NAME OF APPLICANT: Sasol Mining (Pty) Ltd

REFRENCE NUMBER: MP 30/5/1/2/2/10096 MR

FINAL ENVIRONMENTAL IMPACT ASSESSMENT AND ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT SUBMITTED WITH DUE REGARDS TO CONSULTATION WITH COMMUNITIES AND INTERESTED AND AFFECTED PARTIES

AS REQUIRED IN TERMS OF REGULATION 49 OF THE MINERAL AND PEROLEUM RESOURCES DEVELOPMENT ACT (ACT 28 OF 2002), AND IN ACCORDANCE WITH THE STANDARD DIRECTIVE FOR THE COMPILATION THEREOF AS PUBLISHED ON THE OFFICIAL WEBSITE OF THE DEPARTMENT OF MINERAL RESOURCES.

mineral resources

Department:
Mineral Resources
REPUBLIC OF SOUTH AFRICA

Digby Wells and Associates (South Africa) (Pty) Ltd
(Subsidiary of Digby Wells & Associates (Pty) Ltd). Co. Reg. No. 2010/008577/07. Fern Isle, Section 10, 359 Pretoria Ave Randburg Private Bag X10046, Randburg, 2125, South Africa
Tel: +27 11 789 9495, Fax: +27 11 789 9498, info@digbywells.com, www.digbywells.com

DEFINITIONS

"consultation" means a two way communications process between the applicant and the community or interested and affected party wherein the former is seeking, listening to, and considering the latter's response, which allows openness in the decision making process.

"community" means a group of historically disadvantaged persons with interests or rights in a particular area of land on which the members have or exercise communal rights in terms of an agreement, custom or law: Provided that, where as a consequence of the provisions of the Act negotiations or consultations with the community are required, the community shall include the members of the community or part of the community, directly affected by prospecting or mining, on land occupied by such members or part of the community.

"interested and affected parties" include, but are not limited to –

(I) Host Communities

(II) Landowners (Traditional and Title Deed owners)

(III) Land Claimants

(IV) Lawful land occupier

(V) The Department of Land Affairs

(VI) Any other person (including on adjacent and no adjacent properties) whose socio-economic conditions may be directly affected by the proposed prospecting or mining operation

(VII) The Local Municipality

(VIII) The relevant Government Departments, agencies and institutions responsible for the various aspects of the environment and for infrastructure which may be affected by the proposed project.

STANDARD DIRECTIVE

All applicants for mining rights, in terms of the provisions of Section 29(a) and in terms of Regulation 49(4) of the Mineral and Petroleum Resources Development Act, are directed to submit reports strictly in accordance with the following format and subject headings, and as informed by the guideline posted on the Department's Official Website, within 30 days of notification by the Regional Manager of the acceptance of such application.

This document has been prepared by Digby Wells Environmental.

Report Type:	**Final Environmental Impact Assessment and Environmental Management Programme Report**
Project Name:	**Sasol Syferfontein Block IV Expansion Project**
Project Code:	**SAS1744**

Name	Responsibility	Signature	Date
Vumile Dlamini	Report Writer	V. Dlamini	August 2014
Khosi Dlamini	Co-author		October 2014
Marcelle Radyn	1st Reviewer		October 2014
Andries Wilke	2nd Reviewer		November 2014
Michael Hennessy	3rd Reviewer		November 2014

EXECUTIVE SUMMARY

Digby Wells Environmental (hereafter Digby Wells) has been appointed by Sasol Mining (Pty) Ltd (hereafter Sasol Mining), as the independent Environmental Assessment Practitioner (EAP) to conduct an Environmental Impact Assessment (EIA) and associated specialist studies for the proposed Sasol Syferfontein Block IV Expansion Project.

Sasol Mining is the holder of various mining rights in respect of collieries supplying coal to its Secunda Operations. To ensure that the Secunda Complex remains operational for the next forty years and beyond, Sasol Mining has devised a strategy to expand or replace the current collieries. As part of this strategy, Sasol Mining plans to expand their Sasol Syferfontein colliery by applying for a Mining Right in terms of the Minerals and Petroleum Resource Development Act, 2002 (Act No. 28 of 2002) (MPRDA) to mine the No. 4 lower coal seam in the Syferfontein Block IV coal reserves. A Mining Right Application (MRA) was lodged with the Regional Manager, Mpumalanga Region, of the Department of Mineral Resources (DMR) on 24 June 2014. The DMR reference number is MP 30/5/1/2/2/10096 MR.

Sasol Mining plans on using the underground bord-and-pillar mining method as the means of primary development. In addition to this, Sasol Mining utilises a special method for higher extraction, known as the Nevid Mining Method.

The available *in situ* coal resource for Syferfontein is currently estimated at 463 Mt of which 164 Mt will be extracted by bord and pillar mining method at an extraction rate of 35.5% and a life of mine (LoM) of approximately 20 years.

The extractable high extraction mining reserves is estimated at 15 Mt run of mine (RoM) coal and will extend the current life of mine by 18 months.

The farm portions that will be affected by the proposed Project are located approximately 16 km northwest from the town of Secunda and approximately 8 km north from the town of Leandra within South Africa's Mpumalanga Province. The bord and pillar mining method ensures that there will be minimal surface disturbance. . In addition, the Syferfontein Block IV reserves will be accessed by means of an adit in the highwall of the existing Syferfontein mine and the only additional surface infrastructure required are two ventilation shafts. Existing infrastructure located on the existing Tweedraai mining area will be used to service the Sasol Syferfontein Block IV area.

This Environmental Impact Assessment / Environmental Management Programme (EIA / EMP) Report pertains to the application for a Mining Right in terms of the provisions set out in the MPRDA. In addition, an application for listed activities is required in terms of the provisions of the National Environment Management Act, 107 (NEMA Act 107 of 1998) (NEMA). A series of specialist studies were conducted as part of the EIA process to determine the impacts which will potentially emanate from the proposed underground mining activities. The specialist studies undertaken include:

- Noise Assessment;
- Soil Assessment;
- Air Quality Assessment
- Surface Water Assessment;
- Groundwater Assessment;
- Fauna and Flora Assessment;
- Aquatic Assessment;
- Wetlands Assessment;
- Socio-economic Assessment; and
- Heritage Assessment (this depends on the outcome of the South African Heritage Resources Agency (SAHRA) and/or the relevant Provincial Heritage Resources Authorities (PHRA) for the need for further investigations).

A public participation process was conducted as part of the scope of the Environmental Impacts Assessment Report. During the public participation process, the Interested & Affected Parties (I&APs) and stakeholders involved were notified of the project including the impacts as determined during the impacts assessment. This is done to allow all the stakeholders to comment on the impacts which may affect them. These comments were compiled into the Comments and Response Report (CRR) attached in Appendix C of this document.

As mentioned above, the infrastructure which will be used at the Block IV expansion site will be the existing Syferfontein Colliery infrastructure from the Tweedraai mining area. Due to this reason, there will be no impacts imposed onto the environment during the construction phase of this project.

The mining method to be utilised in the Block IV expansion reserves, which is the bord and pillar technique, using the high extraction method where applicable (depending on surface restrictions, safety factors and the type of rock in the roof) will influence the potential impacts imposed during the operational phase of the project.

Table of Contents

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

Appendix A: Plans

Appendix B: Specialist Reports

Appendix C: PPP

LIST OF ACRONYMS

ADU	Animal Demographic Unit
APCD	Air Pollution Control Division
BID	Background Information Document
CEC	Cation Exchange Capacity
COP	Contingency Operating Procedure
CRR	Comments and Response Report
DMR	Department of Mineral Resources
DSR	Draft Scoping Report
DWS	Department of Water and Sanitation
EC	Electrical Conductivity
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EMP	Environmental Management Programme
EMS	Environmental Management System
FSR	Final Scoping Report
GGP	Gross Geographic Product
GIS	Geographic Information System
GMLM	Govan Mbeki Local Municipality
GPS	Global Positioning System
GSDM	Gert Sibande District Municipality
I&APs	Interested and Affected Parties
IDP	Integrated Development Plan
IMS	Integrated Management System

LED	Local Economic Development
LoM	Life of Mine
LTO	Local Tourism Organisation
mamsl	Meters above mean sea level
MAR	Mean Annual Runoff
MCBP	Mpumalanga Conservation and Biodiversity Plan
MDEDET	Mpumalanga Department of Economic Development, Environment and Tourism
MPRDA	Mineral and Petroleum Resources Development Act, (Act No 28 of 2002)
MSDS	Material Safety Data Sheets
NEMA	National Environmental Management Act, (Act No 107 of 1998)
PPP	Public Participation Process
PRECIS	National Herbarium Pretoria Computerised Information Systems
QDS	Quarter Degree Square
RoM	Run of Mine
SANBI	South African National Biodiversity Institute
SAHRA	South African Heritage Resources Agency
Sasol Mining	Sasol Mining (Pty) Ltd
SAWS	South African Weather Services
SDF	Spatial Development Framework
SHE	Safety, Health and Environmental
SOPs	Standard Operating Procedures
SSC	Species of Special Concern
WMA	Water Management Area

1 Introduction

Sasol Mining (Pty) Ltd (Sasol Mining) mines coal within the highveld coal field to supply feedstock to its coal to liquid facility in Secunda. Sasol Mining has devised a sustainable strategy to keep the Secunda Operations operational for at least the next 20 years. In an effort to realise this strategy Sasol Mining has to replace all the current collieries. As part of this strategy, Sasol Mining plans to expand their Sasol Syferfontein colliery by applying for a Mining Right in terms of the Minerals and Petroleum Resource Development Act, 2002 (Act No. 28 of 2002) (MPRDA) to mine the No. 4 lower coal seam in the Syferfontein Block IV coal reserves. The Sasol Block IV area comprises of a number of farm portions which have been listed in Table 1-1 below.

Table 1-1: Directly Affected Farms

Farm Name	Farm Portion
Vaalbank 96 IS	2
Langsloot 99 IS	17
Langsloot 99 IS	16
Wildebeestfontein 122 IS	1
Wildebeestfontein 122 IS	4
Wildebeestfontein 122 IS	13
Wildebeestfontein 122 IS	14
Wildebeestfontein 122 IS	7
Wildebeestfontein 122 IS	18
Wildebeestfontein 122 IS	10
Wildebeestfontein 122 IS	17
Wildebeestfontein 122 IS	3
Zondagsfontein 124 IS	1
Zondagsfontein 124 IS	21
Zondagsfontein 124 IS	7
Zondagsfontein 124 IS	3
Zondagsfontein 124 IS	8
Zondagsfontein 124 IS	2
Zondagsfontein 124 IS	4
Zondagsfontein 124 IS	9
Zondagsfontein 124 IS	6

Farm Name	Farm Portion
Zondagsfontein 124 IS	5
Zondagskraal 125 IS	15
Zondagskraal 125 IS	2
Zondagskraal 125 IS	24
Dieplaagte 123 IS	1
Dieplaagte 123 IS	7

The affected farm portions are located approximately 16 km northwest from the town of Secunda and approximately 8 km north from the town of Leandra within South Africa's Mpumalanga Province (See Plan 2 and Plan 3). Sasol Mining plans to mine the above mentioned areas using the underground bord-and-pillar mining method as the means of primary development. In addition to this, Sasol Mining utilises a special method for higher extraction, known as the Nevid Mining Method. This method ensures that there will be minimal disturbances above ground/ at the surface. The Syferfontein Block IV reserves will be accessed by means of an adit in the highwall of the existing Syferfontein opencast mine. Currently no mine infrastructure is planned for the Syferfontein Block IV area other than 2 ventilation shafts. Existing infrastructure located on the Tweedraai mine will be used to service the Sasol Syferfontein Block IV area.

The existing infrastructure at the Tweedraai mine includes:

- Electrical supply infrastructure;
- Clean water pipeline from the Rand Water board supply;
- Service water infrastructure;
- Various office building, workshops, change houses, parking areas and training facilities;
- An overland conveyor;
- Man-and-material shaft, bunker, decline and ventilation shaft;
- Bunker and stockpile area;
- Polluted water dams;
- Sewage treatment plant;
- ISO Waste handling; and
- Explosive magazine.

2 The baseline environment

2.1 Description of the current environment

The following chapter deals with the current environment for the project area. The chapter contains sections dealing with the various biophysical and social aspects that are relevant to the project in order to understand the pre-mining environment.

2.1.1 Climate and Meteorological Overview

2.1.1.1 Temperature

Air temperature is important, both for determining the effect of plume buoyancy (the larger the temperature difference between the plume and the ambient air, the higher the plume is able to rise), and determining the development of the mixing and inversion layers.

Modelled MM5 data for the Govan Mbeki Local Municipality (GMLM) was used and trends were observed analysing the three years available (2009-2011).

Three-year average monthly maximum, mean and minimum temperatures for Syferfontein are given in Table 2-1. The average monthly maximum temperatures range from 21.3°C in January to 7.5°C in July, with monthly minima ranging from 19.9°C in December to 6.6°C in July. Annual mean temperature for Syferfontein is given as 14.5°C.

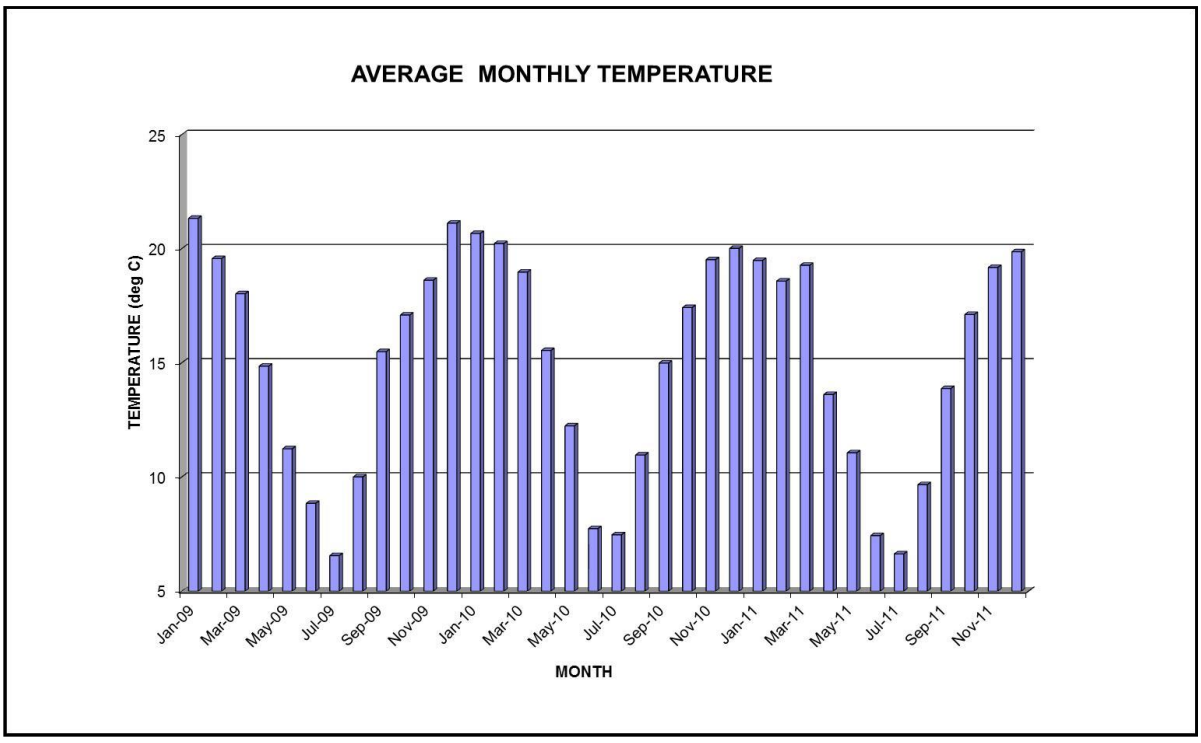

Figure 2-1: Average monthly temperature derived from the Syferfontein modelled data (2009 - 2011)

Table 2-1: Average monthly minimum, maximum and mean temperature values derived from the Syferfontein modelled data (2009 - 2011)

Temperature (deg °C)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Monthly Max.	21.3	20.2	19.3	15.5	12.2	8.8	7.5	11.0	15.5	17.4	19.5	21.1	15.8
Monthly Min.	19.5	18.6	18.0	13.6	11.1	7.4	6.6	9.7	13.9	17.1	18.6	19.9	14.5
Monthly Mean	20.5	19.5	11.5	14.7	11.5	8.0	6.9	10.2	14.8	17.2	19.1	20.3	14.5

2.1.1.2 Relative Humidity

The data in Table 2-2 is representative of the relative humidity for the Syferfontein area. The annual maximum, minimum and mean relative humidity is given as 73%, 68% and 71% respectively. The monthly maximum relative humidity remains above 60% for the whole year and ranges from 82% in winter to 64% in spring. The monthly minimum relative humidity on the other hand is less than 75% throughout the year, with the highest minimum (73%) occurring in June and the lowest (62%) occurring in November and December.

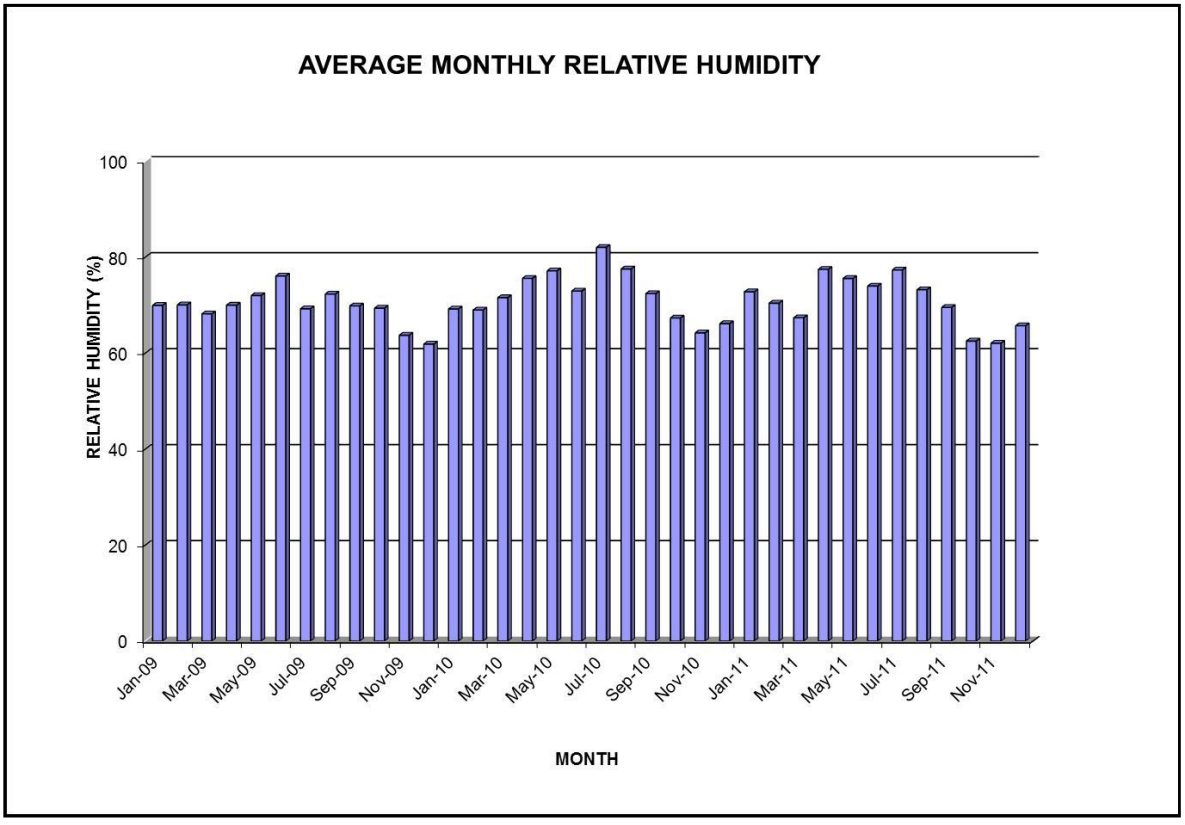

Figure 2-2: Average Monthly Relative Humidity derived from the Syferfontein modelled data (2009-2011)

Table 2-2: Average Monthly Relative Humidity derived from the Syferfontein modelled data (2009-2011)

Relative Humidity (%)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Monthly Max.	73	70	72	77	77	76	82	78	72	69	64	66	73
Monthly Min.	69	69	67	70	72	73	69	72	70	63	62	62	68
Monthly Mean	71	70	75	74	75	74	76	74	71	66	63	65	71

2.1.1.3 Precipitation

The Syferfontein Project area lies in the rainfall zone B1A according to the Water Research Commission (WRC) Reports K5/1491 (WRC, 2005). The mean monthly precipitation for the climatic period from 1920 to 2004 periods determined for the rainfall region is depicted in Figure 2-3.

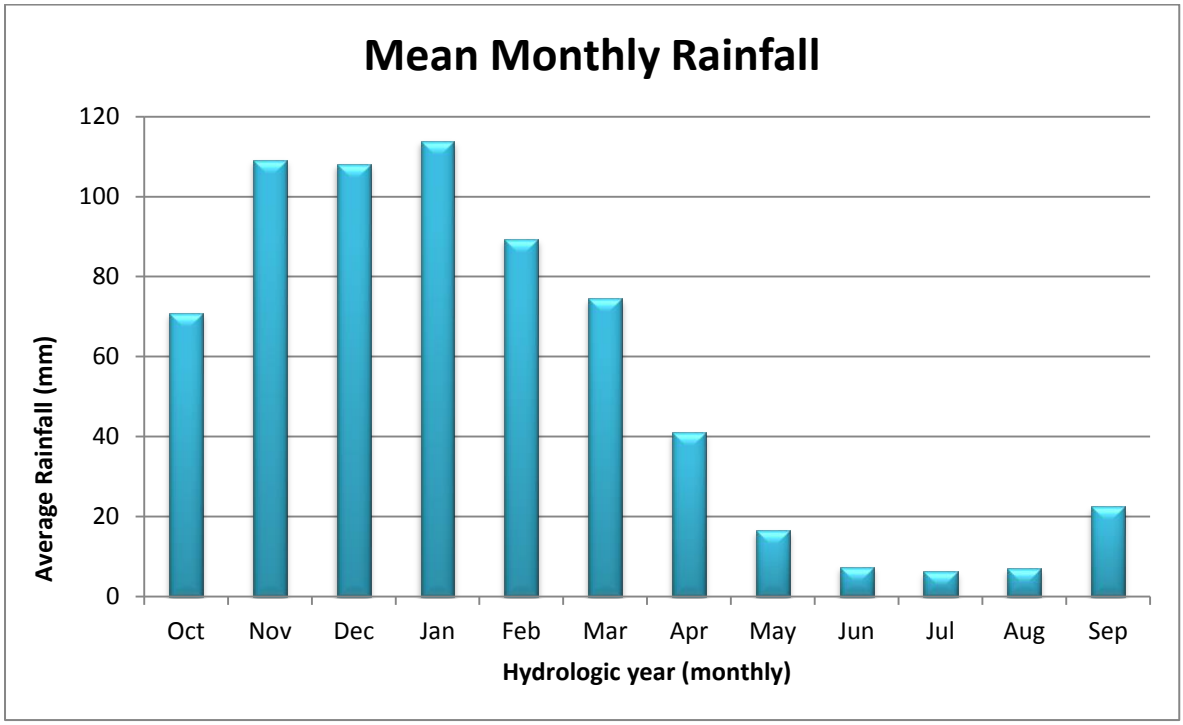

Figure 2-3: WRC, 2005 mean monthly rainfall for rainfall region B1A (1920 to 2004)

Recent records obtained from 2009 to 2011 as shown in Table 2-3, the three year annual maximum, minimum and mean monthly precipitation rates for the Syferfontein site are 82 mm, 43 mm and 57 mm, respectively. The highest monthly maximum precipitation (210 mm) occurs for January. The rate decreases down to 8 mm in July. The monthly minimum precipitation ranges between 129 mm in December and no precipitation in June and July.

Table 2-3: Average monthly precipitation derived from the Syferfontein modelled data (2009-2011)

Precipitation (mm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Monthly Max.	210	92	110	67	16	9	8	28	31	93	116	208	82
Monthly Min.	119	50	49	8	9	0	0	1	19	24	103	129	43
Monthly Mean	158	77	13	42	13	3	3	10	23	64	110	167	57

2.1.1.4 Evaporation

As shown in Table 2-4, the annual maximum, minimum and mean monthly evaporation rates for the Bethal area for the period 1963 to 1987 are 186 mm, 89 mm and 140 mm, respectively. The highest monthly maximum evaporation (264 mm) occurs for December. The rate decreases significantly down to 106 mm in June. The monthly minimum evaporation ranges between 153 mm in January and 7 mm in April. South African Weather Services (SAWS) stopped monitoring evaporation in 1987.

Table 2-4: Maximum, minimum and mean monthly evaporation rates for the Bethal area evaporation station for 1960 - 1987 period (South African Weather Service)

Evaporation (mm)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Monthly Max.	228	188	196	140	123	106	122	178	231	259	200	264	186
Monthly Min.	153	110	100	7	60	61	68	89	118	147	140	17	89
Monthly Mean	180	149	147	107	95	80	89	131	164	184	168	186	140

2.1.2 Air Quality

2.1.2.1 Overview

2.1.2.1.1 Ambient Air Quality

Ambient air quality in this region of South Africa is strongly influenced by regional atmospheric movements, together with local climatic and meteorological conditions. The most important of these atmospheric movement routes is the direct transport towards the Indian Ocean and the recirculation over the sub-continents.

Mpumalanga Province experiences a wide range of both natural and anthropogenic sources of air pollution ranging from power generation to veld fires, mining activities, industrial processes, agriculture, paper and pulp processing, vehicle use and domestic use of fossil fuels. Different pollutants are associated with each of the above activities, ranging from volatile organic compounds to heavy metals, particulate matter, dust and odours. Mpumalanga experiences distinct weather patterns in summer and winter that affect the

dispersal of pollutants in the atmosphere. In summer, unstable atmospheric conditions result in mixing of the atmosphere and rapid dispersion of pollutants. In contrast, winter is characterised by atmospheric stability caused by a persistent high pressure system over South Africa. This dominant high pressure system results in subsidence, causing clear skies and a pronounced temperature inversion over the Highveld central plateau area. This inversion layer traps the pollutants in the lower atmosphere, which results in reduced dispersion and a poorer ambient air quality. Preston-Whyte and Tyson (1988) describe the atmospheric conditions in the winter months as highly unfavourable for the dispersion of atmospheric pollutants.

Precipitation represents an effective mechanism for removal of atmospheric pollutants and is therefore considered during air pollution studies. Rain-days are defined as days experiencing 0.2 mm or more rainfall. The site specific MM5 modelled meteorological data set for full three calendar years (2009 – 2011) was obtained from the Lakes Environmental Consultants in Canada to determine local prevailing weather conditions. This dataset consists of surface data, as well as upper air meteorological data that is required to run the dispersion model. The Pennsylvania State University / National Centre for Atmospheric Research (PSU/NCAR) meso-scale model (known as MM5) is a limited-area, non-hydrostatic, terrain-following sigma-coordinate model designed to simulate or predict meso-scale atmospheric circulation. This data has been tested extensively and has been found to be accurate.

Modelled meteorological data for the period January 2009 to December 2011 was obtained from a point close to the proposed Syferfontein Block IV coal mine site (26.403822 S, 29.131606 E). Data availability was 100%.

Generally, a data set of greater than 90% (taken to be the same as that stipulated for pollutant data availability (SANS, 2005)) is required for that month/year to be considered representative of the assessed area (SANS, 2005).

The ambient air quality in the Syferfontein Block IV expansion area is thus greatly influenced by the various sources of air pollution in the Mpumalanga region as mentioned above. The dense mining activity in Mpumalanga, as well as the industrial activity, veld fires, power generation and the agricultural activity will all have an impact in the ambient air quality in the Syferfontein Block IV expansion area. The impact will be most significant during the winter season due to the constant high pressure system over South Africa, thus stabilising the atmosphere and trapping pollutants in the lower atmosphere, creating poorer ambient air quality.

2.1.2.1.2 Wind Speed

Dispersion of atmospheric pollutants is a function of the prevailing wind characteristics at any site. The vertical dispersion of pollution is largely a function of the wind field. The wind speed determines both the distance of downward transport and the rate of dilution of pollutants. The generation of mechanical turbulence is similarly a function of the wind speed, in combination with the surface roughness.

The amount of particulate matter generated by wind is highly dependent upon the wind speed. Below the wind speed threshold for a specific particle type, no particulate matter is liberated, while above the threshold, particulate matter liberation tends to increase with the wind speed. The amount of particulate matter generated by wind is also dependent on the material's surface properties. This includes whether the material is crusted, the amount of non-erodible particles and the particle size distribution of the material.

Wind roses comprise 16 spokes which represent the directions from which winds blew during the period. The colours reflect the different categories of wind speeds. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories. The figure given at the bottom of the legend described the frequency with which calms occurred, i.e. periods during which the wind speed was below 0.5 m/s.

The spatial and annual variability in the wind field for the Syferfontein modelled data is clearly evident in Figure 2-4. The predominant wind direction is from the north-northwest, north and northwest, with frequent winds also occurring from the east, east-northeast and north-northeast. Over the three year period, frequency of occurrence was 10.8% from the north-northwest, 10.2% from the north and 9.9% from the northwest sector. Less frequent winds (under 3% of the time) were coming from the southwest, west and west-southwest. Calm conditions (wind speeds < 0.5 m/s) occurred for 8.76% of the time.

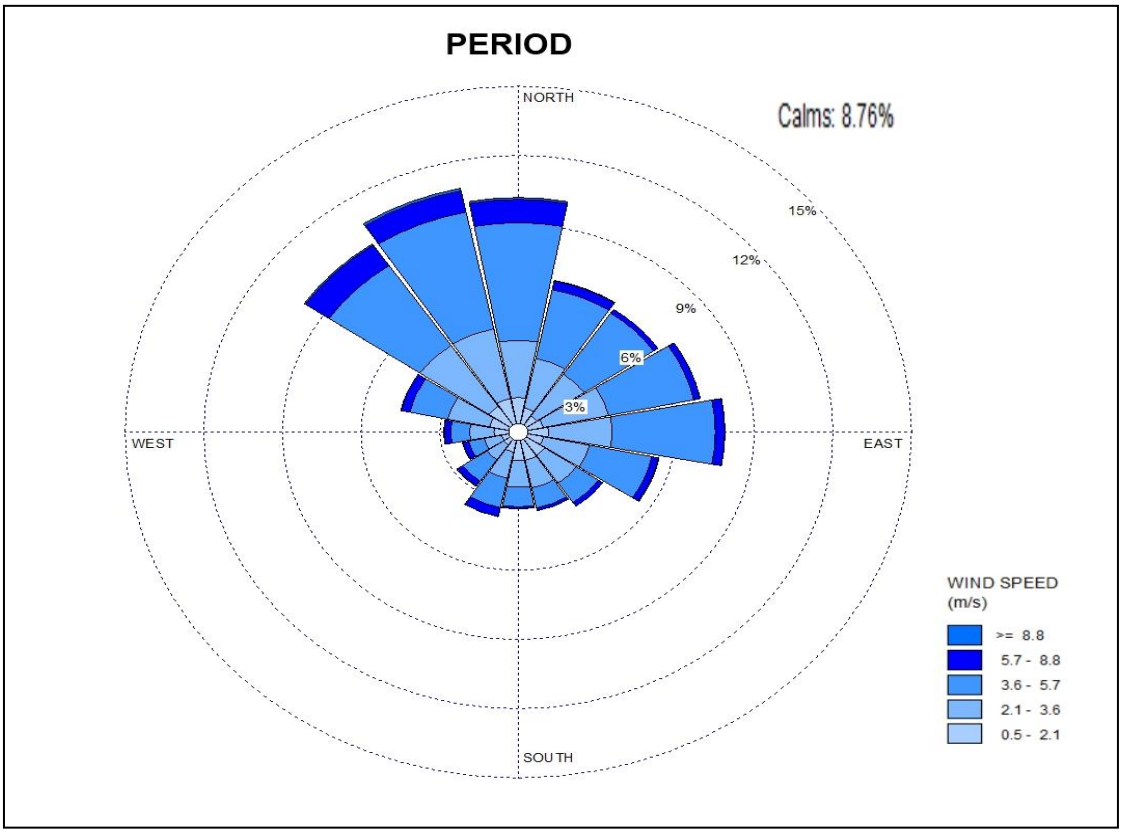

Figure 2-4: Period surface wind rose for Syferfontein modelled data, 01 January 2009 – 31 December 2011

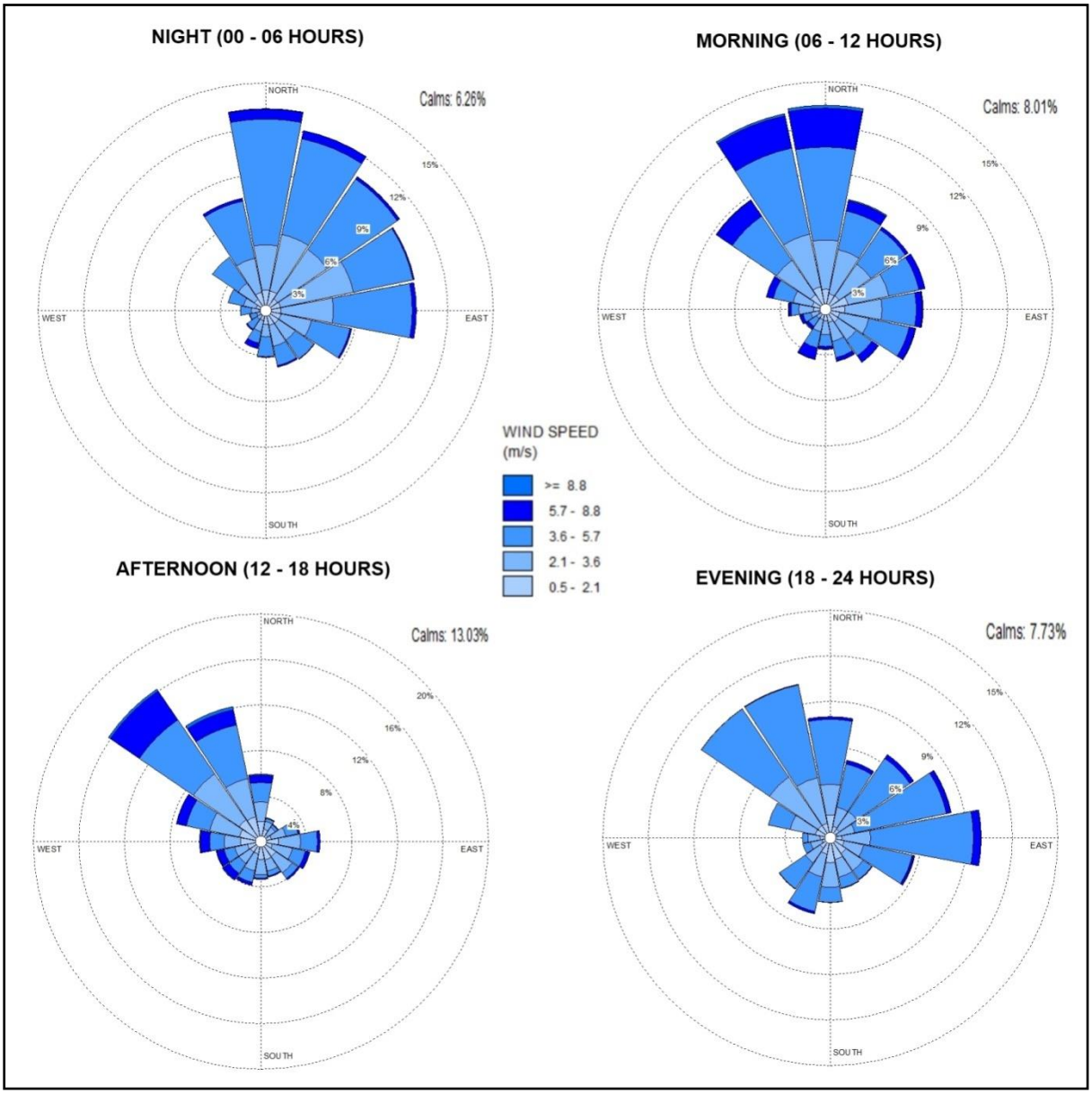

Figure 2-5: Diurnal variation of winds between Night time 00:00 – 06:00 (top left), Morning 06:00 – 12:00 (top right), Afternoon 12:00 – 18:00 (bottom left) and Evening 18:00 – 24:00 (bottom right) (modelled data 01 January 2009 – 31 December 2011)

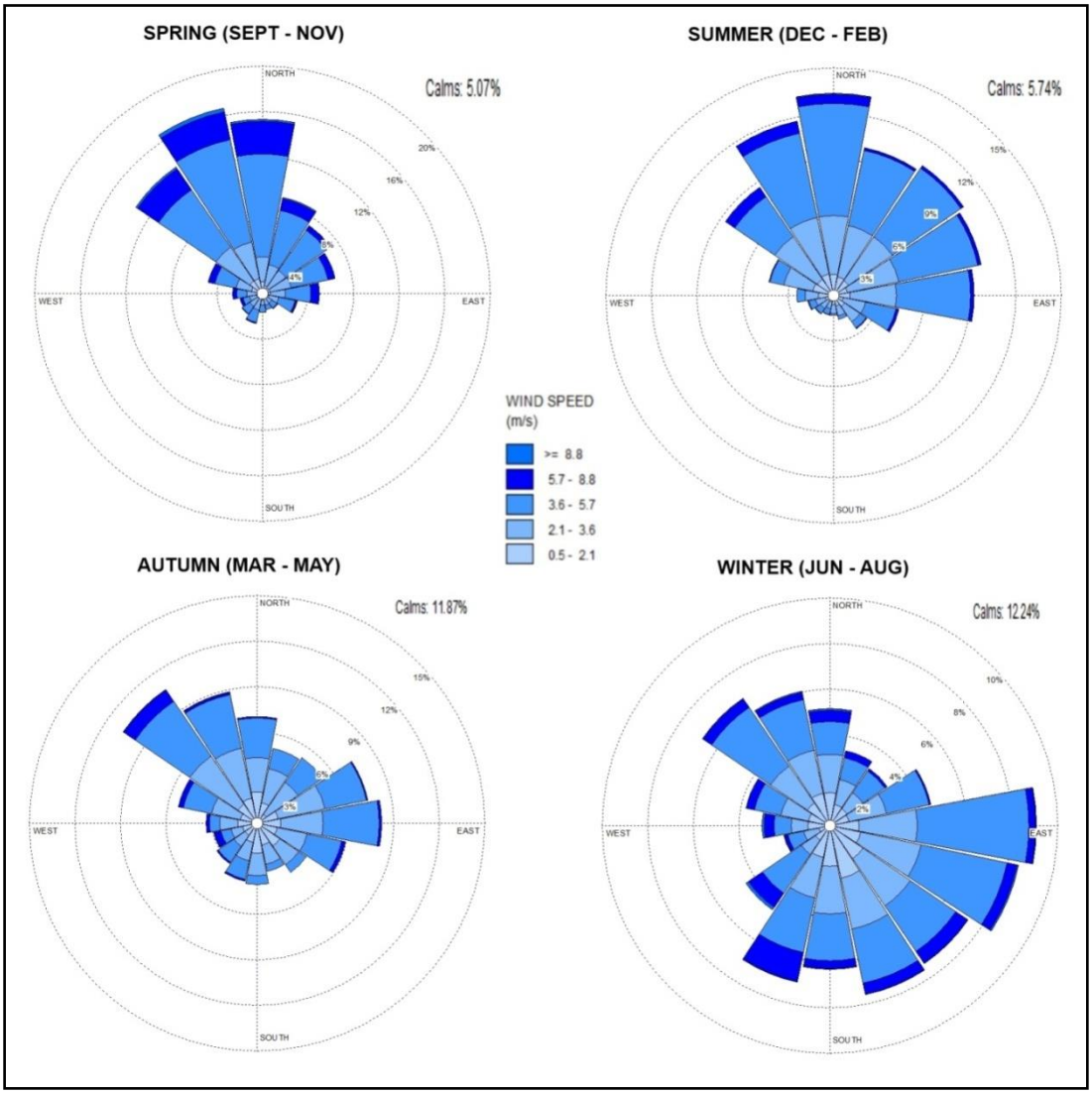

Figure 2-6: Seasonal variation of winds in spring (September – November) (top left), summer (December - February) (top right), autumn (March – May) (bottom left) and winter (June – August) (bottom right) (modelled data 01 January 2009 – 31 December 2011)

A clear distinction in the wind speed and wind direction is noted between the different seasons as illustrated in Figure 2-6 above. More dominant winds were noted to occur in winter with the dominant wind direction coming from an easterly and east-south-easterly direction. Calm winds (below 0.5m/s) occurred 12.24% of the time. The summer season on the other hand, experienced dominant winds from a northern and north western direction. Calm winds were noted to occur 5.74% of the time.

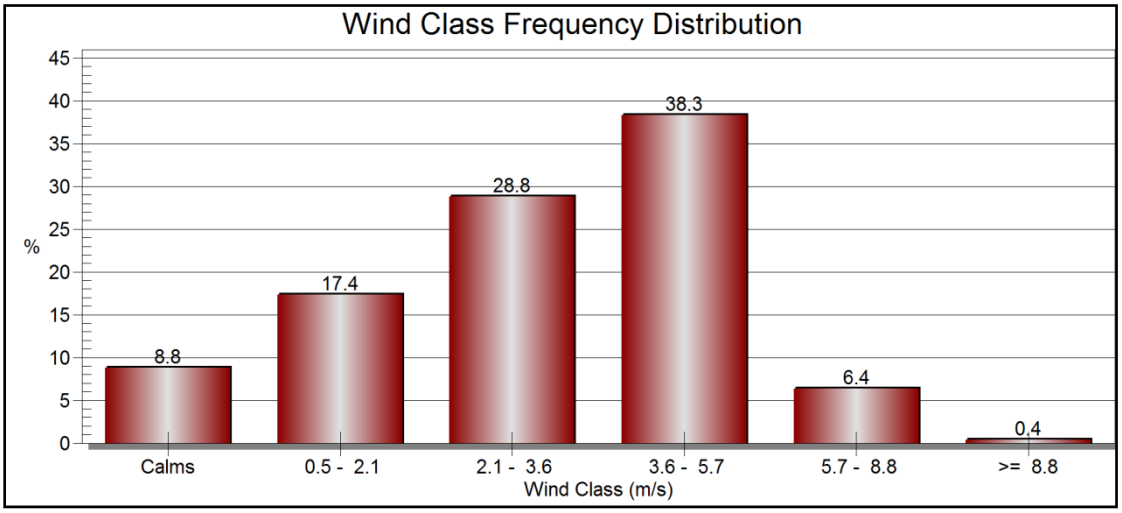

Figure 2-7: Wind Class Frequency Distribution for Syferfontein modelled data, 01 January 2009 – 31 December 2011

2.1.3 Visual and Topography

2.1.3.1 Overview

The topographical model indicates that the elevation of the proposed project area ranges from approximately 1680 metres above mean sea level (mamsl) in the south to 1580 mamsl in the north. The proposed project area is situated on a relatively high-lying area surrounded by a mildly undulating topography. Plan 6 (Appendix A) illustrates the topography of the area. The gradient of the proposed project area topography is typically flat.

The majority of the proposed project area is characterised by a slope of 0 to 4°; slopes of 5 to 12° occur across the eastern and western parts of the proposed Project area. There are also isolated areas with slightly steeper slopes of between 13 to 20° that occur on the northeast, east, and southwest of the proposed project area, as illustrated in Plan 7 (Appendix A).

The surface features identified from the aerial photography within the proposed project boundary include farm houses, roads, agricultural areas, dams/ lakes, perennial streams along the northern and eastern parts of the proposed project boundary and non-perennial streams within the proposed project area. The Dwars-in-die-Wegspruit and Vaalbankspruit streams drain the proposed Project area in a northerly direction. Wetlands occur within the proposed project area along the Dwars-in-die-Wegspruit and the Vaalbankspruit. The aerial photographs, as well as pictures taken on the proposed project area (Figure 2-8) also illustrate the existence of a small town (Kinross) adjacent to the south-western boundary of the proposed Project area.

Figure 2-8: Location of Kinross town adjacent to the Project boundary

Most of the landscape within the proposed project area has been transformed by agricultural activities. Land use in the area is mining and mixed agriculture consisting of mainly maize crops and livestock farming. The general landscape characteristic is that of a slightly undulating topography, with valley bottom wetlands and perennial/ non-perennial streams.

2.1.3.2 Visual/ Aesthetic Character

The visual / aesthetic character of the receiving environment was described in terms of the topography and vegetation.

The proposed project area is predominantly characterized by cultivated land, interlaced with perennial / non-perennial streams and associated wetlands. Mining activities occur at the adjacent Syferfontein Colliery and in the immediate vicinity of the proposed project area. The Matla and Kriel power stations can be distinguished on the horizon (Figure 2-9). At night the power stations become the focus of attention as their lights dominate the nightscape.

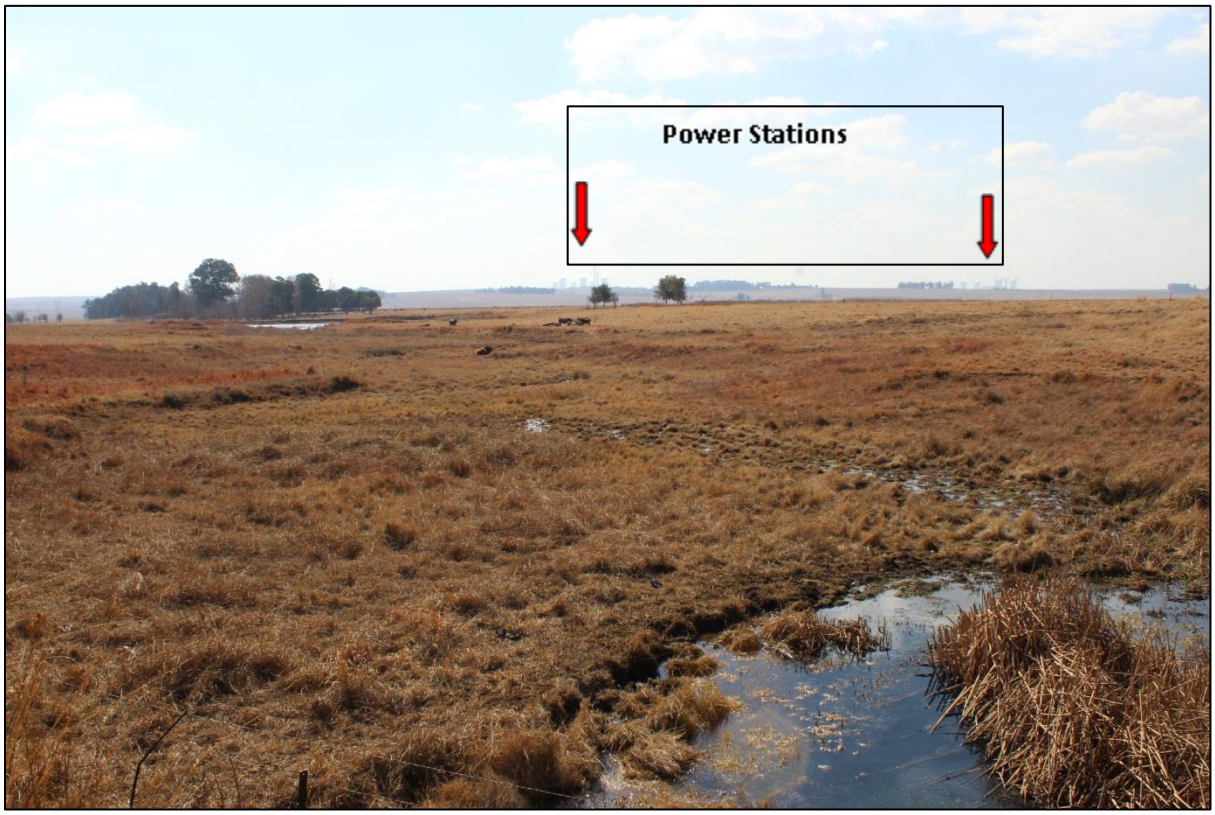

Figure 2-9: Location of power stations near the proposed Block IV Project area

The proposed Syferfontein Block IV mine is not likely to have an impact on the visual / aesthetic character of the surrounding environment considering the proposed development is an underground mine. There is already an existing operational mine adjacent to it and the area is already known as a “mining area”. The infrastructure of the Matla and Kriel power stations also dominate the landscape and has already transformed the sense of place. The proposed Project is situated in an already disturbed landscape and will not have much influence on the visual character of the area. The Kinross community will likely be most affected depending on where the ventilation shafts are placed. The residents here may lose the sense of place created by the surrounding agricultural activities.

2.1.4 Noise

The current ambient noise levels in the proposed project area are not expected to be affected. The current noise levels associated with rural districts and agricultural activities is not likely to be altered. The South African National Standards guidelines (SANS 10103:2008) for typical noise levels in rural districts indicate that noise levels should not exceed 45 dBA during the day time and should not exceed 35 dBA during the night time.

The main noise sources in the area are expected to be the vehicular activity on the R547 which may intermittently impact on the ambient noise levels where it runs across the proposed Project area. Noise associated with livestock and farming activities is expected as

the common daytime noise source, while *Gryllidae* (crickets) and domestic noise are expected to be the common night time noise source.

A baseline assessment was undertaken to determine the current ambient noise levels at the surrounding areas of the proposed project. Locations (farm houses and residential dwellings) were selected that may possibly be impacted on by the proposed mining activities and that were identified as suitable reference points for the measurement of ambient sound levels surrounding the proposed project area. The measurement locations were in the following farms:

- Langsloot 99 IS;
- Rietfontein 100 IS;
- Zondagfontein 124 IS; and
- Wildebeesfontein 122 IS.

These farms were all categorised as rural non-mining locations.

The results of the ambient noise measurements taken at the relevant farm houses near the proposed mining activities indicated that the baseline noise levels are higher than that of the SANS 10103:2008 day and night time guideline levels for rural districts as indicated by Table 2-5. The results from the noise meter recordings for all the sampled points as well as the rating limits according to the SANS 10103:2008 guidelines are presented in Table 2-5.

Table 2-5: Results of the baseline noise measurements.

Sample ID	SANS rating limit			Measurement details		
	Type of district	Period	Acceptable rating level dBA	$L_{Areq,T}$ dBA	Maximum/Minimum dBA	Date
N1	Rural	Daytime	45	50	96 / 23	18/09/2013
		Night time	35	40	72 / 21	18/09/2013
N2	Rural	Daytime	45	51	98 / 26	19/09/2013
		Night time	35	37	89 / 27	19/09/2013
N3	Rural	Daytime	45	56	93 / 30	16/09/2013
		Night time	35	57	97 / 33	16/09/2013
N4	Rural	Daytime	45	49	95 / 31	17/09/2013
		Night time	35	41	77 / 26	17/09/2013
	Indicates $L_{Aeq,T}$ levels above either the daytime rating limit or the night time rating limit					

The noise sources that were influencing the baseline measurements at the time of the noise survey and that were responsible for the day/night time measurements are summarised in Table 2-6.

Table 2-6: Summary of noise sources influencing baseline measurements.

Receptor	Noise Source Description			
	Day	Duration	Night	Duration
N1	Farming activities (Trucks and tractors)	Intermittent	Livestock (sheep) and farming activities	Intermittent
N2	Vehicular activity and human communication	Intermittent	*Gryllidae* (crickets)	Continuous
N3	Domestic animals such as dogs and horses	Intermittent	Wind noise and domestic animals	Continuous and Intermittent
N4	Farming activities (Trucks and tractors) and dogs	Intermittent	*Gryllidae* (crickets) and vehicular activity on the R580 road	Continuous and intermittent

The ambient sound level set for the area surrounding the proposed project area is taken from the average measured day and night time baseline levels. For daytime the ambient sound level it is recommended to be set at 52dBA and for the night time ambient sound level it is recommended to be set at 44dBA.

2.1.5 Fauna and Flora

2.1.5.1 Overview

The proposed Project area falls within the Eastern Highveld Grassland and the Soweto Highveld Grassland as described by Mucina and Rutherford (2006). This vegetation type occurs within Mpumalanga Province at an altitude of 1520 and 1780 mamsl.

The landscape consists slight to moderately undulating plains including some low hills and pan depressions. The vegetation is a short dense grassland characterised by the usual Highveld grass species, (*Aristida, Digitaria, Eragrostis, Themeda* and *Tristachia*) (Mucina and Rutherford, 2006).

Dominant and diagnostic grass species are *Hyparrhenia hirta* and *Sporobolus pyramidalis*. Non-grassy forbs include *Acacia sieberiana, Searsia rehmanniana, Walafrida densiflora, Spermacoce natalensis, Kohautia cynanchica*, and *Phyllanthus glaucophyllus* (Bredenkamp et al. 1989; Coetzee et al. 1993; Eckhardt et al. 1993; Fuls et al. 1993; Cowling et al. 1997, in Mucina and Rutherford (eds) 2006).

Relatively high rainfall maintains the grasslands during the summer months, with the mean annual range between 400 to 900 mm. Frequent fires, frost and heavy grazing – formerly by wild animals and now by cattle and sheep – suppress the presence of shrubs and trees (Low and Rebelo 1998). Summer rainfall is not evenly distributed throughout the region, resulting in several habitat types. Differences in habitat types are further accentuated by the variable soil characteristics of the region (Low and Rebelo 1998).

2.1.5.2 Vegetation Analysis

As the sampling of the entire study area is not possible, representative samples of the vegetation were assessed. The vegetation was classified according to available aerial imagery as well as through an initial site inspection. The number of sample sites visited was determined by the time available for the study as well as the accessibility of each of the sample sites. Then, areas of each vegetation type (classified before going to site) were sampled randomly. This methodology allows for more efficient sampling than overall random sampling.

There is a method for determining the number of plots required for a statistically accurate sample for each vegetation type. However, time limitations did not allow for such complete sampling. The result is the sampling of as many plots as possible in each predetermined vegetation type. At each sample site, a plot size of 100m2 was sampled. Each plot was described with topographical and environmental data recorded. In each plot; the species were identified in the field as far as possible. Plants that could not be identified in the field through the use of field guides, such as Pooley (1988) and Van Outshoorn (1999) were collected and photographed. These were identified later through the use of ispot (www.ispot.org.za). The Braun Blanquet method was used for the listing of species and their associated cover. The Braun Blanquet method is the standard for phytosociological studies (plant description and mapping) in South Africa and is an internationally recognised method of surveying.

2.1.5.3 Vegetation communities

Vegetation communities were defined using the data gathered from each sample plot. The presence of each of the different species in relation to environmental data defined several different vegetation types. Each of these vegetation types exhibits some diagnostic species.

2.1.5.4 Vegetation mapping

Vegetation was mapped using the information gathered from the sample plots and resultant vegetation communities, as well as aerial imagery.

2.1.5.5 Flora

Through the sample plots, several aspects of the flora were identified. These included the Species list, list of Species of Special Concern, and the list of alien and invasive species.

2.1.5.5.1 Species list

The species list is compiled mainly from the data gathered from the sample plots. All species occurring in each of the sample plots were identified as far as possible, either during the site visit or afterwards from photographs. In addition, species seen within the study area, but not occurring within specific sample plots were also recorded. This allowed for the production of a species list representative of the entire study area.

2.1.5.5.2 Species of Special Concern

From the overall species list, a list of SSC can be drawn up. In order to be fully comprehensive, this list includes plants on each of the following lists:

- South African National Biodiversity Institute (SANBI) Red List of South African plants version 2012.1
- National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA) listed species;
- National Forests Act, 1998 (Act No. 84 of 1998) Protected Trees; and
- Mpumalanga Protected Plants.

An initial list of SCC expected to be found within the study area comprises Possible Species of Special Concern (PSSC). If any of these (and any additional species on the above lists) are recorded on site, they are ascribed the status Confirmed Species of Special Concern (CSSC). It is likely that many of the PSSC do occur on site, but were not recorded in this site visit.

SCC (now listed as Confirmed Species of Special Concern) recorded from the study site are presented in Table 2-7 below.

Table 2-7: Species of Special Concern recorded from the study area

Species	Common Name	Ecological status	Growth form
Aloe ecklonis	Grass aloe	MPB Protected	Aloe
Aloe maculata	Soap aloe	MPB Protected	Aloe
Crinium bulbispermum	Orange River Lilly	MBP protected	Herb
Eucomis autumnalis	Common Pineapple Flower	Schedule 11: Protected Plants; TSP Declining	Herb
Gladiolus crassifolius	Thick-leaved Gladiolus	MPB Protected	Shrub
Habenaria epipactidea	Ghost Orchid	MPB Protected	Orchid

Species	Common Name	Ecological status	Growth form
Satyrium longicauda	-	Schedule 11: Protected Plants	Orchid
Watsonia spp.	-	Schedule 11: Protected Plants	Herb

2.1.5.5.3 Alien invasive species

Alien invasive species are recorded from each of the sample plots, as well as through opportunistic sightings throughout the study area. Alien invasive species are those that are classified by the Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983) (CARA) or NEMBA as alien weeds or invasive plants. Each of the categories defined by these Acts has associated legislated control measures.

Sixteen alien invasive or weed species were recorded from site. These usually occurred in the transformed areas along roadsides and in disturbed areas such as the edges of fields. Some species occurred in natural vegetation where there was some disturbance. The entire list is given in Table 2-8 below.

Table 2-8: List of all Alien Invasive species recorded from the Syferfontein project site

Species	Common Name	Ecological status	Growth form
Acacia mearnsii	Black Wattle	Alien Invasive**	Tree
Bidens formosa	Cosmos	Alien Invasive	Herb
Bidens pilosa	Common Black-jack	Alien Invasive	Herb
Cirsium vulgare	Scotch Thistle	Alien Invasive*	Herb
Cyperus rotundus subs. Rotundus	Purple Nutsedge	Weed	Sedge
Datura ferox	Large thorn apple	Alien Invasive*	Herb
Eucalyptus camaldulensis	Red river gum	Alien Invasive**	Tree
Ipomoea purpurea	Morning glory	Alien Invasive***	Sedge
Opuntia ficus-indica	Sweet prickly pear	Alien Invasive*	Succulent
Persicaria lapathifolia	Spotted Knotweed	Alien Invasive	Herb
Pinus pinaster	Cluster pine	Alien Invasive**	Tree
Salix babylonica	Weeping willow	Alien Invasive**	Tree
Solanum sisymbrifolium	Wild Tomato	Alien Invasive*	Shrublet
Tagetes minuta	Tall Khaki Weed	Alien Invasive	Herb
Verbena bonariensis	Tall Verbena	Alien invasive	Shrub
Xanthium spinosum	Spiny cocklebur	Alien Invasive*	Succulent

Species from the CARA Schedule 1*, 2** and 3*** are found in the study site.

2.1.5.6 Fauna

Pertinent notes were made during the survey and desktop studies were also conducted for mammals, birds, reptiles and frogs. All fauna species encountered on site were identified and recorded. The following methods were used during the survey:

2.1.5.7 Mammals

A database search for mammal species that have been recorded in the two Quarter Degree Square (QDS) grids visual sightings and ecological indications were used to identify the mammal inhabitants of the study area; this includes scats, tracks and habitat such as burrows and dens. Scat found was collected (if required), photographed with a scale along with any tracks found and identified. For identification purposes the following field guides were used, Mammals of Southern Africa (Smithers, 1983), The Mammals of the Southern African Sub-region (Skinner & Chimimba, 2005), Red Data Book of the Mammals of South Africa (Friedman & Daly 2004) and The Kingdon field guide to African Mammals (Kingdon, 1997). The following was recorded:

- All mammals encountered, noted or captured during the survey;
- Animals listed in previous studies and observed by people residing in the study area;
- A list of the most prominent mammal species; and
- A list of threatened or protected species encountered during the survey.

Actual sightings, spoor, calls, dung and nesting sites were used to establish the presence of animals on the proposed project site. The evidence of dung and spoor suggests that mammals were present in the area although very few were recorded during the surveys. The observations of local land owners were used to supplement the findings of the mammal survey. Table 2-9 lists protected mammals that were observed in the Syferfontein project area. The mammals recorded were found within a variety of the vegetation communities present. One species was found to be of concern; Serval (*Felis serval*) being a Red Data species protected under IUCN, described as Near Threatened.

Table 2-9: Mammal species observed on the project area.

Scientific Name	Common Name	Red Data Status	Observation Method
Atilax paludinosus	Water mongoose	Least concern	Signs
Canis mesomelas	Black backed jackal	Least concern	Locals
Cryptomys hottentotus	Common Molerat	Least concern	Locals
Cynictis penicillata	Yellow mongoose	Least concern	Seen
Felis serval	Serval	**Near Threatened**	Signs/Locals
Hystrix africaeaustralis	Porcupine	Least concern	Signs/Locals
Otomys angoniensis	Angoni Vlei Rat	Least concern	Signs/Locals

Scientific Name	Common Name	Red Data Status	Observation Method
Poecilogale albinucha	Striped Weasel	No Results	Seen
Sylvicapra grimmia	Common duiker	Least concern	Locals
Tatera brantsi	Highveld Gerbil	Least concern	Seen

2.1.5.8 Avifauna

Birds have been viewed as good ecological indicators, since their presence or absence tends to represent conditions pertaining to the proper functioning of an ecosystem. Bird communities and ecological condition are linked to land cover. As the land cover of an area changes, so do the types of birds in that area (The Bird Community Index, 2007). Land cover is directly linked to habitats within the proposed project area. The diversity of these habitats should give rise to many different species. A total of 147 bird species were identified as occurring in the area of interest. Most of these birds were observed in the vicinity of less disturbed areas. Many were also identified close to the wetland areas in the project area, with birds regularly seen feeding on dried maize kernels on the edges of maize fields. Officially protected bird species recorded are listed in Table 2-10.

Table 2-10: Protected bird species

Scientific name	Common name	IUCN and Protected Status
Sagittarius serpentarius	Secretary bird	VU
Tyto capensis	Grass Owl	LC/Provincially protected

2.1.5.9 Reptiles

Reptiles are ectothermic (cold-blooded) meaning they are organisms that control body temperature through external means. As a result reptiles are dependent on environmental heat sources. Due to this many reptiles regulate their body temperature by basking in the sun, or in warmer areas. Substrate is an important factor determining which habitats are suitable for which species of reptile. The presence of few rocky outcrops within the proposed project area could mean fewer reptile species are present.

A number of reptile species occur on site. Most of these species are easily spotted and have been encountered in residential buildings or gardens. Reptile species identified in the project area are listed in Table 2-11.

Table 2-11: Herpetofauna species identified on the project area.

Scientific name	English name	IUCN Status
Bitis arietans	Pufadder	LC
Causus rhombeatus	Nightadder	LC
Hemachatus haemachatus	Rinkhals	LC
Lamphrophis aurora	Aurora house snake	LC
Psammophylax rhombeatus	Skaapsteker	LC
Rhinotyphlops schlegelii	Schlegel's beaked blind snake	LC

2.1.5.10 Amphibians

Amphibians are viewed as good indicators of changes to the whole ecosystem because they are sensitive to changes in the aquatic and terrestrial environments (Waddle, 2006). Most species of amphibians are dependent on the aquatic environment for reproduction (Duellman and Trueb 1986). Additionally, amphibians are sensitive to water quality and ultra violet radiation because of their permeable skin (Gerlanc and Kaufman 2005). Activities such as feeding and dispersal are spent in terrestrial environments (Waddle, 2006). According to Carruthers (2001), a number of factors influence the distribution of amphibians, but because amphibians have porous skin they generally prosper in warm and damp habitats.

Amphibians expected to occur on the proposed project area are listed in the Table 2-12 (http://sarca.adu.org.za).

Table 2-12: Amphibian species likely to be found on the Syferfontein Project site.

Family	Genus	Species	Common name	Red list category
Bufonidae	*Amietophrynus*	*gutturalis*	Guttural Toad	LC
Bufonidae	*Amietophrynus*	*maculatus*	Flatbacked Toad	LC
Bufonidae	*Amietophrynus*	*rangeri*	Raucous Toad	LC
Bufonidae	*Schismaderma*	*carens*	Red Toad	LC
Hyperoliidae	*Hyperolius*	*marmoratus*	Painted Reed Frog	LC
Hyperoliidae	*Kassina*	*senegalensis*	Bubbling Kassina	LC
Hyperoliidae	*Semnodactylus*	*wealii*	Rattling Frog	LC
Phrynobatrachidae	*Phrynobatrachus*	*natalensis*	Snoring Puddle Frog	LC
Pipidae	*Xenopus*	*laevis*	Common Platanna	LC
Ptychadenidae	*Ptychadena*	*porosissima*	Striped Grass Frog	LC
Pyxicephalidae	*Amietia*	*angolensis*	Common or Angola River Frog	LC

Family	Genus	Species	Common name	Red list category
Pyxicephalidae	*Amietia*	*fuscigula*	Cape River Frog	LC
Pyxicephalidae	*Cacosternum*	*boettgeri*	Common Caco	LC
Pyxicephalidae	*Cacosternum*	*nanum*	Bronze Caco	LC
Pyxicephalidae	*Strongylopus*	*fasciatus*	Striped Stream Frog	LC
Pyxicephalidae	*Strongylopus*	*grayii*	Clicking Stream Frog	LC
Pyxicephalidae	*Tomopterna*	*cryptotis*	Tremelo Sand Frog	LC
Pyxicephalidae	*Tomopterna*	*natalensis*	Natal Sand Frog	LC
Pyxicephalidae	*Tomopterna*	*tandyi*	Tandy's Sand Frog	LC

The presence of suitable habitat within the proposed project area should provide a number of different species of amphibians, none however were recoded. This may indicate a severely degraded wetland system or simply the result of a poor sampling period for amphibians specifically. The sampling period was poor for amphibians as it was noted as a particularly high flow season resulting in fewer habitats for frogs and tadpoles.

2.1.5.11 Species of Special Concern

A number of the Species identified during the field survey are listed as Red Data (IUCN, 2012) and are nationally or provincially protected. The presence of these species indicates that despite the degraded nature of much of the habitat in the area, habitat still exists for the presence of a number of important species. These are listed in Table 2-13 below.

Table 2-13: Species of Special Concern

Species	National Red Data	Endemic	Provincially protected
Mammals			
Felis serval (Serval)	NT	X	X
Birds			
Sagittarius serpentarius	VU		
Tyto capensis	LC		X

2.1.6 Surface Water

2.1.6.1 Water Resources

There are several streams in the Vaalbankspruit sub-catchment draining the proposed project area. The Vaalbankspruit flows along the northern boundary of the proposed project

area and is fed by a number of tributaries which are non-perennial. The Vaalbankspruit flows into the Dwars-in-die-wegspruit towards the northeast. On the eastern boundary of the proposed Project area, the Trichardspruit drains from south to north through the Rietfontein Dam. The Trichardspruit and Dwars-in-die-wegspruit reach a confluence; then flow into the Steenkoolpruit which then flows into the Wilge River and towards the Olifants River. In this light, the Vaalbankspruit sub-catchment; in which the proposed project area is located, (quaternary catchment B11D) (see Plan 11 in Appendix A) makes up the headwaters of the Olifants River Water Management Area.

2.1.6.2 Regional Catchment

The Olifants River flows northeast through the provinces of Mpumalanga and Limpopo into Mozambique. Major tributaries of the Olifants River are the Wilge, Moses, Elands and Ga-Selati, Klein Olifants, Steelport and Blyde Rivers. Outside of the Olifants River catchment, the Letaba River is a major tributary (catchment area 3,264 km^2) that originates in South Africa and joins the Olifants River in the Kruger National Park, just before the river flows into Mozambique.

The Olifants Catchment covers approximately 54,570 km^2 and is subdivided into 7 secondary catchments (excluding the Letaba River catchment), 13 tertiary and 114 quaternary catchments (IWMI, 2008). The Olifants River and some of its tributaries rise in the Highveld grasslands. There are several large dams in the Olifants River Catchment which include the Witbank Dam, Renosterkop Dam, Rust de Winter Dam, Blyderivierspoort Dam, Loskop Dam, Middelburg Dam, Ohrigstad Dam, Arabie Dam and the Phalaborwa Barrage. In addition, there are many smaller and minor dams in this catchment, which have a considerable combined capacity.

The upper reaches of the Olifants River Catchment are characterised mainly by mining, agricultural and conservation activities. Over-grazing and highly erodible soils result in such severe erosion in parts of the middle section that after heavy rains the Olifants River has been observed to have a red-brown colour from all the suspended sediments.

The Olifants River meanders past several mountains namely the Strydpoort Mountains and the Drakensberg Mountains, descending over the escarpment. The Steelpoort and Blyde Rivers join the Olifants River before it enters the Kruger National Park. Crossing the Mozambique border, the Olifants River flows into the Massingire Dam (South African River Health Programme, 2013/11/21).

The Olifants River system has been recorded as one of the most polluted river systems in Southern Africa, this is largely attributed to the high number of anthropogenic stressors that are present; particularly in the upper catchment, and the changes to water quality that have resulted from these activities (Oberholster, et al., 2011). According to Oberholster et al. (2011) these stressors consist of intensive coal mining activities, coal-fired power generation, industrial activities and agriculture, combined with a general decline in the

operation and management of waste water treatment infrastructure, especially sewage treatment.

2.1.6.3 Catchment boundaries and Water Management Area

The proposed project area is located in the Olifants Water Management Area (WMA 04) which is located within the upper catchment areas of quaternary catchment B11D (Plan 11, Appendix A). The proposed project area occupies 9.5 % of the B11D quaternary catchment.

2.1.6.4 Flood peak flows

2.1.6.4.1 Subcatchment Delineation

Subcatchments were delineated to cover the streams within the Project boundary catchments and were utilised to determine the 24 hr flood volumes for the 1: 50 and 1: 100 yr extreme events.

The delineated subcatchments were utilised for determining flood peaks and the obtained characteristics are depicted in Table 2-14.

Table 2-14: Summary of delineated subcatchments with subcatchment characteristics and details

Subcatchment	Area (km²)	Longest stream length (km)	Elevation difference 85% - 10% of stream length (m)	Proportion of catchment in % within slope classes	
				<3%	3 - 10 %
A	13.0	6.95	30.9	10.10	89.9
B	15.0	5.57	35	7.65	92.4
C	5.35	2.93	18.2	0.43	99.6
D	13.3	6.37	44.6	11.8	88.2

2.1.6.4.2 Peak flows

The estimated design flood peaks flows were determined for the delineated subcatchments for the 1: 50 year and 1:100 year recurrence period flood events according. The summary of the calculated flows are presented in Table 2-15.

Table 2-15: Estimated design flood peak flows

Subcatchment	Area (km²)	Rational		Alternative Rational	
		1:50	1:100	1:50	1:100
A	13.0	44.8	57.7	49.6	60.0
B	15.0	64.0	82.2	71.3	86.5
C	5.35	29.6	38.3	32.4	36.3
D	13.3	58.6	75.4	64.9	78.8

The results indicate that the flood peak flow range between 29 and 71 m^3/s for the 1: 50 and between 38.2 and 287 m^3/s for the 1: 100 return periods. In line with Schedule 6 of GN R 704 of the NWA, the design, operation and maintenance of water conveyances and containment facilities must be able to contain the 1: 50 year 24 hour flood peak.

2.1.6.5 Surface Water Quality

2.1.6.5.1 Sampling

A total of 16 sites were sampled for water quality assessments. A summary of the sites sampled, their location and a brief description is presented in Table 2-16.

Table 2-16: A summary of the sampling site visit performed location and the site observation

Site Name	X – coordinate	Y - coordinate	Comment
SW_004	29.12056528	-26.40030345	Sample was collected from low water levels with slow flow and fish was observed on site
SW_006	29.17398516	-26.41010035	Sample was collected from low water level with flowing water, cattle nearby the site
SW_007	29.18234209	-26.41284423	Sample was collected and the river had low flows
SW_009	29.20002559	-26.36589169	Sample collected, stream with high flows
SW_010	29.19140824	-26.34600891	Low water levels with flow with construction of road and bridge taking place, and a sample was collected

Site Name	X – coordinate	Y - coordinate	Comment
SW_011	29.1672094	-26.36139975	Low water levels with flow and a sample was collected
SW_012	29.15015979	-26.36247799	Low water levels with flow and a sample was collected
SW_014	29.13024139	-26.35816804	Sample collected from the low water levels with flow and maize fields were observed near the site
SW_015	29.15501224	-26.38577845	Stagnant and very low water level therefore was not sampled
SW_017	29.20226292	-26.42099103	Not sampled and not accessed
SW_022	29.20863739	-26.36636563	Sampled and flowing
SW_018	29.23525555	-26.36649089	Not sampled and not accessed
SW_019	29.21747792	-26.34920156	Sampled and flowing
SW_020	29.21321671	-26.34354649	Sampled and flowing
SW_021	29.22059616	-26.33670824	Sampled and flowing
SW_023	29.22629773	-26.32271215	Sampled and flowing

2.1.7 Baseline Water Quality

The surface water quality data (detailed in Table 2-17 below) was benchmarked against the SANS 241 Drinking water standards. The data indicated that the metals concentration for elements Aluminium (Al), Iron (Fe) and Manganese (Mn) exceeded aesthetic water quality levels.

Al levels exceeded the acceptable drinking water quality of 0.5 mg/l for SW_004 and SW_014 with levels at 1.12 and 0.53 mg/l respectively. However for SW_007, Al levels were within acceptable drinking water levels.

The concentration of dissolved aluminium in unpolluted water at neutral pH is 0.005 mg/l or less (DWAF, 1996), this implies that the elevated Al levels could emanate from anthropogenic sources. These sources could be attributed to the pollution (including waste disposal) activities taking place at the town of Kinross and the upstream smaller dams.

Elevated Fe and Mg were however within the acceptable drinking water quality for a maximum exposure period of 70 years for the sites SW_004, SW_007, SW_011, SW_012 and SW_14. These can be characteristic of the area.

The consequence of human consumption of water with elevated Al that exceeds 0.5 mg/l if water intake is 5 % of the total daily intake is that no acute health effects are expected. However, severe aesthetic effects (discolouration) occur in the presence of iron or manganese. The predominant land use in the area is agriculture however; levels of Al in the range 0.1 to 0.5 mg/l in soil solution could result in plant toxicity. However, the interaction of Al and soils (through adsorption) could reduce the potential for plant toxicity. The levels of Al for the water have no adverse effects on any livestock ingesting the water.

The Fe levels (1 to 10 mg/l) have slight health effects expected in young children, and sensitive individuals if consumed over seven years. The levels determined below 0.3 mg/l have slight aesthetic effect whilst those from 0.3 mg/l upwards have increasing adverse effects. The most likely effect from the Fe levels determined is aesthetic (taste and colour). For other domestic uses (washing and bathing) there are no expected effects. For agricultural use (irrigation) there are no effects to plant below 5 mg/l. The toxicity to plants can be expected at 20 mg/l and even then, the interaction of the water and soils tend to reduce toxicity. For livestock watering, Fe is an essential constituent of animal diet and has a low order of toxicity in low concentration of less than 10 mg/l.

The Mn levels in the range of 0.15 to 1.0 have increasingly severe staining and taste problems but present no health effects when used for domestic uses. When utilised for irrigation, elevated Mn levels within the range 0.1 to 1.5 results in moderate problems encountered with clogging of drip irrigation systems whilst effects on plants are highly dependent on the tolerance to Mn by the particular plants. It is also dependant on the particular soil type. Elevated Mn if the water is used for livestock watering is not anticipated to have toxicity effects in the ranges up to 10 mg/l.

The baseline quality indicated that the water is of aesthetic quality in most parameters of water quality with the exception of Al, Mn and Fe (Class II). However in terms of Al, for two of the sample sites water exceeds the acceptable drinking water quality limits.

The water quality is fit for drinking but in small amounts domestic use and agricultural use (irrigation and livestock) as determined from the DWAF water quality guidelines (DWAF, 2006).

2.1.8 Geohydrology

2.1.8.1 Regional Geology

South Africa's coal deposits occur in the Karoo Supergroup, a thick sequence of sedimentary rocks deposited between 300 and 180 million years ago (McCarthy and Pretorius, 2009).

The project area is located within the Highveld Coalfield. The coalfield is underlain by pre-Karoo strata belonging to the Transvaal Supergroup and Bushveld Complex. Glacial events at the beginning of the Permian Period resulted in the deposition of tillite (Dwyka Formation)

on the basement rocks over most of the area. Within the Karoo sedimentary sequence the Ecca Group rest on top of the Dwyka Formation.

The coal seams are found within the Ecca Group. Although rocks of the Ecca Group are widespread around the country, conditions suitable for the formation of coal did not occur everywhere and the coal deposits are restricted, occurring in the main Karoo basin in an arc from Welkom in Free State Province to Nongoma in KwaZulu-Natal, and in several smaller outlying remnants of the Karoo Supergroup (Figure 2-10).

In the Highveld Coalfield, six coal seams (numbered 1 through 6 from the base upwards) are contained in successions comprising dominantly of sandstone with subordinate siltstone, mudstone and shale (Vryheid Formation). Partings between the seams are relatively constant; however, seam splitting is common.

All the coal seams of the Highveld Coalfield are found towards the base of the Ecca Group in the Vryheid Formation. The distribution and attitude of the No. 1 and No. 2 Seams are largely determined by the pre-Karoo topography. Sub-crop positions of all seams are controlled by the present-day erosion surface.

It should be noted that the No. 6 Seam is rarely preserved in the present day strata of the Vryheid Formation. Generally the No. 1, 2, 4 and 5 Seams are considered economic based on seam thickness and quality.

Intrusive dykes and sills, predominately doleritic in composition, are common and devolatilisation of the coal adjacent to the intrusives can be significant.

Please see Plan 5 in Appendix A for an overview of the regional geology.

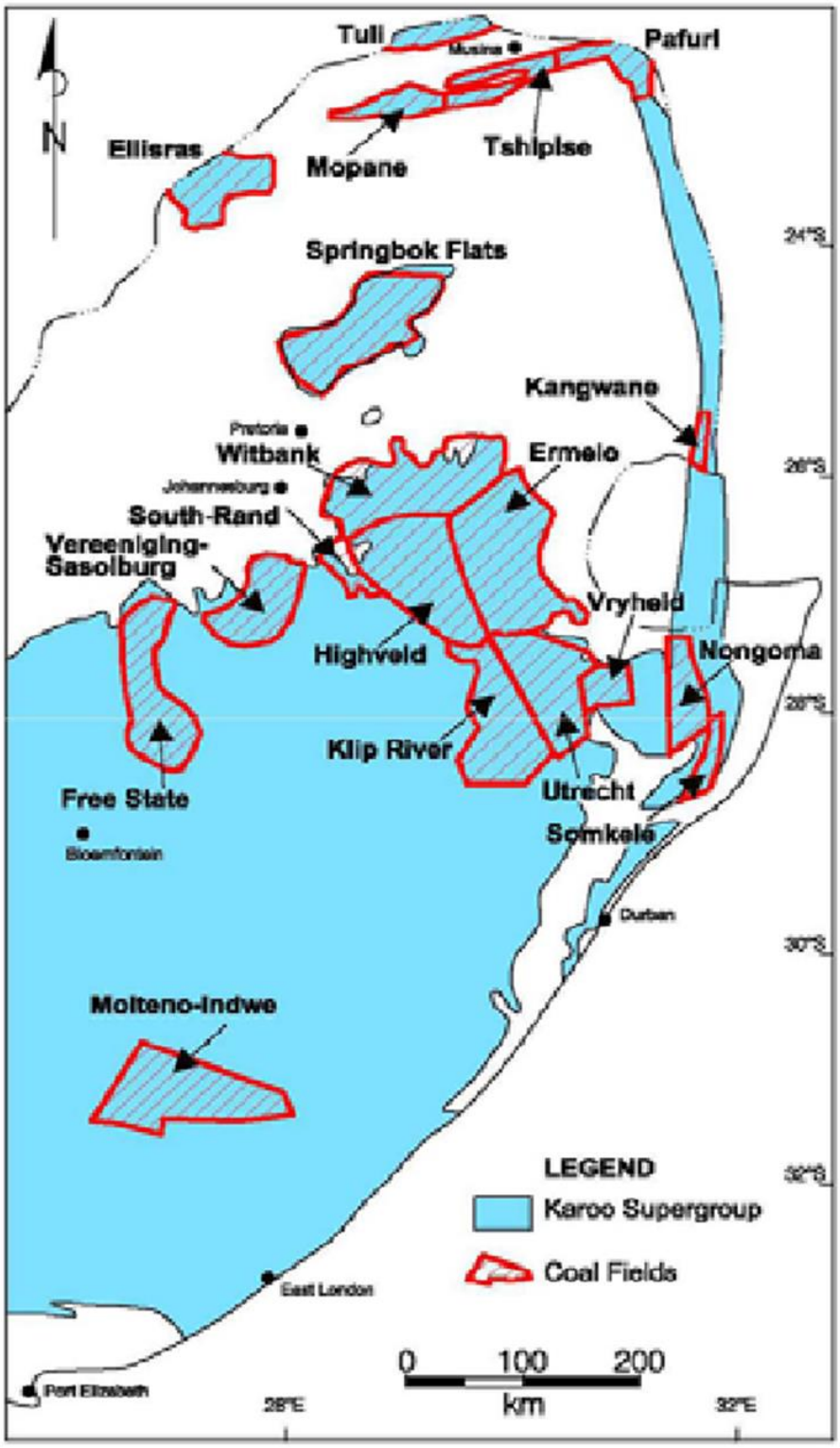

Figure 2-10: Karoo Supergroup and the coalfields regions (McCarthy et al, 2006)

2.1.8.2 Local Geology

Only the No. 4 seam will be mined at the project area, at an average depth of 83m below the surface with an approximate thickness of 4.5 m. The other coal seams are either not fully developed, or are discontinuous in the area. Available geological and geophysical data show that there are numerous sills and dykes at the project area that have resulted in the devolatilisation of parts of the coal seam.

At the existing Syferfontein Mine, the No.4 coal seam floor forms a NNE-SSW coal floor contour high roughly in the middle of the reserve, ranging in elevation between 1520 and 1527 mamsl (Oryx, 2003). From this central high, the coal floor dips towards an elevation of 1500 mamsl at the highwall entrance of the mine workings. The coal floor also dips towards the eastern part of the reserve to a localised low of 1505 mamsl. Another coal floor elevation low can be seen in the most southern part of the study area, dipping to an elevation of 1495 mamsl.

These 3 low-lying areas form distinct compartments in terms of potential water storage during operational phase mining activities. Depending on the direction and sequence of mining, water can be stored in all of these units.

The Karoo sediments were intruded by two phases of post-Karoo dolerite intrusions (Oryx, 2003). The oldest intrusive (commonly known as the B4 sill), is a fine to medium crystalline dolerite sill, mostly restricted to the surface, with a maximum thickness of 48.5 m. This sill is mostly eroded away in the lower lying areas.

In the northern part of the current Syferfontein strip mine area, the B4 is surface bound, with the base being joint-stepped, sloping downwards in a north-westerly direction from surface, transgressing the No.4 coal seam.

The B8 dolerite is a fine grained (porphyritic) dolerite and intruded later than the B4, along semi-planar features. The result is almost vertical intrusives, ranging in thickness from very thin to a maximum of approximately 19 m.

The B8 dolerite sills usually feature near-vertical offshoots (dykes), where they transfer from one horizontal plane to another. These features occur predominantly along the planes of transference. This phenomenon results in extensive geological/ geohydrological compartmentalisation, mainly in the southern parts of the study area.

The prominent east-west striking dyke that cuts through the current Syferfontein Mine has a thickness of up to 15 m.

Displacement of the coal seams caused by dolerite intrusion is seen to range from no displacement, to more or less the thickness of the given coal seam.

The dolerite occurrences in the area have specific significance with regard to the hydrogeology of the study area. Not only can groundwater compartments exist as a result of these features, but the possible groundwater interaction between mines, could also be a function of the dolerite distribution.

Devolitalisation due to the DO8 and DO4 sills is evident. The effect of the DO8 sill extends towards the northeast, while the DO4 sill extends to the west.

2.1.8.3 Groundwater Quality

The groundwater quality results have been compared to the South African National Standards (SANS) 241: 2005 Standards for Drinking Water and have been grouped into Classes in accordance with the above stated standards (See Plan 14 in Appendix A).

According to the SANS 241:2005 standards, water quality have two benchmarks: Class I and Class II:

- Concentrations below the Class I limits are considered of good quality and suitable for human consumption;
- Concentrations between Class I and II are considered as marginal. This is the maximum allowable concentration if consumed for not more than 7 years; and
- Concentrations more than the Class II limits (also referred as Class III) are unacceptable for human consumption.

2.1.8.3.1 Class I

Six of the 14 boreholes sampled are suitable for human consumption. None of the tested parameters exceeded the recommended Class I limits. These boreholes are DPHB1, SPDBH2, VLBBH1, FFNBH7, KFS14 and RTABH2.

Noteworthy is the baseline sulphate levels in all of the boreholes. The recommended sulphate limit (maximum) for drinking is 400 mg/L, but the concentration in the sampled boreholes is currently less than 132 mg/L. Since sulphate is expected to be an element of concern in coal mines, the values obtained during this study can be used as a baseline for future contamination comparisons.

2.1.8.3.2 Class II

Four boreholes (ONVBH3, VLBBH6, ZDFBH1 and VLTBH2) fell within the Class II water quality range.

- Boreholes ONVBH3 and VLBBH6 are within the Class II category due to increased nitrate concentrations (14 and 13 mg/L respectively). The source for these is not fully understood, but is suspected to be due to dissolution from to fertiliser application or animal waste that ended up seeping to the groundwater;
- Borehole ZDFBH1 is in the Class II category due an increased sodium concentration (210 mg/L). The source for this is suspected to be due to fertiliser application or natural dissolution of the host rocks; and

- Borehole VLTBH2 is in the Class II category due to increased iron and manganese concentrations (0.89 and 0.18 mg/L). The source for these is suspected to be due to the natural dissolution of the host rocks.

2.1.8.3.3 Class III

Four boreholes (VLBBH2, VLBBH4, EKNBH2 and LNFBH4) are not recommended for human consumption:

- Boreholes VLBBH2, VLBBH4 and EKNBH2 have fluoride concentrations of 4.4, 3.1 and 5.1 mg/L respectively (the maximum recommended limit is 1.5 mg/L). This is probably due to the natural dissolution of the host rocks, particularly pre-Karoo intrusive rocks; and
- Borehole LNFBH4 has a nitrate concentration of 31 mg/L (the maximum recommended limit is 20 mg/L). The source of this is suspected to be the dissolution of fertilisers or animal waste.

2.1.8.4 Diagnostic Plots

Stiff diagrams (Figure 2-12) were used to characterise the groundwater by analysing the concentration of the major cations (Ca, Mg, Na+K) and anions (SO_4, Cl and HCO_3). In Stiff diagrams, cations are plotted in meq/L on the left side of the zero axis and anions are plotted on the right side. This diagram is useful in making a rapid visual comparison between water of different sources.

The diagram shows that all the samples are enriched in alkalinity and depleted in sulphates. This suggests that no mine-related contamination has taken place, as mine water is typically distinguished by enriched sulphate and depleted alkalinity.

The samples can be classified into two sources based on their cation content: those that are Ca+Mg dominated and those that are Na+K dominated. The Ca+MgHCO_3 type boreholes are typically encountered in recently recharged groundwater. This means that the groundwater does not have significant residence time and is relatively freshly recharged. The NaHCO_3 type water could be a result of mixing of recently recharged water from the weathered aquifer and water of the deep aquifer that are enriched with Na.

The water chemistry is also displayed using a Piper diagram as shown in Figure 2-11. A Piper diagram is used to classify the water type by plotting the ratios of the major cations (Ca, Mg, Na and K) and anions (Cl, SO_4 and HCO_3+CO_3) as two points in tri-linear fields. These two points are then extended into the main diamond-shaped field of the Piper diagram to plot as one point.

The Piper diagram also confirms the results observed in the Stiff diagrams. The dominant anion is HCO_3, while the dominant cations range from Ca+Mg to Na+K and are suspected to be results of ion exchanges between water of higher residence time and those that are recently recharged. No mine-related impacts are evident in the samples.

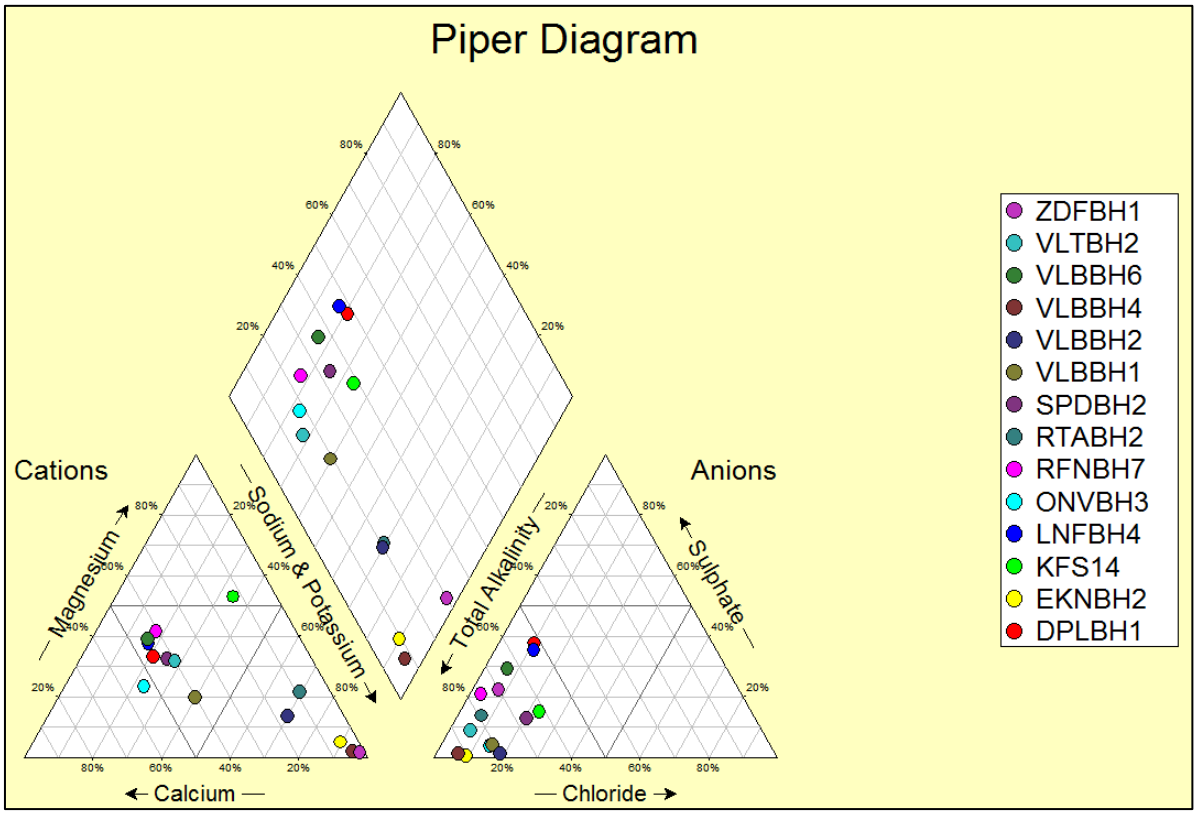

Figure 2-11: Piper diagram of the baseline water chemistry

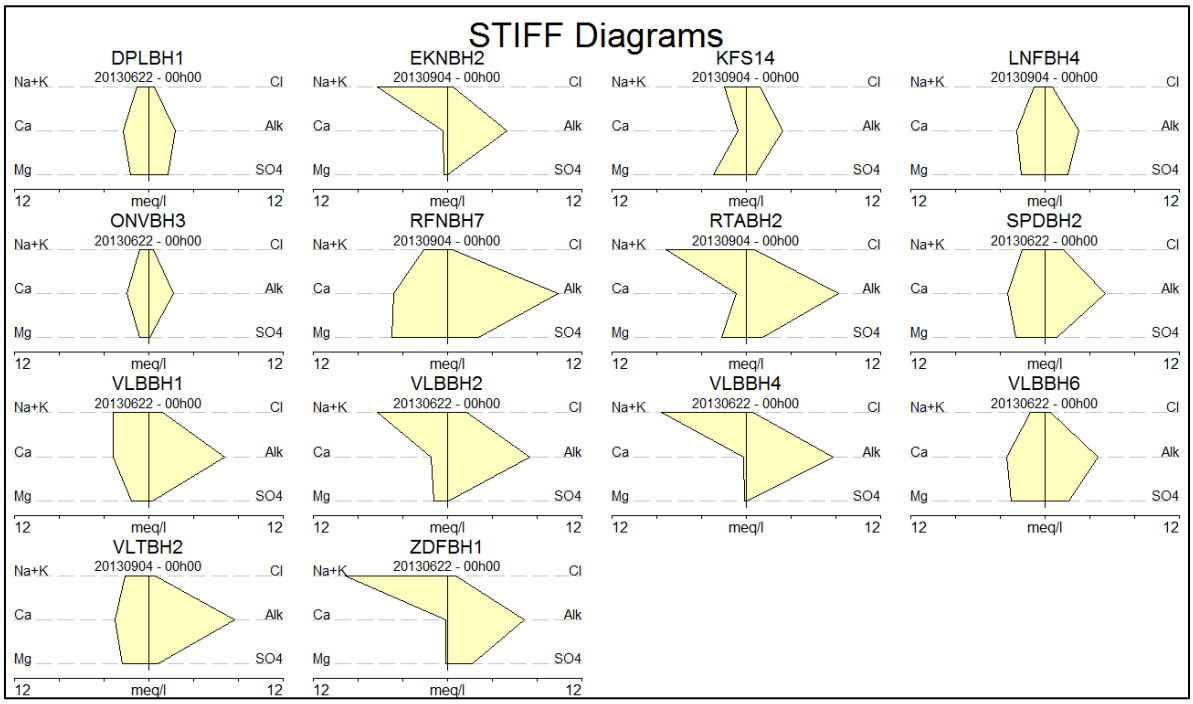

Figure 2-12: Stiff diagram of the baseline water chemistry

		Total Dissolved Solids	Nitrate NO_3 as N	Chlorides as Cl	Total Alkalinity as $CaCO_3$	Sulphate as SO_4	Calcium as Ca	Magnesium as Mg	Sodium as Na	Potassium as K	Iron as Fe	Manganese as Mn	Conductivity at 25° C in mS/m	pH-Value at 25° C	Aluminium as Al	Free and Saline Ammonia as N	Fluoride as F
Class I	(Recommended)	<1000	<10	<200	N/S	<400	<150	<70	<200	<50	<0.2	<0.1	<150	5-9.5	<0.3	<1	<1
Class II	(Max. Allowable)	1000-2400	10-20	200-600	N/S	400-600	150-300	70-100	200-400	50-100	0.2-2	0.1-1	150-370	4-5 or 9.5-10	0.3-0.5	1-2	1-1.5
	Duration	7 years	7 years	7 years	N/S	7 years	7 years	7 years	7 years	7 years	7 years	7 years	7 years	No Limit	1 year	None	1 year
Class III	(Not recommended)	>2400	>20	>600	N/S	>600	>300	>100	>400	>100	>2	>1	>370	<4 or >10	>0.5	>2	>1.5
DPHB1	2013/06/22	318.00	6.00	17.00	120.00	84.00	45.60	20.10	19.80	7.62	-0.03	-0.03	49.00	8.00	-0.10	-0.20	0.30
ONVBH3	2013/06/22	242.00	14.00	14.00	112.00	5.00	38.40	10.20	17.00	3.77	-0.03	-0.03	36.60	8.10	-0.10	0.40	-0.20
SPDBH2	2013/06/22	404.00	0.40	59.00	268.00	50.00	66.90	31.20	44.80	3.13	0.03	0.03	70.80	8.20	-0.10	0.40	0.40
VLBBH1	2013/06/22	430.00	0.40	45.00	340.00	17.00	64.10	19.00	72.40	1.35	0.03	-0.03	72.50	8.20	-0.10	0.20	0.60
VLBBH2	2013/06/22	494.00	0.40	61.00	368.00	-5.00	29.50	14.80	143.00	1.82	-0.03	0.04	82.00	8.40	-0.10	0.40	4.40
VLBBH4	2013/06/22	446.00	-0.20	20.00	388.00	-5.00	5.50	1.92	174.00	1.49	0.05	-0.03	74.10	8.30	-0.10	0.70	3.10
VLBBH6	2013/06/22	496.00	13.00	18.00	236.00	103.00	68.70	36.70	26.30	5.23	-0.03	-0.03	73.10	8.30	-0.10	0.30	-0.20
ZDFBH1	2013/06/22	588.00	1.60	27.00	344.00	106.00	2.55	-2.00	210.00	-1.00	0.03	-0.03	88.00	8.40	-0.10	0.50	0.40
EKNBH2	2013/09/04	390.00	-0.10	19.00	277.00	1.40	7.40	4.30	143.00	2.50	0.02	0.00	64.80	8.50	0.00	0.60	5.10
FFNBH7	2013/09/04	608.00	4.40	15.10	406.00	132.00	97.00	60.00	48.00	0.80	0.01	0.00	96.10	8.00	0.02	-0.10	0.30
KFS14	2013/09/04	276.00	0.70	44.00	167.00	39.00	14.10	36.00	43.00	2.00	0.05	0.01	52.60	8.50	0.00	0.10	0.10
LNFBH4	2013/09/04	362.00	31.00	23.00	124.00	97.00	51.00	26.00	20.00	4.80	0.02	0.01	53.40	7.50	0.00	0.10	-0.10
RTABH2	2013/09/04	540.00	2.50	26.00	406.00	69.00	18.70	27.00	164.00	2.10	0.03	0.00	90.70	8.40	0.02	-0.10	0.30
VLTBH2	2013/09/04	500.00	-0.10	20.00	315.00	39.00	60.00	29.00	39.00	15.60	0.89	0.18	72.10	7.40	0.01	-0.10	0.30
Note: "-" values should be read as "<" (e.g. "-1" = "<1")																	

Table 2-17: Baseline water quality as classified based on the SANS 241: 2005

2.1.8.5 Numerical Model

Following the characterisation of the aquifer, contaminant source and groundwater receptors, the conceptual model was transformed into a numerical model so that the groundwater flow conditions and mass transport can be solved numerically. A conceptual model is a simplified, but representative description of the groundwater system that illustrates the interaction of the sources, pathways and receptors at the site.

- The sources represent any entity that contributes to the groundwater quantity and/or quality;
- The pathways are the aquifers through which the groundwater and contaminants migrate; and
- The receptors are humans, rivers or natural ecosystems that depend on the groundwater and will be impacted negatively if the water is depleted by dewatering or is contaminated.

As illustrated in Figure 2-13, an environmental risk exists only if the three components of a conceptual model (source, pathway and receptor) are linked.

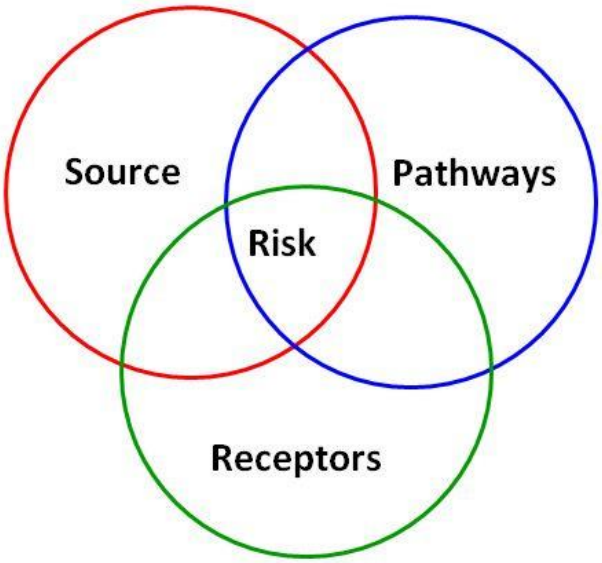

Figure 2-13: A conceptual model based environmental risk

2.1.8.5.1 Aquifer Layers

The groundwater systems in the Mpumalanga coalfields have been discussed extensively by Hodgson et al (1998) and Grobbelaar et al (2004). Three distinct superimposed groundwater systems are present. They are the upper weathered Ecca aquifer, the fractured aquifers within the unweathered Ecca sediments and the aquifer below the Ecca sediments.

The following aquifer description extracted from the previously stated references and field investigations conducted during this study is relevant to Syferfontein. Each aquifer layer has been incorporated in the groundwater model.

The weathered aquifer

The Ecca sediments are weathered to depths between 5 and 12 m below surface throughout the area. The upper aquifer is associated with this weathered zone and water is often found within a few metres below surface. This aquifer is recharged by rainfall. The percentage recharge to this aquifer is estimated to be in the order of 1 to 3% of the annual rainfall, based on work in other parts of the country by Kirchner et al. (1991) and Bredenkamp (1995).

It should, however, be emphasised that in a weathered system, such as the Ecca sediments, highly variable recharge values can be found from one area to the next. This is attributed to the composition of the weathered sediments, which range from coarse-grained sand to fine clay.

Based on the hydrogeological information obtained from the boreholes drilled at Syferfontein, the thickness of the weathered zone was approximated to 12 m. The numerical model was calibrated at a recharge of 1% of the mean annual precipitation (which his approximately 680 mm), and weathered aquifer permeability of 0.07 mg/d.

Fractured Ecca Aquifer

The pores within the Ecca sediments are well-cemented and do not allow any significant flow of water. All groundwater movement therefore occurs along secondary structures, such as fractures and joints in the sediments. These structures are better developed in competent rocks, such as sandstone, hence the better water-yielding properties of the latter rock type.

It should, however, be emphasised that not all secondary structures are water bearing. Many of these structures are constricted because of compressional forces that act within the earth's crust.

Based on aquifer test results at Syferfontein, the hydraulic permeability of this aquifer has been approximated at 0.01 m/d.

Coal Seam Aquifer

Hodgson et al (1998) states that of all the unweathered sediments in the Ecca, the coal seams often have the highest hydraulic conductivity. Since the aquifer permeability and storativity of the seam will also be enhanced by mine excavation, it has been simulated as a separate aquifer with an approximate permeability of 0.1 m/d. This permeability is in the same order of magnitude estimated for the coal seams by Hodgson et al. (1998). A recharge of 3% has been applied to the mined portion of the aquifer. Considering the mining method being a bord-and-pillar, an extraction factor of 40% has been assigned to the mined out section of the coal seam.

2.1.8.5.2 Model Domain

The model domain has dimensions of 33.9 km by 31.3 km. A rectangular mesh was generated over the model domain, consisting of 626 rows and 678 columns. The mesh was refined in the entire model domain to cell sizes of 50 by 50 m. Although a smaller grid size may result in prolonged running time, it was important to refine the model so that the groundwater gradient and pollution plumes can be calculated with accuracy.

Considering the frequency of the water strike distribution and the coal seam layer to be mined, three aquifer layers have been simulated. These are the top 90 m aquifer where all the water strikes were encountered followed by the less permeable fresh rocks underneath. Since this will be a separate aquifer once the mining starts and voids are formed, it has also been simulated as a separate layer in the model.

The model domain is defined by surface water sheds and sub-catchments. A no-flow boundary has been used along water divides and a drain-package along stream channels.

2.1.8.5.3 Steady State Simulation

Prior to the simulation of the mining and dewatering activities, a baseline (pre-mining) steady state groundwater flow model was set-up and calibrated. The objective of the steady state model was to simulate the undisturbed groundwater system in the region prior to mining. The impacts of mining activities on the groundwater environment can then be determined by comparing the transient state results with the steady state results.

Digby Wells compiled all the hydrocensus water levels and quality data into a centralised MS Excel database, in a WISH (Windows Interpretation System for Hydrogeologists) format. Historical water levels were obtained from the client and added to the WISH database to produce time-series water levels.

The model was calibrated by varying model input data until a realistic, but satisfactory match between simulated and observed water level data was achieved.

Since recharge and permeability are dependent on each other, via the measured heads, the model was not calibrated by changing the permeability and recharge simultaneously. The permeability was calibrated based on the aquifer test data while the recharge value was adjusted using the automatic parameter estimation programme - PEST.

The PCG2 package is used to solve the partial differential equations. Convergence criteria of a residual flux of 10^{-3} m^3/day and a head change of 10^{-3} m were selected.

A total of 44 observation boreholes were used for the steady state model calibration. Where more than one water level measurement was available, either the mean or one of the values was used. These boreholes are relatively uniformly distributed across the model domain.

After model calibration, an acceptable correlation of 93.7% was obtained between the simulated and observed groundwater elevation (Figure 2-14). An absolute mean error of 3.7 m for the model calibration was considered to be sufficiently small, given that the observed

maximum head difference over the model domain area was 69.4 m and that the number of unknown input parameters was kept small.

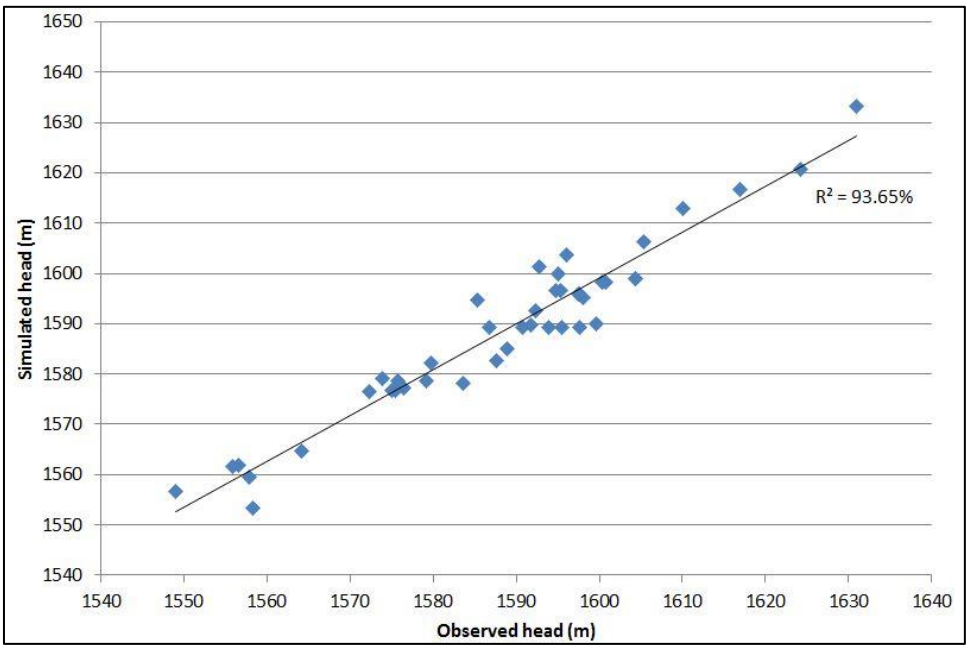

Figure 2-14: Correlation between observed and simulated head

2.1.8.5.4 Transient State Simulation

2.1.8.5.5 Flow Model

The impacts of mining activities are assessed in a transient model with different stress periods over time to simulate changes related to model parameters with time.

During the model setup, the steady state model is converted into a transient model. This stage entails selecting the appropriate time-dependent parameters such as artificial recharge (if any) and mine dewatering. The geometry of the model domain, boundaries, top and bottom of the layers, mesh size, layer type and natural recharge remain as defined in the steady state model. The solution of the calibrated steady-state model was used as initial hydraulic head distribution of the transient model.

After the completion of the transient state model setup, the mine plan was incorporated into the model. This was done to estimate the groundwater inflow rates and also predict the potential cone of dewatering and environmental impacts associated with the mine plan.

2.1.8.5.6 Mass Simulation Transport

In most cases, contaminant transport is driven by advection, i.e. groundwater flow is the main mechanism controlling the movement of solutes in groundwater. Advection implies that contaminants migrate at a rate similar to the groundwater flow velocity and in the same direction as the hydraulic gradient. Therefore, knowledge of groundwater flow patterns and

hydraulic parameters can be used to predict solute transport under advection. Other parameters to consider include dispersion, diffusion, effective porosity and the specific yield.

2.1.8.5.7 Dispersion and Diffusion

Dispersion of contaminants in groundwater is also important in terms of contaminant transport. Dispersive transport is caused by the tortuous nature of pores or fracture openings that result in variable flow velocity distributions within an aquifer and movement of contaminants due to the difference in concentration gradient.

Dispersion has two components; longitudinal and transversal dispersivities. The longitudinal dispersivity is scale dependent and is usually approximately 10% of the travel distance of the plume (Fetter, 1993). The transversal dispersivity is approximately 10% of the longitudinal dispersivity. The higher the dispersivity, the smaller the maximum concentration of the contaminant, as dispersion causes a spreading of the plume over a larger area.

Considering the coal seam depths and streams, a longitudinal dispersivity of 5 m is estimated. A diffusion coefficient of $1x10^{-5}$ m^2/day was selected, acceptable for Karoo sedimentary rocks (Gebrekristos et al, 2008).

2.1.8.5.8 Effective Porosity and Specific Yield

The percentage of void volume that contributes to groundwater flow is expressed by the term “porosity”. Not all pores are interconnected and therefore cannot contribute equally to groundwater flow, leading to the derivation of the term “effective porosity”, used to express the interconnected void volume that effectively contributes to groundwater flow and therefore contaminant transport. The higher the effective porosity, the slower the contamination migration rate, because more pore voids have to be filled. The specific yield of a unit volume aquifer is the quantity of water that can be released or drained as a result of gravity. This implies that the specific yield is either equal or less than the effective porosity.

The extraction factor of the coal seam was assumed to be 40%, while the porosity of the unmined portion of the aquifer was assumed to be 10%; acceptable for Karoo rocks (Van der Voort, 2001). A specific yield of 0.08 and storativity of 10^{-3} was applied across the entire model domain based on transient state model calibration.

2.1.8.5.9 Selection of the Contaminant of Concern

The potential contamination plumes from the project area have been simulated using a relative concentration of 100% at the sources. If for example the concentration of sulphate or total dissolved solids from the underground workings is 10 mg/L, a contour value of 50% indicates a concentration value of 5 mg/L, and a contour value of 10% indicates that a concentration value of 1 mg/L. A constant input concentration of 100% is therefore assumed from the beginning of operation. As per the DWA’s best practice for impact prediction, the plume simulation has been conducted for up to 100 years after mine closure.

2.1.8.5.10 Sensitivity Analysis

The sensitivity of the model to the various hydraulic parameters was evaluated to quantify the uncertainty in the calibrated model caused by input parameters. Input parameters (horizontal permeability, vertical permeability, recharge, specific storage and specific yield) were varied within a factor of 0.5 and 2 of the calibrated value and the corresponding change of the groundwater inflow rate was measured. Figure 2-15 presents the result of the sensitivity analyses for the various hydraulic parameters. The model is slightly more sensitive to the vertical permeability (hydraulic conductivity) followed equally by all the other parameters. This means that changes in the vertical permeability will have slightly more impact on the model output than the other less sensitive parameters.

Since the model is more sensitive to the vertical permeability, any future groundwater study is recommended to focus on and refine this parameter.

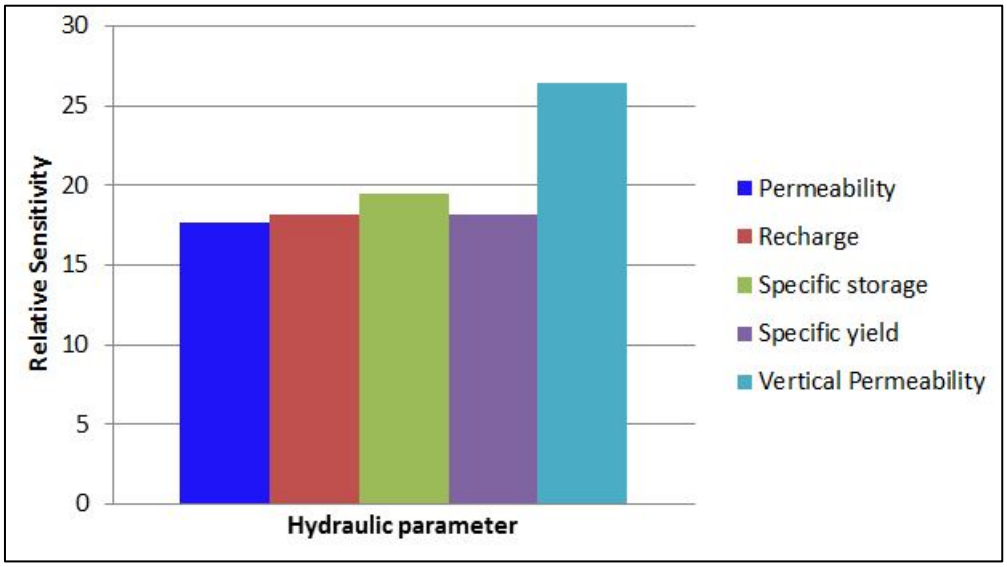

Figure 2-15: Model sensitivity to the hydraulic parameters

2.1.8.6 Current Groundwater Use

A total of 66 boreholes were recorded during hydrocensus. Of this:

- 15 are used for drinking only;
- 6 are used for drinking and livestock watering;
- 5 are used for livestock watering only;
- 1 is used for game watering;
- 1 is used for drinking and game watering;
- 1 is used for drinking, livestock and game purposes;
- 10 are used for groundwater monitoring by the existing Syferfontein mine;
- 22 are boreholes of unknown use; and

- The remaining 5 are unused.

2.1.9 Wetlands

The proposed project area falls within the quaternary catchment B11D. The catchment belongs to the Upper Olifants River Management area and the greater catchment has been allocated a Low to Marginal status due to the impacts from surrounding mining activities and water contamination in particular. The wetland areas on site are regarded as 'not required' according to the Mpumalanga CB-Plan, which implies that they are not necessary for meeting the requirements of MBC-plan. Although small areas of seepage wetland were allocated a rank of two by NFEPA, indicating that they are considered as important for the maintenance of biodiversity, the majority of the wetlands on site were ranked six (which includes all 'other' wetlands not highlighted for their national importance). This may be attributable to the extensive crop farming in the study region, in proximity to and within wetlands, which reduces their value to society and for biodiversity. Based on the presence of seepage wetlands on site as well as valley bottom and pans systems, it can be deduced that the wetlands are linked to both surface and groundwater sources. This is typical of wetlands that occur across the landscape in Mpumalanga Province.

According to the existing desktop information, the majority of wetlands within the proposed project area can be classified as Channelled Valley Bottom wetlands linked to streams associated with the Dwars-in-die-wegspruit; Grootspruit; Trichardspruit and Vaalbankspruit. In addition, the wetlands in the proposed project area belong to un-channelled valley bottom, hillslope seep, floodplain wetlands, artificial wetlands and pan units. Point bar deposits and the formation of ox-bow lakes were recorded to occur in floodplain wetlands on site. These features are characteristic of floodplains. The HGM units for the various wetland classifications mentioned above are detailed in Table 2-18 below.

Table 2-18: Classification of wetlands into HGM units

HGM Unit	Area	% of total wetland area
Hillslope Seep	129.16	15
Pan / Depression	4.75	0.5
Artificial Wetland	52.31	6
Channeled Valley Bottom	511.76	58
Unchanneled Valley Bottom	31.67	4
Floodplain	156.48	17
Total	**881.38**	**100**

The Index of Habitat Integrity (IHI) assessment indicated that the majority of wetlands found within the proposed project area are expected to fall within the modified Present Ecological State (PES) category of 'C'. The major contributor to reduced ecological integrity is the construction of dams. Small dams occur throughout the proposed Project area and as a consequence, have resulted in the shortening of natural channels and promote the onset of

erosion processes. This is particularly the case for wetlands associated with the Vaalbankspruit complex, where dams were frequent and up to 2m high. This can also result in the trapping of sediments within the dams. Sediment trapped in dams is critical for the maintenance of habitats and physical processes downstream. Furthermore, when the sediment load downstream is not replenished, erosional processes are promoted and the stream or river may become deeply incised. Plan 9 illustrating the Wetland PES is attached in Appendix A of this document. The PES rating for the wetland complexes on the site are included in Table 2-19 below.

Table 2-19: PES for wetland complexes on site

Wetland Complex	Module	Health Score	PES Class
Vaalbankspruit wetlands	*Hydrology*	6.5	E↓↓
	Geomorphology	4.3	D→
	Vegetation	5.5	D↓↓
	Overall Score	5.6	D↓↓
Trichardspruit and Dwars-in-die-wegspruit	*Hydrology*	6	E↓
	Geomorphology	2	C↓
	Vegetation	2.3	C↓
	Overall Score	3.8	C↓
Pan / Depressions	*Hydrology*	6	E↓
	Geomorphology	2	C↓
	Vegetation	2.3	C↓
	Overall Score	3.8	C↓

2.1.10 Aquatic Environment

2.1.10.1 Ecological management classifications

In spite of the fact that the Block IV and greater project expansion areas are associated with two quaternary catchments, namely B11C and B11D, the aquatic systems which we assessed for the project are situated within the quaternary catchment B11D. As a result of this, the desktop assessment primarily focussed on the quaternary catchment B11D. The ecological and management categories for the quaternary catchment are detailed in Table 2-20 below.

Table 2-20: The ecological and management categories for the quaternary catchment B20E (Kleynhans, 2000)

Category	Description	State
EISC	Ecological importance and sensitivity category	Low / Marginal
DEMC	Default ecological management class	Class D: Resilient systems
RESC	Present ecological status category	Class D: Largely Modified
AEMC	Attainable ecological management class	Class C: Moderately modified

The ecological importance and sensitivity of the affected quaternary catchment is low/marginal in the quaternary catchment B11D (Kleynhans, 2000). The default ecological management class of the quaternary is Class D, suggesting that the local watercourses are resilient systems. The present ecological status category for the affected catchment is Class D (Largely Modified) and according to Kleynhans (2000), the attainable ecological management class is Class C (Moderately modified). The PES rating for aquatic systems is illustrated in Plan 10 in Appendix A of this document.

2.1.10.2 National Freshwater Ecological Priority Area programme

Based on the National Freshwater Ecological Priority Areas (NFEPA) programme for Mpumalanga Aquatic Biodiversity sub-catchments (Driver et al., 2011), the aquatic biodiversity of the quaternary catchment B11D is not associated with any areas which have been classified as priority areas. The project area is on a catchment divide and is adjacent to the quaternary catchment C12D which has catchment areas classified by the NFEPA programme as river FEPAs and Upstream Management Areas. These Upstream Management Areas were identified in moderately modified rivers (Class C), only in cases where it was not possible to meet biodiversity targets for river ecosystems in rivers that were still in good condition (Class A or B). The river condition of these areas should not be degraded further, as they may in future be considered for rehabilitation once FEPAs in good

condition are considered fully rehabilitated and well managed. A plan showing the NFEPA wetlands for the Project area and the properties in proximity can be found as Plan 12 in Appendix A.

2.1.10.3 The Mpumalanga Biodiversity Conservation Plan

The Mpumalanga Biodiversity Conservation Plan (MBCP) identifies healthy sub-catchments using a combination of PESC (Kleynhans, 2000) and loss of natural habitat in each subcatchment. The greater project area is classified as “Not Required” according to the MBCP. According to Ferrar & Lötter (2007), “Not Required” refers to areas with no natural habitat remaining, and as a result, these transformed areas that make no contribution to meeting targets.

2.1.11 Soils

2.1.11.1 Dominant soil forms contained in Land Type Ea20

According to the Land Type Survey Staff (2006) the land type in the proposed Project area is dominated by dark well-structured clay soils namely:

- The Arcadia (Ar);
- The Swartland (Sw);
- The Mayo (My);
- The Valsrivier (Va); and
- The Mispah (Ms).

These soils will be described in more detail below.

2.1.11.2 Arcadia (Ar)

The Arcadia soil form consists of a Vertic A overlying an unspecified material which is usually a hard rock or saprolite horizon. The Vertic A consists predominantly of 2:1 clays. They shrink in dry conditions and swell when wetter conditions occur.

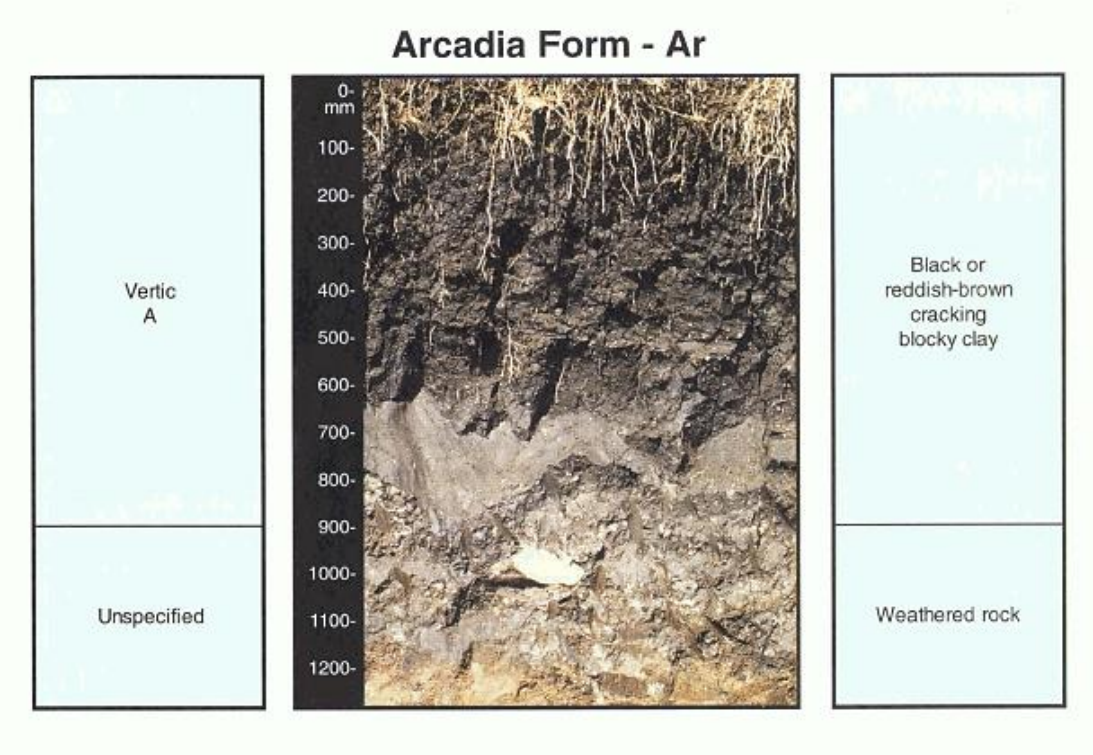

Figure 2-16: A typical cross section of the Arcadia Soil Form (Soil Classification Working Group, 1991)

2.1.11.3 Swartland (Sw)

The Swartland soil form consists of Orthic A and Pedocutanic B, on Saprolite. These soils have a strongly structured B horizon which impede root and water penetration; therefor the effective crop rooting depth is generally limited to the A horizon. These soils are also highly erodible due to the dispersive nature of the B horizon. Once the A horizon has been removed by erosion the subsoil will erode rapidly and large gullies will be formed.

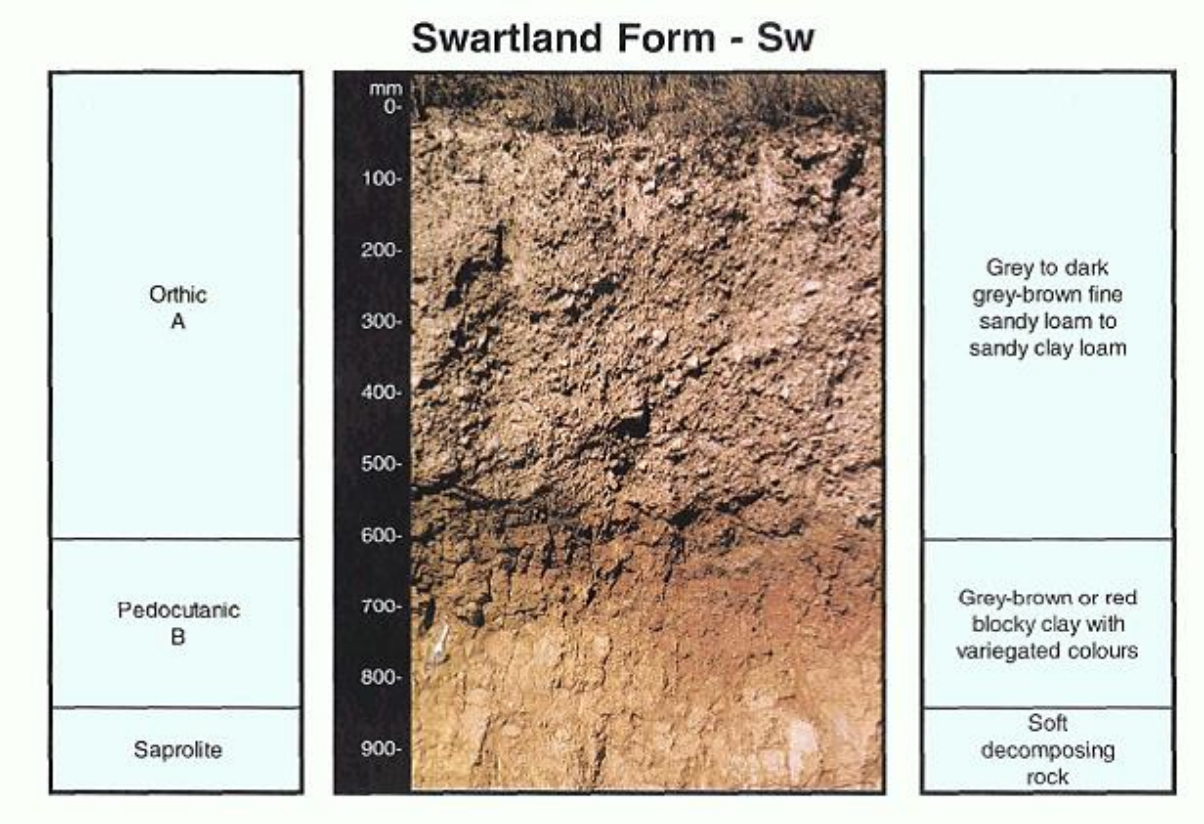

Figure 2-17: A typical cross section of the Swartland Soil Form (Soil Classification Working Group, 1991)

2.1.11.4 Mayo (My)

The Mayo soil form consists of a Melanic A horizon. However, the subsoil's are Lithocutanic (weathering rock). The Melanic horizon is very fertile and if there is sufficient depth these soils can be very productive under the correct management practises.

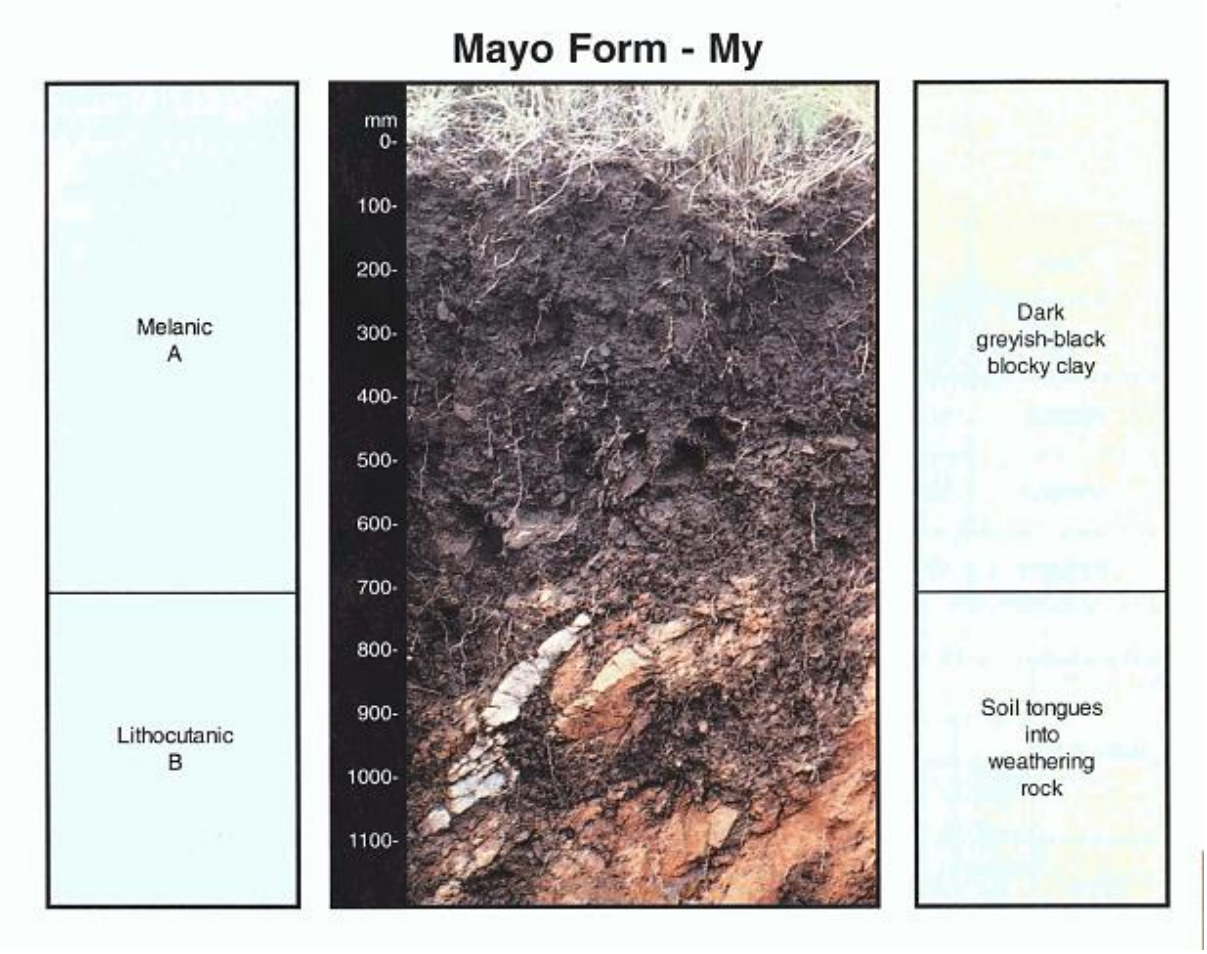

Figure 2-18: A typical cross section of the Mayo Soil Form (Soil Classification Working Group, 1991)

2.1.11.5 Valsrivier (Va)

The Valsrivier soil form consists of Orthic A and Pedocutanic B, on unconsolidated material without signs of wetness. These soils have a strongly structured B horizon which impede root and water penetration; therefor the effective crop rooting depth is generally limited to the A horizon. These soils are also highly erodible due to the dispersive nature of the B horizons. Once the A horizon has been removed by erosion the subsoil will erode rapidly and large gullies will be formed.

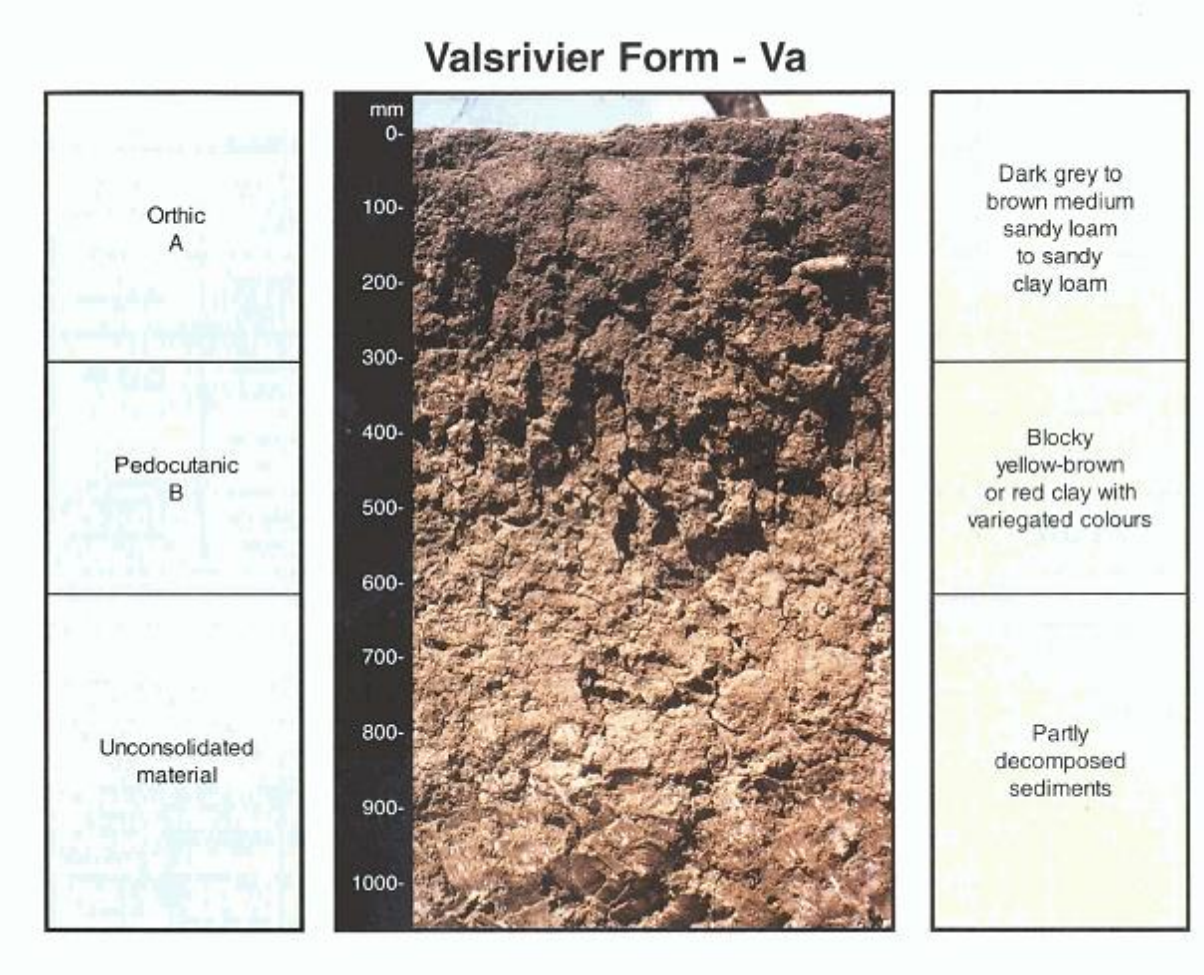

Figure 2-19: A typical cross section of the Valsrivier Soil Form (Soil Classification Working Group, 1991)

2.1.11.6 Dominant soil forms contained in Land Type Bb4

This Land Type is dominated by red and yellow apedal soils namely:

- The Avalon (Av); and
- The Hutton (Hu).

These soils are described in more detail below.

The Bb4 Land Type has shallow slopes of between 1% and 5 % and the effective rooting depths of these soils are all greater than 800mm with the exception of the Mispah soils, as these are shallow rocky soils (see Plan 8 in Appendix A). The clay contents of these soils range between 15% and 30% making them ideal for agricultural purposes. The dominant land capability of these soils is a Class II soil which is of good agricultural potential.

2.1.11.7 Avalon (Av)

The Avalon soil form consists of an Orthic A horizon, a Yellow brown apedal B horizon, and a soft plinthic C horizon. The A and B horizons have good internal drainage properties, therefor water can move freely through them. However the Plinthic C shows signs of mottling and localization of iron and manganese concretions as a result of a fluctuating water table. Anaerobic conditions occur in this zone and iron and manganese reduce and then later when the water table drops oxidizes into localized concretions.

These soils are highly sought after for dry land crop production as they can produce good crop yields due to the ability of the A and B horizons to drain freely. It has the propensity to hold water in the lower part of the profile where the water can then be tapped at a later stage during the growing season by the roots.

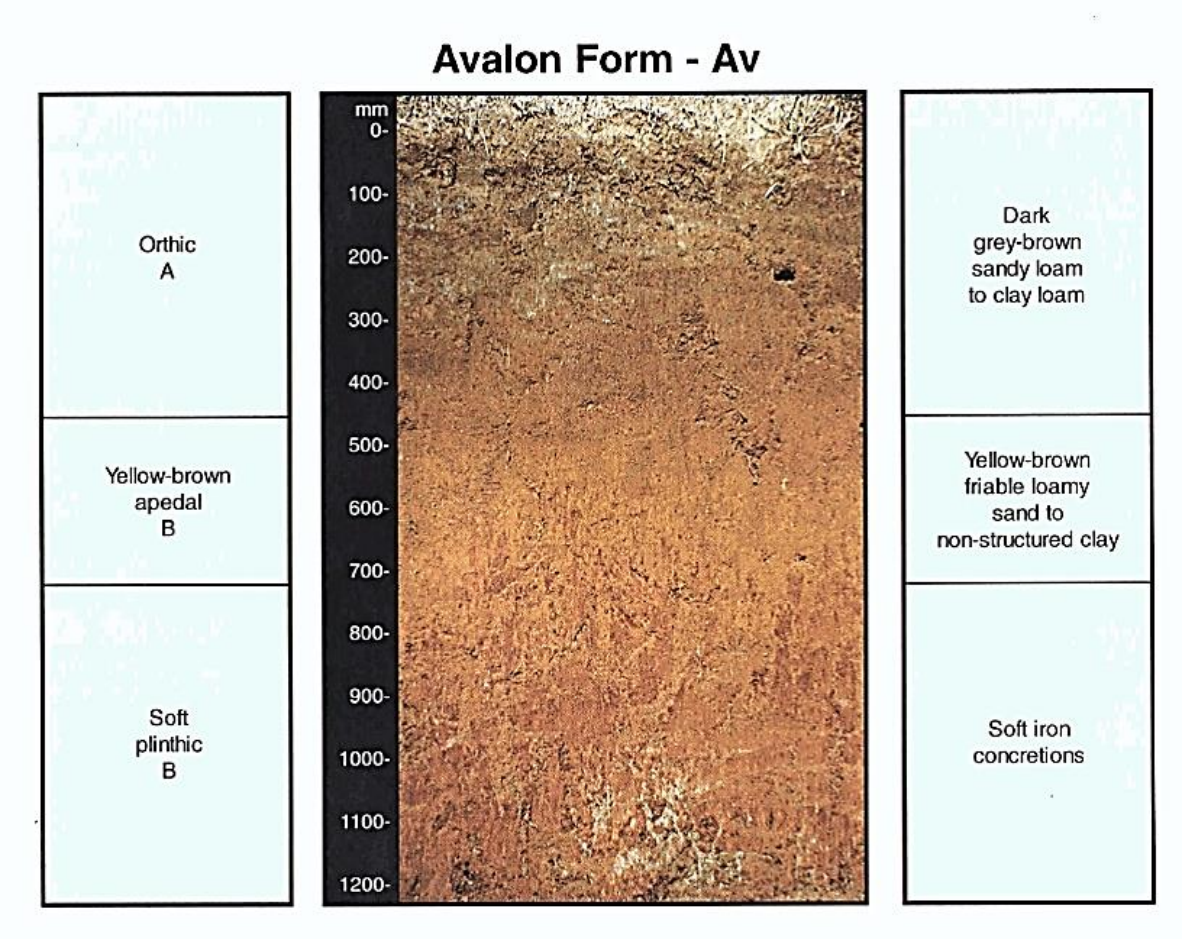

Figure 2-20: A typical cross section of the Avalon Soil Form (Soil Classification Working Group, 1991)

2.1.11.8 Hutton (Hu)

The Hutton soil form consists of an Orthic A, Red apedal B, and an unspecified C horizon which could be hard rock, saprolite, or unknown as no limiting layer was identified. These soils are freely drained and as a result, can be slightly acidic due to the low cation exchange capacity (CEC) and thus the low base status. These soils are prime soils for irrigated crop production; however they are marginal to good in dry land conditions.

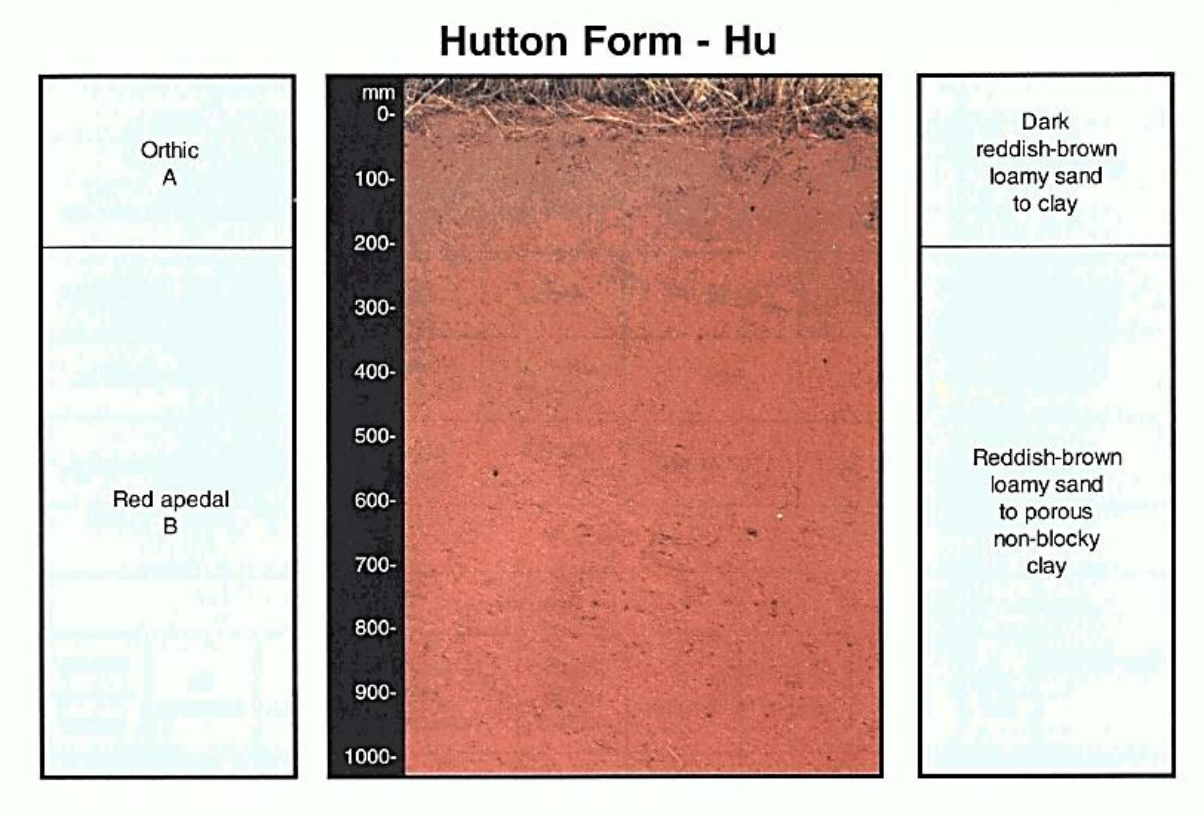

Figure 2-21: shows a typical cross section of the Hutton Soil Form (Soil Classification Working Group, 1991)

2.1.11.9 Fertility

The proposed project area can be divided into two fertility zones. Fertility is largely based on the cation exchange capacity of the soil, as well as the type of top soil.

The Bb4 land type generally has a clay percentage between 15% and 30% which will have a low CEC. These soils will have naturally low fertility as they acidify naturally, either by rain or by vegetative removal of bases.

The Ea20 land type has a high CEC due to the increased clay content in the topsoil horizons. These top soils are also derived from base rich parent material and thus the natural fertility of these land types should be higher than that of Bb4 (see Plan 8 in Appendix A).

2.2 Description of each of the existing environmental aspects may require protection or remediation

The aspect most at risk of impact, requiring protection and management, is the groundwater and surface water environment due to the undermining activity. Please refer to Section 2.1.8 for a detailed description of the groundwater system.

2.3 Description of the specific land uses, cultural and heritage aspects and infrastructure on the site and neighbouring properties/farms

2.3.1 Cultural Environment

2.3.1.1 District Overview

As the largest district in Mpumalanga Province, Gert Sibande District Municipality (GSDM) has deep rural pockets where communities have challenges in accessing health services. Rural communities within the primary study area only have access to central clinics in the surrounding towns, which is often short staffed, and lack supplies. The percentage of residents with medical aid in the district is about 14% (Day, 2012). Within the GMLM, the primary clinic within Kinross (Thistle Grove Clinic) is also already exceeding its capacity to deliver health services. The nearest hospital to the primary study area is situated in Evander.

The TB cure rate for 2010 was 64% in GSDM and well below both the provincial (73%) and the national (73%) averages. The TB defaulter rate dropped from 11% in 2009 to 9% in 2010. The TB two-month smear conversion rate increased from 54% to 72% between 2010 and 2011 (Massyn et al, 2011).

Mpumalanga is one of the three provinces with the highest infection rates of HIV/AIDS. GSDM has been identified as one of the most affected areas in the country. Amongst the three district municipalities of Mpumalanga, GSDM has the highest HIV/AIDS prevalence rate at 46%, which shows an increase of 7% since 2010 (GSDM, IDP 2012/13).

The antenatal client HIV/AIDS prevalence rate in GMLM was 44% in 2010. The rate of antenatal clients initiated on Highly Active Antiretroviral Therapy (HAART) of 60% is significantly lower than the national average of 80% and ranks the district fifth lowest in the country. The rate of HIV-positive infant under 18 months initiated on HAART was 49% in 2011/12 (Massyn et al, 2011).

The hypertension detection rate was 0.4% for the second year in a row and slightly above the provincial and national averages of 0.3%. Mental health case load comprised 0.9% of the total case load, which is below the national average of 1.4% (Massyn et al, 2011).

Immunisation coverage under 1 year has varied over the last five years, but increased by 4.4 percentage points from 2010/11 to 84% in 2011/12 – the highest coverage in the province.

The diarrhoeal incidence under five years decreased consistently from 74 per 1 000 children in 2007/08 to 35 in 2011/12, the second lowest incidence in the country. The mortality rate among children under 5 years, due to diarrhoea with dehydration, was 6% (Massyn et al, 2011).

The stillbirth rate decreased consistently from 28 per 1 000 births in 2007/08 to 23 in 2011/12 and is lower than the province average of 24. The early neonatal death rate was 11 per 1 000 live births, close to the national average of 10 per 1 000 live births. The under-1 and the under-5 facility mortality rates decreased between 2010/11 and 2011/12 to 9% and 5% respectively, but are both still above their respective national averages (Massyn et al, 2011).

2.3.1.2 Population demographics

The population of the GSDM and GMLM is roughly 1 044 000 and 295 000 respectively (StatsSA, 2012). According to the GSDM IDP 2012-2015, the district has the smallest population size in Mpumalanga. Of the seven local municipalities in the district, GMLM has the largest population, calculated at approximately a third of the district population in 2011. With towns like Kinross, Secunda, Evander and Leandra offering more job opportunities than other towns in Mpumalanga, it seems that migration to urban areas is driven by the hope of employment.

More than half of the district's population (57%) resides in urban areas, such as Embalenhle. It is estimated that 53% of the Black population is urbanised, while only 12% of the White population, 17% of the Coloured population and 5% for the Asian population reside in non-urban areas (GSDM IDP 2012-2015). The SDF reiterates that rapid urbanisation within the Govan Mbeki Municipality increases the demand for land for urban development. The largest proportion of the GMLM population resides in Embalenhle (36%), followed by the eMzinoni/ Milan Park/ Sorrento Park settlement cluster (18%). Only 9% of the local municipal's population resides in Secunda, which is the economic heartland of the GMLM

The population distribution within the primary study area is characterised by a relatively low population density, which could be attributed to the fact that the majority of this area comprises commercial farms.

2.3.1.3 Poverty, vulnerability and crime

Within the district, GMLM has the lowest percentage of people living in poverty (29%) and the lowest unemployment rate. Table 2-21 below provides some indicators of poverty, further demonstrating that GMLM is in a relatively better socio-economic position than the rest of the district and province as a whole. It should be noted that this situation is skewed towards the more affluent urban areas such as Kinross and Secunda, with rural and informal communities experiencing high levels of poverty and underdevelopment, as is evidenced among especially farm-worker and other households residing in the rural outskirts of the primary study area, such as Embidini Informal settlement.

Crime in general was identified by the informants as a problem within Kinross. Crime prevention and safety were noted by most in the primary study area as a priority. The most common crimes in this study area include prostitution, house breaking, robbery, and livestock theft.

Table 2-21: Indicators of poverty

Development indicators (2010)	GMLM	GSDM	Mpumalanga
Human Development Index 1(HDI) (0 worst to 1 best)	0.59	0.52	0.52
Gini-coefficient2 (0 best to 1 worst)	0.65	0.65	0.64
Poverty rate	37.1%	49.2%	45.6%
Per capita personal income per year3 (current prices)	R37 880	R25 769	R26 623
% households earning below R42 000 per year (R3 500 p/m)	40.7%	49.9%	46.9%

The current cultural landscape is primarily agrarian comprising mainly maize and vegetable crop lands and grazing. Industrial and commercial nodes exist, particularly on Wildebeestfontein 122 IS Portion 14, whilst isolated parts of the landscape are reserved for public works such as the sewage treatment plant on Zondagsfontein 124 IS Portions 2 and 8.

2.3.2 Heritage Environment

The National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA) stipulates that all cultural heritage resources such as archaeological objects, paleontological material and meteorites are the property of the State and may not be disturbed without authorisation from the relevant heritage authority. In addition, Section 34 (1) of the NHRA states that “no person

[1] The HDI is an indicator developed by the United Nations to measure the level of social and economic development based on four criteria: Life expectancy at birth, mean years of schooling, expected years of schooling and gross national income per capita.

[2] The Gini-coefficient, developed in 1912 by Italian statistician Corrado Gini, is a mathematical measure of income inequality. Its theoretical maximum value is 1 – which would imply that a single person receives 100% of the total income and the remaining people receive none – and its theoretical minimum value is 0 – in which case everyone receives exactly the same income.

[3] Per capita personal income per year: the mean income of the people in an economic unit such as a District or Local municipality or city. It is calculated by taking a measure of all sources of income in the aggregate (such as GDP or Gross national income) and dividing it by the total population

may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the relevant provincial heritage resources authority."

The heritage team from Digby Wells undertook a preliminary heritage survey in the specific area of Block IV. They identified three werfs, an historical building, four graves and two burial grounds. Although no impact on surface heritage is envisaged, palaeontological resources may be affected by the mining. The area is underlain by the Madzaringwe Formation of the Karoo Supergroup which is considered of high palaeontological sensitivity. Intrusions of igneous dolerite are considered of no palaeontological significance and normally decrease the significance of the Madzaringwe Formation. However, evidence of plant fossils and specifically Glossopteris leaves, roots and inflorescences, lycopod and sphenophyte stems, ferns, cordaitaleans and early gymnosperms have been previously identified in this formation in the proximity of this area.

2.3.3 Current Land Uses and the Socio-Economic Environment

2.3.3.1 Land Use

Commercial agricultural is the most dominant land use in the district (although the petrochemical industry is the main contributor to municipal output). Mining, particularly coal mining, is also an important land use, with Secunda being the most active business hub in the municipality. The expansion of industrial activity and mining, while promoting economic growth, has led to the encroachment of agricultural land (GMLM, 2014).

The most dominant land use is agriculture, including several commercial maize and soya farms and a variety of livestock and game farming. Livestock kept is mostly cattle, with some sheep and goat farming; game farming is mostly limited to springbuck, blesbuck, ostrich and gnu. Livestock is usually sold at auctions, whereas game is hunted on the farms. Agricultural activities may potentially be directly affected by the proposed project, if subsidence occurs – as agricultural activities may cease to exist after subsidence, depending on the severity and scale of the subsidence.

2.3.3.2 Economy

According to Table 2-22, mining is the dominant sector in the Gert Sibande region. Community services are the second most dominant (15.1%), followed closely by manufacturing (14.6%). Agriculture is the lowest contributor to the regional economy (3.5%).

Table 2-22: Contribution of sectors to the regional economy (percentage)

Sectors	2006	2007	2008	2009
Mining	22.7	23.5	30	28.8
Community services	15.4	15.1	14	15.1
Manufacturing	18.4	17.7	15.8	14.6
Finance	12.8	13.2	12	12
Trade	10.9	10.5	10.4	10.7
Transport	8.6	8	7.2	7.6
Electricity	5.1	4.9	4.4	4.8
Agriculture	3.9	4.6	3.6	3.5
Total	**100**	**100**	**100**	**100**

Source: Global Insight South Africa: Regional Explorer 421 (2.2j), 2010, in GSDM IDP, 2012

Mining and manufacturing are the foremost contributors to the GSDM economy. Mining activities are mainly tied to coal, which serves as input material for the petrochemicals industry in GMLM, and electricity generation for the various power stations. Gold mining also contributes to the mining output in the district according to the GSDM IDP 2012-2015.

GMLM's manufacturing sector is driven mainly by Sasol's petrochemical / synthetic fuels plants at Secunda. Economic activity in this area contributes 60% towards the district municipality's total economy.

According to the Govan Mbeki IDP report, Secunda is the most active business zone in the municipality; 45% of the financial, administrative and professional concerns of the region are situated in Secunda. Industrial activity in the area is dominated by Sasol, whose site area makes up to 85.7% of the total industrial / commercial land in the area.

2.3.3.3 Demographics

The population of the GSDM and GMLM is 1 043 195 and 294 538 respectively (StatsSA, 2012). According to the GSDM IDP 2011-2014, the District has the smallest population size in Mpumalanga. Of the seven local municipalities in the District, GMLM has the largest population, calculated at 28% of the District population in 2009. With towns like Trichardt, Secunda, Evander, Bethal and Kinross offering more job opportunities than other towns in Mpumalanga, it seems to show that migration to urban areas is driven by the hope of employment.

2.3.3.4 Employment

According to Figure 2-22 below, there is little difference in employment between the GSDM and the GMLM; overall employment levels in the GMLM are only slightly higher than in the district. Sasol mining is one of the most prominent sources of employment throughout the

area, with Sasol Mining directly responsible for the employment of approximately 8 600 people and a further 7 000 indirect employment opportunities (GMLM IDP 2012-2015).

Throughout the primary study area unemployment is high especially among rural households outside Kinross. Areas such as Evander, Leandra, and Embalenhle also experience high unemployment when compared to Secunda.

When comparing male and female employment, unemployment amongst females is significantly higher than males at both municipal levels. Furthermore, when women do generate income, it is likely to be through the informal sector and of a survivalist nature. The shortage of, and associated long distances to, primary health facilities in the area puts additional pressure on mothers to engage in employment opportunities, as the distant location of provincial and district hospitals increases travelling expenses. Where access to grid electricity is lacking, women (and girl children) need to allocate time for collecting wood, which further affects income generating ability of women.

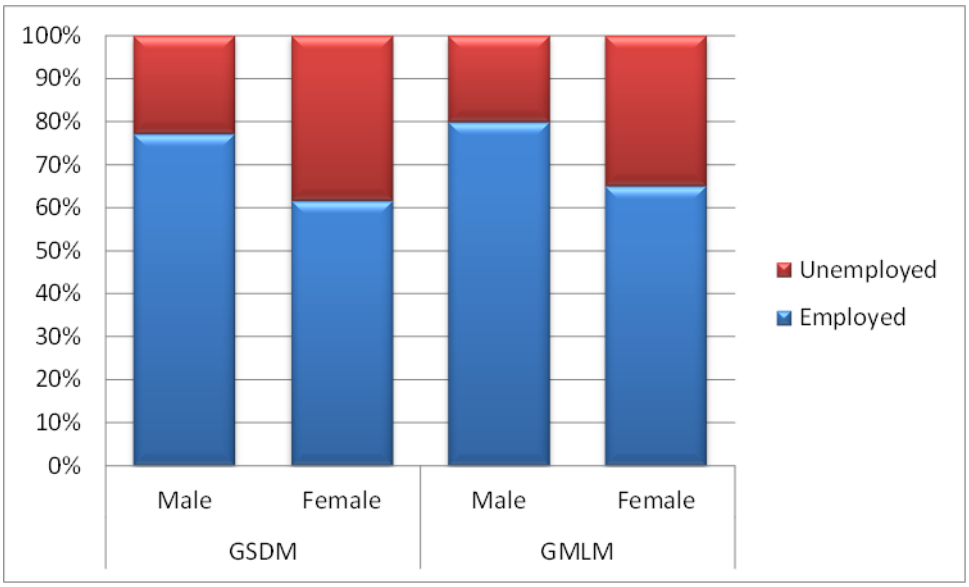

Figure 2-22: Employment status by sex

2.3.3.5 Education

Functional literacy is the ability of an individual to apply reading, writing and computational skills efficiently in everyday life situations. An increase in the basic literacy skills of adults has a positive effect on any economy. Research has found that adults with higher literacy skills are more likely to earn more than those with lower literacy skills, even when taking account of other factors which affect work performance. Within the GSDM, the GMLM has the highest level (74.3%) of functionally literate people.

According to Figure 2-23, 32% of the GMLM and 31% of the GSDM have some secondary as their highest level of education. This is on par with the provincial average of 31%. The proportion of the population that has some primary education (23% in GMLM and 28% in

GSDM) is high compared to all the provinces in the country that average 14%. The proportion of the population with their secondary education is slightly lower than other provinces and the levels of higher education are substantially lower (StatsSA, 2012). This highlights that the population of both municipalities have relatively low levels of education. It should be noted that these figures are skewed towards urban areas, where access to education services are readily available. During the site visit it was established that those within the more rural outskirts of the secondary study area (also including the primary study area) tend to have even lower levels of education.

Primary schools form the majority at both municipal scales, as shown in Table 2-23, followed by secondary schools. There is only one tertiary institution within the district. Currently schools within Kinross and its surrounds are experiencing extensive pressure to accommodate an increasing number of learners. Five educational facilities are situated within Kinross and another two facilities are situated within the rural outskirts of the primary study area; these include the Embidini Combined School and the Ethokolomala Secure care centre, the latter is used by the Department of Correctional Services as an educational centre for offenders.

Table 2-23: Educational facilities in the GMLM and GSDM

Status	GMLM	GSDM
Independent Schools	5	19
Public Primary Schools	62	417
Public Secondary Schools	21	171
Further Education and Training Colleges	1	5
Tertiary Institutions	1	1

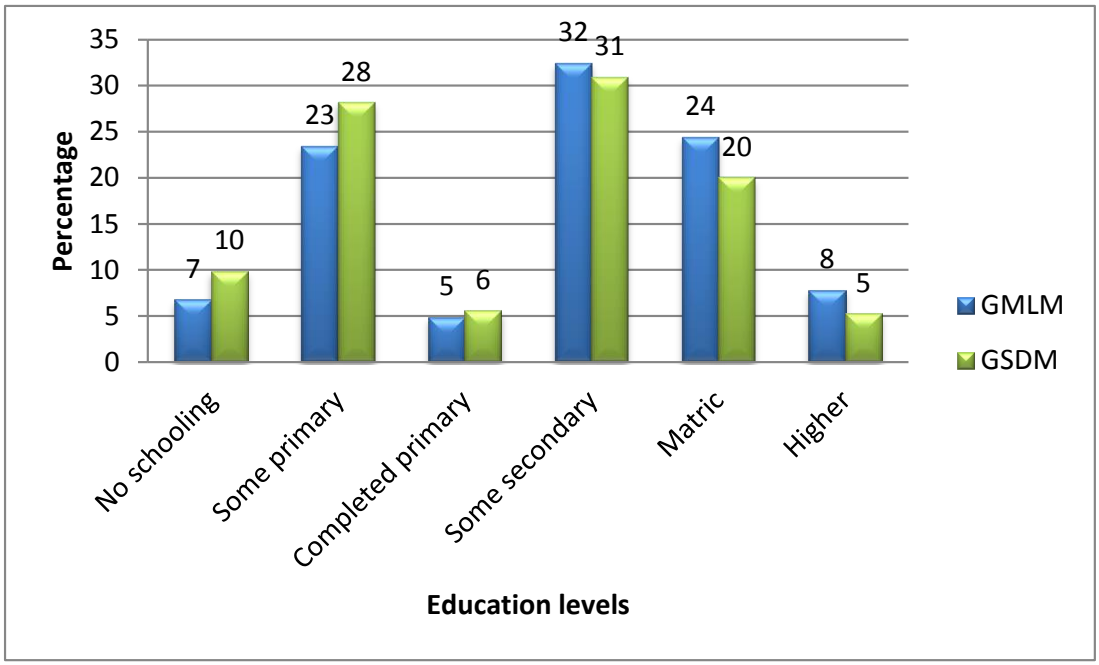

Figure 2-23: Highest levels of education for persons aged 20 and older

Source: StatsSA Census 2011

2.3.4 Infrastructure

The area surrounding the proposed project area is fully serviced by roads, power lines, telephone lines, railway lines and buildings.

Municipal services infrastructure in the municipality is located mostly within the urban areas. According to the Municipal Integrated Development Plans (IDP) report and the Govan Mbeki Spatial Development Frameworks (SDF) report, some infrastructure backlogs exist especially within the previously disadvantaged township areas. Inadequate maintenance of existing infrastructure is a problem. As far as the outlying rural areas are concerned, these rely almost exclusively on borehole water and septic tanks/pit latrines, while electricity is provided by Eskom (Govan Mbeki SDF, June 2006).

The N17 national toll road and the Johannesburg - Richards Bay freight rail line traverse the area in an east-west direction and are augmented by a number of provincial roads connecting it to a wider region (Govan Mbeki Municipality IDP 2007 – 2011). The N17 is on the southern boundary of the proposed Project area, whilst the R547 runs across the proposed Project area. The R547 will therefore be directly affected by the proposed Project.

2.4 Annotated map

Please see Plan 2 and Plan 4 in Appendix A showing the spatial locality and aerial extent of all environmental, cultural/heritage, infrastructure and land use features identified on site and on the neighbouring properties and farms.

3 Proposed mining operation

The proposed Project area is situated in the GMLM in the Gert Sibande District of the Mpumalanga Province. Please refer to Plan 1 and Plan 2, Appendix A.

Sasol Mining proposes the high extraction mining of the No. 4 seam.

A series of ventilation simulations indicated that a new upcast ventilation shaft has to be established in the eastern part of the Weltevreden underground reserves, to allow deployment of four continuous miner sections and one stonework section into these reserves. This will entail establishing a single 6.1 m diameter upcast shaft, with two 750 kW surface fans, to the east of the Weltevreden dyke. The ventilation shaft has already been constructed and will remain operational until the current end of the LoM in 2030.

3.1 The mineral to be mined

The proposed Project area is 5 224.6 ha in size, but only 2 783.6 ha will be undermined. The infrastructure that will service the mine will be on the adjacent, existing Sasol Syferfontein Colliery. The new ventilation shafts will be located on two farms. The first will be located on the farm Zondagsfontein 124 IS on Portion 6. The second will be located in the border of portion 16 of Langsloot 99 IS and portion 7 of Dieplaagte 123 IS. This is clearly illustrated in Plan 13 in Appendix A.

The proposed Project area falls within the Highveld Coalfield. More specifically, the proposed Project area is located in the northern portion of the coal reserves owned by Sasol Mining, which stretch from Greylingstad in the southwest to Bethal in the northeast. The proposed Project area, together with Sasol Mining's Twistdraai, Brandspruit, Bosjesspruit and Middelbult Collieries is responsible for the extraction of approximately 46 Mt of coal per annum of which 41 Mt is supplied to Sasol Synfuels. The remainder of the coal is exported. The estimated coal reserves are expected to last until ±2055 (GMLM, 2006b).

There are currently a total of 13 shafts in the municipal area, as well as an extensive network of surface conveyor belts to transport coal from the shafts to the Sasol Coal Supply blending facility, where the coal is blended and homogenised to ensure a stable feed to Sasol Synfuels. Coal destined for export is transported to a coal export facility located near the Sasol Coal Supply blending facility (GMLM, 2006b).

Sasol Mining is responsible for the direct employment of approximately 6 800 people and a further 2 000 indirect employment opportunities. The employment opportunities associated with the proposed project are detailed in Section 7.1 of this report.

The available *in situ* coal resource for Syferfontein is currently estimated at 463 Mt of which 164 Mt will be extracted by bord and pillar mining method at an extraction rate of 35.5% and a life of mine (LoM) of approximately 20 years.

The extractable high extraction mining reserves is estimated at 15 Mt run of mine (RoM) coal and will extend the current life of mine by 18 months.

3.2 The mining method

Underground mining will take place by bord and pillar method on advance, while high extraction methods will be used on retreat.

Mining methods to be undertaken are the conventional bord and pillar and Nevid high extraction mining methods with the use of continuous miners feeding shuttle cars. Coal mined from the sections will be fed through a feeder breaker and then transported by a conveyor belt system to the surface at the existing Sasol Syferfontein Colliery shaft, for beneficiation or sale as raw coal. An illustrative example of the mining method is depicted in Figure 3-1.

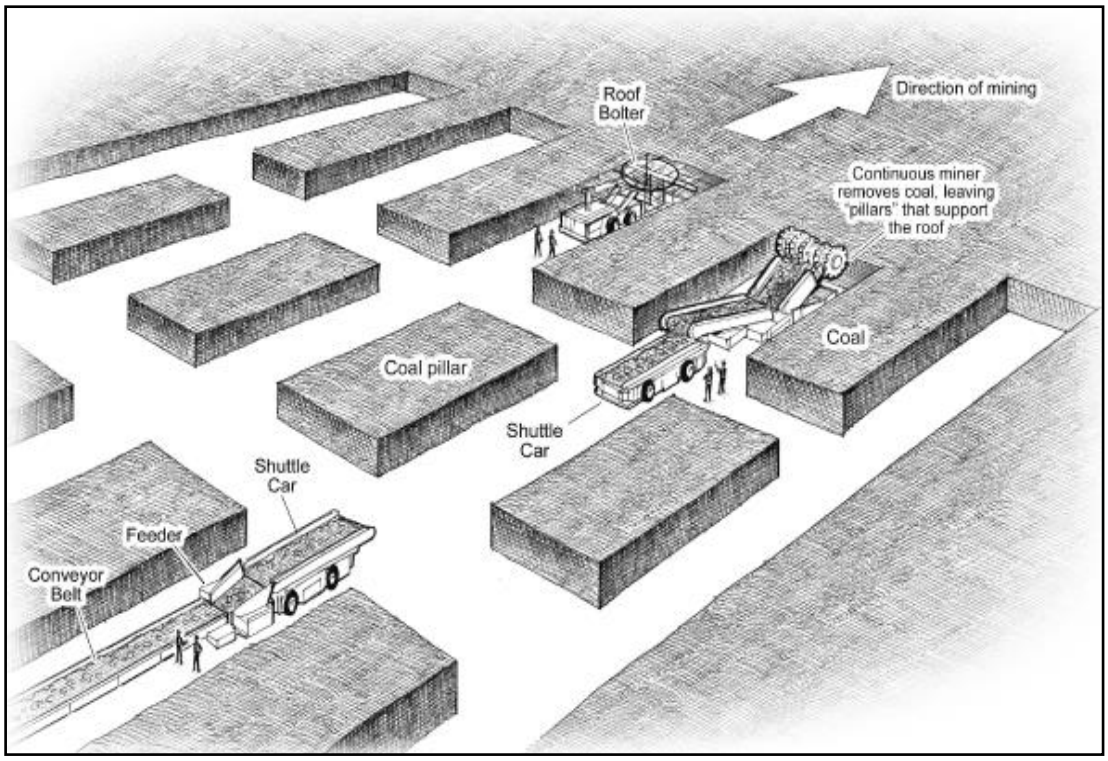

Figure 3-1: Bord and pillar Mining Method (www.interdisciplinaryenergystudy.org)

Surface subsidence in bord and pillar underground workings is generally prevented by ensuring that the pillars are correctly sized to support the mine's roof. However, due to the nature of high extraction mining, settlement of the surface is inevitable, except in certain areas where the presence of thick intrusive rocks and the depth of mining can combine to

prevent subsidence. The average depth of mining the No. 4 seam is between 80 to 140 m below the surface.

3.2.1 Coal Seam Quality

The mineral deposit is a low-grade bituminous coal occurring in horizontal seams within the Vryheid Formation. The coal will be supplied to Sasol Synfuels in Secunda as feedstock in the manufacturing of petrochemical products.

In the northern central portion of Block IV there is high amount of soft inorganics (siltstone, mudstone, carbonaceous shale) within the seam, with the thickness ranging up to an accumulated thickness of 1.5 meters. These inorganics can be easily mined through and the ash grid also indicates that the qualities have not been adversely affected, as the maximum ash content in that area is approximately 35%. The calorific values (CV) display the same distribution as the ash and the inorganics, whereby the CV values are lower in the areas with a high amount of inorganics. The CV ranges between only 20% to 22%, and drops down to between 9% and 15% in the high inorganics regions, throughout the whole area.

Table 3-1: Estimated qualities for No. 4 lower coal seam in Block IV area

Quality of Coal	Lower Limit	Upper Limit
	Area A	Area A
Ash, % (AD)	16.75	49.89
Inherent Moisture, % (AD)	1.98	7.93
Volatile matter, % (AD)	6.94	26.61
Fixed Carbon, % (AD)	34.32	53.33
Total Sulphur, % (AD)	0.19	2.09
Calorific Value, MJ/kg	9.97	25.13

3.2.2 Coal beneficiation

Coal is screened and crushed at the mine and transported along the existing conveyor belt system to the current Sasol Coal Supply blending facility. The blending facility is located within the existing Sasol Syferfontein mining area. No other beneficiation activities will occur on site.

3.2.3 Water management

The Syferfontein Colliery is located on part of the DWS inter-basin transfer scheme from the Grootdraai Dam to the Rietfontein Dam. This scheme makes water from the Vaal River available to various power stations by pumping water over the catchment divide into the Olifants River Catchment.

The start of the scheme is Grootdraai Dam from where water is pumped to the Trichardtsfontein Dam. From there, water is allowed to gravitate via the Trichardtspruit down to Rietfontein Dam, where a second pump station pumps the water to the Kriel Power Station and via Kriel into the Eskom water network.

With the commencement of mining in the lowest lying valley of the Trichardtspruit, the water running into the spruit from the upstream catchment had to be diverted around the mine utilising a large upstream dam (Tweedraai Dam) and pumping system discharging the water to the Rietfontein Dam downstream of the mining activities.

A number of dams and canals were subsequently constructed to separate the clean and dirty water and manage the water in and around the mine.

Water storage at the mine is also achieved via the storing of water in underground compartments. As far as is practical, water at the Syferfontein Colliery is currently left underground and reuse maximised.

3.3 A list of all the main mining actions, activities, or processes

3.3.1 Construction phase

Mining will be undertaken by the conventional bord-and-pillar technique using high extraction methods. Provided full pillar strengthening is applied, it can be assumed that the conventional bord-and-pillar mining method will have no surface-related environmental impact. Based on this, no surface-related impacts have been rated. It should be noted, however, that appropriate geotechnical design will be required to ensure there is no surface impact.

All access shafts to the underground workings will be constructed at the existing and adjacent Syferfontein Colliery. The ventilation shafts will be constructed by way of adits from the existing Syferfontein Colliery high wall.

3.3.2 Operational phase

Mining will be undertaken by the conventional bord-and-pillar technique using high extraction methods. Provided full pillar strengthening is applied, it can be assumed that the conventional bord-and-pillar mining method is not likely to have surface-related environmental impacts; however, there may be other indirect environmental impacts as discussed within this phase of the proposed Project.

3.4 A plan showing the location and aerial extent of the main mining actions, activities, or processes

A plan showing the location and aerial extent of the main mining actions, activities, or processes is attached as Plan 2 in Appendix A.

3.5 Listed activities in terms of NEMA EIA regulations

Currently no listed activities are proposed to be triggered. If any listed activities are triggered according to the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) during the full EIA study, the necessary applications will be compiled within the terms of NEMA. However, all existing activities and infrastructure have already been authorised.

3.6 Indication of Phases and Estimated Timeframes

The mining right for Block IV is required for a total of 28 years to allow for the various phases of the mining activity to be implemented. The expansion of the Syferfontein Block IV reserve also assists Sasol in extending the life of the mine. The various phases which have been extracted from the Block IV Mine Work Programme (MWP) include:

3.6.1 Development

Block IV is adjacent to the existing Syferfontein mine, thus the mining in the Block IV expansion area will commence from the mine workings of the existing Syferfontein mine. The Block IV expansion coal reserves will be accessed through an adit in one of the high walls from the previous opencast mine. The adit and other infrastructure will be established between 2013 and 2016.

3.6.2 Production build-up

The production build-up will take place over nine years from 2016 to 2024, with full production anticipated to occur in 2022. The Life of Mine will be from 2016 to 2041, and it is expected that the production yield will level out to 4.5 Mt per annum from the year 2024 until 2039.

4 Potential impacts

The mining method which will be employed during the operation is the bord-and-pillar method with high extraction where applicable, depending on the surface restrictions, safety factors and the type of rock in the roof. There is a specific cutting sequence used to allow for easy tramming of machinery, ventilation flow and support of cut faces. The Sasol Mining pillar extraction mining (Nevid mining) utilises the same equipment and the bord-and-pillar method. Wooden poles are inserted as a temporary support mechanism after pillar extraction. The Sasol Mining Rock Engineering Department was responsible for conducting the pillar stability assessment and ensuring that all aspects relating to safety regarding the

pillar stability and design were thoroughly considered before the underground mining took place. This is to minimise the risk of shaft collapsing as far as possible (Jones and Wagner, 2012). It should be noted that the No.4 coal seam with a thickness of 4.5m will be mined at an average depth of 80 to 140m below the surface. When assessing the potential impacts, the mining method and risks associated with it should be taken into consideration.

4.1 List of the potential impacts

4.1.1 Construction Phase

Due to the nature of the project there only potential impacts during the construction phase is on air quality. For this reason only air quality impacts have been included into the EIA for this phase however more detail can be viewed in each of the specialist reports.

4.1.2 Operation Phase

The mining method to be utilised in the Block IV expansion reserves is the bord and pillar technique, using the high extraction method where applicable (depending on surface restrictions, safety factors and the type of rock in the roof). The impacts in the operational phase will be influenced by the mining method used. However, pillar supports will be provided to reduce the potential for surface subsidence occurring.

4.1.2.1 Aquatics

Underground mining, particularly bord and pillar methods may result in unplanned surface collapses, changing the topographical features of the catchment permanently. Changes to the topography will result in changes to geomorphology of the catchment which will further result in changes to hydrological regime of the respective systems. Subsidence can also as a result cause ground and surface water contamination due to acidification and salinisation of nearby aquifers. Additionally, subsidence may also result in a loss of water quality for the catchment due to fissures or pits which may result.

4.1.2.2 Groundwater

During the operational phase of the project, drilling and blasting activities could result in the contamination of groundwater resources. Furthermore, underground hydrocarbon spillages could result in groundwater contamination if not properly managed. Should subsidence occur and sinkholes form, the infiltration of water and oxygen from the fractures could come into contact with the exposed pyrite rich rocks and contaminate the mine water. During excavation, mine dewatering is also anticipated to occur. This could result in the lowering of the groundwater levels. Thus both groundwater quality and quantity could potentially be affected as a result of the underground mining activities.

4.1.2.3 Surface Water

No impacts in terms of surface water quality are anticipated during the operational phase. The potential on subsidence occurring during the implementation if the bord and pillar method and the high extraction method (where applicable) is eminent. During the undermining of streams, potential leakages of surface water to the subsurface could occur through fractures within the streambed. These fractures could be mining induced and could result in the increased rainfall infiltration, reduced runoff and consequently, it could potentially decrease the surface water flow. Surface subsidence is another potential impact which could result in the formation of fractures and potentially affect mine water and surface catchment balance.

4.1.2.4 Wetlands

The potential for subsidence of unconsolidated surface sediments during the operational phase and life of mine is a risk and is a commonly observed phenomenon due to underground mining. If surface subsidence occurs within wetland areas, a loss of wetland habitat as well as a loss of connectivity between wetland areas is likely to occur.

During the operational phase of the underground mining, groundwater sources are dewatered. Therefore, wetlands habitats could be indirectly impacted since the wetlands in this area are linked to the ground and surface water resources. The wetland recharge rate could potentially be affected.

4.1.3 Decommissioning Phase

4.1.3.1 Aquatics

The impacts of the underground mining activities described during the operational phase are also relevant during the decommissioning phase of the project as surface subsidence may occur during decommissioning and closure.

4.1.3.2 Groundwater

It is anticipated that the subsidence impacts described during the operational phase are most likely to carry through to the decommissioning phase of the project. However, since the mining operations will discontinue during this phase, dewatering is expected to stop, thus groundwater levels are most likely not subject to decreasing. Mine water contamination is likely to occur however due to the chemical reactions resulting from the exposure of underground rocks to moisture and oxygen.

4.1.3.3 Surface Water

The impact of subsidence described during the operational phase is also anticipated during the decommissioning phase of this project.

4.2 Potential impacts on cultural and/ or heritage resources

4.2.1 Archaeological and Cultural Historical Sites

4.2.1.1 Construction Phase

There will be no impacts during the construction phase of the proposed Project.

4.2.1.2 Operational Phase

Mining will occur by bord and pillar technique using high extraction methods where applicable. Subsidence as a result of high extraction could possibly have an impact on the four graves located in the proposed Project area. The Digby Wells heritage team also located three werfs, a historical building and two burial grounds on the Block IV expansion site which could potentially be impacted upon should subsidence occur.

Paleontological resources may be affected by the mining since underground mining is expected to occur in the proposed project area. It was noted that the project area is underlain by the Madzaringwe Formation of the Karoo Supergroup which is considered of high paleontological sensitivity. Upon correspondence with SAHRA, it was established that a palaeontologist, which specialises in palaeobotany, draft a letter to SAHRA outlining a proposed way forward to ensure the conservation of significant palaeontological heritage that is likely to be impacted by the proposed mining activities. This letter should contain instructions on the frequency of site inspections, as well as a procedure for chance finds. This letter must be submitted to SAHRA for assessment.

4.2.1.3 Decommissioning and Closure Phase

Post-closure potential risk of subsidence is still a possibility, if subsidence does occur, it will have a negative impact on the four graves located within the proposed Project area. Over and beyond the four graves located on site, various other historical and heritage resources were identified on site during the heritage study such as three werfs, a historical building and two burial grounds. Therefore, should subsidence occur, these heritage resources could potentially be impacted.

4.3 Sensitive Landscapes

4.3.1 Construction Phase

Sensitive landscapes in relation to the present proposed Project are defined as wetlands. There will be no impacts during the construction phase of the proposed Project.

4.3.2 Operational Phase

Mining will occur by bord and pillar methods and high extraction where applicable. Based on the low-risk nature of the proposed underground mining project, as well as the fact that less

than 10% of the site is comprised of wetlands, it can be deduced that the overall impacts of the Syferfontein underground coal mine on wetland habitat is expected to be minimal.

4.4 List of all impacts that may potentially emanate from each activity

4.4.1 Construction Phase

4.4.1.1 Air Quality

Since the Syferfontein Block IV expansion is an extension of an existing mine, most infrastructure is already present. However, the construction of additional surface infrastructure such as access roads and ventilation shafts might have potential impacts on the air quality. These impacts can include increased dust load in the area and vehicle re-entrained dust, as well as emissions from the upcast ventilation shafts.

4.4.2 Operational Phase

4.4.2.1 Air Quality

To remove of the ore, the bord and pillar method will be used. This activity includes drilling and blasting the hard overburden. Drilling is an intermittent exercise that emits fugitive dust. Fugitive dust will be released containing TSP, PM_{10} and $PM_{2.5}$.

Transportation of ore using haul roads will result in dust generation.

4.4.2.2 Fauna

The main impact of mining will be ponding, which could significantly reduce the area of grassland, but increase wetland habitats proportionately.

4.4.2.3 Flora

Relatively large areas are at risk of being affected by subsidence as a result of high extraction mining methods and the resultant ponding. In this regard, the land capability could potentially be altered significantly, with large areas where permanent ponding or water logging may occur thus reducing the capability of the land to “wilderness” or “wetland” status.

4.4.2.4 Geology

A percentage of the bord and pillar development will also be mined through high extraction mining. With high extraction mining the impact on the geology includes both the extraction of the coal, as well as the impact on the overlying aquifer above the highly extracted areas with possible surface subsidence. The main catalyst for surface subsidence is the partial removal of pillars within the coal seam. As the coal pillars are extracted, progressive collapse of the roof leads to fracturing and collapse of the overlying rock strata into the void created by coal removal.

The extent of fracturing and collapse in the vertical dimension is a function of various parameters including the level of primitive stresses, the panel extraction width, competence of roof strata and coal seam thickness.

Bord and pillar underground mining will have an impact on the geology in the proposed Project area. Neither surface infrastructure nor agricultural activities will are likely to be affected above bord and pillar areas, but could be impacted upon beneath high extraction areas.

Other coal mining title holders in the coalfield include Anglo Operations, Ingwe, Xstrata (now Glencore Operations South Africa), Eyesiswe and Total Exploration SA. Most of the coal mining activities during the next 10 years will take place in the central part of the municipal area (GMLM, 2006b). Since the coal seams are generally shallow, undermining in the municipal area leads to the sterilisation of land for surface development. The land normally takes approximately 1 to 2 years to settle, after which surface development can be considered subject to certain conditions (GMLM, 2006a). In some areas, subsidence might only occur later.

4.4.2.5 Groundwater

4.4.2.5.1 Mine dewatering

Mine dewatering is crucial to keep the underground workings dry for safe working conditions. The dewatering is recommended to start with the starting of the excavation. This however can potentially impact the groundwater environment negatively by lowering the water level and creating a cone of depression/dewatering.

Numerical model simulations show that at the end of operation (in 2042) the cone of dewatering could be up to 5m in the top weathered aquifer. This means that mine dewatering could have a potential negative impact on the weathered aquifer and boreholes located in this aquifer. However, no private boreholes have been identified during the hydrocensus that fall within the radius of influence.

The following conclusions are made on the impact of mine dewatering:

- The dewatering will mainly impact the groundwater in the deep coal seam aquifer. Deep private boreholes (more than 90 m) are assumed to be uncommon in the project area and none have been identified within the impacted zone;
- The dewatering process can potentially lower the water table of the top weathered aquifer in the south-eastern portion of the mine to up to 5 m. However, no boreholes have been identified the area where there could be an impact.; and
- There is a dam in the area where the water table of the top weathered aquifer could be affected and the lowering of the water table could possibly affect the dam water content.

4.4.2.5.2 Mine Water Contamination

Groundwater draining into the underground mine workings will be of a good quality. The pH will be slightly neutral to alkaline due to the presence of bicarbonate species. However, once the groundwater reaches the mine, the material that it comes into contact with will influence its quality. Due to the exposure of groundwater to sulphur containing formations such as coal, the coal floor and roof, the oxidation which occurs leads to the formation of sulphuric acid. Saline water with acidic or alkaline pH can be released from the underground workings. This water can come into contact with sulphur bearing coal pillars and nearby rocks which have been exposed to oxygen and moisture due to fracture formations or subsidence. The resultant reactions could cause mine water contamination.

4.4.2.5.3 Underground hydrocarbon spillage

Organic solvents, diesel or other organic fluids may be spilled in the underground workings or leak from storage tanks during mine operation. This could have a potential negative impact on groundwater quality. This impact could occur over a longer period of time and could have the potential of impacting the environment.

4.4.2.6 Land Capability

Due to the relatively large areas that could possibly be affected by the collapse of the high extraction areas, and the resultant “ponding” that may occur, the land capability of the mining area could potentially alter significantly, changing the capability of the land to possible “wilderness” or “wetland” status.

4.4.2.7 Land Use

Land use of over the mining area will remain unchanged apart from areas affected by ponding subsidence.

4.4.2.8 Noise

There will be no impacts during the operational phase of the proposed Project.

4.4.2.9 Surface Water

After the area (including streams) has been undermined there is a possibility that subsidence could occur. These could result in depressions and fractures that could impacts on the natural drainage patterns and which will affect the mine water balance.

These subsidence could occur on a limited area but depending on scale, impacts could spread to be at a local extent as due to the site being located upstream of the Waterval River catchment area. This impact could be a permanent impact on the landscape if not avoided or minimised and has could have a serious impact on the environment as it changes the entire geomorphology of the landscape.

4.4.2.10 Soils

The impacts associated with the project will be based on the fact that there will be no surface infrastructure or surface mining in the project area and the mining will occur underground. As a result the only possible impact will take place after mining at the decommissioning and closure phases. The possible impact of underground mining is subsidence. The impacts of subsidence will be described further under the decommissioning phase.

4.4.2.11 Topography

It is estimated that underground mining activities in the proposed Syferfontein Block IV area will occur at a depth of between 60 and 150 m below the surface. If underground mining occurs this close to the surface and insufficient pillars are left to support the surface then subsidence could result. This subsidence would have an impact on the topography. Therefore the risk associated with the occurrence of subsidence will be increased.

The proposed Syferfontein Block IV Project will have a negligible impact on topography therefore it was not necessary to conduct a topography impact assessment.

4.4.2.12 Visual Aspects

The visual impacts during the operational phase of the project are associated with the ventilation shafts. Upon completing an impact assessment, it was found that the visual impacts are not significant due to the location of the ventilation shafts and the activity around the area.

4.4.3 Decommissioning Phase

4.4.3.1 Air Quality

There will be no impacts during the Decommissioning phase of the proposed Project.

4.4.3.2 Fauna

Once mining activities come to an end, the subsidence associated with the high extraction areas will have occurred and the extent and intensity of it will be known. It is expected that upon the occurrence of subsidence, habitats and micro ecosystems will be destroyed, thus leading to the death of their respective faunal species.

4.4.3.3 Flora

Once mining activities will have come to an end, the subsidence associated with the high extraction areas will have occurred and the extent and intensity of it will be known. It is expected that upon the occurrence of subsidence, habitats and micro ecosystems will be destroyed, thus leading to the death of their respective floral species. Due to the altered landscape, wetlands in proximity could potentially to dry up.

4.4.3.4 Groundwater

4.4.3.4.1 Mine Water Contamination

Once the mine is closed and dewatering ceases, groundwater will start to recover to its pre-mining level. No vertical migration of contaminants is expected to occur and therefore the contamination plume will not move towards the top weathered aquifer. The system was modelled and even after 100 years, allowing full recovery, the contamination plume has not spread; the contaminants will start to migrate away from the mine site within the fractured aquifer. Secondly, Model simulation has shown that no contamination from the underground workings will reach nearby private boreholes in the long-run, except those that are within the mine boundary and drilled to the coal seam aquifer.

4.4.3.5 Geology

No additional impacts on the geology are incurred as a result of the decommissioning or closure activities.

4.4.3.6 Land Capability

Due to the relatively large areas that could be affected by the subsidence as a result of the high extraction, and the resultant “ponding” that may occur; the land capability could potentially be altered.

4.4.3.7 Land Use

The manner in which the soils were stockpiled will affect the land use in terms of soil fertility and therefore function. Should the topsoil and subsoil be backfilled in the wrong order of layers, the soil fertility will be compromised. As a result, the land may be unable to be used for agricultural purposes and. Agricultural productivity of the land is compromised.

4.4.3.8 Noise

There will be no impacts during the decommissioning phase of the proposed Project.

4.4.3.9 Surface Water

The will be no impacts during the decommissioning phase of the proposed Project.

4.4.3.10 Soils

After the area has been undermined there is a possibility that subsidence could occur. This Surface subsidence can and should be modelled as published by Asadi et al, 2005. Subsidence can impact on the natural drainage patterns of the area changing soil physical properties as well as the chemical properties over time, as a result of this change, the soils are then downgraded in their land capability to the detriment of all parties.

The impacts are generally limited in area to the undermined area, but could impact larger areas due to changes in flow paths of surface water. This impact could be a permanent impact on the landscape if not mitigated and has a serious impact on the environment as it changes the entire geomorphology of the landscape. The impact is likely if the correct support pillar design factors are not used to undermine the area.

4.4.3.11 Topography

Due to the relatively large areas that could be affected by the subsidence as a result of the high extraction, and the resultant “ponding” that may occur, the topography could potentially be altered.

4.4.3.12 Visual Aspects

There will be no impacts during the decommissioning phase of the proposed Project.

4.5 List of all potential cumulative environmental 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”.

4.5.1 Air Quality

Current land use activities surrounding the proposed Project area which includes clearing areas for agricultural activities such as commercial crop farming has an impact on the current ambient air quality due to barren soil being susceptible to wind erosion. It must also be taken into account that mines do exist within close proximity of the Project area which can contribute to the cumulative impact on ambient air quality of the area. The impact emanating from the ventilation shafts will be minimal as compared to the impacts detailed above.

4.5.2 Groundwater

The most dominant land use in the proposed Project area is commercial farming and agricultural activities. Many of the residents surrounding the Project area abstract water from boreholes for their livelihoods and to use in their agricultural activities. In the event of mine subsidence, or lack thereof, the coal contaminated underground rocks may be exposed to oxygen and moisture, resulting in chemical reactions contaminating the underground mine water. Groundwater may be contaminated as a result thus potentially affecting boreholes which the local farmers use to abstract water. Furthermore, mining activities in the area have been going on for many years with Secunda being the most active mining hub. However, combined mining impacts could render larger parts of the aquifer unusable due to contamination or dewatering.

4.5.3 Soil, Land Use and Land Capability

The cumulative impacts noted for the proposed project area are related to the possible subsidence that may emanate from the underground mining activities. The proposed Project area is dominated by commercial farming and agricultural activities including cattle grazing. The surrounding communities largely depend of these land uses activities for their livelihoods. Therefore, should mine subsidence occur, land capability may be compromised and thus decreasing the potential agricultural productivity of the land. This will affect the residents of the neighbouring towns who depend of such land use activities.

4.5.4 Topography

The cumulative impacts on the topography are those related to landscape level changes in surface water flow dynamics and overall topographical functioning. The topographical functioning of the landscape will be subjected to external influences caused by man-made structures that change the elevation, slope and landscape features. These impacts need to be considered and thoroughly investigated in order to reduce the impacts of the development on the receiving environment.

Topographical impacts associated with the proposed underground mining activities at the Block IV expansion site include mine subsidence. Mine subsidence may result in topographical alterations thus affecting the surface water flow dynamics in which the overlying watercourses may flow into the underground voids and result in ponding. In some cases surface water flow may cease.

4.5.5 Fauna and Flora

There are currently several mines surrounding the Syferfontein study site, most of these are coal mines. This has a high cumulative impact on the general area as a whole. The construction of yet another mine in the area can be seen to have serious impacts on ecosystem function. Even though the proposed Syferfontein mine is underground, and not open-cast, it will add to the general environmental degradation caused by the numerous mines in the area in conjunction with other land uses (agriculture, residential development and cattle farming).

4.5.6 Surface Water

The project area is dominated by several streams and water resources including farm dams. Therefore, subsidence would result in an alteration of the hydrology of the area which could impact on the general catchment water balance. The water balance is important for other land uses determined such as agriculture and other mining activities within the area.

4.5.7 Social

Development of the proposed project, together with other existing or planned developments, could result in large-scale economic development in the broader project area. The impacts

that would result from a combination of the proposed project and other future developments in the broader project area are likely to have a significant cumulative effect in the region. A list of potential cumulative impacts is provided in Table 26 below. The list is only intended to illustrate the scope of potential cumulative impacts. These impacts are likely to increase gradually, while the contribution of the proposed project towards cumulative impacts will be incremental based on the implementation of various project phases, peak phases.

Table 4-1: Potential cumulative impacts

Nature	Direction of change	Extent of impact
Contribution to energy security in the country.	Positive	National and regional
Potential diversification of the local economy through LED activities of the mine and other companies.	Positive	Local
Improved standard of living through increased employment, local business development and improved public infrastructure and community services and facilities (the latter will be dependent on private-sector contributions)	Positive	Local and district and regional
Urban sprawl, housing backlog and/or growth of informal settlements.	Negative	Local
Added pressure on local public service delivery and infrastructure, including roads, water and sewage treatment works, schools, police services and waste management facilities.	Negative	Local and district
Possible increase in poverty in the area due to greater influx of job seekers and inability of the economy to absorb job seekers or to generate local employment.	Negative	Local
Climate change	Negative	International

For a more detailed description of each of the socio-economic cumulative impacts, please see the SIA (2014) as referenced.

4.5.8 Wetlands

If the risk of subsidence of unconsolidated sediments underlying wetlands is avoided, via proper management and adherence to the specifications of a geotechnical report, the proposed activity may be regarded as an insignificant contributor to the cumulative impacts on the water resources in the greater study area. Owing to the existing pressure on the water resources in the Upper Olifants catchment, however, the cumulative impacts of the proposed activity may be regarded as significant if subsidence is likely to occur. Wetlands are complex, interlinking systems and should be regarded on a large ecosystem-scale.

The wetlands found on the proposed project area have been classified as necessary and irreplaceable by the Mpumalanga Biodiversity Conservation Plan as stated in section 2.1.9 above. However, the ecological integrity of these wetlands could be compromised by the potential for subsidence due to the increased mining activity in the area. Furthermore, the increased pressure to deliver which is placed on subsistence farmers in proximity could result in poor agricultural practices and in some cases, extensive agricultural practices being implemented. This could further lead to more indirect impacts such as eutrophication or erosion into the wetlands thus decreasing the wetland integrity and threatening their function. The pan/depression habitats identified in proximity could also be at risk of being infringed by crops.

4.5.9 Heritage

An increase in other developments such as the Kriel South Project, the Syferfontein Colliery and the Twistdraai Colliery will create an increase in human presence (i.e. pedestrian and vehicle traffic) within the area which may place added stress on heritage resources within the surrounding areas.

4.6 Risk of Acid Mine Drainage

Upon sampling six boreholes within the study area for Acid-base Accounting (ABA) to determine the potential for Acid Mine Drainage (AMD), a series of steps was undertaken during the sample analysis and testing process. The samples analysed were:

- Two samples from the overburden (rocks above the No. 4 seams that could be exposed after mining);
- Two samples from the No. 4 coal seam; and
- Two samples from the underburden (rocks below the No. 4 seam that could be exposed after mining).

The results obtained were through undertaking the Phase pH, Sulphur speciation, Net Neutralisation Potential (NNP) and the Neutralisation Potential Ratio (NPR).

The paste pH of samples was found to be neutral, with an average of 7.2, and ranging between 6.5 and 8.1. None of the samples were found to have definite acidic or alkaline properties. This indicates that once the different layers are oxidised, the coal seam, the underlying rocks and overlying rocks could potentially be non-acid generating, depending on their sulphide mineral content. However, the paste pH alone is not a conclusive methodology for ABA classification. The sulphide content, acid generating and acid neutralisation materials of the samples need to be quantified for more comprehensive ABA evaluations.

For the sulphur speciation, the average sulphide content of all of the samples (coal seam, overburden and underburden) is 0.44% and could sustainably generate acid, unless they contain sufficient alkalinity to buffer over a prolonged period. The sulphide content of these rocks is however less than the typical values obtained from similar rocks of the Witbank and Highveld coal field with values between 1% and 3% not being uncommon.

The conclusion based on the NNP value is that the geochemical compositions of the rocks at the project area are heterogeneous, with some areas likely to generate acid whilst slightly acid neutralising in other areas.

Based on the ratio of NPR versus sulphide-sulphur of the six samples tested, one sample falls in the potentially acid generating zone, two fall in the non-acid generating zone, and three of the samples fall in the uncertain zone.

REGULATION 50 (B)

5 The alternative land use or developments that may be affected

When considering the allocation of land for development and in deciding applications for planning permission affecting agricultural land, the agricultural implications must be considered together with the environmental, cultural and socio-economic aspects. In particular, prime quality land should normally be protected against permanent development or irreversible damage.

5.1 A concise description of the alternative land use of the area in which the mine is proposed to operate

Consideration of land use alternatives is one of the cornerstones of community planning. Land use decisions must be evaluated in terms of sustainability, broadly defined as balancing environmental, economic and social equity concerns. The primary land use categories that encompass basic functions are residential, commercial, industrial, recreational, institutional, and agricultural uses. Land use is determined by a number of factors. These include climate, resources, population growth, economic activity and topography. When considering a new development for an area, it is required that other land use alternatives be considered to ensure that the development is justified and viable.

Agricultural and mining activities border the proposed project area. The land may also be used for additional agricultural purposes such as grazing. Mining will be by underground bord and pillar methods with high extraction which could possibly result in surface subsidence. It should be noted that should subsidence not occur, then other economic activities, such as farming, can co-exist with mining. Thus commercial farming and cattle grazing are regarded as the probable alternative land uses for the proposed Project area.

5.2 A list and description of all the main features and infrastructure related to the alternative land uses or developments

The features and infrastructure which can be expected in relation to the above mentioned alternative land uses include farmsteads and cattle kraals.

5.3 Map/plan

Please refer to Plan 1 and Plan 2 in Appendix A of this document.

6 The potential impacts of the alternative land use or development (REGULATION 50 (B))

6.1 A list of the potential impacts of each of the aforesaid main features and infrastructure related to the alternative land use or development and related listed activities

Subsistence and commercial crop production may have the following potential impacts on the proposed project area:

- Introduction of pollutants from agriculture runoff (including sedimentation);
- Modification of riparian zones through agricultural encroachment, erosion and flooding of the riparian zones;
- Loss of grassveld habitat;
- Influx of alien invasive plants;
- Introduction of dissolved salts from agriculture; and
- Increased pressure on water resources resulting in a loss of habitat and reduced water flows.

Subsistence animal farming may have the following potential impacts on the proposed Project area:

- Introduction of pollutants from agriculture runoff (including sedimentation);
- Overgrazing and trampling;
- Loss of grassveld habitat;
- Loss of faunal species of special concern;
- Loss of flora species of special concern;
- Influx of alien invasive plants;
- River bank livestock impacts through trampling and erosion, as well as nutrient input; and
- Introduction of dissolved salts from agriculture.

It is important to note that subsistence and commercial farming are able to commence concurrently with the underground mining activity.

6.2 Description of potential cumulative impacts of the main features and infrastructure related to the alternative land use or development.

When determining the impacts of a development such as this, one needs to consider cumulative impacts. Cumulative impacts take into account impacts of current land use and land use change in the broader area. Discussed below are the potential cumulative impacts caused by the alternative land use structures or features.

Subsistence crop farmers could potentially be implementing improper farming methods or using pesticides and various fertiliser chemicals on their crop fields. This may accumulate over years, combined with runoff and seeping into nearby water courses causing eutrophication. As a result, surface water quality may be compromised. Groundwater quality could also be compromised should some of the contaminated water seep into fractures on the ground. Furthermore, during subsistence crop farming, the overgrazing and trampling of cattle could potentially result in erosion over a long period of time. This could have an impact on land capability. It may also result in the loss of floral species of concern. Poor maintenance of the agricultural land could result in the influx of alien species.

REGULATION 50 (C)

7 Identification of potential social and cultural impacts

Mining will be undertaken by the conventional bord-and-pillar and high extraction method. Provided full pillar strengthening is applied, it can be assumed that the conventional bord-and-pillar mining method will have no surface-related environmental impact. It should be noted, however, that appropriate geotechnical design will be required to ensure there is no surface impact.

7.1 List of potential impacts of the proposed mining operation on the socio-economic conditions of other parties' land use activities both on the site and on adjacent and non- adjacent properties and farms to the extent that their socio-economic conditions may be directly affected

7.1.1 Job creation during operation through continuance of current employment

7.1.1.1 Impact description

A large proportion of the mine's permanent operational workforce will be sourced from the existing workforce of Sasol Syferfontein Colliery. The proposed project would therefore create the opportunity for these employees to extend current employment, instead of being retrenched. A large number of these employees are likely to reside within secondary study area, due to the close proximity to the operation.

Employment during the operational phase has the potential of being over an extended period (life of mine is estimated at 20 years), which can have a major, long term, positive impact for employees and their dependents. It is anticipated that production will span over 28 years from 2016-2041, the number of people to be employed by the project will be 113 people, which will decline to 34 in the last three years of operation.

The operational phase of the proposed project could give rise to some indirect employment opportunities. These could include jobs in the informal sector (as increased disposable income will likely create more employment opportunities in this sector), and in the formal sector (for instance, by sourcing goods and service from enterprises in the local municipal area where possible).

7.1.2 Regional economic development during operational phase

7.1.2.1 Impact description

The state will receive royalty and tax payments in the amount of R 309 331mil for the permanent extraction of non-renewable commodities by Sasol Mining (SARS, 2011). A proportion of these funds will likely be used to stimulate regional economic growth by re-investing the funds into infrastructure development throughout the secondary study area.

It is expected that the benefits of the proposed project will extend beyond members of the mine's workforce to suppliers through the procurement of products and services. In terms of current legislation, the mine and its contractors should consider the use of HDSA companies in their procurement practices. Sasol Mining's preferential procurement strategy adheres to the stipulation of the MPRDA and aims to achieve HDSA procurement targets. The strategy will increase opportunities for HDSA suppliers which will in turn be conducive to economic growth in the region.

The mine will employ a substantial workforce during its operational phase, and the projected monthly operational wage and procurement bill will result in a substantial injection of cash into the economies of the both study areas. This will stimulate the formal and informal retail and service sectors and other downstream secondary industries.

7.1.3 Decommissioning phase

The eventual termination of a mine's operating life is common to most extractive operations, and socio-economic consequences are inevitable. It should be noted that Socio-economic impacts associated with the eventual decommissioning of the mine at the end of its life are briefly discussed but are not subject to detailed assessment. This omission is motivated by the fact that predictions concerning the characteristics of the receiving socio-economic environment at the time of decommissioning (e.g. 28 years in the future) are subject to a large margin of error, thus significantly reducing the accuracy of impact assessment.

Several socio-economic impacts could arise when the mining operation is decommissioned and therefore form part of the scope of study when the EIA, SLP and mine closure plan for decommissioning of the mine is drafted. Socio-economic issues that could be focussed on include:

- **Impacts on the workforce** – *psychological issues* (e.g. distraction from normal activities, with a potentially negative impact on performance and safety), and *personal and family income issues* (e.g. concerns about the effect of reduced income on family life);
- **Impacts on the local community** – *economic dependency* (e.g. if new jobs are created, through dismantling and plant rehabilitation, but at remuneration levels lower than those in the mining industry, this might impact negatively on the local economy), *demographic changes* (e.g. migration of skilled workforce from the area); and

dependency on CSI initiatives (e.g. financial support to local amenities may be withdrawn by the mine);

- **Impacts on the wider community** - *the national and regional economy* (e.g. impact on the viability of other industries, such as Sasol Synfuels, due to the loss of locally produced outputs), financing of decommissioning (e.g. adequate funds may not have been provided for decommissioning and site rehabilitation); and infrastructure (e.g. mining assistance with road and infrastructure maintenance); and
- **Impacts on government** - District/local governments will no longer receive tax and royalty payments.
- As with several of the construction and operational phase impacts, decommissioning impacts can contribute to existing cumulative impacts, especially if closure of mining operations overlaps with the closure of other major mining or industrial operations in the secondary study.

7.2 List of potential impacts of the mining operation on any cultural and/ or heritage resources which may be applicable

The potential impacts identified relate to the bord and pillar underground mining technique used to mine coal. Since no blasting is to occur for the proposed mining activity, paleontological, archaeological, built environment resources and burial grounds and graves that may exist on the surface will not be impacted.

However, during the operational phase, potential subsurface paleontological resources may be exposed during underground mining activities. During the decommissioning phase, there are negligible risks for heritage resources. However, if the operational period is longer than 60 years, any structures including buildings, dumps, and industrial structures older than 60 years may be considered heritage resources. If this is the case, a HIA inclusive of a Built Environment Assessment may need to be conducted to assess the significance of the structures.

7.3 In cases where cultural impacts have been identified, describe the cultural aspect that will potentially be affected, and describe the potential impact on such cultural aspect.

No cultural resources were identified within the Project area.

7.4 In Cases where heritage features have been identified, describe such heritage feature and describe the potential impact on such heritage feature.

Heritage resources identified in the Project area include burial grounds and graves, and farmsteads or werwe (sing. werf). These ranged from obvious historical to more recent sites. The farms Vaalbank 96 IS and Zondagskraal 125 IS were surveyed during the HSA. The identified heritage resources include an old house and two graves. The old house may have been part of a werf that was identified on a 1955 Kinross-Trichardt aerial photograph during historical layering. There are two graves approximately 200 m north of the old house at site SAS1744/2629AC/S.36-001. The two graves comprise a single informal, stone-packed grave (S.36-001/1) and a formal grave dating to 1882 (S.36-001/2). The age of the grave suggests that the old house and/or werf on Vaalbank 96 IS may be between 131 and 58 years old. Two burial grounds were identified and recorded on Zondagskraal 125 IS Portion 2. The burial ground SAS1744/2926AC/S.36-002 comprises approximately 26 formal and informal graves. The graves date between 1961 and 1996. The burial ground SAS1744/2629AC/S.36-003 comprises approximately 68 formal and informal graves.

The farm Wildebeestfontein 122 IS Portions 1 and 3 were also surveyed during the HSA. The identified heritage resources include a werf and two formal graves. The werf comprising a stable, a house and a work shed that have been modified with new additions. During the historical layering, a homestead corresponding to the exact location of the werf at Site SAS1744/2629AC/S.34-002 was identified in a 1954 aerial photograph of Bethal. This suggests that the werf S.34-002 may be 59 years or older. A werf was identified and recorded on the farm Langsloot 99 IS Portion 16 during the HSA. During the historical layering, a homestead corresponding to the exact location of the werf at Site SAS1744/2629AC/S.34-003 was identified in a 1954 aerial photograph of Bethal. This suggests that the werf S.34-003 may be 59 years or older. The werf comprises a house, a stable and a work shed and many of these structures have been modified.

7.4.1 Operational Phase

Underground mining through the bord and pillar technique will not impact on archaeological, paleontological, and built environment resources and burial grounds and graves that may exist on the surface as there will be no blasting. This activity will not require a HIA.

During the Operational Phase, underground mining was identified as a source of risk to subsurface paleontological resources:

- Potential subsurface paleontological resources may be exposed during underground mining activities.

In terms of Section 2 (xxxi) of the NHRA, fossiliferous deposits that have commercial value are exempt from assessments. Furthermore it is not possible to assess any potential, value, and impact of fossils that may be found during especially underground mining. This activity

will therefore not require an HIA however a Fossil Find Procedure must be implemented during this phase.

7.4.2 Decommissioning Phase

During the decommissioning phase, there are negligible risks for heritage resources. However, if the operational period is longer than 60 years, any structures including buildings, dumps, and industrial structures older than 60 years may be considered heritage resources. If this is the case, a HIA inclusive of a Built Environment Assessment may need to be conducted to assess the significance of the structures.

7.4.2.1 SAHRA Recommendations

SAHRA agrees with the specialist that an exemption should be given from undertaking a heritage impact assessment in terms of the archaeological, built environment, visual and burials component. In the light of the high sensitivity of the palaeontology in the area though, SAHRA recommends that a palaeontologist, which specialises in palaeobotany, draft a letter to SAHRA outlining a proposed way forward to ensure the conservation of significant palaeontological heritage that is likely to be impacted by the proposed mining activities. This letter should contain instructions on the frequency of site inspections, as well as a procedure for chance finds. This letter must be submitted to SAHRA for assessment.

Should any new evidence of archaeological sites or remains (e.g., remnants of stone-made structures, indigenous ceramics, bones, stone artefacts, ostrich eggshell fragments, marine shell and charcoal/ash concentrations), rock art, unmarked human burials, fossils or other categories of heritage resources be found during the proposed activities, or in any future activities, SAHRA APM Unit (Tel: 021 462 4502) must be alerted immediately, and a professional archaeologist or palaeontologist, depending on the nature of the finds, must be contacted as soon as possible to inspect the findings. If the newly discovered heritage resources prove to be of archaeological or palaeontological significance a Phase 2 rescue operation might be necessary.

7.5 Quantification of the impact on the socio-economic conditions of directly affected persons, as determined by the findings and recommendations of a specialist report in that regard

7.5.1 The amount of the quantified potential impact expressed in terms of the loss in value of property or infrastructural assets that will potentially be impacted upon as a result of the mining activity

All surface subsidence could affect the quality of life of people in surrounding communities, and should therefore be viewed as constituting a potential social impact. The MWP indicates that the proposed project will represent extensive underground mining activities. Underground mining can be associated with surface subsidence, which would in turn impact

on surface land uses as well as groundwater levels in boreholes. In the context of this study subsidence can impact on:

Business and residential structures, by damaging and reducing the structural integrity of buildings, which could potentially displace residents and farm dwellers residing on affected properties.

- Road networks and power lines could be affected in a similar fashion;
- Groundwater, in that yields of deeply drilled boreholes can decrease considerably, which can diminish the financial viability of some agricultural operations in the vicinity in the mining right area as they would have to supplement water supply by purchasing water from the municipality;
- Surface contours on agricultural land, by changing water flow and damming patterns on land, which can have negative effect on commercial farming; and
- Land value, as land rendered vulnerable to subsidence will likely be perceived less valuable and less attractive for prospective properties developers, buyers and tenants.

It should be noted that from a technical point of view the proposed project is highly unlikely to result in any subsidence that will affect surface land uses, which implies that any displacement and consequential resettlement impacts involving farm-workers are unlikely to manifest. According to the proposed Projects MWP minimum, if any, subsidence will occur as result of mining activities.

However, public perception with regard to subsidence might be different, these perceptions, albeit incorrect, can still ultimately result in a devaluation of land. Ultimately such perceptions can have financial implications on surface rights owners who could expect certain profit margins on their initial property investments (SIA, 2014).

7.5.2 The amount of the quantified potential impact expressed in terms of the loss in net present value of commercial, economic or business activity which will be impacted upon as a result of the mining activity

During the Social Impact Assessment (SIA), it was noted that the proposed mining operation might entail negative financial implications for some commercial farmers. Several commercial farms operate and depend on land within and surrounding the primary study area, most of these farms depend solely on underground water for irrigation purposes. The geo-hydrological impact assessment established that the proposed mining activities will not significantly decrease the yield of most private boreholes, as these tend to be relatively shallow. However, boreholes deeper than 90m would potentially be impacted upon. It is assumed that a very small number of farmers, if any, rely on water from boreholes below this threshold. Such farmers, especially crop farmers, could potentially be affected in that they would have to supplement crop irrigation from boreholes with water from municipal schemes, in some instances this would require substantial supply infrastructure to be installed to

access government schemes. Additionally farmers would have the added cost of purchasing water from the GMLM, which would likely exceed the cost of electricity used to pump water from boreholes. Several commercial crop farmers indicated that a significant decrease in borehole yields would likely result in considerable financial implications for their businesses.

The following measures are recommended to mitigate the potential impacts described above:

- Sasol Mining should consider negotiating terms with the relevant farmers to supply or partially subsidise water to any affected operations; such provisions would have to be considered with the available water supply for the remainder of the population in the surrounding area;
- It is recommend that Sasol Mining should monitor borehole yields and suitability of water for irrigation in the primary study area during the mine's operational life and 5 years beyond. Such programmes should be incorporated into the Mine's EMP;
- Recommendations contained in the Project's EIA and EMP should continuously be implemented to minimise impacts on ground water levels;
- Sasol Mining should establish efficient channels of communication with surrounding farmers to promote the early identification of any water quality and quantity problems. Reported problems should be subject to objective monitoring, which will allow the mine to verify the validity of each claim; and
- Such a channel of communication will also serve to manage farmers' perceptions and concerns regarding the proposed project's impact on ground water.

8 Impact assessment and evaluation

8.1 Impact assessment methodology

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 Digby Wells, and the majority of environmental impact assessment practitioners, 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 I&APs 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 EIA's make reference to the environmental and socio-economic context of the 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 methodology employed for environmental impact assessment is divided into two distinct phases, namely, impact identification and impact assessment.

8.2 Impact identification

Impact identification is performed by use of an Input-Output 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 operational, closure and post-closure phases of the Project.

Outputs may generally be described as any changes to the biophysical and socio-economic environments, both positive and negative in nature, and also include the product and waste produced by the activity. Negative impacts could 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, construction of infrastructure, skills transfer 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, etc.) is considered.

8.3 Impact rating in terms of its nature, extent, duration, probability and significance

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 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. This gives the Project proponent a greater understanding of the impacts of his Project and the issues which need to be addressed by mitigation and also give the regulators information on which to base their decisions.

The equations and calculations were derived using Aucamp (2009).

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

Significance = Consequence x Probability

Where: Consequence = Severity + Spatial Scale + Duration

And: Probability = Likelihood of an impact occurring

The matrix calculates the rating out of 147, whereby Severity, Spatial Scale, Duration and Probability are each rated out of seven as indicated in Table 8-1. The weight assigned to the various parameters for positive and negative impacts is provided for in the formula.

Impacts are rated prior to mitigation and again after consideration of the mitigation measure proposed in the EMP. The significance of an impact is then determined and categorised into one of four categories, as indicated in Table 8-3, which is extracted from Table 8-2. In accordance with Regulation 51 of the MPRDA, management actions are assigned for all identified impacts.

Table 8-1: Impact assessment parameter ratings

Rating	Severity		Spatial scale	Duration	Probability
	Environmental	***Social, cultural and heritage***			
7	Very significant impact on the environment. Irreparable damage to highly valued species, habitat or ecosystem. Persistent severe damage.	Irreparable damage to highly valued items of great cultural significance or complete breakdown of social order.	International The effect will occur across international borders	Permanent: No Mitigation No mitigation measures/ natural process will reduce the impact after implementation.	Certain/ Definite. The impact will occur regardless of the implementation of any preventative or corrective actions.
6	Significant impact on highly valued species, habitat or ecosystem.	Irreparable damage to highly valued items of cultural significance or breakdown of social order.	National Will affect the entire country	Permanent: Mitigation Mitigation measures of natural process will reduce the impact.	Almost certain/Highly probable It is most likely that the impact will occur.
5	Very serious, long-term environmental impairment of ecosystem function that may take several years to rehabilitate	Very serious widespread social impacts. Irreparable damage to highly valued items	Province/ Region Will affect the entire province or region	Project Life The impact will cease after the operational life span of the Project.	Likely The impact may occur.

Rating	Severity		Spatial scale	Duration	Probability
	Environmental	***Social, cultural and heritage***			
4	Serious medium term environmental effects. Environmental damage can be reversed in less than a year	On-going serious social issues. Significant damage to structures / items of cultural significance	Municipal Area Will affect the whole municipal area	Long term 6-15 years	Probable Has occurred here or elsewhere and could therefore occur.
3	Moderate, short-term effects but not affecting ecosystem function. Rehabilitation requires intervention of external specialists and can be done in less than a month.	On-going social issues. Damage to items of cultural significance.	Local Local extending only as far as the development site area	Medium term 1-5 years	Unlikely Has not happened yet but could happen once in the lifetime of the Project, therefore there is a possibility that the impact will occur.
2	Minor effects on biological or physical environment. Environmental damage can be rehabilitated internally with/ without help of external consultants.	Minor medium-term social impacts on local population. Mostly repairable. Cultural functions and processes not affected.	Limited Limited to the site and its immediate surroundings	Short term Less than 1 year	Rare/ improbable Conceivable, but only in extreme circumstances and/ or has not happened during lifetime of the Project but has happened elsewhere. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures

Rating	Severity		Spatial scale	Duration	Probability
	Environmental	***Social, cultural and heritage***			
1	Limited damage to minimal area of low significance that will have no impact on the environment.	Low-level repairable damage to commonplace structures.	Very limited Limited to specific isolated parts of the site.	Immediate Less than 1 month	Highly unlikely/None Expected never to happen.

Table 8-2: Probability X consequence matrix

Significance									
		Consequence (severity + scale + duration)							
		1	3	5	7	9	11	15	18	21
Probability / Likelihood	1	1	3	5	7	9	11	15	18	21
	2	2	6	10	14	18	22	30	36	42
	3	3	9	15	21	27	33	45	54	63
	4	4	12	20	28	36	44	60	72	84
	5	5	15	25	35	45	55	75	90	105
	6	6	18	30	42	54	66	90	108	126
	7	7	21	35	49	63	77	105	126	147

Table 8-3: Significance threshold limits (environmental and social)

Significance			
Environmental	**Social**		
High	Major	108- 147	
Medium-High	Moderate	73 - 107	
Medium-Low	Minor	36 - 72	
Low	Negligible	0 - 35	

8.4 List of all potential environmental impacts

8.4.1 Construction Phase

The Syferfontein Block IV mining area is an already existing mine. The proposed Block IV expansion site will be accessed by means of an adit in the highwall from the existing Syferfontein mine. The infrastructure in the Syferfontein mine will be used in the Block IV expansion site. Therefore, the construction phase of this project will not be extensive. The expected noise impact from the proposed activities will be limited to the Syferfontein mining area, therefore the noise impact on the current ambient noise levels near the surrounding relevant receptors will be negligible. Thus Noise impacts will not be included in this section. Furthermore, since the project will be employing underground mining activities, visual

aspects and topographical features will incur negligible impacts. Therefore, they will not be described in this section.

8.4.1.1 Air Quality

Impact 1: Construction of underground structures - incline

Criteria	Details / Discussion				
Description of impact	Construction of the incline shaft results in the production of fugitive dust, PM10, PM2.5.(dust with a size less than 10 micron, and dust with a size less than 2.5 micron giving rise to health impacts). This activity will be short-term, localised, and will have low impacts on the atmospheric environment seizing after the construction activities.				
Mitigation required	Limiting construction activities during the windy months of August, September and October as dust levels will increase.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	2	2	3	6	42
Post-Mitigation	2	2	2	4	24

Impact 2: Transportation of materials & workers on site

Criteria	Details / Discussion				
Description of impact	During this activity, there is transportation of the workers and materials onsite. This leads to the production of fugitive dust (containing TSP (total suspended particulate, giving rise to nuisance impacts as fallout dust), as well as PM_{10} and $PM_{2.5}$ (dust with a size less than 10 micron, and dust with a size less than 2.5 micron giving rise to health impacts).				
Mitigation required	To mitigate the impacts of the activity, reduced vehicle speed, drop heights of loose and erodible materials should be minimised. Roads utilised when transporting the workers needs to be watered constantly.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*

Criteria	Details / Discussion				
Pre-Mitigation	2	2	2	7	42
Post-Mitigation	2	2	2	4	24

8.4.1.2 Wetlands

Impact 1: Loss of wetland habitat

Criteria	Details / Discussion				
Description of impact	Although the wetlands on site are not regarded as 'pristine' with regards to their PES values, further degradation of these systems should be avoided at all costs. As no surface infrastructure is anticipated for the proposed development, no direct loss of wetland habitat is expected. The potential for subsidence of unconsolidated surface sediments during the construction,				
Mitigation required	It is highly recommended that a geotechnical report is submitted in order to quantify the risk of subsidence, stipulate specifications for the bord and pillar methods to be followed as well as to supply a suitable Safety Factor (SF).				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	1	5	1	2	14
Post-Mitigation	1	5	1	1	7

8.4.2 Operational Phase

8.4.2.1 Air Quality

Impact 1: Underground bord and pillar mining method

Criteria	Details / Discussion
Description of impact	To remove of the ore, the bord and pillar method will be used. This activity includes drilling and blasting the hard overburden. Drilling is an intermittent exercise that emits fugitive dust. Fugitive dust will be released containing TSP, PM10 and PM2.5.

Criteria	Details / Discussion				
	Transportation of ore using haul roads will result in dust generation.				
Mitigation required	When blasting, it is advised to wet the proposed blasting area through the use of water cartridges alongside the explosives. The blast area needs to be minimise.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	5	4	7	84
Post-Mitigation	2	5	4	5	55

8.4.2.2 Aquatics

Impact 1: Changes to flow regimes

Criteria	Details / Discussion				
Description of impact	Subsidence could result in the alteration of topographical features, thus altering the surface water flow and catchment dynamics. Therefore, changes to surface water flow regimes are most likely to occur due to mine subsidence.				
Mitigation required	A geotechnical investigation should be conducted in order to quantify this risk of subsidence occurring. Should the risk of subsidence occurring be high, it is recommended that no mining of the resource take place within a 100m buffer of the respective watercourses.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	4	7	5	4	64
Post-Mitigation	4	7	4	1	15

Impact 2: Deterioration of water quality

Criteria	Details / Discussion				
Description of impact	Subsidence can also as a result, cause ground and surface water contamination due to acidification and salinisation of nearby aquifers. Additionally, subsidence may also result in a loss of water quantity for the catchment due to fissures or pits which may result.				
Mitigation required	A geotechnical investigation should be conducted in order to quantify this risk of subsidence occurring. Should the risk of subsidence occurring be high, it is recommended that no mining of the resource take place within a 100m buffer of the respective watercourses.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	4	7	4	4	60
Post-Mitigation	4	7	3	1	14

8.4.2.3 Fauna and Flora

Impact 1: Underground bord and pillar mining method

Criteria	Details / Discussion				
Description of impact	During the operational phase the board and pillar mining method could cause subsidence.				
Mitigation required	No Mitigation is possible for surface subsidence.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	5	5	4	52
Post-Mitigation	N/A				

8.4.2.4 Surface Water

Impact 1: Potential subsidence of the undermined surface

Criteria	Details / Discussion				
Description of impact	Subsidence potential could occur when mining takes place which can also cause open fractures which allows for surface water to flow into lower strata or open mine workings. This could occur as a result of pillars being mined out completely or partially not adequate to support overburden material. As a result mine induced fracturing could result in increased rainfall infiltration, reduced runoff and reduced base flow discharge thus resulting in stream flow reduction and loss particularly during the low flow conditions affecting the catchments water balance.				
Mitigation required	■ The correct safety factors to be used to insure reduced collapse of undermined areas ■ The subsidence prediction calculations should be carried out based on the various factors such as geology, extraction patterns and ore thickness amongst others; ■ Annual subsidence monitoring (Aerial surveys/ Land surveys) can assist in determining where the impact is taking place and planning control of damages; and ■ Where it is feasible backfilling could be considered				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	6	3	5	4	56
Post-Mitigation	6	2	4	2	24

8.4.2.5 Groundwater

Impact 1: Mine dewatering

Criteria	Details / Discussion				
Description of impact	Mine dewatering is crucial to keep the underground workings dry for safe working conditions. The dewatering is recommended to start with the starting of the excavation. This however can potentially impact the groundwater environment negatively by lowering the water level and creating a cone of depression/dewatering once subsidence occurs or in the vicinity of vertical fractures				
Mitigation required	Monitoring of water levels is recommended with continuous refining and updating of the monitoring network based on the results obtained. Since the operation phase will take place over a prolonged period, more monitoring boreholes will be required.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	5	4	5	60
Post-Mitigation	3	5	3	3	33

Impact 2: Mine water contamination

Criteria	Details / Discussion
Description of impact	Once the coal pillar and nearby rocks are exposed to oxygen and moisture, saline water can be released from the underground workings. Contaminants can also be generated as a result of drilling and blasting during the operation. During operation any potential contaminants that could originate from the mine workings will be pumped out as part of the mine dewatering process and the hydraulic gradient will be towards the mine.
Mitigation required	■ If subsidence occurs and sinkholes are formed during operation, they should be rehabilitated as soon as possible to minimise water and oxygen inflow from the atmosphere. This will minimise or avoid oxidation reactions and potential acid generation;

Criteria	Details / Discussion				
	■ Nitrate-based explosives should be avoided or minimised to lower groundwater contamination; ■ Monitoring of groundwater quality and water levels is recommended (particularly down gradient of the mine site) with continuous refining and updating of the monitoring network based on the results obtained. Since the operational phase will take place over a prolonged period, more monitoring boreholes will be required; ■ Refine the conceptual and numerical models every year in the first four years and thereafter every five years based on groundwater monitoring results; and ■ Annual audits of monitoring and management systems should be conducted by independent environmental consultants.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	6	5	5	70
Post-Mitigation	2	5	2	3	27

Impact 3: Underground hydrocarbon spillage

Criteria	Details / Discussion
Description of impact	Organic solvents, diesel or other organic fluids may be spilled in the underground workings or leak from storage tanks during mine operation. This could have a potential negative impact on groundwater quality.
Mitigation required	■ All underground storage areas containing hazardous substances need to be bunded, with the necessary spill prevention and emergency response measures in place; ■ It is recommended that diesel or other chemicals to be used are handled properly and not spilled; ■ If a considerable amount of fluid is accidentally spilled, the contaminated rock should be scraped off and disposed of at an

Criteria	Details / Discussion				
	acceptable dumping facility; and ■ Both groundwater level and quality have to be monitored to detect any changes in water conditions.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	5	3	4	44
Post-Mitigation	2	5	2	3	27

8.4.2.6 Wetlands

Impact 1: Loss of wetland areas and vegetation

Criteria	Details / Discussion				
Description of impact	If surface subsidence occurs within wetland areas, a loss of wetland habitat as well as a loss of connectivity between wetland areas is likely to occur. A total of 263.77 ha of wetland habitat are underlain by proposed underground mining.				
Mitigation required	It is highly recommended that a geotechnical report is submitted in order to quantify the risk of subsidence, stipulate specifications for the bord and methods to be followed as well as to supply a suitable Safety Factor (SF).				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	5	3	4	44
Post-Mitigation	1	5	1	2	14

Impact 2: Loss of sensitive species

Criteria	**Details / Discussion**				
Description of impact	Due to the potential of subsidence, wetland integrity is at risk of being compromised thus resulting in the loss of sensitive species.				
Mitigation required	It is highly recommended that a geotechnical report is submitted in order to quantify the risk of subsidence, stipulate specifications for the bord and methods to be followed as well as to supply a suitable Safety Factor (SF) of 2 below streams and infrastructure and 1.6 in all other areas.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	5	3	4	44
Post-Mitigation	1	5	1	2	14

8.4.3 Decommissioning Phase

8.4.3.1 Fauna and Flora

Impact 1: Subsidence

Criteria	**Details / Discussion**				
Description of impact	During the decommissioning phase, there is a possibility that subsidence could occur.				
Mitigation required	No Mitigation is possible for surface subsidence.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	5	5	4	52
Post-Mitigation	N/A				

8.4.3.2 Surface Water

Impact 1: Subsidence

Criteria	Details / Discussion				
Description of impact	The impacts experienced in this phase of the project are as described in the operational phase. The potential of subsidence could occur when mining takes place which can also cause open fractures which allows for surface water to flow into lower strata or open mine workings. This could occur as a result of pillars being mined out completely or partially not adequate to support overburden material. As a result mine induced fracturing could result in increased rainfall infiltration, reduced runoff and reduced baseflow discharge thus resulting in streamflow reduction and loss particularly during the low flow conditions affecting the catchments water balance.				
Mitigation required	■ The correct safety factors to be used to insure reduced collapse of undermined areas ■ The subsidence prediction calculations should be carried out based on the various factors such as geology, extraction patterns and ore thickness amongst others; ■ Annual subsidence monitoring (Aerial surveys/ Land surveys) can assist in determining where the impact is taking place and planning control of damages; and ■ Where it is feasible backfilling could be considered				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	6	3	5	4	56
Post-Mitigation	6	2	4	2	24

8.4.3.3 Groundwater

Impact 1: Mine water contamination

Criteria	Details / Discussion				
Description of impact	Once the mine is closed and dewatering ceases, groundwater will start to recover to its pre-mining level. Following full recovery; the contaminants will start to migrate away from the mine site.				
Mitigation required	■ Water monitoring should continue after mine closure. If sinkholes are formed, they should be rehabilitated as soon as possible to minimise water and oxygen inflow from the surface; ■ Water abstraction from deep boreholes that are close to the mine workings should be avoided so that contaminants will not migrate towards the abstraction boreholes, and away from the mine voids; and ■ Monitoring of groundwater quality and water levels is recommended (particularly down gradient of the mine site) with continuous refining and updating of the monitoring network based on the results obtained.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	6	5	6	84
Post-Mitigation	3	5	3	4	44

Impact 2: Mine decant

Criteria	Details / Discussion
Description of impact	Model simulations show that the mine is unlikely to decant after closure. As stated previously, no new shafts will be constructed within the project boundary. The only shaft in the area will be located at the existing Syferfontein Mine, east of the current project site. If the effects of only the project area are considered, no decant at the shaft will take place.
Mitigation required	■ No decant mitigation is required, since no decanting is expected to occur at the shaft. However, if sinkholes are formed they should be sealed and rehabilitated as soon as possible to minimise or avoid

Criteria	Details / Discussion				
	decanting; and ■ Should decanting occur, passive or active treatment plants should be considered for treatment before the decant joins the streams.				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	5	5	2	26
Post-Mitigation	3	3	3	1	9

8.4.3.4 Soil

Impact 1: Subsidence

Criteria	Details / Discussion				
Description of impact	Subsidence occurs when underground mining has taken place and the correct safety factors are not used, the undermined areas can collapse and change surface drainage and as a result change Land Capabilities				
Mitigation required	■ The correct safety factors to be used to insure no collapse of undermined areas; and ■ Annual subsidence monitoring (Aerial surveys/ Land surveys).				
Parameters	*Spatial*	*Duration*	*Severity*	*Probability*	*Significant rating*
Pre-Mitigation	3	7	5	5	75
Post-Mitigation	1	3	4	3	24

REGULATION 50 (D)

9 Alternative land uses which will be impacted upon

9.1.1 Impacts on current land use

The affected farm portions are listed in Table 1-1 in this document. They are located approximately 16 km northwest from the town of Secunda and approximately 8 km north from the town of Leandra within South Africa's Mpumalanga Province.

The current land use on the farm portions where the proposed Block IV expansion area extends is agriculture. Commercial farming is the most prominent land use in Gert Sibande District. The potential of mine subsidence due to the high extraction bord and pillar technique poses a negative impact on the agricultural productivity of the project area. The underground mining operations also impact on the current land use in that all agricultural activity in the affected farm portions could be compromised. Although growing crops could still be possible, it could be potentially reduced due to subsidence. The grazing on the affected farms should not be affected in any significant manner depending on the level of subsidence. However, those adjacent farms which are not directly affected by the underground mining activities can continue to be used for agricultural purposes.

9.1.2 Assessment of duration of impacts

The proposed Project area is expected to yield coal reserves during the underground mining operations up until ±2055. However, should the area subside due to the high extraction mining methods, the impacts could be permanent.

9.1.3 Assessment of severity

Various specialist studies were conducted to assess the impacts of the proposed mining activities and the associated severity. The severity level for the operation and decommissioning phases have been calculated for each of the specialist studies and can be found in section 8.4 of this report. In general the only environmental aspect that may be significantly impacted upon is groundwater quality. The severity of this impact, prior to mitigation is 70. However with the proposed mitigation measures implemented, the severity is 27.

10 Sustainable development

Currently, no study has been conducted in accordance with generally accepted principles of sustainable development by integrating social, economic and environmental factors into a comparison of the costs and benefits of the alternative land uses with those of the mining operation on an equitable basis. However, taking into account the minimal potential environmental impacts, and the positive economic and social aspects associated with the project, it is likely that the project will be sustainable in the long term. The mitigation measures recommended for each of the environmental impacts contribute towards a sustainable project. As mentioned above, the most significant impacts anticipated for this project are imposed onto groundwater quality, with the most significant source of impact being subsidence. Due to the extension of the LoM by at least 20 years, the mine employees are able to keep their jobs for a longer period. More socio-economic benefits of the project can be found in the SIA. Therefore, in light of the economic and social benefit of the project, coupled with the mitigation and monitoring measures established by the specialists for the proposed impacts, this project is regarded as sustainable.

11 Mitigation Measures (REGULATION 50 (e))

11.1 List of all significant impacts as identified in the EIA

Table 11-1: Mitigation and Management Measures Following Rehabilitation

Impact	Mitigation and Management Measures
Contamination of groundwater due to subsidence and exposure of pyrites present in underground workings to oxygen and water. This may potentially result in AMD.	If subsidence occurs and sinkholes are formed during operation, they should be rehabilitated as soon as possible to minimise water and oxygen inflow from the atmosphere. This will minimise or avoid oxidation reactions and potential acid generation. Monitoring of groundwater quality and water levels is recommended (particularly down gradient of the mine site) with continuous refining and updating of the monitoring network based on the results obtained.
Mine subsidence altering the natural drainage patterns of the area changing soil physical properties as well as the chemical properties over time. Land capability is also decreased as a result.	Ensure that the correct safety factors are used to minimise the potential for collapse of undermined areas. Safety factors of at least 1.8 are to be used with higher safety factors employed beneath watercourses. No high extraction mining to be undertaken beneath watercourses. Annual subsidence monitoring (Aerial surveys/ Land surveys) to be done

Impact	Mitigation and Management Measures
Surface subsidence could affect the quality of life of people in surrounding communities, and should therefore be viewed as constituting a potential social impact. Additionally, surface land uses as well as groundwater levels in boreholes can be impacted upon.	Sasol Mining should establish efficient channels of communication with surrounding landowners to promote the early identification of any surface subsidence. Reported problems should be subject to objective monitoring, which will allow the mine to verify the validity of each claim. Sasol Mining should prepare contingency measures to compensate for any financial and/or livelihood impacts that might result from mining related surface subsidence.

12 Public consultation (REGULATION 50 (f))

A Public Participation Process (PPP) has been initiated, which is central to the investigation of environmental impacts as it is important that stakeholders who are potentially affected by the proposed Project are given an opportunity to identify issues relevant to them and to ensure that local knowledge, needs and values are understood and utilised. The views of stakeholders are included in the Comment and Responses Report (CRR) (Appendix C) and used either to validate the scope of specialist studies that were commissioned or to indicate where additional specialist studies may be required to ensure that relevant issues are addressed.

12.1 The identification of interested and affected parties

12.1.1 State whether or not the Community is also the Landowner.

The majority of farm portions located within the Project area are privately owned (there are no communal landowners). The Govan Mbeki Local Municipality, Eskom and Transnet are also owners of a few portions. Please refer to Table 12-1 for a full list of landowners within the proposed Project area.

12.1.2 State whether or not the Department of Land Affairs have been identified as an interested and affected party

The Department of Rural Development and Land Reform has been identified as an Interested and Affected Party (I&AP) and the Background Information Document (BID) has been emailed to the relevant contact person. Throughout the PPP the Department of Rural Development and Land Reform has also been invited to attend public meetings and provided with reports in order to submit comments about the proposed Project.

12.1.3 State specifically whether or not a land claim is involved

Digby Wells enquired if there are any land claims on the various properties and have received confirmation from Ms Gift Mathonsi of the Department of Rural Development and

Land Reform, Land Claims Commission, that none exist on these properties. Please refer to Appendix C for the Department of Rural Development and Land Reform, Land Claims Commission's response dated 4 March 2014.

12.1.4 Name the Traditional Authority identified by the applicant.

No traditional authorities for the area were identified as the properties do not fall within communal land.

12.1.5 List the landowners identified by the applicant (Traditional and Title Deeds owners).

The land owners are indicated in Table 12-1 below. The land tenure of the proposed area is depicted on Plan 3 (Appendix A). No traditional landowners were identified.

Table 12-1: Landowners and properties directly affected

Farm	Portion	Registered Landowner
DIEPLAAGTE 123 IS	7	Nicol de Vos Paulina Boerderye (Pty) Ltd
DIEPLAAGTE 123 IS	1	Nicol de Vos Paulina Boerderye (Pty) Ltd
LANGSLOOT 99 IS	16	Nicol de Vos Paulina Boerderye (Pty) Ltd
LANGSLOOT 99 IS	17	Nicol de Vos Paulina Boerderye (Pty) Ltd
RIETFONTEIN 100 IS	12	Nelius Greyling
RIETFONTEIN 100 IS	7	Robert Schwartz
RIETFONTEIN 100 IS	6	Nicol de Vos Paulina Boerderye (Pty) Ltd
RIETFONTEIN 100 IS	14	Nicol de Vos Paulina Boerderye (Pty) Ltd
RIETFONTEIN 100 IS	4	Nicol de Vos Paulina Boerderye (Pty) Ltd
RIETFONTEIN 100 IS	10	Robert Schwartz
RIETFONTEIN 100 IS	8	Nicol de Vos Paulina Boerderye (Pty) Ltd
RIETFONTEIN 100 IS	2	Nelius Greyling Farm Manager Frans Geyser

Farm	Portion	Registered Landowner
RIETFONTEIN 100 IS	13	Nicol de Vos Paulina Boerderye (Pty) Ltd
RIETFONTEIN 100 IS	9	Nicol de Vos Paulina Boerderye (Pty) Ltd
RIETFONTEIN 100 IS	15	Robert Schwartz
RIETFONTEIN 100 IS	5	Nicol de Vos Paulina Boerderye (Pty) Ltd
RIETFONTEIN 100 IS	11	Nicol de Vos Paulina Boerderye (Pty) Ltd
RIETFONTEIN 101 IS	4	Nelius Greyling
RIETFONTEIN 101 IS	5	Cornelius Johannes Greyling
RIETFONTEIN 101 IS	RE	Dirk Kitching Anglo Operations Ltd
RIETFONTEIN 101 IS	2	Dirk Kitching Anglo Operations Ltd
RIETFONTEIN 101 IS	1	No Information available
RIVERSDALE 119 IS	13	Robert Schwartz
RIVERSDALE 119 IS	1	Piet-Nel de Vos Sasol Mining (Pty) Ltd
UITKYK 136 IS	5	No Information available
VAALBANK 96 IS	2	Johan Barnard Highland Night Inc 59 (Pty) Ltd
WILDEBEESTFONTEIN 122 IS	3	Gustaf Heymans Highveld Bargains & Deals CC
WILDEBEESTFONTEIN 122 IS	4	Thianne Volschenck Volschenk Familie Trust"
WILDEBEESTFONTEIN 122 IS	13	Anton Engelbrecht Boerdery (Pty) Ltd
WILDEBEESTFONTEIN 122 IS	1	Gustaf Heymans Highveld Bargains & Deals CC
WILDEBEESTFONTEIN 122 IS	7	Thianne Volschenck Volschenk Familie Trust
WILDEBEESTFONTEIN 122 IS	5	Johanna Gustavus Taljaard

Farm	Portion	Registered Landowner
WILDEBEESTFONTEIN 122 IS	RE	No Information available
WILDEBEESTFONTEIN 122 IS	14	George du Toit GOR Konstruksie CC
WILDEBEESTFONTEIN 122 IS	11	Francois Viljoen JC van der Walt
WILDEBEESTFONTEIN 122 IS	12	Thianne Volschenck Volschenk Familie Trust
WILDEBEESTFONTEIN 122 IS	6	Kosie van der Merwe PJ Rossouw
WILDEBEESTFONTEIN 122 IS	15	Johanna Gustavus Taljaard
WILDEBEESTFONTEIN 122 IS	19	No Information available
WILDEBEESTFONTEIN 122 IS	2	Phillip de Klerk Transnet
WILDEBEESTFONTEIN 122 IS	20	Phillip de Klerk Transnet
WILDEBEESTFONTEIN 122 IS	8	Josiah Zungu Eskom
WINKELHAAK 135 IS	RE	No Information available
ZONDAGSFONTEIN 124 IS	1	Nicol de Vos Paulina Boerderye (Pty) Ltd
ZONDAGSFONTEIN 124 IS	5	Nicol de Vos Paulina Boerderye (Pty) Ltd
ZONDAGSFONTEIN 124 IS	7	Nicol de Vos Paulina Boerderye (Pty) Ltd
ZONDAGSFONTEIN 124 IS	6	Nicol de Vos Paulina Boerderye (Pty) Ltd
ZONDAGSFONTEIN 124 IS	3	Nicol de Vos Paulina Boerderye (Pty) Ltd
ZONDAGSFONTEIN 124 IS	4	Nicol de Vos Paulina Boerderye (Pty) Ltd
ZONDAGSFONTEIN 124 IS	9	Nicol de Vos Paulina Boerderye (Pty) Ltd
ZONDAGSFONTEIN 124 IS	10	Basil Plastzky (Kinross Farms (Pty) Ltd

Farm	Portion	Registered Landowner
ZONDAGSFONTEIN 124 IS	21	Nicol de Vos Paulina Boerderye (Pty) Ltd
ZONDAGSFONTEIN 124 IS	8	Lukas JB Potgieter
ZONDAGSFONTEIN 124 IS	2	Lukas JB Potgieter
ZONDAGSFONTEIN 124 IS	29	Ms Sabeth Nkosi/Ms Nomalizo Wetbooi Govan Mbeki Local Municipality Kinross
ZONDAGSFONTEIN 124 IS	26	Nicol de Vos Paulina Boerderye (Pty) Ltd
ZONDAGSFONTEIN 124 IS	12	Nicol de Vos Paulina Boerderye (Pty) Ltd
ZONDAGSKRAAL 125 IS	2	Johan Barnard Orambamba 25 (Pty) Ltd
ZONDAGSKRAAL 125 IS	15	Russel Pilay
ZONDAGSKRAAL 125 IS	25	No Information available
ZONDAGSKRAAL 125 IS	24	Nicol de Vos Paulina Boerderye (Pty) Ltd
ZWAKFONTEIN 120 IS	15	Piet-Nel de Vos Sasol Mining (Pty) Ltd
ZWAKFONTEIN 120 IS	34	Russel Pilay
ZWAKFONTEIN 120 IS	23	Piet-Nel de Vos Sasol Mining (Pty) Ltd
ZWAKFONTEIN 120 IS	35	Piet-Nel de Vos Sasol Mining (Pty) Ltd
ZONDAGSFONTEIN 124 IS	26	Vosstoffel Pty Ltd
ZONDAGSFONTEIN 124 IS	12	Vosstoffel Pty Ltd
ZONDAGSFONTEIN 124 IS	29	Mun Kinross
ZONDAGSFONTEIN 124 IS	10	Kinross Farms Pty Ltd
RIETFONTEIN 101 IS	1	Anglo Operations Pty Ltd
RIETFONTEIN 101 IS	2	Anglo Operations Pty Ltd
RIETFONTEIN 101 IS	4	Greyling Cornelius Johannes
RIETFONTEIN 101 IS	5	Greyling Cornelius Johannes
RIETFONTEIN 101 IS	R/E	Anglo Operations Pty Ltd

Farm	Portion	Registered Landowner
RIETFONTEIN 101 IS	20	No Information Available
RIETFONTEIN 101 IS	4	Vosstoffel Pty Ltd
RIETFONTEIN 101 IS	5	Vosstoffel Pty Ltd
RIETFONTEIN 101 IS	8	Paulana Boerderye Pty Ltd
RIETFONTEIN 101 IS	10	Schwartz Theodore
RIETFONTEIN 101 IS	11	Vosstoffel Pty Ltd
RIETFONTEIN 101 IS	13	Vosstoffel Pty Ltd
RIETFONTEIN 101 IS	9	Vosstoffel Pty Ltd
RIETFONTEIN 101 IS	14	Paulana Boerderye Pty Ltd
RIETFONTEIN 101 IS	12	Greyling Cornelius Johannes
RIETFONTEIN 101 IS	2	Greyling Cornelius Johannes
RIETFONTEIN 101 IS	6	Paulana Boerderye Pty Ltd
RIETFONTEIN 101 IS	7	Schwartz Theodore
RIETFONTEIN 101 IS	15	National Government Of The Republic Of South Africa
WILDEBEESTEFONTEIN 122 IS	12	Volschenk Familie Trust
WILDEBEESTEFONTEIN 122 IS	2	Transnet Ltd
WILDEBEESTEFONTEIN 122 IS	11	Van Der Walt Johanna Christina
WILDEBEESTEFONTEIN 122 IS	8	Eskom
WILDEBEESTEFONTEIN 122 IS	29	No Information available
WILDEBEESTEFONTEIN 122 IS	25	No Information available
WILDEBEESTEFONTEIN 122 IS	21	Taljaard Jacobus Abraham
WILDEBEESTEFONTEIN 122 IS	22	De La Guerre Florence Julia
WILDEBEESTEFONTEIN 122 IS	6	Rossouw Petrus Jacobus
WILDEBEESTEFONTEIN 122 IS	19	No Information available
WILDEBEESTEFONTEIN 122 IS	28	South African National Roads Agency Ltd
WILDEBEESTEFONTEIN 122 IS	5	Taljaard Johanna Gustavus
ZWAKFONTEIN 120 IS	23	Sasol Mining Pty Ltd
ZWAKFONTEIN 120 IS	35	Sasol Mining Pty Ltd
ZWAKFONTEIN 120 IS	15	Sasol Mining Pty Ltd
ZWAKFONTEIN 120 IS	34	Sasol Mining Pty Ltd

Farm	Portion	Registered Landowner
RIVERSDALE 119	13	Republiek Van Suid-Afrika
RIVERSDALE 119	1	Sasol Mining Pty Ltd

12.1.6 List the lawful occupiers of the land concerned.

The land owners are indicated in Table 12-1 above. All properties are privately owned, as indicated, with no lawful occupiers idetified. The land tenure of the proposed area is depicted on Plan 3 (Appendix A).

12.1.7 Explain whether or not other persons' (including on adjacent properties) socio-economic conditions will be directly affected by the proposed prospecting or mining operation and if not, explain why not.

Adjacent property owners and occupiers' socio economic conditions may be affected by the proposed Project. Adjacent farms and farm owners have been identified and are indicated in Table 12-2.

Table 12-2: Adjacent property details

Farm	Portion	Registered Landowner
AANGEWYS 81 IS	22	Dirk Kitching Anglo Operations Ltd
AANGEWYS 81 IS	28	Dirk Kitching Anglo Operations Ltd
AANGEWYS 81 IS	26	Dirk Kitching Anglo Operations Ltd
AANGEWYS 81 IS	23	Dirk Kitching Anglo Operations Ltd
BAKENLAAGTE 84 IS	RE	Bakenlaagte Boerdery (Pty) Ltd
BRAKFONTEIN 117 IS	1	Dirk Kitching Anglo Operations Ltd
HOLFONTEIN 138 IS	10	NU-VAC (Pty) Ltd
HOLFONTEIN 138 IS	9	Holfontein Trust
HOLFONTEIN 138 IS	4	Holfontein Trust
HOLFONTEIN 138 IS	2	Johan Barnard Orambamba 25 (Pty) Ltd
LANGSLOOT 99 IS	4	Karen Brytenbach

Farm	Portion	Registered Landowner
LANGSLOOT 99 IS	14	Nicol de Vos Paulina Boerderye (Pty) Ltd
LANGSLOOT 99 IS 13	13	Nicol de Vos Paulina Boerderye (Pty) Ltd
Number Null 15	1	Dirk Kitching Anglo Operations Ltd
ONVERWACHT 97 IS	5	Nicol de Vos Paulina Boerderye (Pty) Ltd
ONVERWACHT 97 IS	1	Nicol de Vos Paulina Boerderye (Pty) Ltd
ONVERWACHT 97 IS	2	Nicol de Vos Vosstoffel (Pty) Ltd
ONVERWACHT 97 IS 4	4	Nicol de Vos Vosstoffel (Pty) Ltd
ONVERWACHT 97 IS 3	3	Nicol de Vos Vosstoffel (Pty) Ltd
RIETFONTEIN 101 IS 3	3	Johannes Cornelius Greyling
RIVERSDALE 119 IS	11	Piet-Nel de Vos Sasol Mining (Pty) Ltd
RIVERSDALE 119 IS	2	Piet-Nel de Vos Sasol Mining (Pty) Ltd
SPANDOW 121 IS	1	Nicol de Vos Vosstoffel (Pty) Ltd
SPANDOW 121 IS	RE	Nicol de Vos Vosstoffel (Pty) Ltd
TWEEDRAAI 139 IS	11	Nicol de Vos Vosstoffel (Pty) Ltd
TWEEFONTEIN 13 IS	81	No Information available
UITKYK 136 IS	R	Chivic Boerdery CC
UITKYK 136 IS	1	Phillip de Klerk Transnet
UITKYK 136 IS	4	Phillip de Klerk Transnet

Farm	Portion	Registered Landowner
UITKYK 136 IS	3	Josiah Zugu Eskom
VAALBANK 96 IS	1	Highveld Night INV 56 Pty Ltd
VAALBANK 96 IS	RE	Razorbill Prop 301 Pty Ltd
VLAKLAAGTE 83 IS	4	Josiah Zugu Eskom
VLAKLAAGTE 83 IS	5	Josiah Zugu Eskom
VLAKLAAGTE 83 IS	1	Josiah Zugu Eskom
VLAKLAAGTE 83 IS	3	Josiah Zugu Eskom
WITBANK 80 IS	23	H J Pieterse Vlakfontein Tweehondered Pty Ltd
ZONDAGSKRAAL 125 IS	8	Johan Barnard Orambamba 25 (Pty) Ltd
ZONDAGSKRAAL 125 IS	7	Sabeth Nkosi Govan Mbeki Local Municipality
ZWAKFONTEIN 120 IS	22	Elizabeth Deonie Du Rand
ZWAKFONTEIN 120 IS	24	Nicol de Vos Vosstoffel (Pty) Ltd
ZWAKFONTEIN 120 IS	29	Hennie Marais
ZWAKFONTEIN 120 IS	25	Nicol de Vos Paulina Boerderye (Pty) Ltd
ZWAKFONTEIN 120 IS	1	Piet-Nel de Vos Sasol Mining (Pty) Ltd
ZWAKFONTEIN 120 IS	12	Marius Hendrik
ZWAKFONTEIN 120 IS	21	William Thomas Johan Charter
ZWAKFONTEIN 120 IS	20	Marius Hendrik
ZWAKFONTEIN 120 IS	19	Marius Hendrik
ALEXANDER 102 IS	5	Dunn Maria Magdalena Catharina
AANGEWYS 81 IS	22	Anglo Operations Pty Ltd

Farm	Portion	Registered Landowner
AANGEWYS 81 IS	26	Anglo Operations Pty Ltd
AANGEWYS 81 IS	81	No Information available
AANGEWYS 81 IS	28	Anglo Operations Pty Ltd
AANGEWYS 81 IS	23	Anglo Operations Pty Ltd
BOSCHMANSKRAAL 113 IS	4	Theron Daniel Albertus
BRAKFONTEIN 117 IS	R/E	Anglo Operations Pty Ltd
BAKENLAAGTE 84 IS	84	Bakenlaagte Boerdery Pty Ltd
DRIEFONTEIN 197 IS	137	Eskom Holdings Ltd
HOLFONTEIN 138	2	Orambamba 48 Pty Ltd
HOLFONTEIN 138	9	Holfontein Trust
HOLFONTEIN 138	10	Nu-Vac Pty Ltd
HOLFONTEIN 138	4	Holfontein Trust
HOLFONTEIN 138	20	No Information available
KRUISEMENTFONTEIN 95 IS	1	Octo Consobrini Beleggings Pty Ltd
KINROSS 133 IS	6	Vosstoffel Pty Ltd
LANGSLOOT 99 IS	4	Breytenbach Karen
LANGSLOOT 99 IS	14	Vosstoffel Pty Ltd
LANGSLOOT 99 IS	13	Vosstoffel Pty Ltd
TWEEDRAAI 139 IS	11	Vosstoffel Pty Ltd
UITKYK 136 IS	1	Transnet Ltd
UITKYK 136 IS	3	Eskom
UITKYK 136 IS	R/E	Chivic Boerdery Cc
UITKYK 136 IS	5	No Information available
VLAKLAAGTE 83 IS	4	Eskom
VLAKLAAGTE 83 IS	5	Eskom
VLAKLAAGTE 83 IS	3	Eskom
VLAKLAAGTE 83 IS	1	Eskom
WINKELHAAK 135 IS	54	Evander Township Ltd
WINKELHAAK 135 IS	154	No Information available
WINKELHAAK 135 IS	158	No Information available

Farm	Portion	Registered Landowner
WINKELHAAK 135 IS	157	Suid-Afrikaanse Nasionale Padagentskap Ltd
WINKELHAAK 135 IS	8	Homann Anna Leonora
WINKELHAAK 135 IS	9	Vosstoffel Pty Ltd
WINKELHAAK 135 IS	26	Republiek Van Suid-Afrika
WITBANK 80 IS	23	H J Pieterse Vlakfontein Tweehonderd Pty Ltd
ZONDAGSKRAAL 125 IS	24	Vosstoffel Pty Ltd
ZONDAGSKRAAL 125 IS	25	No Information available
ZWAKFONTEIN 120 IS	22	Du Rand Deonie Elizabeth

During the process of public engagement, concerns and comments the landowners have made, and how they could be affected by the proposed mining activities, have been captured in a CRR which is attached as an Appendix to the FEIAR. A social impact assessment was also undertaken during the EIA for the proposed Project, which further highlighted how these landowners may be impacted.

12.1.8 Name the Local Municipality identified by the applicant.

The proposed Project will be located within the Govan Mbeki Local Municipality and within the Gert Sibande District Municipality.

12.1.9 Name the relevant Government Departments, agencies and institutions responsible for the various aspects of the environment, land and infrastructure which may be affected by the proposed prospecting or mining operation.

12.1.9.1 National

The national government departments are listed below.

12.1.9.1.1 Competent Authority

- Department of Mineral Resources (DMR)

12.1.9.2 Commenting Authorities

- South African National Heritage Resources Agency (SAHRA);
- Mpumalanga Regional Office of the Department of Water and Sanitation (DWS); and
- Department of Agriculture, Forestry & Fisheries (DAFF).

12.1.10 Provincial

12.1.10.1 Commenting Authority

- Mpumalanga Department of Economic Development, Environment and Tourism;
- Department of Rural Development and Land Reform: Mpumalanga Shared Services Centre (DRDLR);
- Mpumalanga Regional Office of the Department of Water and Sanitation (DWS);
- Mpumalanga Tourism and Parks Agency;
- Department of Public Works, Roads and Transport (DPWRT);
- Department of Labour (DoL); and
- Department of Health & Social Development (DoHSD).

12.1.10.2 District and Local Municipality

The district and local municipality government departments are listed below, as commenting authorities:

- Gert Sibande District Municipality managers, environmental and social departments; and
- Govan Mbeki Local Municipality municipal managers, ward councillors and environment departments.

12.2 The details of the engagement process

12.2.1 Confirm that evidence that the landowners or lawful occupiers of the land in question, and any other interested and affected parties including all those listed above, were notified, and has been appended hereto.

The following materials have been used to disseminate project information to stakeholders (see Table 12-3 for further details):

- Background Information Document (BID) (Appendix C): including the location and a description of the proposed project, project location, the legislative processes that would be followed, specialist studies to be conducted and the consultation and registration process including contact details of the responsible person.
- Newspaper Advertisements (Appendix C): an advert was placed in two Local Newspapers, in English (Ridge Times and the Echo on Friday, 28 February 2014). The advert included a brief project description, project location, information about the required legislation, the competent authority, details of the appointed independent

environmental consultant, information about availability of the Draft Scoping Report (DSR) for public comment.

- Site Notices: Site notices were put up at various places as indicated in Appendix B. The site notices contained a brief project description, project location, information about the required legislation, the competent authority, details of the appointed independent environmental consultant, information about availability of the DSR for public comment.
- Letters with Comment and Registration Sheet: Letters were sent to stakeholders via post and email containing information about the proposed project, project location, applicable legislation and competent authority, information on availability of the various reports. A Registration and Comment Sheet was also provided for stakeholders to use for formal registration as I&APs or to submit comments.

Table 12-3 provides a summary of the PPP activities undertaken.

Table 12-3: Public Participation Activities

Activity	Details	Reference in Report
Scoping Phase		
Identification of stakeholders	Stakeholder database which includes I&APs from various sectors of society including directly affected and adjacent landowners in and around the proposed Project area.	**Appendix C** Stakeholder Database.
Land Claims Commissioner	A letter was sent on the 26 February 2014 to Ms Thandeka of the Mpumalanga Department of Rural Development and Land Reform: Land Claims Commission. The outcome of the investigation is attached.	**Appendix C**
Distribution of proposed project announcement material	BID, announcement letter with comment and registration sheet was emailed and posted to stakeholders on ***Tuesday, 25 February 2014.*** The Background Information Document was also available on www.digbywells.com, ***on Tuesday, 25 February 2014.***	**Appendix C** BID, letter with registration and comment sheet Proof of emails sent
Placing of adverts	An advert was placed in the Ridge Times and The Echo on ***Friday, 28 February 2014***.	**Appendix C** Adverts
Putting up of site notices	Site notices (13) were put up at various places within proposed project site, local library at municipal offices and venues in the proposed Project area on ***Friday, 28 February 2014:*** ▪ Trichardt Public Library, Bekker street, Trichardt (Behind the Traffic Dept.); ▪ Evander Public Library, 13 Lisbon street, next	**Appendix C** Site notice report and site notice map

Activity	Details	Reference in Report
	to taxi rank; and ■ Kinross Public Library, 27 Rasool Malek street, Kinross. A site notice map has also been developed which provides location points of the site notices that were put up.	
Announcement of the DSR	A letter was emailed and posted to the full database to announce the availability of the DSR on ***Thursday, 6 March 2014.***	**Appendix C** Announcement Letter
Proponent Letter	A letter postponing availability of the DSR and the Public Meeting was distributed to the I&AP database by email on 20 March 2014. This was due to a delay in the Mining Right Application process.	**Appendix C**
DSR Re-announcement Letter	A letter was emailed and posted to the full stakeholder database to announce availability of the DSR on **Tuesday, 5 August 2014**. The DSR are available at the following public places: ■ Trichardt Public Library, Bekker street, Trichardt (Behind the Traffic Dept.); ■ Evander Public Library, 13 Lisbon street, next to taxi rank; and ■ Kinross Public Library, 27 Rasool Malek street, Kinross. The DSR was also available on www.digbywells.com (Public Documents) and will be made available at the Public Meeting. *(**Comment period: Tuesday, 12 August - Wednesday, 10 September 2014**) (30 days)*	**Appendix C**
Public Meeting with Stakeholders	A Public Meeting was held ***on Wednesday, 27 August 2014 at the Multilink Conference Venue (4 Grey Street, Trichardt) from 15:00 – 17:00***. All comments received at this meeting are captured in the Comment and Response Report.	**Appendix C** Comment and Response Report.
Obtained comments from stakeholders	Comments, concerns and suggestions received from stakeholders will be captured in the Comment and Response Report.	**Appendix C** Comment and Response Report.
Final Scoping Report	The FSR was finalised with lapse of the public comment period on the DSR and was submitted to the DMR. It included additional comments	

Activity	Details	Reference in Report
	raised by stakeholders and relevant information that may have been generated during the public comment period. A progress feedback letter informing stakeholders of the date of submission and availability of the FSR for public comment was emailed and posted to stakeholders informing them that the FSR has been submitted to the DMR. The FSR was placed on the Digby Wells website www.digbywells.com for a 21 day comment period from ***Wednesday, 17 September to Wednesday, 8 October 2014***.	
DEIAR Announcement Letter	A letter was emailed and posted to the full stakeholder database to announce availability of the DEIAR on Tuesday, 3 February 2015. The DEIAR are available at the following public places: ■ Trichardt Public Library, Bekker street, Trichardt (Behind the Traffic Dept.); ■ Evander Public Library, 13 Lisbon street, next to taxi rank; and ■ Kinross Public Library, 27 Rasool Malek street, Kinross. The DEIAR will also be available on www.digbywells.com (Public Documents) and CDs will be made available at the Public Meeting. *(**Comment period: Wednesday, 4 February – Thursday, 11 March 2015**) (30 days)*	**Appendix C**
Land Owners Meeting	A landowners' meeting was held on Wednesday at the Multilink Conference Venue (4 Grey Street, Trichardt) from 10:00 – 12:00. This was to specifically discuss the proposed project with landowners and to obtain their comments. All comments made at this meeting are captured in the Comments and Response Report.	**Appendix C** Comment and Response Report**.**
Public Meeting with Stakeholders	A Public Meeting was held on ***Tuesday, 3 March 2015*** at the Multilink Conference Venue (4 Grey Street, Trichardt) from 15:00 – 17:00. All comments received at this meeting are captured in the Comment and Response Report.	**Appendix C** Comment and Response Report.
Obtained comments from stakeholders	Comments, concerns and suggestions received from stakeholders through the PPP were captured in the Comment and Response Report.	**Appendix C** Comment and Response Report.

12.3 Scoping Phase

A Scoping Report, which provided an overview and description of the proposed activities and alternatives associated with the proposed Sasol Syferfontein Block IV Expansion Project, was submitted to the National DMR. It provided background information of the proposed Project area and presented the preliminary findings of specialist studies (desktop studies). In addition, the Scoping Report provided the Terms of Reference (ToR) for specialist studies and provided stakeholders with the opportunity to comment on these ToRs and identify any other specialist studies that may be required with respect to the NEMA process. The Scoping Report essentially set the foundation for the way forward of the EIA/EMP process.

12.4 Environmental Impact Assessment Phase

Specialists in the necessary fields conducted the required investigations that were identified during the Scoping phase. These studies included quantifying the risks / impacts involved with the proposed development and proposed measures to minimise or eliminate negative impacts and enhance positive impacts where possible.

12.5 Compilation of an Environmental Impact Report (EIR)

Findings of the impact assessment have been combined into a final report (this document), which forms the basis for decision-making by the authorities. I&APs had an opportunity to comment on the draft report before submission to the authorities. This document was also available on request to all I&APs after submission to the authorities.

12.6 Details regarding the manner in which the issues were addressed

- Confirm specifically in this section whether or not the description of the environment under Regulation 50 (a) has been compiled with the participation of the landowner, interested and affected parties, and the communities concerned.
- Confirm specifically in this section whether or not the list of potential impacts under Regulation 50 (a) has been compiled with the participation of the landowner and interested and affected parties,
- Confirm specifically in this section whether or not the list of potential impacts related to social and cultural impacts under Regulation 50 (c) has been compiled with the participation of the parties who may be directly affected.
- Provide a list, of the issues raised by the interested and affected parties referred to in paragraph 13 above, and indicate where they have been accommodated in this document.

All comments and inputs received from I&APs are included in the Comments and Response Report which can be found in Appendix C of this report.

13 Knowledge Gaps and Limitations (REGULATION 50 (g))

No knowledge gaps or limitations have been identified for the Project.

14 Monitoring and management of environmental impacts (REGULATION 50 (h))

14.1 Provide a list of identified impacts which will require monitoring programmes

The identified risks to the environment include the potential impact on surface water, groundwater and fauna and flora.

However, if sufficient monitoring and management strategies are implemented (as described in the following chapter) the potential risk to the environment can be minimised.

It should be noted, however, that appropriate geotechnical design will be required to minimise the potential for surface impacts.

14.2 Specify the functional requirements for the said monitoring programmes

Monitoring programmes are to continue through all phases of the mine operation to identify impacts on the environment over time. This is to ensure that effective measures are taken at an early stage to mitigate the impacts before the damage becomes significant. Various monitoring programmes have been set into place for each of the abovementioned specialist fields in Table 14-1 below.

Table 14-1: Monitoring and Management of Environmental Impacts

Impact	Monitoring Plan	Functional Requirements	Frequency	Roles / Responsibility	Project Phase
Surface subsidence impacting red data species and the natural biodiversity. Alien invasive species may develop	Alien invasive management plan Fauna and flora monitoring plan Biodiversity Land Management Plan	Monitoring programme for red data species and alien invasive species to be conducted seasonally by comparing surveys conducted in the surrounding farms	Annually	Environmental Manager/ Specialists.	Operational Rehabilitation
Potential subsidence which could impact on the natural drainage patterns of the area changing soil physical properties as well as the chemical properties over time, thus decreasing land capability	Mapping of Project area.	Area should be mapped by land surveyors or by aerial mapping methods to check for subsidence taking place. Should subsidence be detected, corrective actions to minimise further impacts are to be implemented.	Annually	Environmental Specialists	Operational Rehabilitation
Sinkholes may be formed should subsidence occur. This results in water and	Groundwater Monitoring Programme	Use monitoring boreholes present on site to monitor groundwater quality	Quarterly (groundwater quality and quantity)	Geohydrologist	Construction Operational Rehabilitation/ post

Impact	Monitoring Plan	Functional Requirements	Frequency	Roles / Responsibility	Project Phase
oxygen inflow from the atmosphere. This will cause oxidation reactions and potential acid generation		and quantity. Samples to be analysed using best practice guidelines in a SANAS accredited Laboratory			closure
Potential subsidence that would results in altered surface subcatchment hydrology	Mapping of Project area.	Area should be mapped by aerial mapping methods to check for subsidence taking place. Should subsidence be detected, corrective actions to minimise further impacts are to be implemented.	Annually	Environmental Specialist	Operational Rehabilitation

14.3 Define the roles and responsibilities for the execution of the monitoring programmes

Sasol Mining will be responsible for the implementation of all monitoring, mitigation and management measures as well as compliance to this EMP. Refer Table 14-1, above, for roles and responsibilities relating to the monitoring and management responsibilities.

14.4 Specify the time frames for monitoring and reporting

The monitoring and reporting time frames are detailed within Table 14-1

SECTION 2:

ENVIRONMENTAL MANAGEMENT PROGRAMME

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

15.1 Environmental goals and objectives (Regulation 51 (a))

15.1.1 Environmental objectives

Rehabilitation objectives need to be tailored to the Project at hand and be aligned with the EMP and Mine Closure Plan. And thus, the overall rehabilitation objectives for the Project are as follows:

- Provide for a sustainable post-mining land use and re-establishment and maintenance of the pre-mining land capability;
- Maintain and minimise impacts to the functioning wetlands and water bodies within the area;
- Prevent soil, surface water and groundwater contamination;
- Comply with the relevant local and national regulatory requirements; and
- Rehabilitate, maintain and monitor any areas of subsidence.

15.1.2 Specific goals for the management of identified environmental impacts

An EMP is used to provide guidance in terms of the management of impacts which may emanate from the proposed mining activities during the construction, operational and decommissioning phase of the project. During the various environmental impact assessments conducted for the Block IV expansion project, potential impacts and their significance rating were established as described in Section 8.4 of this report. The mitigation measures for each of the potential impacts detected were also provided to ensure that the impacts are managed before they cause severe or lasting damage to the biophysical, socio-economic and cultural environment.

In terms of Section 39 (1) of the 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.

Table 15-2 describes in detail the mitigation measures for each of the potential impacts detected as per MPRDA regulations.

15.1.3 Description of environmental objectives and specific goals for the socio-economic conditions as identified in the social and labour plan

Table 15-1: Summary of the Appropriate Management Options for the Socio-economic Impacts Anticipated during the LoM

Phase	Potential Impact description	Mitigation and management requirements
Construction	Job creation during construction	■ Recruitment to be coordinated through the appropriate institutions ■ Update and optimal use of the skills database; Promotion of female and youth employment; ■ Effective implementation of training and skills development initiatives; and ■ Monitoring subcontractors in terms of local employment targets.

Phase	Potential Impact description	Mitigation and management requirements
	Multiplier effects on the local economy	■ Sasol Mining should give preference to suitable subcontractors/SMMEs located in the local municipality; ■ Establish linkages with other mining proponents in the area involved in skills and SMME development; ■ Align skills development to build capacity of SMMEs; ■ Utilise electronic business database to identify local SMMEs; and ■ Utilise the accommodation database to identify local accommodation option.
Operational	Mining induced subsidence	■ Undertake a detailed geotechnical investigation to establish whether the proposed activates may result in unpredictable and unstable soil conditions; ■ Establish efficient channels of communication with surrounding landowners to promote the early identification of any surface subsidence. ■ Prepare contingency measures to compensate for any financial and/or livelihood impacts that might result from mining related surface subsidence.
	Operation-related health and safety impacts	■ Roads must be adequately maintained to prevent further deterioration of road surfaces due to heavy vehicle traffic. ■ Safe travelling speeds must be determined and measures implemented. ■ Heavy Motor Vehicle (HMV) traffic should be restricted to daylight hours and the workweek if at all possible. ■ A mechanism, which is accessible to the

Phase	Potential Impact description	Mitigation and management requirements
		public, should be put in place to lodge complaints regarding mine induced damage to roads with the mine or contractor's Environmental Safety Officer

15.1.4 Description of environmental objectives and specific goals for historical and cultural aspects

The objectives to be met are:

- To protect cultural and heritage resources from the adverse impacts of project related activities;
- To manage and monitor activities during construction, operational and decommissioning phases;
- To promote the overall conservation of natural and cultural resources;
- To avoid potential damage to items of mining heritage significance as a result of earthworks undertaken as part of construction, operation, maintenance and inspections in the proposed project; and
- To avoid looting and/or unauthorised excavation of heritage and cultural resources.

15.2 Management programme (Regulation 51 (b))

15.2.1 Mining actions, activities and processes

Reviews of the Project's performance and Environmental Audits are necessary during all mining phases to ensure that procedures are appropriate and to ensure the desired environmental outcomes are being achieved. It is recommended that regular internal and external Environmental Audits be conducted to assess the performance of the EMP. The Environmental Officer will be responsible for evaluating if the EMP is effective and relevant, and provide recommendations for improvement. Internal audits needs to be undertaken by the Environmental Officer be on an annual basis (at least once a year). Management measures for environmental impacts emanating from the proposed mining operations have been established and provided in the EMP. These management measures can be found in Table 15-2 below.

Table 15-2: Environmental Management Programme

Project Activities	Receiving Environment	Objectives	Management and Mitigation measures	Frequency	Legal Requirements	Recommended Action Plans	Duration	Responsible Person
Construction Phase								
Construction of the incline shaft results in the production of fugitive dust, PM10, PM2.5	Air Quality	Minimise dust fallout	Limiting construction activities during the windy months of August, September and October as dust levels will increase.	Throughout LoM	National Environment Management: Air Quality Act (Act No. 39 of 2004)	Dust Monitoring programme	Construction Phase	▪ Environmental co-ordinator; and ▪ Operations Manager
There is transportation of the workers and materials onsite. This leads to the production of fugitive dust	Air Quality	Minimise the production of fugitive dust	Reduced vehicle speed, drop heights of loose and erodible materials should be minimised. Roads utilised when transporting the workers needs to be watered constantly.	Throughout LoM	National Environment Management: Air Quality Act (Act No. 39 of 2004)	Dust Monitoring programme	Construction Phase	▪ Environmental co-ordinator; and ▪ Operations Manager
Operational Phase								
To remove of the ore, the bord and pillar method will be used. This activity includes drilling the hard overburden. Drilling is an intermittent exercise that emits fugitive dust. Fugitive dust will be released containing TSP, PM10 and PM2.5.	Air Quality	Minimise dust generation	▪ When blasting, it is advised to wet the proposed blasting area through the use of water cartridges alongside the explosives. The blast area needs to be minimised; ▪ There is need for the application of dust suppressant on the well-defined truck routes. Use of water sprayers can also be implemented. Speed limits need to be observed and having speed humps reduces emissions.	Throughout LoM	National Environment Management: Air Quality Act (Act No. 39 of 2004)	Dust Monitoring programme	Operational Phase	▪ Operations Manager
Underground mining activities will require mine dewatering which can lower the groundwater level and create a cone depression/ dewatering	Groundwater Quantity	Prevent decrease in groundwater levels	▪ Monitoring of water levels, with continuous refining and updating of the monitoring network based on the results obtained ▪ Measure actual depth of all boreholes overlying the mine workings, as well as within a 500 m radius. ▪ Install piezometers (conduit) to allow water level measurements in all boreholes overlying the mining area and within a 500 m radius.	▪ Annually	National Water Act (Act 36 of 1998)	▪ Groundwater Monitoring plan	▪ Operational Phase ▪ Decommissioning Phase	▪ Environmental co-ordinator; and ▪ Operations Manager.
Saline water with acidic or alkaline pH can be released from the underground workings once the coal pillar and nearby rocks are exposed to oxygen and moisture.	Groundwater Quality	Minimise the potential of groundwater being exposed to oxygen and pyrite or nitrate-based	▪ Subsidence to be rehabilitated immediately as it occurs to reduce potential for oxidation reactions; ▪ Nitrate-based explosives should be	▪ Annually	National Water Act (Act 36 of 1998)	▪ Groundwater Monitoring Plan ▪ Audit of monitoring and management	▪ Operational Phase ▪ Decommissioning Phase	▪ Environmental co-ordinator; and ▪ Operations Manager.

Project Activities	Receiving Environment	Objectives	Management and Mitigation measures	Frequency	Legal Requirements	Recommended Action Plans	Duration	Responsible Person
Contaminants can also be generated as a result of drilling and blasting during the operation		substances.	avoided or minimised to lower groundwater contamination; ▪ Monitoring of groundwater quality and water levels is recommended (particularly down gradient of the mine site) with continuous refining and updating of the monitoring network based on the results obtained			systems		
Organic solvents, diesel or other organic fluids may be spilled in the underground workings or leak from storage tanks during mine operation	Groundwater Quality	Prevent spillages from occurring and from reaching groundwater levels	▪ Underground storage areas containing hazardous substances need to be bunded, with the necessary spill prevention and emergency response measures in place; ▪ If a considerable amount of fluid is accidentally spilled, the contaminated rock should be scraped off and disposed of at an acceptable dumping facility; ▪ Both groundwater level and quality have to be monitored to detect any changes in water conditions.	▪ Annually	National Water Act (Act 36 of 1998)	▪ Groundwater Monitoring Plan	▪ Operational Phase ▪ Decommissioning Phase	▪ Environmental co-ordinator; and ▪ Operations Manager.
Mining induced subsidence could affect the quality of life of people in surrounding communities and could also impact on surface land uses as well as groundwater levels in boreholes.	Social	▪ Minimise subsidence potential; ▪ Ensure effective management measures should subsidence occur	▪ Undertake a detailed geotechnical investigation to establish whether the proposed activates may result in unpredictable and unstable soil conditions; ▪ Establish efficient channels of communication with surrounding landowners to promote the early identification of any surface subsidence. ▪ prepare contingency measures to compensate for any financial and/or livelihood impacts that might result from mining related surface subsidence	▪ Annually	National Environment Management Act, 1998 (Act 107 of 1998)	▪ Detailed geotechnical investigation; and ▪ establish efficient channels of communication with surrounding landowners	▪ Operational Phase ▪ Decommissioning Phase	▪ Environmental Specialist; and ▪ Operations Manager
The potential of subsidence could cause open fractures allowing surface water to flow into the open mine workings. This could result in reduced runoff and reduced baseflow discharge	Surface Water Quantity	Minimise the potential of subsidence	▪ Correct safety factors to be used to insure reduced collapse of undermined areas; ▪ The subsidence prediction calculations to be carried out based on geology, extraction patterns and	▪ Annual monitoring	National Water Act (Act 36 of 1998)	▪ Subsidence monitoring using aerial or land surveys	▪ Operational Phase; ▪ Decommissioning Phase	▪ Environmental Specialist; and ▪ Operations Manager.

Project Activities	Receiving Environment	Objectives	Management and Mitigation measures	Frequency	Legal Requirements	Recommended Action Plans	Duration	Responsible Person
			ore thickness amongst others factors; ▪ Where it is feasible backfilling could be considered					
			▪	▪		▪	▪	▪
Decommissioning Phase								
Subsidence occurs when underground mining has taken place and the correct safety factors are not used, the undermined areas can collapse and change surface drainage and as a result change Land Capabilities.	Soil	Minimise the potential of subsidence	▪ The correct safety factors to be used to insure no collapse of undermined areas ▪ Annual subsidence monitoring (Aerial surveys/ Land surveys)	▪ Annually	National Environment Management Act, 1998 (Act 107 of 1998)	▪ Area to be mapped using aerial mapping methods	▪ Decommissioning Phase	▪ Environmental Specialist
The potential of subsidence could cause open fractures allowing surface water to flow into the open mine workings. This could result in reduced runoff and reduced baseflow discharge	Surface Water Quantity	Minimise the potential of subsidence	▪ Correct safety factors to be used to insure reduced collapse of undermined areas; ▪ The subsidence prediction calculations to be carried out based on geology, extraction patterns and ore thickness amongst others factors; ▪ Where it is feasible backfilling could be considered	▪ Annual monitoring	National Water Act (Act 36 of 1998)	▪ Subsidence monitoring using aerial or land surveys	▪ Operational Phase; ▪ Decommissioning Phase	▪ Environmental Specialist; and ▪ Operations Manager.

16 Environmental Emergency plan

The environmental management programme and associated management options are intended to minimise environmental risk as far as possible. Should circumstances, however, lead to unacceptable risks, emergency systems and procedures have been designed and will be implemented in the case of an emergency to prevent or minimise the consequential environmental damage. The environmental emergency contingency plan addresses any reasonably anticipated failure (most probable risk) for the entire mining area and focuses on incidents that could cause environmental emergencies.

The most crucial aspect of the emergency system is the identification and communication of the emergency to the appropriate persons. Consequently, the names of the appropriate contact person, together with their contact numbers, will be prominently displayed around the facility. The contact details will be updated on a regular basis. First-party employees (such as security, safety superintendents, mine overseers, environmental officers) will be trained to respond to the responsible personnel in the event of an emergency.

16.1 Description of the on-going monitoring and management measures to be implemented, to provide the early warning systems necessary to avoid environmental emergencies

Syferfontein Colliery has certain procedures in place as part of their emergency preparedness and response plan. The information in this section is taken from the approved Syferfontein Emergency Response Plan compiled according to ISO 14001:2004 and BS OHSAS 18001:2007.

To ensure that all emergencies are promptly and effectively addressed to:

- Ensure the safety and health of all personnel
- Recover to normal operation as soon as possible
- Coordinate orderly evacuation and clean up
- Minimise impacts to equipment and production loss
- Minimise impact to the environment

This procedure is applicable to all Syferfontein Colliery employees, Service providers, visitors on site and any interested and effected parties. Syferfontein Colliery shall actively assess potential incidents/impacts and emergency response, plan to meet them, develop procedures and processes to cope with them, test its planned responses and seek to improve the effectiveness of its response.

16.2 Description of procedures that will be in place in cases of environmental related emergencies

16.2.1 Reporting structure

Any person witnessing or being involved in, or is the first person on the scene of an emergency, must first try to minimise or prevent the spread of the emergency where applicable. If the emergency is of such an extent that it cannot be controlled locally or pose a direct danger to the person who found it, the person as mentioned above must inform the control room operator immediately.

16.2.2 Access to adits

After declaration of an emergency situation, no person shall be allowed to enter the underground workings without permission.

16.2.3 Communication

During an emergency, no information may be given to the media and non-employees. Continuous communication is crucial and therefore, communication systems must be kept in working condition at all times.

16.2.4 Emergency stations

The following emergency stations should be manned during an emergency:

- Emergency control (located at the management conference room);
- Operational control room (located at the shaft communication area);
- Adit control (located at a point in the highwall of the existing Syferfontein mine) to monitor persons emerging and people going underground;
- Fresh air base (located in a safe position as established by the rescue team);
- Lamp room control to implement strict control over the issuing and receipt of cap lamps, self-rescue apparatus and methane monitors;
- First-aid room to apply first aid and care for injured persons;
- Transport control to control the movement of vehicles and transport of personnel and material;

The mine layouts to be used as guidelines must be obtained from the Survey Services Department. The mine should ensure that appointed scribes are available at the emergency control room and operations control room to record all messages and decisions taken.

The Mine Manager shall ensure an updated telephone directory with the telephone numbers of key persons on the mine is available at all shaft offices and control rooms.

16.2.5 Emergency exercise

Every employee will, at employment as well as annually, receive training in the emergency procedure. Possible emergencies will be tested as per the emergency drill schedule by doing either a mock drill or a theoretical simulation during training, to test the knowledge of the people.

The result and actions will be documented and discussed to the team by the person in charge and records shall be kept. Deviations will be logged and handled via the incident or non-conformance system of the mine. The procedure shall be reviewed after the occurrence of incidents or emergency situations as needed. The report on a physical mock drill shall, when performed, will be presented to the Mine Manager for evaluation and discussion at his Workgroup meeting.

16.2.6 Roles and Responsibilities in case of an emergency

The roles and responsibilities of respective persons in an emergency situation are detailed in Appendix C of this document

16.2.7 Monitoring of environmental impacts

Accurate and up-to-date monitoring and management records will be kept. The applicant will also, within 24 hours, ensure that the relevant authorities are notified of the occurrence or detection of any incident which has the potential to cause, or has caused pollution of the environment, health risks or which is a contravention of any EMP or environmental authorisation condition. The applicant is then to submit an action plan indicating measures which will be taken to:

- Correct the impacts resulting from the incident;
- Prevent the incident from causing any further impact; and
- Prevent a recurrence of a similar incident.

A complaints register will be kept on site and all complaints from the public will be noted therein as well as measures taken to rectify the situation as described above.

The monitoring and management measures to be taken for any impact imposed onto the environment are provided in Table 14-1 and in Table 15-1 of this document.

16.3 Technical, management and financial options that will be in place to deal with the remediation of impacts in cases of environmental emergencies

The potential environmental emergencies to be expected on site are listed below:

- Major spillages of potentially contaminated water, both surface and underground pipelines;

- Diesel spills when transported to underground works, or when delivered in bulk, exceeding 3000 litres;
- Oil spills when exceeding 3000 litres;
- Any underground fire at the mine;
- Any fire on surface;
- Underground and surface explosion;
- Uncontrollable emission of methane/flammable gas;
- Serious flooding of workings (Water/mud);
- Extensive roof fall or subsidence/pillar failure;
- Labour unrest;
- Main fan failure or stoppage for an extensive time;
- Any other SHE emergency declared by the Mine Manager;

The nature and extent of every emergency may differ and minor adaptations/changes/additions will have to be made, as the situation dictates. The procedures to be followed in terms of managing and remediating the imposed impacts are detailed in Appendix C of this document.

Mitigation measures for the imposed impacts are also provided in Table 15-2 of this document.

17 EMP performance assessment

17.1 List of the environmental aspects that will be monitored

17.1.1 Description of the manner in which the monitoring will be conducted

The Environmental Manager will conduct annual internal performance audits against the commitments in the EMP. These audits will be conducted on an on-going basis until final closure. The audit findings will be documented for both record keeping purposes and for informing continual improvement. In addition, and in accordance with the MPRDA Regulations (GN R 527 of 23 April 2004), an independent professional (external) will conduct an EMP performance assessment every 2 years. The site's compliance with the provisions of the EMP and the adequacy EMP relative to the on-site activities will be assessed in the performance assessment. Audit findings of both the internal and external performance assessments will be documented and the reports will be submitted to the DMR.

17.1.2 Description of the location where each monitoring activity will take place

17.1.2.1 Air Quality Monitoring

17.1.2.1.1 Dust Monitoring

Syferfontein should continue the current dust monitoring programme throughout the life of mine in order to amass historical dust deposition data that will feed into management practices aimed at reducing impacts from the construction, operation and closure phases of the project

As the area exposed is directly proportional to the amount of dust generated and transported, it is advised that construction activities be limited during the windy periods of August, September and October. If construction has to be done during this period, it is advised to disturb a small area at a time.

In order to determine the wind speed for each particular day, a wind anemometer installed on site should be utilised. Wind speeds are recorded daily and when it exceeds 5.4 m/s (the threshold for transporting particles) extra dust control measures need to be carried out. During dust generating periods, sprinkling of the area until it is moist is ideal for haul roads and traffic routes (Smolen et al., 1988). It must be noted however that excessive sprinkling to manage dust may result in runoff from the site.

17.1.2.2 Groundwater Monitoring

Groundwater monitoring has to continue during all phases of the mine operation to identify impacts on the groundwater environment over time, and effective measures can be undertaken at the early stage before serious damage to the environment occurs.

The main objectives in positioning the monitoring boreholes are to:

- Monitor the movement of polluted groundwater migrating away from the mine area; and
- Monitor the lowering of the water table and the radius of influence.

The positions of the recommended monitoring points are listed in Table 17-1. The points are composed of existing boreholes, with additional recommended boreholes in areas of borehole scarcity.

Ideally the monitoring borehole should be made up of two monitoring sets: deep and shallow boreholes.

The purpose of the deep borehole is to monitor the groundwater conditions in the mine void and coal seam aquifer. All of the boreholes drilled during this study are deep and should be used for the monitoring of the coal seam aquifer.

The purpose of the shallow borehole is to monitor the weathered aquifer and should not be more than 15 m deep.

In total 24 monitoring points are recommended for the purpose groundwater monitoring as listed in Table 17-1

Table 17-1: List of the proposed monitoring boreholes

Borehole	X	Y	Comment
SFNBH1	8590	-2921480	existing borehole
SFNBH2	10249	-2917897	existing borehole
SFNBH3	11242	-2919222	existing borehole
SFNBH4	13578	-2919490	existing borehole
SFNBH5	13337	-2921322	existing borehole
SFNBH6	13824	-2924023	existing borehole
SFNBH7	15757	-2922668	existing borehole
SFNBH8	17685	-2918907	existing borehole
MONBH1	10543.29	-2923618	proposed borehole
MONBH2	13731.07	-2926806	proposed borehole
MONBH3	18533.45	-2923494	proposed borehole
MONBH4	13275.68	-2917367	proposed borehole
MONBH5	19113.04	-2920513	proposed borehole
MONBH6	22093.83	-2913185	proposed borehole
MONBH7	23874.02	-2915048	proposed borehole
MONBH8	24577.81	-2913558	proposed borehole
MONBH9	27475.79	-2915504	proposed borehole
MONBH10	23470.51	-2911712	proposed borehole

Borehole	X	Y	Comment
MONBH11	26680.73	-2912696	proposed borehole

17.1.2.2.1 Water levels

Groundwater levels must be recorded on a quarterly basis using an electrical contact tape or pressure transducer, to detect any changes or trends in groundwater elevation and flow direction.

17.1.2.2.2 Sampling frequency

Groundwater is a slow-moving medium and drastic changes in the groundwater composition are not normally encountered within days. Considering the proximity of private boreholes and streams to the proposed mine, monitoring should be conducted bi-annually to reflect influences of wet and dry seasons.

Samples should be collected by an independent groundwater consultant, using best practice guidelines and should be analysed by an accredited laboratory.

It is suggested that bi-annual samples be collected, extending up to two years post closure and based on the results. Post closure monitoring should continue until a sustainable situation is reached and after it has been signed off by the Authorities.

17.1.2.2.3 Parameters to be monitored

At coal mining facilities, analyses of the following constituents are recommended:

- Macro Analysis i.e. Ca, Mg, Na, K, SO_4, NO_3, F, Cl;
- Initial full suite metals and then Al, Fe, Mn and other metals identified according to results of the initial analyses;
- pH and Alkalinity; and
- TDS and EC.

17.1.2.3 Subsidence Monitoring

Sasol Mining should undertake a rock engineering study, which could be supplemented by a detailed geotechnical investigation to establish whether the proposed activates may result in unpredictable and unstable soil conditions to detect the potential of subsidence occurring early.

Sasol Mining should also establish efficient channels of communication with surrounding landowners to promote the early identification of any surface subsidence. Reported problems should be subject to objective monitoring, which will allow the mine to verify the validity of each claim.

Annual subsidence monitoring through analysing aerial or land surveys should be conducted to determine where the impact is taking place and planning control of the damages incurred.

17.1.2.4 Surface Water Monitoring

It is recommended that the area is mapped annually by aerial surveys to check for any subsidence taking place and then if subsidence has occurred corrective actions need to be implemented to minimise/reduce any further impacts from occurring.

17.1.3 Description of the various standards that must be maintained, which standards must meet the requirements of the regulatory authority concerned, or the relevant SABS standard as the case may be.

17.1.3.1 Air Quality

A fundamental aspect of the new approach to the air quality regulation, as reflected in the NEM: AQA, is the establishment of National Ambient Air Quality Standards (NAAQS). These standards provide the goals for air quality management plans and also provide the benchmark by which the effectiveness of these management plans is measured. The NEM: AQA provides for the identification of priority pollutants and the setting of ambient standards with respect to these pollutants.

17.1.3.2 Groundwater

The groundwater quality results have been compared to the South African National Standards (SANS) 241: 2005 Standards for Drinking Water (Table 4.1) and have been grouped into Classes in accordance with the above stated standards.

According to the SANS 241:2005 standards, water quality have two benchmarks: Class I and Class II:

- Concentrations below the Class I limits are considered of good quality and suitable for human consumption;
- Concentrations between Class I and II are considered as marginal. This is the maximum allowable concentration if consumed for not more than 7 years; and
- Concentrations more than the Class II limits (also referred as Class III) are unacceptable for human consumption.

17.1.3.3 Surface Water

All surface water sampling done is submitted to a South African National Accreditation Standards (SANAS) accredited laboratory for chemical analysis. Data capturing, interpretation and benchmarking is conducted against South African National Standard (SANS) 241: 2011.

17.1.4 Description of the frequency of the monitoring to be conducted in each specific case

17.1.4.1 Air Quality

Syferfontein should continue the current dust monitoring programme throughout the life of mine in order to amass historical dust deposition data that will feed into management practices aimed at reducing impacts from the construction, operation and closure phases of the project.

17.1.4.2 Groundwater

It is suggested that quarterly samples be collected, extending up to two years post closure and based on the results. Post closure monitoring should continue until a sustainable situation is reached and after it has been signed off by the Authorities.

17.1.4.3 Surface Water

It is recommended that the area is mapped annually by aerial surveys to check for any subsidence taking place.

17.1.5 Description of the analysis to be conducted and the records to be kept

17.1.5.1 Air Quality

In general, the distributions of concentrations follow closely the main wind directions (wind roses generated for the site Numerical values of maximum depend on the emission rate and the meteorological data used. Simulations were undertaken to determine concentrations of SO_2, NO_2 particulate matter with a particle size of less than 10 microns (µm) in size (PM_{10}), particle size of less than 2.5 microns (µm) in size ($PM_{2.5}$), and of deposition of total suspended particulates (TSP) for Syferfontein underground operations.

17.1.5.2 Groundwater

Parameters to be monitored

At coal mining facilities, analyses of the following constituents are recommended:

- Macro Analysis i.e. Ca, Mg, Na, K, SO4, NO3, F, Cl;
- Initial full suite metals and then As, Al, Fe, Mn and other metals identified according to results of the initial analyses;
- pH and Alkalinity; and
- TDS and EC.

Data Storage

During any project, good hydrogeological decisions require good information developed from raw data. The production of good, relevant and timely information is the key to achieve qualified long-term and short-term plans. For the minimisation of groundwater contamination it is necessary to utilize all relevant groundwater data.

The generation and collection of this data is very expensive as it requires intensive hydrogeological investigations and therefore the data has to be managed in a centralised database if funds are to be used in the most efficient way. Digby Wells has compiled a WISH-based database during the course of this investigation and it is highly recommended that Sasol utilise this database and continuously update and manage it as new data becomes available (see Appendix B).

17.1.5.3 Surface Water

The parameters measured and records kept during the surface water assessment are as follows:

- The catchment description;
- 24-hr design rainfall depth;
- Flood peaks; and
- Surface water quality sampling.

17.1.6 Description of the standard procedures for cases where the results of monitoring indicate non-compliance with the relevant standards

Environmental audits will be conducted to determine areas of compliance and non-compliance with the EMP, as per the requirements of Regulation 55 of the regulations made in terms of the MPRDA. A report will be compiled and submitted to mine management, who will in-turn provide suggestions and recommendations regarding the progress of the rehabilitation programme, impacts of current operations and any improvements or corrective actions that should be made.

An assessment of compliance to applicable legislation will be included in the assessment and will take into consideration the management principles and strategies stated in the EMP and assess whether this strategy is providing the required results. Any flaws or gaps found in the management process will be included in the review together with the recommended mitigation measures.

17.2 Performance Assessment Process

As a minimum, the following documents will be submitted to the relevant authorities from the start of construction until mine closure:

- EMP performance assessment: internal – submitted annually and external - submitted every second year to the DMR;
- Updated closure and rehabilitation cost estimate, submitted annually to the DMR;
- Groundwater monitoring reports submitted annually to DWA – these reports will not only present monitoring data but will also provide interpretations of trends in the data and reporting on compliance with water quality guidelines; and
- Detailed plan for decommissioning/closure, submitted to DMR at least five years prior to decommissioning.

18 Financial provision

South Africa's legislation unambiguously places the responsibility of mitigating environmental damage as a result of mining operations on mining companies. The liability exists throughout the life of the mine, and beyond in terms of residual impacts. The broad rehabilitation objectives are to restore the mined area to its predetermined state; to restore the land to the previous land capability and to ensure there is no net loss of biodiversity.

The key legislation governing the requirements for legislation for rehabilitation is contained in the following acts:

- The National Environmental Management Act (Act 107 of 1998, NEMA);
- The Mineral and Petroleum Resources Development Act (Act 28 of 2002, MPRDA); and
- The National Water Act (Act of 1998, NWA).

18.1 Decommissioning and closure map

Plan 2 (Appendix A) displays the local setting and aerial extent of the mining operations. Rehabilitation will at the end of the life of mine when mining operations have ceased and the shaft needs to be sealed.

18.2 Standard guideline document (Regulation 54(1) 2)

The environmental liability costs were calculated using the Department of Mineral Resources (DMR) standard methodology. The cost calculation methodology used was based on the DMR's "Guideline Document for the Evaluation of the Quantum of Closure- related Financial Provision provided by a Mine" (DME, 2005), as per the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA).

The closure cost for Syferfontein Block IV only focused on the additional infrastructure. It is assumed that the areas will be disturbed as part of the construction phase of the proposed Project.

18.3 Capacity to manage and rehabilitate (Section 39 (4))

Section 39 (4) (a) (iii) of the Act, read together with section 37 (2) of the Act, requires that the applicant will have the capacity, or have provided for the capacity, to rehabilitate and manage negative impacts on the environment.

Digby Wells recommends that the sum of **R 85 914.00** is provided as a guarantee. This guarantee, however, is specific to the infrastructure that is constructed additionally within the mine area. Thus it does not take into consideration the concurrent rehabilitation that will be occurring at the Syferfontein site.

It is recommended that the liability figures be updated on an annual basis as a requirement by the MPRDA. This will ensure that all costs become more accurate over time and will reflect current market conditions. A summary of the calculated environmental liability costs is presented in Table 18-1

Table 18-1: Environmental liability for Syferfontein Block IV according to standard DMR methodology

No.	Description	Unit	A	B	C	D	E=A*B*C*D
			Quantity	Master rate	Multiplication factor	Weighting factor 1	Amount (rands)
1	Dismantling of **processing plant and related structures** (including overland conveyors and powerlines)	m^3	0.00	12.29	0.00	0.00	0
2(A)	Demolition of **steel buildings and structures**	m^2	250.00	171.24	1.00	1.10	47,091
2(B)	Demolition of **reinforced concrete buildings and structures**	m^2	0.00	252.35	0.00	0.00	0
3	Rehabilitation of **access roads**	m^2	0.00	30.65	0.00	1.00	0
4(A)	Demolition and rehabilitation of **electrified railway lines**	m	0.00	297.41	0.00	0.00	0
4(B)	Demolition and rehabilitation of **non-electrified railway lines**	m	0.00	162.23	0.00	0.00	0
5	Demolition of **housing and/or administration facilities**	m^2	0.00	342.48	0.00	0.00	0
6	**Opencast rehabilitation** including final voids and ramps	ha	0.00	179531.13	0.00	0.00	0
7	Sealing of **shafts, adits and inclines**	m^3	29.33	91.93	1.00	1.10	2,966

No.	Description	Unit	A	B	C	D	E=A*B*C*D
			Quantity	Master rate	Multiplication factor	Weighting factor 1	Amount (rands)
8(A)	Rehabilitation of **overburden and spoils**	ha	0.00	119687.42	0.00	0.00	0
8(B)	Rehabilitation of processing waste **deposits and evaporation ponds (basic salt-producing waste)**	ha	0.00	149068.51	0.00	0.00	0
8(C)	Rehabilitation of processing waste **deposits and evaporation ponds (acidic, metal-rich waste)**	ha	0.00	432965.63	0.00	0.00	0
9	Rehabilitation of **subsided areas**	ha	0.00	100220.18	0.00	0.00	0
10	**General surface rehabilitation**	ha	0.10	94812.62	1.00	1.10	10,429
11	**River diversions**	ha	0.00	94812.62	0.00	0.00	0
12	**Fencing**	m	0.00	108.15	0.00	0.00	0
13	**Water management**	ha	0.00	36050.43	0.00	0.00	0
14	2 to 3 years of **maintenance and aftercare**	ha	0.10	12617.65	1.00	1.10	1,388
15A	Specialist study	Sum	0.00	0.00	0.00	0.00	0
15	Specialist studies (soil remediation)	ha	0.00	0.00	0.00	0.00	0.00

No.	Description	Unit	A	B	C	D	E=A*B*C*D
			Quantity	Master rate	Multiplication factor	Weighting factor 1	Amount (rands)
B							
					SubTotal 1		**61,874**
				(Sum of items 1 to 15 above)			
1	Preliminary and General	6.0 %	if Subtotal 1 > 100 000 000		Weighting factor 2		64,968
		12.0 %	if Subtotal 1 < 100 000 000		1.05		3,898
7	Contingency	10.0 %	of Subtotal 1				6,497
					SubTotal 2		**75,363**
				(Subtotal 1 plus sum of management and contingency)			
						Add Vat (14%)	10,551
						GRAND TOTAL	**85,914**
						(Subtotal 2 plus VAT)	

19 Environmental Awareness Plan (Section 39 (3) (c))

The purpose of an Environmental Awareness Plan is to outline the methodology that will be used to inform the mine's employees of any environmental risks which may result from their work and the manner in which the risks must be dealt with in order to avoid contamination or the degradation of the environment. The awareness plan is primarily a tool to introduce and describe the requirements of the range of environmental and social plans to the Sasol Mining construction and operational personnel.

19.1 Description of awareness plan

Section 39 of the MPRDA requires Sasol Mining: Block IV Expansion Operation to develop an environmental awareness plan to inform the employees of any environmental risks which may result from their work. In addition to this environmental awareness training has been identified during the EIA process as a mitigatory measure to prevent and minimise impacts on the receiving environment. Sasol Mining: Block IV Expansion Operation recognises the role of the environmental awareness plan in preventing and minimising its impacts from mining operations on the environment.

Therefore the objectives of the environmental awareness plan will be:

- To educate employees regarding their role in conserving the environment and the importance of conserving natural resources.
- To identify environmental training needs for employees and contractors at all levels.
- To ensure that employees whose work could cause significant environmental impact as identified by the mine are competent to perform those tasks to which they are assigned.
- To enable employees to identify environmental impacts or non-conformances of their work activities on the environment.
- To familiarise employees with emergency preparedness and response requirements.
- To be aware of the potential consequences of deviation from specified operating procedures.
- To conduct their work and manage mining activities in an environmentally responsible manner.

19.1.1 Training Requirements

19.1.1.1 Induction training

All new employees and contractors who will be doing work on the mine will undergo induction training. It is therefore suggested that basic environmental training should form part

of this training. All existing and new employees will undergo annual induction training when they need to renew their Red Ticket and undergo an annual medical check-up.

The Induction training will be a broad introduction to what the environment is and the reasons why it is important to conserve the animals, plants, water and other natural resources. The training will include topics but shall not be limited to the following;

- What activities can impact on the environment?
- Type of impacts associated with mining activities.
- Employees' responsibility and role in conserving the environment.
- Actions that will be needed to prevent or minimise the impacts.
- Waste management.
- Water conservation.
- Emergency response and preparedness procedures.

19.1.1.2 Other training

Once the employees are trained in the basic environmental aspects more detailed training will be provided on other aspects as they become required but could include but shall not be limited to:

- Waste Management (recycling, reusing).
- Spill kit training.
- Conservation of natural resources (water, electricity, oil).

This training will be applicable to employees working in areas where these topics are of importance.

19.1.1.3 Awareness training

Awareness training of employees will be conducted featuring different environmental topics on a monthly basis. These topics will be discussed at their toolbox talks, shift meetings and posted on the notice boards for everyone to see.

These topics will summarise an issue an/or an incident that occurred during the previous month, e.g. the pollution control dam overflowed due to poor housekeeping and maintenance. This method will also be used to disseminate information at the grass root level in an effective and sufficient manner.

A record will be kept of topics that management have identified and requested to be discussed.

19.1.2 Frequency of Training

The frequency of training will be determined by the need for continues training. It is proposed that all employees will be scheduled for annual induction training. Other training will be conducted on an ad hoc basis, which will be determined by the need for specific training, e.g. spill kit training will be conducted when a new spill response team is appointed. High awareness regarding the environment among employees will be sustained through the use of monthly environmental topics. These topics could summarise themes from the induction training, or it could be based on the normal seasonal trends such as dry periods and the conservation of water and prevention of fires.

19.2 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.

The evaluation of the Environmental Awareness Plan will be conducted by the management of Sasol Mining. This evaluation will entail the auditing of the operation during the construction and operation phase once the activity has commenced.

The Environmental Awareness Plan described above is sufficient to make all those involved with the Project aware of those risks that may occur as well as the necessary mitigation required to minimise these risks. This awareness plan displays that Sasol Mining is serious about the environment's well–being, empowerment of the local people and returning the land to appropriate use once the reclamation activities have been completed.

20 Undertaking

The Environmental Management Programme will, should it comply with the provisions of section 39 (4) (a) of the Act and the right be granted, be approved and become an obligation in terms of the right issued. As part of the proposed Environmental Management Programme, the applicant is required to provide an undertaking that it will be executed as approved and that the provisions of the Act and regulations thereto will be complied with.

IDENTIFICATION OF THE REPORT

Herewith I, the person whose name and identity number is stated below, confirm that I am the person authorised to act as representative of the applicant in terms of the resolution submitted with the application, and confirm that the above report comprises EIA and EMP compiled in accordance with the guideline on the Departments official website and the directive in terms of sections 29 and 39 (5) in that regard.	
Full Names and Surname	
Identity Number	

APPENDICES (REGULATION 50 (I))

This regulation requires the inclusion of technical and supporting information as appendices.

The contents of the EIA must be a clear and concise description of the findings, interpretation and conclusions of the applicant, or the findings and recommendations of specialist reports.

Supporting information must therefore not be included in the EIA, but when relevant it must be provided as appendices to the EIA. The following information is required as appendices:-

17. Inclusion of technical and supporting information. The applicant must:-

17.1. Attach a specialist report regarding the investigation, assessment and evaluation of cultural and heritage resources, in consultation with regional organs of state e.g. SAHRA, tasked with a cultural and heritage mandate and in cognisance of local knowledge (community and landowner)

17.2. Attach a specialist report with regard to the determination and description of the baseline environment

17.3. Attach a specialist geo-hydrological report in cases where the mineral commodity to be mined has the potential to generate acid mine drainage or result in the contamination of groundwater.

17.4. Attach a specialist report on the impact of the proposed mining operation on the socio-economic conditions of directly affected parties.

17.5. Attach a specialist study informing the comparative land use assessment referred to in paragraph 9 herein, and the information in paragraph 6.5 herein, which study must be conducted in accordance with generally accepted principles of sustainable development by integrating social, economic and environmental factors into a comparison of the costs and benefits of the alternative land uses with those of the mining operation on an equitable basis

17.6. Attach any other specialist reports that may be required.

21 References

Kleynhans, C.J. 2000. Desktop estimates of the ecological importance and sensitivity categories (EISC), default ecological management classes (DEMC), present ecological status categories (PESC), present attainable ecological management classes (present AEMC), and best attainable ecological management class (best AEMC) for quaternary catchments in South Africa. DWAF Report, DWAF, Pretoria, South Africa.

Ferrar, A.A. and Lotter, M.C. 2007. Mpumalanga Biodiversity Conservation Plan Handbook. Mpumalanga.

Driver A, Maze K, Rouget M, Lombard AT, Nel, JL, Turpie JK, Cowling R, Desmet P, Goodman P, Harris J, Jomas Z, Reyers B, Sink K, Strauss T. 2005. National spatial biodiversity assessment 2004: priorities for biodiversity conservation in South Africa. Strelitzia 17: 1–45.

Appendix A: Plans

Plan 1: Regional Setting

Plan 2: Local Setting

Plan 3: Land Tenure

Plan 4: Identified Heritage Resources

Plan 5: Regional Geology

Plan 6: Topography Model

Plan 7: Slope Model

Plan 8: Land Type

Plan 9: Wetland PES

Plan 10: Aquatic PES

Plan 11: Quaternary Catchments

Plan 12: Wetlands

Plan 13: Mine Shafts

Plan 14: Borehole Classes

Appendix B: Specialist Reports

Appendix C: PPP