation measures and are discussed as such.

The establishing and spreading of alien and invader species to rehabilitated areas should be prevented. It should also be eliminated from un-mined land. This significance of this impact is expected to be medium-low (43/100).

6.5.10 Animal life

Although the amount of animals on the property will likely increase during and following rehabilitation, the actions performed are classed as mitigation measures and are discussed as such.

6.5.11 Sites of archaeological and cultural interest

Subsequent to the effective management of identified archaeological and heritage resources, impacts during the decommissioning and closure of the mine are not expected. However, impacts on potential sites could be severe if areas are not properly assessed, documented, fenced off, demarcated, managed and provided a buffer zone to prevent accidental damage.

Should alternative sites or features of archaeological and heritage significance be made during the decommissioning phase, a qualified archaeologist be contacted for an assessment of the discovery.

6.5.12 Sensitive landscapes

There are no sensitive landscapes in the area. No impacts are expected.

6.5.13 Visual aspects

Rehabilitation of the area will have a moderately positive impact on the visual aspect of the area. The impact is expected to be of medium-high significance (43/100).

6.5.14 Traffic and safety

Heavy machinery and trucks used during decommissioning pose a safety risk on site and in the area surrounding the mine. This could increase the risk of road and pedestrian accidents. The impact is expected to have medium-high significance (60/100). Mitigation will be required to minimise or prevent any road, pedestrian and site accidents.

6.5.15 Regional socio-economic structure

During mine closure, Vaal Sand's employees will be susceptible to losing their jobs and hence their income. The families of these employees are often dependent on this income for survival, and therefore employee households are thus very vulnerable to this impact. In the absence of mitigation measures, this impact is expected to be of medium-high significance with a score of 73/100.

6.5.16 Interested and affected parties

During the decommissioning of the mine, there is likely to be a short term increase in dust and noise pollution, through the dismantling of infrastructure, rehabilitation, and related decommissioning activities. Over the long-term, however, the impact is likely to be positive in nature as the noise and dust associated with sand mining operations will be ceased and the area will be returned to its original state. The overall impact is thus positive, and is expected to be of medium-low significance with a rating of 43/100.

7 CUMULATIVE IMPACTS

Cumulative effects are caused by the accumulation and interaction of multiple stresses affecting the parts and the functions of ecosystems. Of particular concern is the knowledge that ecological systems sometimes change abruptly and unexpectedly in response to apparently small incremental stresses. For purposes of this report, cumulative impacts have been defined as "**the changes to the environment caused by an activity in combination with other past, present, and reasonably foreseeable human activities**".

Where cumulative impacts are expected to be significant, these have been discussed.

7.1 Topography

Topography of the area surrounding the mine is rather flat. Mining and agricultural activities are dominant in the area. Both of these activities have impacted on the local topography. Mining activities have resulted in the creation of disposal and storage facilities. Areas that were reshaped during rehabilitation also have an altered topography.

A change in topography will result in a change in drainage patterns, surface water streams, groundwater recharge and visual aspects.

7.2 Geology

Coal mining operations in the area have had an impact on the geology since the coal seam has been removed permanently. The sand will also be removed permanently but the impacts will be substantially less than that of a coal mine.

7.3 Soil

Mining and agricultural activities increase the potential for soil loss through erosion and degradation. An increase in erosion could also lead to siltation of streams. The permanent loss of soil will have a significant impact on the local area.

7.4 Surface Water

No significant impacts are expected from the Bankfontein operation since only domestic water will be used. Vaal Sand will thus have no impact on the surface water quantity in the

area. Mining and agricultural activities can lead to an increase in erosion which can lead to siltation of streams.

7.5 Groundwater

Current utilisation of local aquifer systems coincides with the principle land uses of stock farming and to provide domestic water supply. The planned mining activities will not lead to a loss of groundwater for farming and domestic water supply and no major impacts are expected to deteriorate water quality or quantity. Regionally, mining has a significant impact on ground water quality and quantity through acid mine drainage and changes in storage capacity in opencast and underground workings. The current industry stance is to manage groundwater on a catchment basis as management on an individual mine basis is not effective due to inter mine flow. The mining companies, DWAF and water users associations need to establish a working relationship to allow for the integrated management of cumulative impacts.

7.6 Land Capability

Mining and agricultural activities in the area have already impacted on the land capability. The cumulative impact on land capability will increase in significance due to the existence of other mines in the area. After rehabilitation land capability should be restored to at least a grazing class.

7.7 Air Quality

Agricultural activities, the Bankfontein operation and other mining activities in the area could cause higher levels of dust in the area. After closure dust levels on site should return to their natural state. Once the vegetation has re-established itself in the disturbed areas, the risk of dust fallout will be insignificant.

7.8 Noise

Once mining has finished the noise levels on site will be reduced. There will be no significant cumulative impacts caused by the noise generated during operation of the mine.

7.9 Natural Vegetation

Cumulative impacts on vegetation are significantly negative, but almost all negative impacts can be mitigated with the proper measures. Also, plant pollination occurs on a local scale and removing vegetation as part of opencast mining could affect survival of plant species outside the area. On a national level much of South Africa's grassland has already been impacted due to mining, agriculture and urban development. Regionally, these activities have also impacted on vegetation. Most of the vegetation in the area has already been disturbed due to agricultural activities and this increases the cumulative impact.

7.10 Animal Life

As fauna in the area has already been disturbed by agricultural and industrial developments, the removal of habitat due to opencast mining may have significant negative cummulative impacts on local fauna, especially where grassland fauna and dependant species are concerned.

7.11 Sensitive Landscapes

No impacts are expected.

7.12 Visual Aspects

Other mining activities as well as agricultural activities in the region have already impacted visually on the area. The significance of the cumulative impact will increase. Rehabilitation should decrease the significance of these impacts.

7.13 Traffic and Safety

Sand will be transported to various locations depending on where the client is situated. Different routes will thus be used. An increase in the amount of large trucks in the region will thus occur. This will increase the cumulative possibility of road and pedestrian accidents.

7.14 Regional Socio-economic Structure

Operations at Vaal Sand will contribute to the economic growth locally and regionally. Together with other mining activities in the area the significance of this positive impact will be higher.

8 PUBLIC PARTICIPATION PROCESS

The PPP for Vaal Sand (**Appendix G**) attempted to ensure that all IAPs were adequately involved in the project. Stakeholders were afforded the opportunity to participate in and contribute to the EIA/EMP studies. IAPs were presented with detailed and up-to-date information regarding the Vaal Sand Mining Rights Application to ensure that all feedback was relevant and well-informed.

8.1 Process of Engagement

A public meeting and authorities' meeting formed the essence of the PPP. This served to inform affected parties of the Mining Rights Application process, involve them in process decisions, and determine their concerns, expectations, and perceptions regarding the proposed Bankfontein project. The process was intended to record and address specific issues to the satisfaction of both Vaal Sand and IAPs. Extensive consultation took place by means of telephonic communication, email, fax, and post with stakeholders and relevant national, provincial, and local authorities.

Contributions from IAPs were reflected in reports and minutes of the meetings. In order to allow for transparency and the right of access to information, the public and authorities were given access to the minutes of all meetings and were allowed a comment period. All informative documents were mailed, faxed and emailed to registered IAPs.

8.2 Outcomes of Meetings

A number of significant issues and findings were uncovered. The most pertinent positive project impact was identified as being the continuation of existing employment and with this a few families' lives would be enhanced. Negative impacts, such as water pollution, increased dust, and increased traffic on the roads were of concern to stakeholders. Most concerns were raised by authorities who attended the meetings. The positive and negative

environmental impacts are discussed in detail in the previous sections of the EIA/EMP report.

8.3 Addressing Issues and Concerns

The PPP for the Bankfontein project should continue throughout the Life of Mine (LoM) and all IAPs should remain involved from this stage of the project, to construction of the mine, up to and including closure.

Stakeholders will be provided with the opportunity to review all reports and to raise further comments if not satisfied that all relevant issues regarding this project have already been addressed.

8.4 Recommendations

Meeting the communication expectations of stakeholders is an important aspect of the project. If poor relationships are established at this stage, then the issue of trust will be a continual hurdle for Vaal Sand. To this end, it is recommended that a programme of ongoing engagement be set up beyond the EIA process.

It is further recommended that a complaints or grievance resolution procedure be set up which should be managed to ensure efficient and ongoing communication.

A diagram of a complaints/ grievance procedures is shown in Figure 8.1 below.

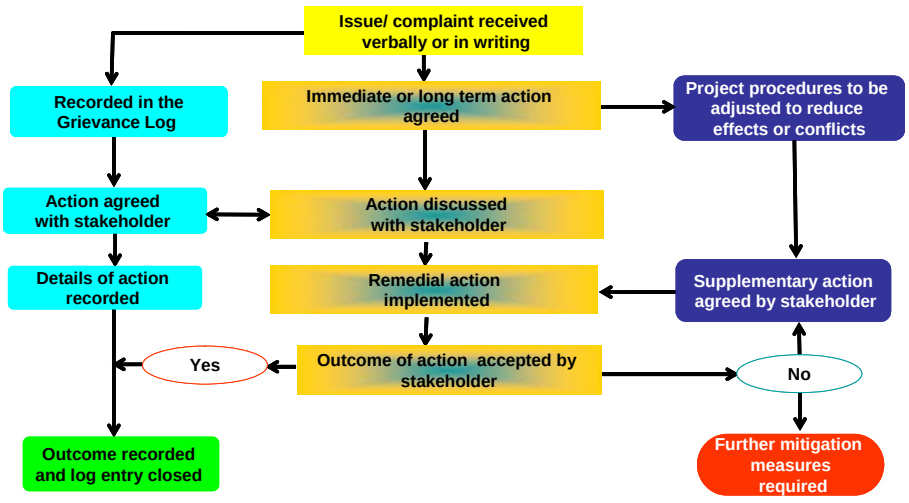


Figure 8.1: Grievance/ Complaints Procedure

9 ENVIRONMENTAL OBJECTIVES

9.1 Environmental Objectives and Goals

The environmental objectives for the construction and operational phases are to:

- Protect the biophysical environment from any impacts that can not be mitigated and that will negatively impact on biodiversity on a regional scale;
- Preserve the water resources in line with the objectives of the integrated catchments management and thereby ensure that the limited available resources are utilised to the maximum benefit of the country and its inhabitants;
- To ensure that activities are carried out so as to aid rehabilitation;
- To ensure a safe environment for people to live in as is stipulated in the constitution.

The specific objectives for the construction, operational, decommissioning and closure phases are given for each aspect in Chapter 11.

9.2 Socio-Economic Objectives and Goals

The following socio-economic objectives should be attained during the operation and decommissioning phases of the project:

- Adhere to an open and transparent communication procedure with stakeholders at all times;
- Ensure that accurate and timeous information is communicated to IAPs;
- Ensure that information is communicated in a manner which is understandable and accessible to IAPs;
- Enhance project benefits and minimise negative impacts through intensive consultation with stakeholders;
- Assemble adequate, accurate, appropriate, and relevant socio-economic information relating to the context of the mining operation;
- Ensure an atmosphere of equality and non-discrimination among the workforce;

- Contribute to the development of functional literacy and numeracy among employees through Adult Basic Education and Training;
- Empower the workforce to develop skills that will equip them to obtain employment in other sectors of the economy;
- Contribute to the development of a self-reliant community surrounding the mine's area of operation;
- Ensure that retrenchments and decommissioning take place in a legally compliant and humane manner;
- Adhere to principles of international best practice in all socio-economic activities; and
- Contribute to meaningful upliftment and development of rural communities within the area.

9.3 Archaeological and Heritage Aspects

In order to attain effective archaeological and heritage objectives, an archaeological and heritage assessment was conducted for the proposed Bankfontein mining operation in 2007. During the archaeological and heritage survey, three sites of archaeological and heritage significance were found within the footprint of the proposed mining area. Of these, only **MHC003** will require further work in the form of further evaluation in low vegetation conditions. All sites identified during the survey are mapped on the plan provided in Annexure A and B of the HIA report (**Appendix F**).

In essence, the objectives of archaeological and/or heritage impact assessments are:

- To describe and assess potential impacts related to archaeological and heritage resources in the project area that may result from project related activities;
- To include mitigation measures for the potential impacts, and to make suitable recommendations;
- To recommend a monitoring programme (if applicable) detailing the frequency, reasoning, methodology and reporting to be implemented once the project commences construction;

- To identify and describe any fatal flaws to the project relating to archaeological and heritage resources in the environment;
- To estimate capital and operating costs relating to the field of speciality (i.e. archaeology and heritage studies) for the proposed project;
- To recommend (if applicable) rehabilitation and a closure plan which will include methods of closure, costs involved, extended monitoring and management of potential long term impacts.

Current mining plans for the proposed project indicate that site **MHC003** will be protected from mining related developments. If this is not an option, it is recommended that site **MHC003** be re-evaluated when vegetation conditions makes it possible for better visibility of the area. Conditional to the implementation of aforementioned recommendations, there are no archaeological or heritage risks associated with the proceedings of the proposed Vaal Sand mining operation.

10 MANAGEMENT OF IDENTIFIED ENVIRONMENTAL IMPACTS

Those impacts identified during the impact assessment must be mitigated to reduce or eliminate negative effects of the project.

Each phase of the project has been considered and management measures for each impact have been discussed below.

10.1 Construction Phase

Aspect	Mitigation Required	Objectives	Management Measures	Monitoring
Topography	Yes	• Limit topographical disturbances to the mine.	• Plan all construction beforehand to prevent unnecessary disturbance.	
Geology	No	•	•	
Soil	Yes	• Prevent spillages of hydrocarbons. • Prevent or limit the occurrence of erosion.	• Storage and use of hydrocarbons should be confined to bunded areas. • The removal of topsoil should be kept to a minimum. • Topsoil should be stored properly to limit nutrient loss and prevent erosion of the stockpiles.	Yes
Surface water	No	•	•	
Groundwater	Yes	• Prevent leaks, failure or normal operation and the disposal of absorbent materials and hazardous waste. • Prevent incorrect sewerage handling • Limit contamination of hydrocarbons and chemicals by construction machines	• Fuel and lubricant storage facilities will be bunded in accordance with SANS specifications to reduce the risk of any leaks or failures. • Sewage will be handled in portable chemical latrines to reduce the risk of contamination. • Construction machines used during topsoil stripping will be checked, serviced and maintained to reduce the risk of ground water quality.	No
Land capability	Yes	• To prevent total deterioration of the area.	• Rehabilitation should take place during the life of mine to ensure that the land capability does not deteriorate to total wilderness.	Yes
Air quality		• Minimise dust creation through dust suppression measures	• Monthly monitoring of dust levels on site through a network of dust buckets located around the pit, • Dust suppression measures should be employed in all tipping sites, haul roads, and areas where soil is exposed. Dust suppression should include; - Water truck operating along all haul roads and access roads to the site, as well as any exposed soils, the water should contain a binding agent to allow the water to soak the soil and stay damp for longer periods thus minimising the consumption of water, - Spray nozzles over all tipping areas, • A truck wash system will be constructed, if necessary, to prevent vehicles leaving the site with muddy tyres and spreading the material around surrounding roads.	Yes
Noise				
Natural vegetation	Yes	• To prevent the unnecessary destruction, damage or loss of any vegetation. • To prevent the spread of alien invasive species.	• Construction of infrastructure and the haul roads will be planned carefully to reduce the impact on the affected areas. • Should any Red Data plants be found growing in an area where the vegetation will be removed they will be relocated. • People involved in the construction phase will be educated on which Red Data plants could potentially occur in the area and how to deal with these species if encountered. • Manage and control plant species declared as invasive and declared weeds through weed killers	Yes
Animal life	Yes	• Not to alienate, other than by mining, the wildlife in the area or to harm any animal life found on the property and to prevent the unnecessary destruction of natural habitat for animal life.	• Vehicles and machines used during the construction phase will be serviced and maintained properly to ensure they are in a good working order. • All workers, contractors and visitors will be informed about any rare and endangered species through an environmental awareness plan and posters. • Any pollution of water, soil and vegetation which can cause harm to animal life will be prevented.	
Archaeology	Yes	• Ensure archaeological and heritage resources are assessed, identified, documented and protected according to the NHRA	• Site **MHC003** will require evaluation in low vegetation conditions. • Site should be re-evaluated when vegetation conditions makes it possible for better visibility of the area. • If it is identified that the area is a cemetery it is recommended that the site be preserved and fenced or relocated. • If applicable, issues relating to the removal of graves, access to grave and damage to graves will be handled by the South African Heritage Resources Agency (SAHRA) or the relevant provincial heritage resources authority, who will issue permits to ensure that all actions are permissible	Yes

Aspect	Mitigation Required	Objectives	Management Measures	Monitoring
Sensitive landscapes	No	•	•	
Visual	Yes	• To minimise visual impacts where as effectively as possible.	• Paint buildings a natural colour and minimise night lighting.	
Traffic & safety	No	• To minimise accidents on site.	• Ensure machine operators are trained properly. • Put signs in place.	Yes
Socio-economic		• Enhance the positive impacts associated with the creation of employment positions during construction.	• Where possible local service providers and contractors from the Vereeniging/Sasolburg area will be recruited to undertake infrastructure construction activities.	
IAPs		• Avoid or deter increased trespassing through the presence of contractors on site. • Minimise impacts associated with increased dust and noise pollution on directly adjacent properties.	• Contractors and mine employees will be made aware that trespassing on private land is an offence and that they should respect the privacy and security of the adjacent land owners • Noise pollution will be kept to a minimum during the construction phase of the project to ensure that IAPs are not affected more than necessary. All construction operations will be planned and executed according to current professional standards	

10.2 Operational Phase

Aspect	Mitigation Required	Objectives	Management Measures	Monitoring
Topography	Yes	• Use the removed topsoil during rehabilitation to minimise topographical disturbances. • To rehabilitate the disturbed areas while mining is still ongoing.	• Store topsoil separately. • Ensure rehabilitation is done effectively throughout the life of mine.	Yes
Geology	No	•	•	
Soil	Yes	• Prevent unnecessary compaction of soil. • Prevent spillages of hydrocarbons. • Prevent or limit the occurrence of erosion.	• Limit the movement of heavy machinery to roads. • Storage and use of hydrocarbons should be confined to bunded areas. • The removal of topsoil should be kept to a minimum.	Yes
Surface water	Yes	• Prevent unnecessary removal of vegetation. • Prevent hydrocarbon spillages. • Prevent contamination from different waste streams	• Keep the removal of vegetation to a minimum. • Ensure hydrocarbons are stored and managed correctly and report spillages. • Ensure that waste is disposed of correctly according to different waste streams.	Yes
Groundwater	Yes	• Prevent leaks, failure or normal operation and the disposal of absorbent materials and hazardous waste. • Prevent incorrect sewerage handling • Limit contamination of hydrocarbons and chemicals by construction • machines	• Fuel and lubricant storage facilities will be bunded in accordance with SANS specifications to reduce the risk of any leaks or failures. • Sewage will be handled in portable chemical latrines to reduce the risk of contamination. • Construction machines used during topsoil stripping will be checked, serviced and maintained to reduce the risk of ground water quality.	No
Land capability	Yes	• To prevent the deterioration of land capability.	• Impacts on other aspects of the environment especially soil, should be mitigated or prevented to prevent the area to deteriorate completely.	Yes
Air quality		• Minimise dust creation through dust suppression measures	• Monthly monitoring of dust levels on site through a network of dust buckets located around the stripping, screening and dumping areas. • Dust suppression measures should be employed in all tipping sites, haul roads, and areas where soil is exposed. Dust suppression should include: - Water truck operating along all haul roads and access roads to the site, as well as any exposed soils, the water should contain a binding agent to allow the water to soak the soil and stay damp for longer periods thus minimising the consumption of water, - Spray nozzles over all tipping areas, - A truck wash system will be constructed, if necessary, to prevent vehicles leaving the site with muddy tyres and spreading the material around surrounding roads.	
Noise		•	•	
Natural vegetation		• To prevent the unnecessary destruction of the vegetative cover, to protect plant species of importance, to maintain biological activity and a viable seed bank. • Manage and control plant species declared as invasive and declared weeds.	• Visual assessments of the site will be conducted on a regular basis to monitor potential soil erosion. • Regular flora surveys will be conducted to monitor impacts of operational activities. • If found to be present, Red Data Status species will be removed prior to the clearing of mining areas. • Disturbed surfaces will be re-vegetated as soon as they become available. • An exotic and invader control programme will be implemented.	Yes
Animal life		• To minimise the disturbance of animal life and encourage the return of invertebrates, birds, amphibians, reptiles and mammals after rehabilitation. • To prevent the unnecessary destruction of natural habitat and animal life within the boundaries of the mining area and adjacent areas.	• Any pollution of water, soil and vegetation which can cause harm to aquatic invertebrates and other forms of animal life will be prevented as far as possible. • All workers, contractors and visitors will be informed about any rare and endangered species through an environmental awareness plan and the distribution of posters.	
Archaeology	Yes	• To ensure additional (potential subterranean) archaeological and heritage resources are assessed, identified, documented and protected according to the NHRA.	• If any possible finds are made during the operational phase, the process must be stopped and a qualified archaeologist be contacted for an assessment of the find. • Should preservation of these significant sites not be a viable option, it should be properly documented and assessed by relevant experts	Yes

Aspect	Mitigation Required	Objectives	Management Measures	Monitoring
Sensitive landscapes	No	•	•	
Visual	Yes	• To minimise visual impacts where as effectively as possible.	• Paint buildings a natural colour and minimise night lighting. • Bare areas should be re-vegetated. • Trees, walls and vegetated berms can be used as a screen during mining.	Yes
Traffic & safety	No	• Minimise accidents on site. • Prevent/minimise vehicle and pedestrian accidents.	• Ensure machine operators are trained properly. • Machine operators should be sensitised. • Put road signs in place to indicate hazardous areas. • Ensure truck drivers are properly trained.	Yes
Socio-economic		• To enhance the positive impacts associated with the continuation of employment positions during operations.	• The implementation of a full Social and Labour Plan which details measures involving the upliftment of employees. Employees will be uplifted specifically through the implementation of Adult Education, skills development, employment equity, bursary and internship programmes. Mentorship will also be offered on an appropriate scale within the operation	
IAPs		• To avoid or deter increased trespassing through the presence of mine employees on site. • To minimise impacts associated with increased dust and noise pollution on directly adjacent properties.	• Mine employees will be made aware that trespassing on private land is an offence and that they should respect the privacy and security of the adjacent land owners. Any theft or trespassing by employees that is noted will be dealt with severely by mine management. • Noise pollution will be kept to a minimum during the operational phase of the project to ensure that interested parties are not affected more than necessary. All operations will be planned and executed according to current professional standards. • Public participation will continue through the life of the mine to ensure local communities are kept informed and allowed to raise issues. These issues will then be addressed by the mine manager. • IAPs that are affected by Vaal Sand's activities will be consulted with on a regular basis. A complaints management system will be maintained by the mine to ensure that all issues raised by community members are followed up and addressed appropriately.	

10.3 Decommissioning Phase

Aspect	Mitigation Required	Objectives	Management Measures	Monitoring
Topography	Yes	• To rehabilitate the area its original state or better.	• Ensure rehabilitation is done effectively.	Yes
Geology	No			
Soil	Yes	• Prevent unnecessary compaction of soil. • Prevent spillages of hydrocarbons. • Prevent or limit the occurrence of erosion. • Replace topsoil correctly and facilitate rehabilitation.	• Limit the movement of heavy machinery to roads. • Storage and use of hydrocarbons should be confined to bunded areas. • Ensure that rehabilitation (e.g. replacement of soil, fertilisers) in done correctly	Yes
Surface water	Yes	• Prevent hydrocarbons spillages.	• Ensure that hydrocarbons are managed correctly and that vehicles and machinery do not spill. • Spillages should be reported.	Yes
Groundwater	Yes	• Incorrect disposal of hazardous, industrial and domestic waste may affect ground water quality • Prevent spillage of hydrocarbons by construction machines • Prevent incorrect sewerage handling	• A waste management system will be implemented which will make sure that domestic and hazardous waste, including sewage, generated during decommissioning and closure are disposed of in a manner that will not affect groundwater quality. • Accidental hydrocarbon spillages will be remediate in situ using appropriate microbial technologies. • Sewage will be handled in portable chemical latrines to reduce the risk of contamination. •	No
Land capability	Yes	• Rehabilitate the area effectively to ensure other possible uses.	• Rehabilitation process should be monitored to ensure effective rehabilitation.	Yes
Air quality	Yes	• Minimise dust creation through dust suppression measures.	• Monitoring of dust levels on site will continue through a network of dust buckets located around the stripping, screening and dumping areas whilst the surface infrastructure is being removed. • Dust suppression measures should be employed in all tipping sites, haul roads, and areas where soil is exposed while the infrastructure is removed from site.	Yes
Noise		•	•	
Natural vegetation		• To address residual impacts on natural vegetation which were not addressed during concurrent rehabilitation of opencast areas. • To establish a good indigenous vegetative cover and to encourage natural biological succession to a climax status. • To prevent alien and invader species establishing and spreading to rehabilitated areas, and to eliminate them from un-mined land.	• Visual assessments of the site will be conducted on a regular basis to monitor potential soil erosion on site and to assess the status of the vegetation cover on rehabilitated areas. • Vegetation monitoring should be introduced to ensure good vegetation cover and monitor plant succession and biodiversity. • Disturbed surfaces will be re-vegetated as soon as they become available, by seeding with a seed-mix. • An exotic and invader control programme will be implemented. All disturbed areas will be inspected at least annually (in spring) and any invader species will be eradicated using appropriate control measures.	
Animal life		• To follow mitigation measures set out for flora to recreate habitat and encourage animals to move back into the area.	• Animal shelters and habitats will be re-created to encourage new animals, insects and birds into the area. • The ongoing and long term commitment to successfully re-establish the vegetation of the opencast areas will establish a habitat that will encourage animal life to return to the rehabilitated land.	
Archaeology		• To ensure additional (potential subterranean) archaeological and heritage resources are assessed, identified, documented and protected according to the NHRA.	• Subsequent to the effective management of identified archaeological and heritage resources during construction and operational phases, impacts during the decommissioning and closure of the mine are not expected (i.e. rating not relevant). • Should alternative sites or features of archaeological and heritage significance be made during the decommissioning phase, a qualified archaeologist be contacted for an assessment of the discovery.	
Sensitive landscapes	No	•	•	
Visual	Yes	• To remove and rehabilitate all the negative visual impacts.	• Remove all buildings completely. • Rehabilitate and re-vegetate all the impacted areas.	Yes
Traffic & safety	No	• Minimise/prevent accidents on site. • Minimise/prevent road and pedestrian accidents.	• Ensure machine operators are trained properly. • Machine operators should be sensitised. • Put road signs in place to indicate hazardous areas. • Ensure truck drivers are properly trained.	

Aspect	Mitigation Required	Objectives	Management Measures	Monitoring
Socio-economic		• To minimise the negative impact that will be associated with job losses at the time that the mine closes.	• Vaal Sand will implement a Social and Labour Plan that deals with the re-skilling of employees. This will equip them to access job opportunities outside of the mining industry after closure. • The mine will investigate the possibility of acquiring additional sand resources in the nearby area, thus extending the life of the operation. • The mine will sufficiently investigate opportunities for employees to become involved in other mining operations in the nearby area. This will be done through liaison with other mining companies as well as the local Department of Labour centre.	
IAPs		• To optimise and enhance the overall positive impact associated with mine closure and the ceasing of mine related activities.	• Undertake rehabilitation activities to the extent that the area is returned to as close to its original state as possible • All surface infrastructure will be dismantled so as not to cause further impact to surrounding residents • Rehabilitation and decommissioning activities will be undertaken in such a manner that they cause minimal disturbance to nearby residents and businesses.	

11 EMERGENCY RESPONSE PLAN

The emergency response plan details the procedures to be followed in the event of any emergency. This plan will be drawn up and placed around the mine where it will be easily viewed. The plan will contain evacuation routes and a list of emergency numbers. It is advisable that the mine tests the emergency response plan by running training and simulations, in order to identify any weaknesses.

Emergencies that have been listed here include: accidents, fires, hydrocarbon spillages and flooding.

If the emergency has potential to affect surrounding communities, they will be alerted via alarm signals or contacted in person. The surrounding community will be informed prior to mining taking place of the potential dangers and emergencies that exist, and the actions to be taken in such emergencies.

Communication is vital in an emergency and thus communication devices, such as mobile phones, radio's, pagers or telephones, must be placed around the mine. In the case of an emergency, a checklist of emergency response actions appropriate to the emergency and participants in controlling a specific emergency must be consulted and the relevant units notified. In this case, many of the emergency services will be sourced from Vereeninging, the nearest town.

The checklist includes:

- Fire department;
- Police;
- Emergency health services such as ambulances, paramedic teams, poisons centres;
- Hospitals, both local and for evacuation for specialist care;
- Public health authorities;

- Environmental agencies, especially those responsible for air, water and waste issues;
- Other industrial facilities in the locality with emergency response facilities;
- Public works and highways departments; and
- Public information authorities and media organisations.

The following is a list of potential emergencies that could occur:

11.1 Accidents

In the case of a medical accident or problem, a first aid kit will be available on the mine.

- A checklist of emergency response participants must be consulted and the relevant units notified. In this case, many of the emergency services will be sourced from the nearest main town, Vereeniging.

The following numbers should be made accessible to all mine staff:

- Fire department: Emergency number 10177 / 016 440 1000(Vereeniging Fire Department)
- Police: Emergency number 10111/ 016 450 2911 (Vereeniging Police Department)
- Emergency health services such as ambulances & paramedic teams: 10111 / 016 440 1000 (Vereeniging Ambulance)
- Hospitals, both local and for evacuation and specialist care: 10111/ 016 930 2000 (Vereeniging Sebokeng Provincial Hospital) / 016 440 5000 (Vereeniging Medi Clinic)

11.2 Fire

Veld fires and fires resulting from other sources must be handled with extreme caution. Fire extinguishers will be placed at strategic points around the mine and will be kept in a serviceable condition.

Procedure:

- Occupants of the mine should be alerted in the event of a fire;
- In the event of a small fire the fire extinguishers placed around the mine should be used to contain and extinguish the fire;
- In the event of a large fire, the local area council's fire department will be consulted; and
- All staff will receive training in response to a fire emergency on site.

11.3 Hydrocarbon Spillage

Hydrocarbons such as diesel, petrol, and oil will be kept on site as fuel for the mine machinery. In the event of a spillage, procedures must be put into place to ensure that there are minimal impacts to the surrounding environment.

Procedure:

- In the event of a small spillage, the soil will be excavated and treated;
- In the event of a large spillage, adequate emergency equipment for spill containment or collection such as additional supplies of booms and absorbent materials will be available and if required, a specialised clean up crew will be called in to decontaminate the area; and
- After a major spill water quality samples of any water sources utilised within 500 m from the spill will be monitored for hydrocarbons for the next three months on a monthly basis and further remediation recommended based on the results thereof.

Contact numbers for emergency services and local authorities:

Authorities	Contact number
Vaal River System Regional Offices	016 371 1121
DWAF: Free State Province (Bloemfontein)	051 405 9000
SAPD: Emergency number	10111
Vereeniging SAPD	016 450 2911
Emergency health services such as ambulances & paramedic teams (Vereeniging ambulance)	016 440 1000 10177 (Emergencies)
Sebokeng Provincial Hospital	016 930 2000
Vereeniging Medi Clinic	016 440 5000 016 440 5440 (24hour emergency unit)

12 ENVIRONMENTAL MONITORING PROGRAMMES AND PERFORMANCE ASSESSMENTS

12.1 Air Quality

12.1.1 Aim and Objectives

The aim of this monitoring programme is to establish the baseline fallout levels and to observe the conditions on sight, and to monitor any changes in the conditions. Annual monitoring of the dust fallout will ensure that there is a very low chance of any detrimental effects to the surrounding environments.

12.1.2 Position

The position of the samplers is essential to the interpretation of the results, and needs to take into account the historical directional wind data for the area, and topographical features that may affect the wind direction.

Before the samplers are erected on site the area is surveyed using topographical maps and historical climate data to determine the various wind flow patterns and topographical features that may influence the dispersion patterns of fallout dust on site. Once these factors have been determined the location of the dust buckets is pinpointed taking into consideration the position of various infrastructure on site which require monitoring such as the pit and haul roads. The buckets are filled with distilled water and left out on site for a period of a month; from there the buckets are transported to a reputable laboratory for analysis.

12.1.3 Frequency

Dust samples will be analysed monthly to establish the current baseline air quality for the site, and will continue for the life of the mine.

12.1.4 Methodology

All samples will be taken in accordance to Department of Environmental Affairs and Tourism (DEAT) and World Bank guidelines.

12.1.5 Precautionary measures

The following measures have to be in place when taking the samples from the single bucket samplers;

- The buckets must be labelled using a marker pen and masking tape according to which sampling point they are located; and
- Bucket lids must be place firmly on the sample buckets.

The following measure has to be in place when re-setting the sampler:

- Buckets must be ¾ full with distilled water and one teaspoon of bleach to ensure they do not dry out and algae does not accumulate inside the buckets.

12.1.6 Sample Submission

All the samples must be submitted to a reputable laboratory with a quality management plan.

12.1.7 Analysis

Analysis of samples should take place within one week of collection to ensure the accuracy of the results. The sample bucket lids should not be removed at any stage after the lid has been placed on the bucket at the site until the samples have reached the laboratory. The constituents to be analysed for are displayed in Table 12.1.

Table 12.1: Constituents to be analysed for

Relevant Fall-out Per Bucket	**Total Fall-out Per Bucket**
mg/m²/day	mg

12.1.8 Data Interpretation

In order to assess the results, the collected dust is filtered through a sub-micronic pre-weighed filter using a vacuum filter bench. Once the wet filtrate has been desiccated by evaporation of any retained moisture, the filter is reweighed to ascertain the collected mass (insoluble particulate). The soluble particulate is assessed by evaporating the catch media and weighing the resulting solids.

Table 12.2: World Bank Dust-Fall Classification Index

World Bank Classification	**mg/m²/day**
Slight	<250
Moderate	251 – 500
Heavy	501 – 1200
Very heavy	>1200

The results are then analysed and placed into various graphs and tables that best indicate the dust fallout situation on site.

12.1.9 Reporting

A report should then be compiled every three months detailing all findings and includes a full assessment of the results along with conclusions and recommendations for future monitoring on site. These reports should highlight any negative impacts on the air quality due to the mining operations as well as determine the sources of the impacts. The reports will discuss possible actions which can be used to mitigate any negative impacts. Relevant results will be graphed so that trends may be visually observed.

12.1.10 Duration

The programme should be implemented on a monthly basis for the life of the mine. This will only be altered if the sampling data indicates that either more or less sampling is to take place. The programme will be reviewed on an annual basis.

12.1.11 Conclusion

The above programme is sufficient to ensure that monitoring of the fall-out dust at Bankfontein is conducted to the necessary standards. The effectiveness of the mitigatory measures will be evaluated against these.

12.2 Hydrological

12.2.1 Surface Water

Due to the lack of surface water on site, no surface water monitoring will take place

12.2.2 Groundwater

A ground water monitoring programme will be instituted during the construction phase of the project and will include the following:

- The sampling of the existing borehole on a three-monthly basis to determine variations in ground water levels.
- The three-monthly analyses of the chemical constituents of the ground water samples. Samples will be taken by an independent party according to approved SANS sampling procedures and will be submitted to an accredited laboratory for analysis.

Monitoring will, furthermore, be performed monthly for those water quality parameters that may be specified by the DWAF where these are not covered by the parameters referred to above, and will be collated in a database which will be maintained until a closure certificate has been issued in respect of the mining area.

All monitoring data will be compared to the requirements regarding water quality specified in the approved Water Use Licence and deviations will be reported as is required in terms of the licence and the requirements of the National Water Act, 1998 (36 of 1998)

12.3 Noise Monitoring

Noise monitoring should take place quarterly to ensure that the South African Bureau of Standards (SABS) parameters are adhered to.

12.4 Soil and Vegetation Monitoring

Soil monitoring will be conducted in all soils that are recovered from topsoil stockpiles once placed on rehabilitated areas. Soil condition monitoring will be done by an accredited laboratory, at least six weeks after the application of fertiliser and will test for the following:

- pH (H2O);
- Electrical conductivity (mS/m);
- Calcium (mg/Kg)
- Magnesium (mg/Kg);
- Potassium (mg/Kg);
- Sodium (mg/Kg);
- Cation exchange capacity;
- Phosphorus (Bray I);
- Zinc (mg/Kg);
- Clay percentage; and
- Organic matter content (C %).

Deficiencies identified during testing will be taken into consideration when fertiliser requirements are considered.

Vegetation monitoring will include the annual monitoring of the health of vegetation on re-vegetated areas and will include monitoring for pests and plant diseases, vegetation die-back and the extent of coverage achieved on re-vegetated areas. Monitoring will also record the vegetation progression in areas rehabilitated to a wilderness standard. The detail of the monitoring programme is provided below:

- Sampling technique: the results of the Step point / Wheel point techniques can be used to compile a species list for each sampling site;

- Data analysis: the computer programme Graze can be used for data analysis, as well as to calculate the grazing capacity. This programme also takes other parameters into account, such as accessibility, average annual rainfall, grass cover, tree cover (if present), herb/forb cover and ecological classes of all grass species;
- Time of year: the rainy season will be the best time to do the survey as this is when vegetation, grasses and forbs, are actively growing. The months of February, March and April are recommended;
- Photographs: photographs of each sampling point can be taken at the same time of year, within the same direction and angle (markers can be set out to ensure the margins and angles of each photograph are correct); and
- Points: using a GPS, the location of each relevé can be recorded so that the same point can be monitored each year.

As part of the soil and vegetation monitoring programmes, areas of subsidence due to total extraction underground mining will be identified and recorded. These areas will be targeted for remedial action as described in the EMP

13 ENVIRONMENTAL AWARENESS PLAN

13.1 Communication Strategy

Environmental awareness should be promoted through different mediums amongst all levels of staff. Some possibilities are described below:

- Producing “Environmental Talk Topics” which will be posted on notice boards throughout the organisation on a monthly basis. These will address topics such as pollution prevention, resource conservation, waste management and spill clean-up and will be made appropriate to the working and home environments of employees;

- Posting the Environmental Policy of the organisation on notice boards throughout the organisation and discussing the implications of the policy during appropriate meetings; and
- Including environmental management as a standing agenda item in all safety and production meetings. Topics for discussion during such meetings should include current Environmental Talk Topics, recent environmental incidents and environmental action plans of interest. Discussions of applicable legislation and changes to legislation, where this affects the operation's activities may also be discussed at such meetings.

13.2 Management Sector

The building of environmental awareness and management capacity at management level will be focussed on ensuring that management is aware of their responsibility and accountability for the management of the environmental aspects of their activities. Communication and training interventions will focus on the applicability of legislation and legislative changes to their activities, the content of regulatory instruments, such as licences, permissions and exemptions, the importance of leading in environmental management by setting examples and environmental management tools and techniques, such as environmental impact assessment and current environmental best practice.

13.3 Administrative Sector

Environmental awareness building in the administrative sector will be appropriate to the level of impact associated with administrative activities, such as resource consumption and waste separation, but also includes the generation of general environmental awareness principles, such as may apply in the purchasing of products, services and consumables, the use of which may have an impact on the environmental performance of the organisation.

13.4 Mine workers Sector

Environmental awareness in the lower worker categories will be achieved by, firstly, including an environmental awareness module in all engagement and ex-leave induction material. The content of such a module will include the mine's environmental policy, its significant impacts on the environment, the basics of mitigation measures employed and organisational environmental rules relating to waste management, spill clean-up, resource consumption and the like.

Where training modules for specific worker categories exist, such training modules will include a discussion of the real and potential environmental impacts of their activities and their responsibilities relating to the mitigation and avoidance of such impacts. The training modules will also elaborate on the real and potential consequences of deviation from procedures aimed at managing environmental impacts.

13.5 Evaluation of the Environmental Awareness Plan

The effectiveness of environmental management training and awareness building interventions will be gauged by:

- The performance of annual audits aimed at testing the environmental awareness of employees directly, and
- Analysing the root causes of environmental incidents, including non-conformance to legal requirements, to determine which incidents were caused by a lack of environmental awareness and training.

14 FINANCIAL PROVISION

In accordance with the requirements of the MPRDA, the policy of the Department of Minerals and Energy, provision for closure must be made and updated on a yearly basis.

The closure costing liabilities for this operation have been calculated in accordance with the DME guidelines for closure. In addition a calculation based on the observed site conditions was also performed.

According to the DME guidelines Copper Sunset Trading 324 (Pty) Ltd (trading as Vaal Sand) has to provide R 502 576.73 for rehabilitation and closure of the Bankfontein Mine. The cost calculation table is attached in **Appendix I**. Using previous experience we estimate that the cost for rehabilitation is approximately R 449 650.53 (**Appendix I**). DWA is of the opinion that the DME guidelines are of a general nature and do not uniquely consider the nature of the operation taking place at the Bankfontein Mine as well as the local conditions of the mine, therefore it is felt that the DWA calculation is more accurate with regards to the closure and rehabilitation provision required.

The proposed operation will utilise existing buildings and workshops in the Bertha Village. Continuous rehabilitation will occur during the operational phase, and only 3 strips will be open at any one time. These strips will be rehabilitated completely before new strips are excavated. This means that an area of only 3ha will need to be rehabilitated when operations cease. The plant area will be rehabilitated and the actual plant dismantled and removed

A bank guarantee for this amount will be issued to the DME. This bank guarantee will be reduced as the site is rehabilitated.

15 CONCLUSION

Implementation of this project will allow for the extraction and sale of sand on Bankfontein, which has been revealed to be the most optimal way to use the resource.

If the project is implemented as planned and the necessary management measures instituted then there is no reason from an environmental perspective, why the project should not proceed. Long term impacts will be noticed through the formation of a slight depression in the landscape due to the removal of the sand layer. Positive impacts of the project will include the continuation of an employment base in the greater area, the acquisition of skills by workers and associated financial income. It has to be ensured that the financial benefits of the project are used in such a way to offset their long term impacts.

16 STATUTORY REQUIREMENTS

The current mining operation and any future expansion of the mine will need to comply with the following legislation of the Republic of South Africa, which were developed to achieve most importantly, production of more informed and better decisions which further the national policy to protect and enhance the quality of the human environment.

- The Minerals and Petroleum Resources Development Act, Act 28 of 2002;
- Environment Conservation Act, Act 73 of 1989;
- The National Water Act, Act 36 of 1998;
- The Mine Health and Safety Act, Act 29 of 1998;
- The Atmospheric Pollution Prevention Act, Act 45 of 1965;
- National Environmental Management Act, Act 107 of 1998;
- Explosives Act, Act 26 of 1956;
- Conservation of Agricultural Resources Act, Act 43 of 1983;
- The National Road Traffic Act, Act 93 of 1996; and
- The National Heritage Resources Act, Act 25 of 1999.

17 REFERENCES AND SUPPORTING DOCUMENTATION

ACOCKS, J.P.H. 1988. *Veld Types of South Africa*. Bot. Surv. S. Afr. Mem. No 57

BARNES, K.N. (Ed.) 2000. The Eskom Red data Book of Birds of South Africa, Lesotho & Swaziland. Birdlife South Africa, Johannesburg.

BAUMANN & WINTER Consultants, *Guideline for involving Heritage specialists in EIA processes*, CSIR, Edition 1, June 2005

Endangered Wildlife Trust 2004. Biomes of South Africa: Grasslands. www.ewt.org.za/news_fullstory

FOURIE, W. BA (Hon) Archaeology (UP) and Van der Walt, J. BA (Hon) Archaeology (WITS), *Naudesbank 001 HIA Report*, June 2005

Giesen and Geurts. University of Lancaster, Lancaster

HANNEKENS, S.M. 1996a. MEGATAB – A visual editor for phytosociological tables.

HILTON-TAYLOR, C. 1996. Red Data List of Southern African Plants. Strilitzia 4. Aurora Printers, Pretoria.

IFC, International Finance Corporation, *IFC Performance Standard, Guidance Note*, April 2006

KOESLAG, L. 2005. Note on the application of the National Environmental Management: Biodiversity Act 20 of 2004 to Xstrata Coal SA (Pty) Ltd. Environmental Legal Concepts, Johannesburg

LOW, A.B. & REBELO, A.G. (eds) 1996. *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria.

MAHINDAPALA, R. 2004. Medicinal Plants: Conservation and Sustainable Use in Sri Lanka. IK Notes, www.research-alliance.net

MEFFE, G.K & CARROLL, C.R. 1997. Principles of Conservation Biology (2nd Ed.). Sinauer Associates, Massachusetts

NATIONAL MONUMENTS *Website, Archaeology and the South African Heritage Resource Agency*, http://www.nationalmonuments.co.za/archaeology.htm, Online, 2006

PISTORIUS, J. *Eskom Archaeological Identification guide*, Johannesburg, 1994

ROBERTS 2003. *Roberts' Multimedia Birds of Southern Africa*. Southern African Birding, Westville

RUTHERFORD, M.C & WESTFALL, R.H. 1986. Biomes of Southern Africa – an objectivecategorization. Memoirs of the Botanical Survey of South Africa 54: 1-98

SAHRA APMHOB Permit Committee, *Assessment & Mitigation as a Prerequisite for Mining & Prospecting,* 2006

SOUTH African History website, http://sahistory.org.za/pages/mainframe.htm, 2006

TAINTON, N.M.(Ed). 1999. Veld Management in South Africa. University of Natal press. Pietermaritzburg.

VAN OUDTSHOORN, F. 1999. *Guide to Grasses of Southern Africa.* Briza, South Africa

VAN RYNEVELD, K., VAN DER WALT, J and DR. WALKER DR. N. J, *Phase 1 Archaeological Impact Assessment [AIA] for a portion of the Mine and Power Station Development area, Botswana. Mmamabula Energy Project (MEP*), December 2006

VAN WYK, A.E. & VAN WYK, P. 1997. *Field Guide to the Trees of Southern Africa.* Struik Publishers, Cape Town

WORLD BANK Operational Policy Note no. 11.03, *Management of Cultural Property in Bank financed Projects,* September 1986

LIST OF PLANS

LIST OF APPENDICES

APPENDIX A

DECLARATION OF APPLICANT – MINE HEALTH AND SAFETY

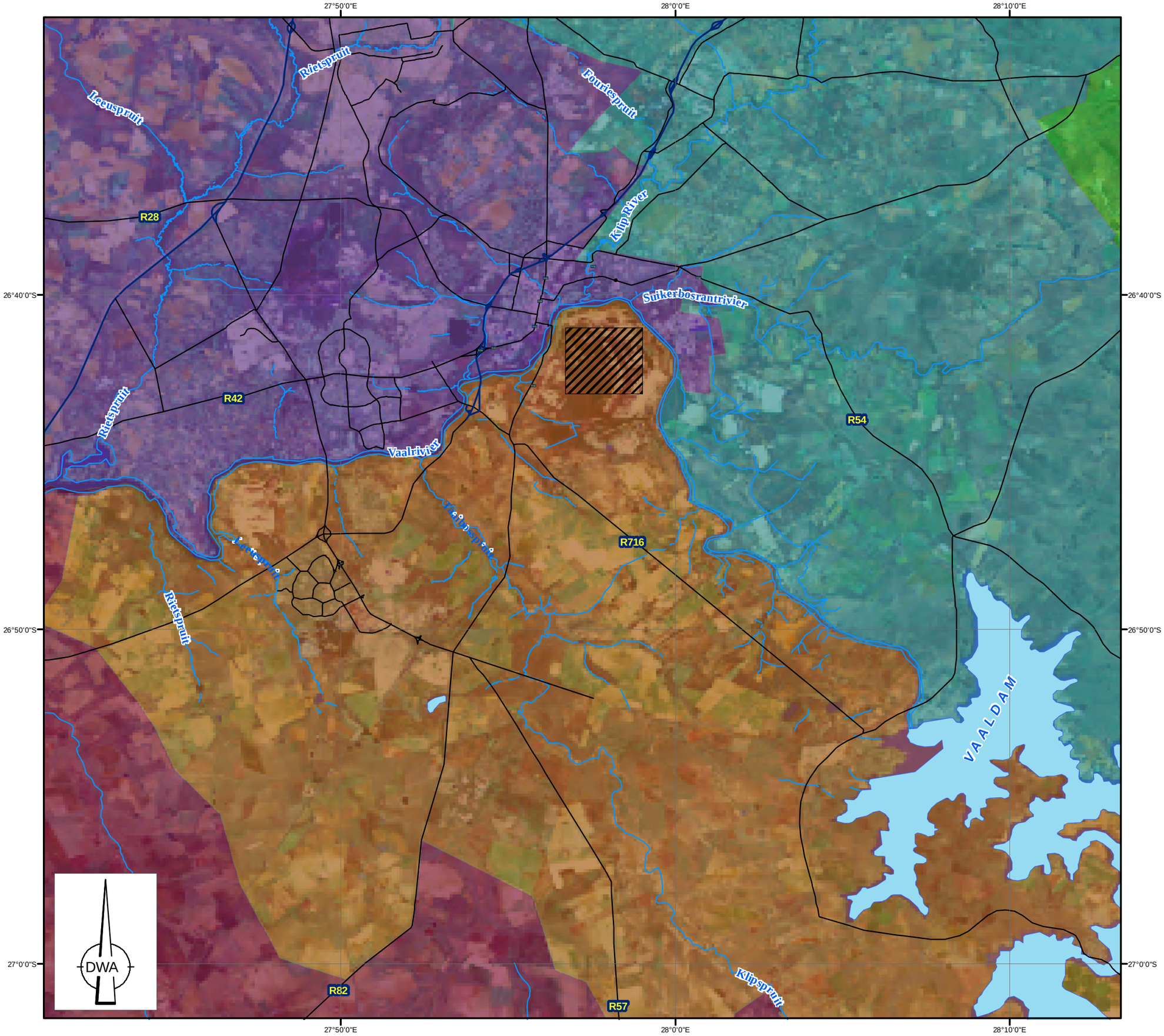
APPENDIX B

PLANS

Plan 1

Copper Sunset Trading 324 (Pty) Ltd
Bankfontein 9

Regional Setting



Legend

Towns

- Major Town
- Other Town
- Secondary Town
- Settlement

Main Roads

- Main Roads
- Freeway
- National
- Rivers
- Water Areas

Municipalities

- Emfuleni Local Municipality
- Lesedi Local Municipality
- Metsimaholo Local Municipality
- Midvaal Local Municipality
- Ngwathe Local Municipality

Area of Interest

DWA

Projection: WGS84

1:200,000

0 1.25 2.5 5 7.5 10 12.5 15

Kilometres

Ref:/bjt.VAA213.200706.003

Plan 2

Copper Sunset Trading 324 (Pty) Ltd
Bankfontein 9

Proposed Mining Area

LETHABO POWER STATION 1814
Waste Dump
Start of Strip Mining (100m x 50m)
Entrance
Office
Gate House
Workshop
BERTHA SHAFT VILLAGE
1574.6
52 Ha mineable
1497.2
BANKFONTEIN 9
1495.7
MODDERFONTEIN 1279
1460
1480
Ptn 23/9
Ptn 22/9
Ptn 7
Ptn 8
Ptn 12
Ptn 17
Ptn 13
Ptn 11
Ptn 14
Ptn 18
27°56'0"E
27°56'30"E
27°57'0"E
27°57'30"E
27°58'0"E
27°58'30"E
27°59'0"E
26°44'30"S
26°45'0"S
26°45'30"S
26°46'0"S
26°46'30"S
26°47'0"S

Legend

- Trig Beacons
- Arterial Route
- Main Road
- National Freeway or Route
- On/Off Ramp
- Other Access
- Secondary Road
- Street
- Railway Lines
- Power Lines
- Canal
- Furrow
- Dam Walls / Weirs
- Non-Perennial Stream
- Perennial Stream
- Water Areas
- Urban Areas
- Contours 20m
- Servitudes
- Bankfontein Site
- Farm Portions
- Farm Boundaries

Elevation (m asl)

- 1716 - 1900
- 1594 - 1716
- 1530 - 1594
- 1500 - 1530
- 1486 - 1500
- 1475 - 1486
- 1464 - 1475
- 1450 - 1464
- 1440 - 1450

Conceptual Plan, for display purposes only.

Projection & Datum: WGS84

1:20,000

0 0.15 0.3 0.6 0.9 1.2

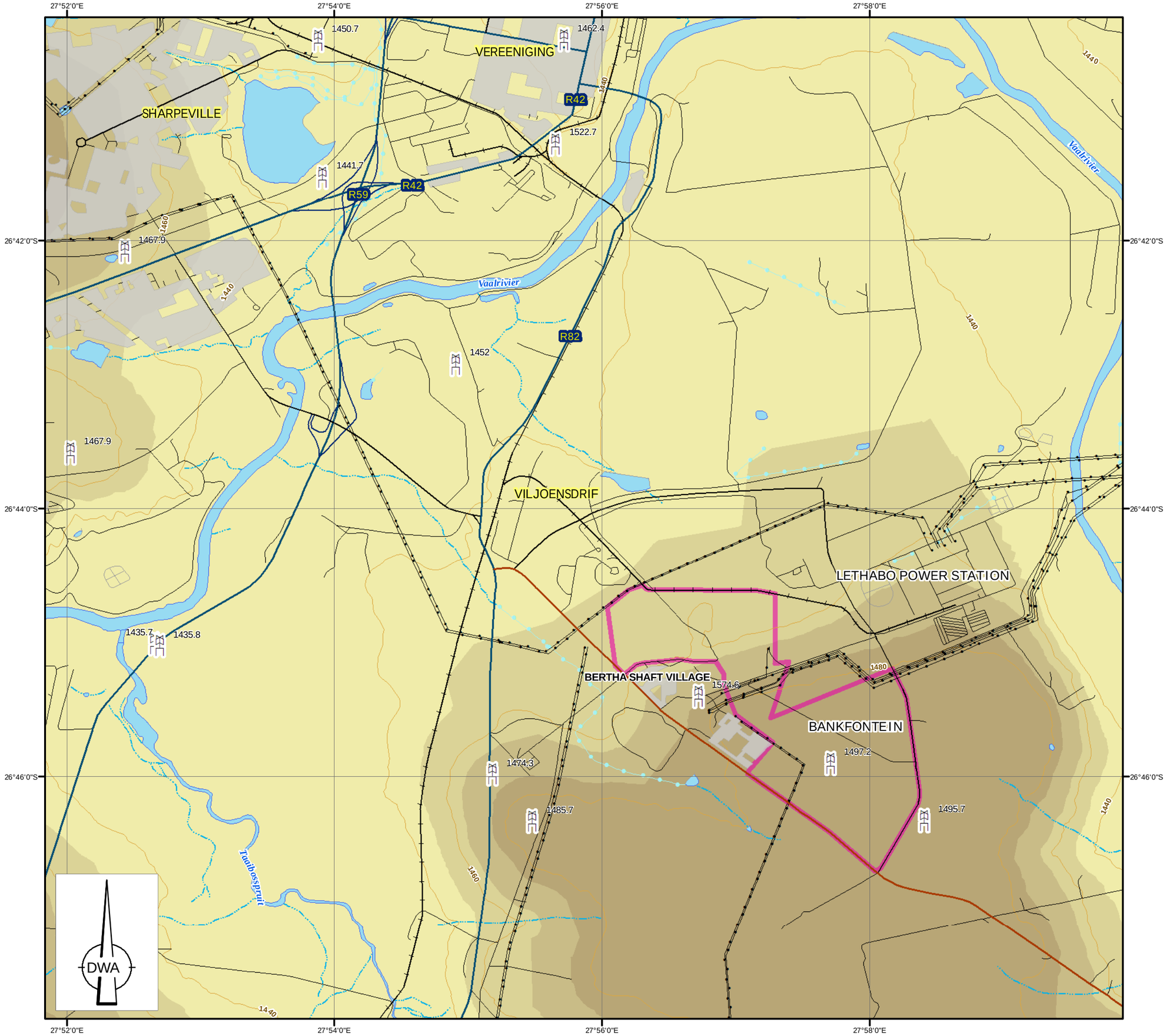
Kilometres

Ref:/bjt.VAA213.200706.021

Plan 3

Copper Sunset Trading 324 (Pty) Ltd
Bankfontein 9

Topography



Legend

- Trig Beacons
- Arterial Route
- Main Road
- National Freeway
- National Route
- On/Off Ramp
- Other Access
- Secondary Road
- Street
- Railway Lines
- Power Lines
- Canal
- Furrow
- Dam Walls / Weirs
- Non-Perennial Stream
- Perennial Stream
- Water Areas
- Urban Areas
- Contours (20m)
- Bankfontein Site

Elevation (m asl)

- 1716 - 1900
- 1594 - 1716
- 1530 - 1594
- 1500 - 1530
- 1486 - 1500
- 1475 - 1486
- 1464 - 1475
- 1450 - 1464
- 1440 - 1450

Projection: WGS84

1:50,000

0 0.5 1 2 3

Kilometres

Ref:/bjt.VAA213.200708.001

Plan 4

Copper Sunset Trading 324 (Pty) Ltd
Bankfontein 9

Geology

27°52'0"E 27°54'0"E 27°56'0"E 27°58'0"E

26°42'0"S 26°44'0"S 26°46'0"S

SHARPEVILLE
VEREENIGING
VILJOENSDRIF
LETHABO POWER STATION
BERTHA SHAFT VILLAGE
BANKFONTEIN
Vaalrivier
Tuinbosspruit
R42 R59 R82

Label	Lithology	Description
Pv	VRYHEID	Fine- to coarse-grained sandstone, shale, coal seams
Vdp	DASPOORT	Quartzite with minor shale and siltstone
Vh	HEKPOORT	Andesitic lava, subordinate pyroclastic rocks, minor quartzite, shale and conglomerate
Jd	KAROO DOLERITE	Network of dolerite sills, sheets and dykes, mainly intrusive into the Karoo Supergroup

Legend

- Bankfontein Site
- Trig Beacons
- Arterial Route
- Main Road
- National Freeway
- National Route
- On/Off Ramp
- Other Access
- Secondary Road
- Street
- Railway Lines
- Power Lines
- Contours (20m)
- Canal
- Furrow
- Dam Walls / Weirs
- Non-Perennial Stream
- Perennial Stream
- Water Areas
- Urban Areas

Geological Features

- Aeromagnetic Lineament

Lithology

- QUATERNARY SOIL COVER (Q)
- QUATERNARY RIVER SAND & ALLUVIUM (Q)
- QUATERNARY AEOLIAN SAND (Q)
- KAROO DOLERITE (Jd)
- DASPOORT (Vdp)
- HEKPOORT (Vh)
- VRYHEID (Pv)

Projection: WGS84

1:50,000

0 0.5 1 2 3

Kilometres

Plan 5

Copper Sunset Trading 324 (Pty) Ltd
Bankfontein 9

Soils

LETHABO POWER STATION 1814

BERTHA SHAFT VILLAGE

BANKFONTEIN 9

MODDERFONTEIN 1279

1460

1480

1574.6

1497.2

1495.7

1
h
Lo
Cv/Av
Cv (sa)
Disturbed Area

2
h
Gc
Av/Wa
Cv (sa)

3
h
Gc
Av (sa)
Lo
Gc/Av

Ptn 23/9
Ptn 22/9
Ptn 8
Ptn 12
Ptn 7
Ptn 17
Ptn 11
Ptn 13
Ptn 14
Ptn 18

27°56'0"E
27°56'30"E
27°57'0"E
27°57'30"E
27°58'0"E
27°58'30"E

26°44'30"S
26°45'0"S
26°45'30"S
26°46'0"S
26°46'30"S
26°47'0"S

Legend

h Sampling Positions

Soil Classification

- Av (sa) - Avalon (sandy)
- Av/Wa - Avalon / Wasbank
- Cv (sa) - Clovelly (sandy)
- Cv/Av - Clovelly / Avalon
- Disturbed Area
- Gc - Glencoe
- Gc/Av - Glencoe / Avalon
- Lo - Longlands
- Bankfontein Site

? Trig Beacons

- Arterial Route
- Main Road
- National Freeway or Route
- On/Off Ramp
- Other Access
- Secondary Road
- Street
- Railway Lines
- Power Lines
- Canal
- Furrow
- Dam Walls / Weirs
- Non-Perennial Stream
- Perennial Stream
- Water Areas
- Urban Areas
- Contours 20m
- Servitudes
- Farm Portions
- Farm Boundaries

DWA

Projection & Datum: WGS84

1:20,000

0 0.25 0.5 1 1.5

Kilometres

Ref:/bjt.VAA213.200709.010

Plan 6

Copper Sunset Trading 324 (Pty) Ltd
Bankfontein 9

Land Capability

27°56'0"E 27°56'30"E 27°57'0"E 27°57'30"E 27°58'0"E 27°58'30"E

26°44'30"S 26°45'0"S 26°45'30"S 26°46'0"S 26°46'30"S 26°47'0"S

LETHABO POWER STATION 1814

Grazing

Grazing (poor)

Disturbed Area

BERTHA SHAFT VILLAGE

Arable

Grazing (poor)

Grazing

Arable

1497.2

BANKFONTEIN 9

Arable

1495.7

MODDERFONTEIN 1279

1574.6

1460

1480

Ptn 23/9

Ptn 22/9

Ptn 8

Ptn 12

Ptn 7

Ptn 17

Ptn 11

Ptn 13

Ptn 14

Ptn 18

DWA

Legend

Land Capability

- Arable
- Disturbed Area
- Grazing
- Grazing (poor)
- Bankfontein Site
- Trig Beacons
- Arterial Route
- Main Road
- National Freeway or Route
- On/Off Ramp
- Other Access
- Secondary Road
- Street
- Railway Lines
- Power Lines
- Canal
- Furrow
- Dam Walls / Weirs
- Non-Perennial Stream
- Perennial Stream
- Water Areas
- Urban Areas
- Contours 20m
- Servitudes
- Farm Portions
- Farm Boundaries

DWA

Projection & Datum: WGS84

1:20,000

0 0.25 0.5 1 1.5

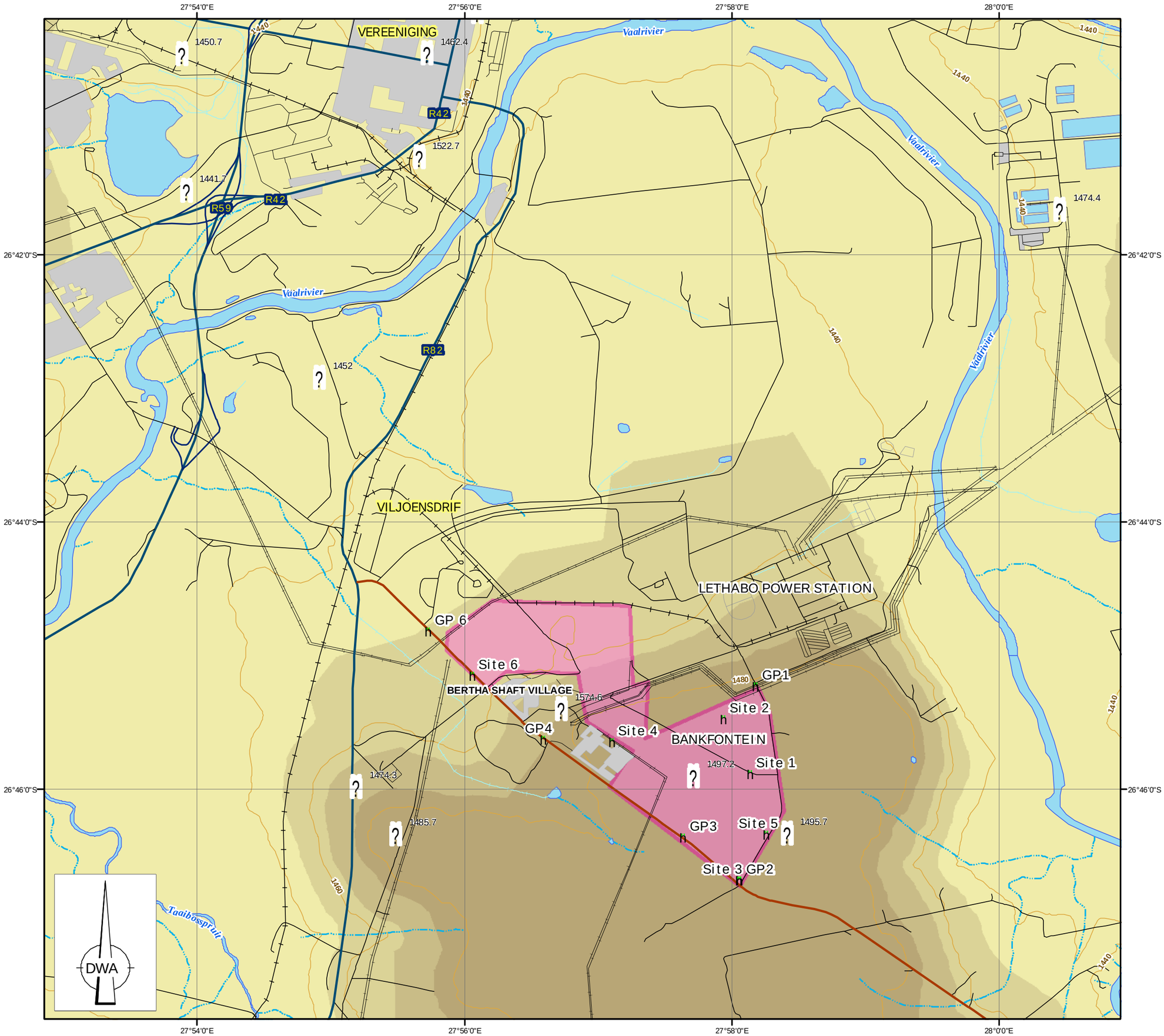
Kilometres

Plan 7

Vaal Sand (Pty) Ltd.

Bankfontein 9

Fauna and Flora Sampling Points



Legend

- GPS Points
- Trig Beacons
- Arterial Route
- Main Road
- National Freeway
- National Route
- On/Off Ramp
- Other Access
- Secondary Road
- Street
- Railway Lines
- Power Lines
- Canal
- Furrow
- Dam Walls / Weirs
- Non-Perennial Stream
- Perennial Stream
- Water Areas
- Urban Areas
- Contours 20m

Elevation (m asl)

- 1716.01 - 1900
- 1593.726 - 1716.01
- 1529.716 - 1593.726
- 1499.852 - 1529.716
- 1486.497 - 1499.852
- 1474.779 - 1486.497
- 1464.423 - 1474.779
- 1450.437 - 1464.423
- 1440 - 1450.437

DWA

Projection: WGS84

1:50,000

0 0.5 1 2 3

Kilometres

Ref:/bjt.VAA213.200707.015

APPENDIX C

LETTER OF AGREEMENT FROM THE SASOLBURG WASTE DISPOSAL SITE

APPENDIX D

SOIL REPORT

APPENDIX E

FAUNA AND FLORA

APPENDIX F

HERITAGE IMPACT ASSESSMENT REPORT

APPENDIX G

PUBLIC PARTICIPATION REPORT

APPENDIX H

IMPACT ASSESSMENT MATRIX

APPENDIX I

QUANTUM OF FINANCIAL PROVISION