Agricultural Potential Assessment for the proposed Vlakvarkfontein Coal Mine

Mpumalanga, South Africa

November 2017

CLIENT

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Report Name	**Agricultural Potential Assessment for the proposed Vlakvarkfontein Coal Mine**	
Submitted to	**EIMS**	
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EXECUTIVE SUMMARY

Ntshovelo Mining Resources (Pty) Ltd, a subsidiary of Mbuyelo Coal (Pty) Ltd, has appointed Geo Soil and Water cc (GSW) as the Environmental Assessment Practitioner (EAP) to assist with undertaking the necessary authorisation and amendment processes for Vlarkvarkfontein Coal Mine. In turn GSW has appointed Environmental Impact Management Services (EIMS) as well as various specialist sub-consultants to assist with compiling the necessary reports and undertaking the statutory consultation processes, in support of proposed extensions to the Vlakvarkfontein Coal Mine.

The Biodiversity Company was commissioned to conduct specialist studies to supplement the abovementioned applications. An assessment of the agricultural potential of the soil was conducted on the 6th November 2017.

During the survey three main soil forms were identified, namely the Clovelly, Oakleaf, and Katspruit soil forms.

The Climate capability for this region was determined to be C7 classification. C7 (Severe to very severe limitation rating): Severely restricted growing season due to low temperatures, frost and/or moisture stress. Suitable crops at risk to yield loss (Smith, 2006).

The Land Capability for the project area is shown in Figure 11. The Clovelly soil form has been classified as Class III. The Katspruit soil form has been classified as Class V (Vlei), due to signs of wetness within the first 200mm. The Oakleaf soil form was classified as land capability class IV.

The Land Potential of the project area is shown in Figure 12 and the land potential groups are described previously in Table 2.

The classes III and Class IV land capability was rated as L5 land potential. The Class V land capability was determined to be a **Vlei**.

The major impacts associated with mining are the disturbance of natural occurring soil profiles consisting of layers or soil horizons. Rehabilitation of disturbed areas aims to restore land capability but the South African experience is that post mining land capability usually decreases compared to pre-mining land capability. Soil formation is determined by a combination of five interacting main soil formation factors. These factors are time, climate, slope, organisms and parent material. Soil formation is an extremely slow process and soil can therefore be considered as a non-renewable resource.

Soil quality deteriorates during stockpiling and replacement of these soil materials into soil profiles during rehabilitation cannot imitate pre-mining soil quality properties. Depth however can be imitated but the combined soil quality deterioration and resultant compaction by the machines used in rehabilitation, leads to a net loss of land capability. A change in land capability then forces a change in land use.

The impact on soil is high because natural soil layers will be stripped and stockpiled for later use in rehabilitation. In addition, soil fertility is impacted because stripped soil layers are usually thicker than the defined topsoil layer.

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Declaration

I, Wayne Jackson declare that:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.

Wayne Jackson

Soil Specialist

The Biodiversity Company

20 November 2017

1 Introduction

Ntshovelo Mining Resources (Pty) Ltd, a subsidiary of Mbuyelo Coal (Pty) Ltd, has appointed Geo Soil and Water cc (GSW) as the Environmental Assessment Practitioner (EAP) to assist with undertaking the necessary authorisation and amendment processes for Vlarkvarkfontein Coal Mine. In turn GSW has appointed Environmental Impact Management Services (EIMS) as well as various specialist sub-consultants to assist with compiling the necessary reports and undertaking the statutory consultation processes, in support of proposed extensions to the Vlakvarkfontein Coal Mine.

Ntshovelo has an approved Mining Right (Reference: MP 30/5/1/2/2/300 MR) and Environmental Management Programme (EMPR), in terms of the Minerals and Petroleum Resources Development Act (Act 28 of 2002, as amended) (MPRDA), for the mining of coal at the Vlakvarkfontein Coal Mine. Ntshovelo wishes to extend the mining operations at the Vlakvarkfontein Coal Mine, located on Portions 5, 13, and 18 of the Farm Vlakvarkfontein 213 IR.

It is proposed to expand the open cast mining operations, using the roll-over mining method, onto Portion 5 of the farm Vlakvarkfontein 213IR. This area is within the existing approved mining right boundary but was not specifically included and assessed in the approved Environmental Management Programme Report (EMPR) and associated environmental permits and authorisations. The proposed new mining operations will necessitate the relocation and re-establishment of the existing ancillary infrastructure associated with the current mining operations, including the Pollution Control Dam (PCD) and the administrative structures. It is also proposed to establish a coal processing plant (wash plant) to decontaminate the Run of Mine (RoM) coal. An application for the amendment to the existing Mine Works Programme (MWP) and EMPR, through an MPRDA Section 102 Application, and a full Environmental Impact Assessment (EIA) for the proposed new mining area is, therefore, required to support an application for environmental authorisation (EA) / waste management licence (WML) as applicable.

The Biodiversity Company was commissioned to conduct specialist studies to supplement the abovementioned applications. An assessment of the agricultural potential of the soil was conducted on the 6th November 2017.

The conservation of South Africa's limited soil resources is essential. In the past misuse and poor management of the soil resource has led to the loss of these resources through erosion and destabilisation of the natural systems. In addition, loss of high potential agricultural land due to land use changes is a big concern presently in South Africa.

Soils can be seen as the foundation for ecological function as shown in Figure 1. Without a healthy soil system for microbes to thrive in, both flora and fauna would be negatively impacted, which in turn feeds the natural soil system with organics and nutrients.

To identify soils accurately, it is necessary to undertake a soil survey. The aim is to provide an accurate record of the soil resources of an area. Land capability and land potential is then determined from these results. The objective of determining the land capability/potential is to find and identify the most sustainable use of the soil resource without degrading the system.

Soil mapping is essential to determine the types of soils present, their depths, their land capability and land potential. These results will then be used to provide practical recommendations on preserving and managing the soil resource.

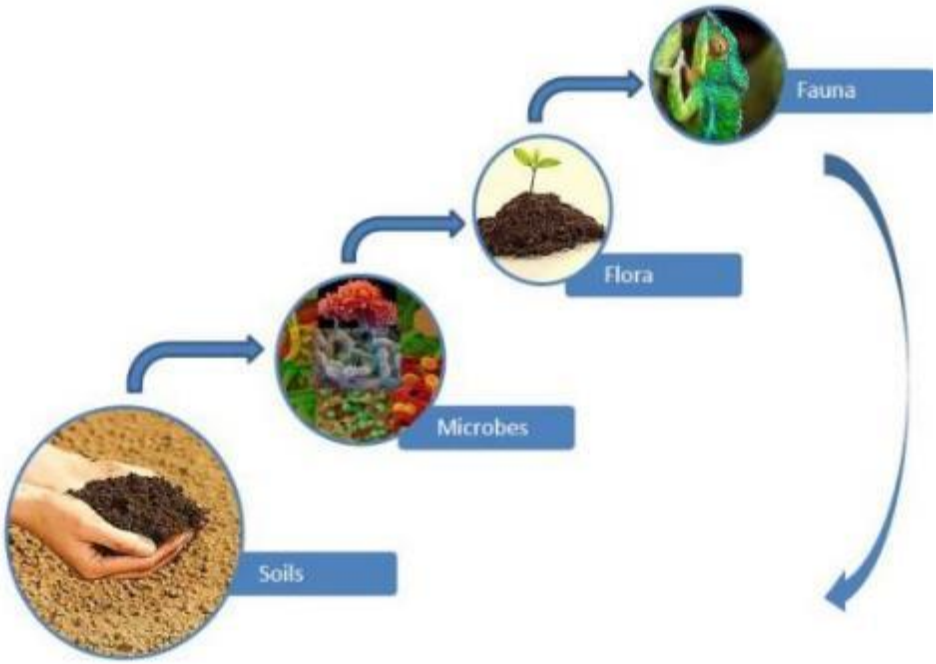


Figure 1: The relationship between soil and above-ground ecological succession

1.1 Objectives

It was requested that an agricultural potential assessment be conducted on the project area as per the Provincial and National Departments of Agriculture recommendations:

- Assess and discuss historic climate statistics;
- Assess and discuss geological information;
- Assess and discuss the terrain features using 5 m contours;
- Source best recent satellite or aerial imagery and georeferenced;
- Assess and discuss current agricultural land use on site;
- Conduct soil assessment as described in the methodology;
- Assess and discuss agricultural land potential (eight class scale); and
- Compile informative reports and maps on current land use and agricultural land potential.

The results will be mapped in GIS format and will include the following maps:

- A soil distribution map;
- A current land use map; and
- An agricultural potential map.

1.2 Study Area

The Vlakvarkfontein mining operations are located approximately 40 km South West of the City of Emalahleni, Mpumalanga Province. The project site is located in the Kendal area in the Nkangala District Municipality and the Delmas Local Municipality, Mpumalanga province (Figure 2).

Figure 2: Map showing the project area

2 Assumptions & Limitations

The following assumptions and limitations have been made:

- The information provided in this report is based on information gathered from site visits undertaken on the 31st of October 2017;
- The information contained in this report is based on auger points taken and observations on site. There may be variations in terms of the delineation of the soil forms presented compared to when stripping of soil is undertaken. If this is encountered the soil stripping

plan may need to be updated to reflect these variations in terms of how soil is stripped and stockpiled;
- Soil Samples for fertility will be taken at a later stage;
- The area surveyed was based on the mining layout presented by the Applicant.

3 Methodology

The agricultural assessment was conducted using the Provincial and National Departments of Agriculture recommendations. The assessment was broken into two phases. Phase 1 was a desktop assessment to determine the following:

- Historic climatic conditions;
- The terrain features using 5m contours;
- The base soils information from the land type database (Land Type Survey Staff, 1972 - 2006); and
- The geology for the proposed mining site.

Phase 2 of the assessment was to conduct a soil survey to determine the actual agricultural potential. During this phase the current land use was also surveyed.

3.1 Desktop Assessment

As part of the desktop assessment, baseline soil information was obtained using published South African Land Type Data. Land type data for the site was obtained from the Institute for Soil Climate and Water (ISCW) of the Agricultural Research Council (ARC) (Land Type Survey Staff, 1972 - 2006). The land type data is presented at a scale of 1:250 000 and comprises of the division of land into land types.

3.2 Field Survey

A study of the soils present within the project area was conducted during field visit in October 2017. The site was traversed by vehicle and on foot. A soil auger was used to determine the soil form/family and depth. The soil was hand augured to the first restricting layer or 1.5 m. Soil survey positions were recorded as waypoints using a handheld GPS. Soils were identified to the soil family level as per the “Soil Classification: A Taxonomic System for South Africa” (Soil Classification Working Group, 1991). Landscape features such as existing open trenches were also helpful in determining soil types and depth. The sampling locations are shown in Figure 3. Only areas that have not been disturbed could be sampled.

Figure 3: The sampling points for the agricultural potential assessment

3.3 Agricultural Potential Assessment

Land capability and agricultural potential is determined by a combination of soil, terrain and climate features. Land capability is defined by the most intensive long term sustainable use of land under rain-fed conditions. At the same time an indication is given about the permanent limitations associated with the different land use classes (Smith, 2006)

Land capability is divided into eight classes and these may be divided into three capability groups. Table 1 shows how the land classes and groups are arranged in order of decreasing capability and ranges of use. The risk of use increases from class I to class VIII (Smith, 2006).

Table 1: Land capability class and intensity of use (Smith, 2006)

Land Capability Class	Increased Intensity of Use									Land Capability Groups
I	W	F	LG	MG	IG	LC	MC	IC	VIC	Arable Land
II	W	F	LG	MG	IG	LC	MC	IC		
III	W	F	LG	MG	IG	LC	MC			
IV	W	F	LG	MG	IG	LC				
V	W	F	LG	MG						Grazing Land
VI	W	F	LG	MG						

VII	W	F	LG							
VIII	W									**Wildlife**
W - Wildlife		**MG - Moderate Grazing**			**MC - Moderate Cultivation**					
F- Forestry		**IG - Intensive Grazing**			**IC - Intensive Cultivation**					
LG - Light Grazing		**LC - Light Cultivation**			**VIC - Very Intensive Cultivation**					

The land potential classes are determined by combining the land capability results and the climate capability of a region as shown in Table 2. The final land potential results are then described in Table 3.

Table 2: The combination table for land potential classification

Land capability class	Climate capability class							
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**
I	L1	L1	L2	L2	L3	L3	L4	L4
II	L1	L2	L2	L3	L3	L4	L4	L5
III	L2	L2	L3	L3	L4	L4	L5	L6
IV	L2	L3	L3	L4	L4	L5	L5	L6
V	Vlei	Vlei	Vlei	Vlei	Vlei	Vlei	Vlei	Vlei
VI	L4	L4	L5	L5	L5	L6	L6	L7
VII	L5	L5	L6	L6	L7	L7	L7	L8
VIII	L6	L6	L7	L7	L8	L8	L8	L8

Table 3: The Land Potential Classes.

Land potential	Description of land potential class
L1	Very high potential: No limitations. Appropriate contour protection must be implemented and inspected.
L2	High potential: Very infrequent and/or minor limitations due to soil, slope, temperatures or rainfall. Appropriate contour protection must be implemented and inspected.
L3	Good potential: Infrequent and/or moderate limitations due to soil, slope, temperatures or rainfall. Appropriate contour protection must be implemented and inspected.
L4	Moderate potential: Moderately regular and/or severe to moderate limitations due to soil, slope, temperatures or rainfall. Appropriate permission is required before ploughing virgin land.

L5	Restricted potential: Regular and/or severe to moderate limitations due to soil, slope, temperatures or rainfall.
L6	Very restricted potential: Regular and/or severe limitations due to soil, slope, temperatures or rainfall. Non-arable
L7	Low potential: Severe limitations due to soil, slope, temperatures or rainfall. Non-arable
L8	Very low potential: Very severe limitations due to soil, slope, temperatures or rainfall. Non-arable

3.4 Current Land Use

Land use was identified using aerial imagery and then ground-truthed while out in the field. The possible land use categories are:

- Mining;
- Bare areas;
- Agriculture crops;
- Natural veld;
- Grazing lands;
- Forest;
- Plantation;
- Urban;
- Built-up;
- Waterbodies; and
- Wetlands.

3.5 Impact Assessment Methodology

The impact assessment methodology is guided by the requirements of the NEMA EIA Regulations (2010). The broad approach to the significance rating methodology is to determine the environmental risk (ER) by considering the consequence (C) of each impact (comprising Nature, Extent, Duration, Magnitude, and Reversibility) and relate this to the probability/likelihood (P) of the impact occurring. This determines the environmental risk. In addition, other factors, including cumulative impacts, public concern, and potential for irreplaceable loss of resources, are used to determine a prioritisation factor (PF) which is applied to the ER to determine the overall significance (S).

4 Scope of Work

The main purpose of the above-mentioned specialist study is to provide an EIA/EMP Report for the proposed mine extension as well as input into alternatives for consideration in the EIA, identified impacts list and scoping sensitivity map.

4.1 Soil Specific Scope

The soil specific scope required is as follows:

- A soils study was conducted which includes a description of the physical properties which characterise the soil within the proposed area of development of the relevant portions of the property.
- The findings from the study were used to determine the existing land capability and current land use of the entire surface area of the relevant portions of the study area.
- Soil sampling during the field work was based on a grid of 150 x 150 m for the areas where opencast mining will occur, while a grid of 300 x 300 m was required for the remaining surface areas.
- The soil classification was done according to the Taxonomic Soil Classification System for South Africa, 1991. The following attributes must be included at each observation:
    - Soil form and family (Taxonomic Soil Classification System for South Africa, 1991);
    - Soil depth;
    - Estimated soil texture;
    - Soil structure, coarse fragments, calcareousness;
    - Buffer capacities;
    - Underlying material;
    - Current land use; and
    - Land capability.

5 Legislative & Policy Framework

Currently, various pieces of legislation and related policies exist that guide and direct the land user in terms of land use planning both on a national and provincial level. This legislation includes, but is not limited to:

- The Constitution of the Republic of South Africa (Act 108 of 1996);
- Sub-division of Agricultural Land Act (Act 70 of 1970);
- Municipal Structures Act (Act 117 of 1998);
- Municipal Systems Act (Act 32 of 2000); and
- Spatial Planning and Land Use Management Act, 16 of 2013 (not yet implemented).

The above are supported by additional legislation that aims to manage the impact of development on the environment and the natural resource base of the country. Related legislation to this effect includes:

- Conservation of Agricultural Resources Act (Act 43 of 1983);
- Environment Conservation Act (Act 73 of 1989);
- National Environmental Management Act (Act 107 of 1998); and
- National Water Act (Act 36 of 1998).

6 Desktop Information

6.1 Climate

The project area falls within the Rand Highveld Grassland region (Gm11) (Mucina & Rutherford, 2006). The region has a strongly seasonal summer-rainfall, with very dry winters. MAP is 654 mm, ranging between 570 mm and 730 mm. The coefficient of variation of MAP is 28% in the west and 26-27% in the east, and varies only slightly from 25% to 29% across the unit. The incidence of frost is higher in the west (30-40 days) than in the east (10-35 days). The mean annual temperature is 15.8 ºC. The mean annual evaporation is approximately 2184mm.

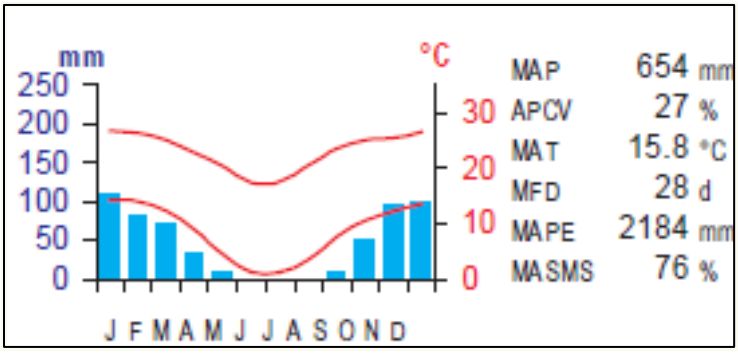


Figure 4: The climate summary for the Rand Highveld Grassland (Gm 11) region (Mucina & Rutherford, 2006)

The climate capability for this region falls within the **C7 classification**. C7 (Severe to very severe limitation rating): Severely restricted growing season due to low temperatures, frost and/or moisture stress. Suitable crops at risk to yield loss (Smith, 2006).

6.2 Terrain

A National Aeronautics and Space Administration (NASA) Shuttle Radar Topography Mission (SRTM) (V3.0, 1 arcsec resolution) Digital Elevation Model (DEM) was obtained from the United States Geological Survey (USGS) Earth Explorer website. Basic terrain analysis was performed on this DEM using the SAGA GIS software that encompassed a slope and channel network analyses in order to detect catchment areas and potential drainage lines respectively. The following processes have been considered for the desktop assessment:

- **The relief map (Figure 5):** The project area is flat throughout with an elevation range from approximately 1540 meter above sea level (masl) to 1565 masl. A relatively flat slope is located to the eastern parts of the project site sloping down to the western side.
- **The slope map (Figure 6):** The project area is flat with slopes between 0% and 4% without any major height changes within the project boundaries.
- **The aspect map (Figure 7):** The map shows that most of project area is north facing.

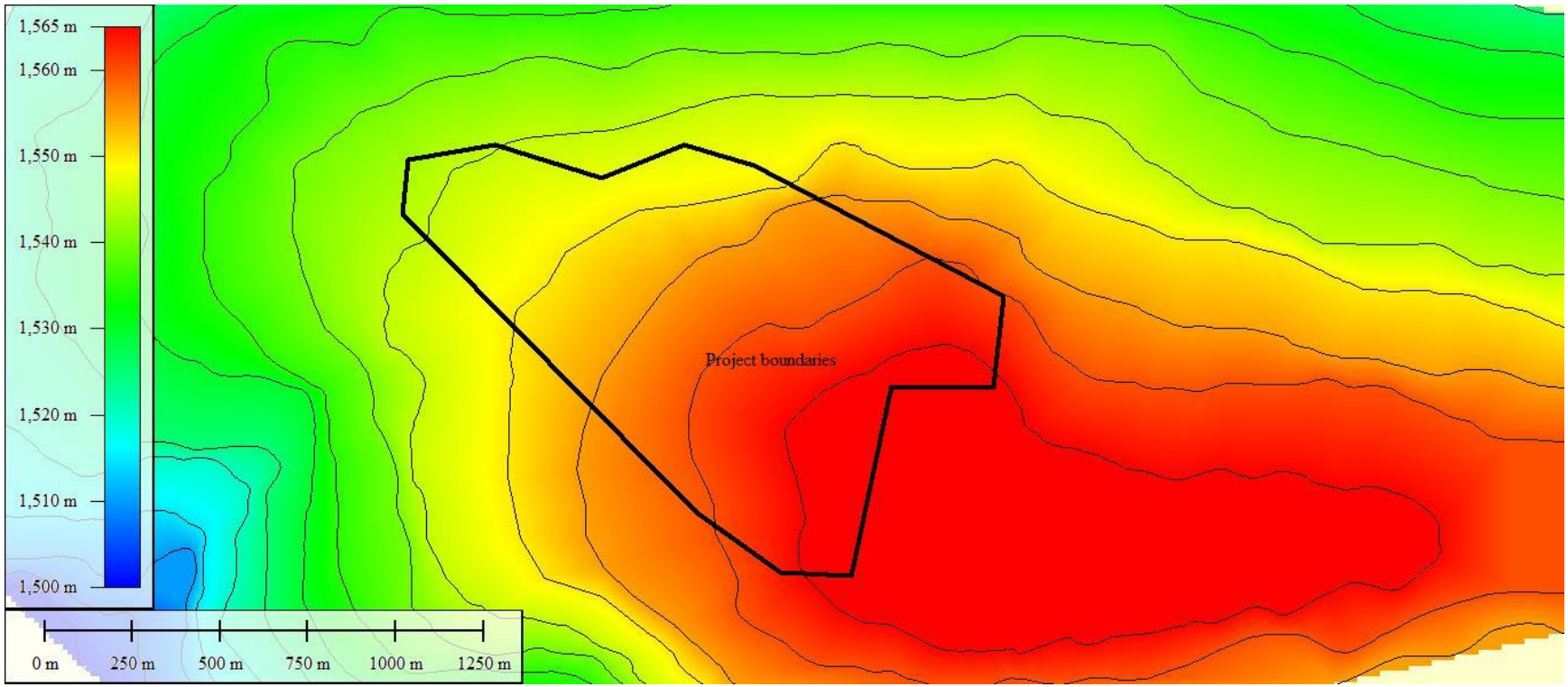


Figure 5: The relief map for the project area

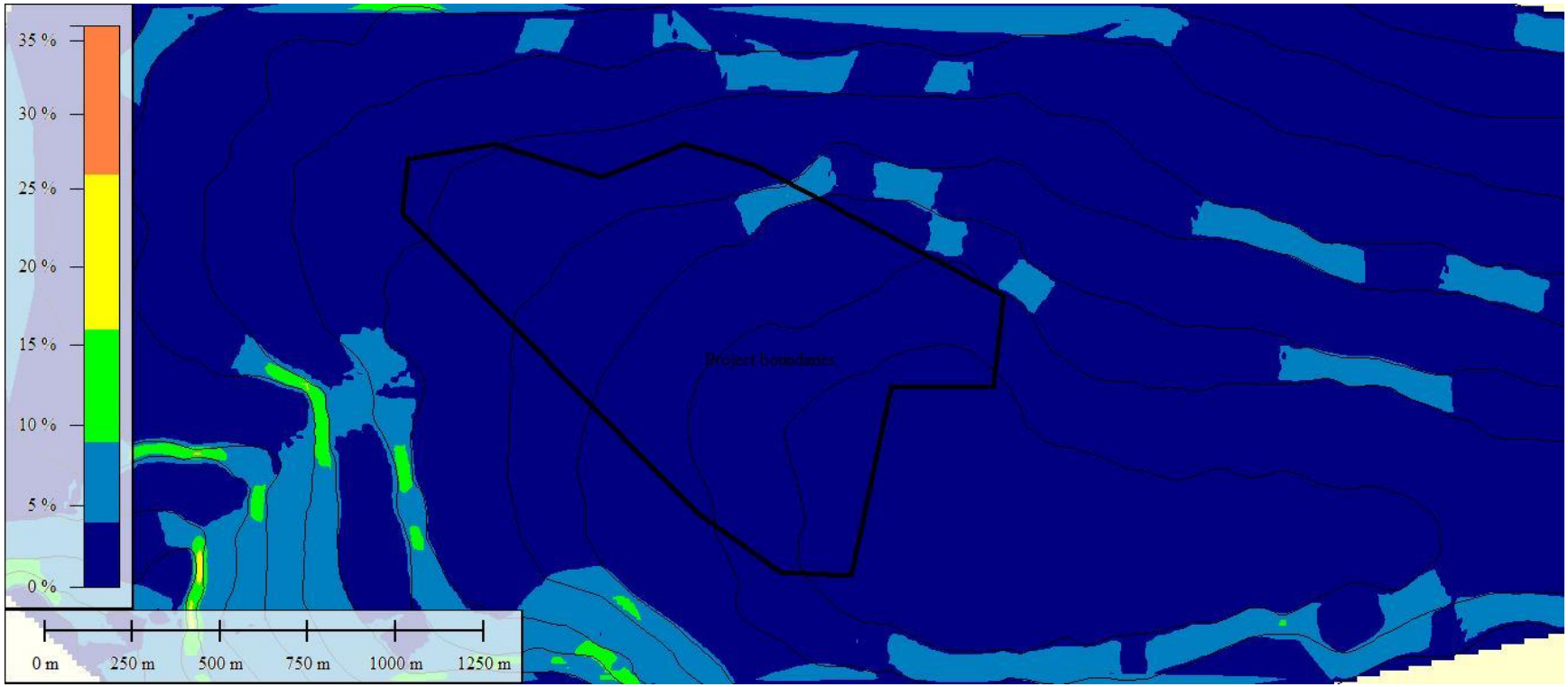


Figure 6: The Slope Percentage map for project area

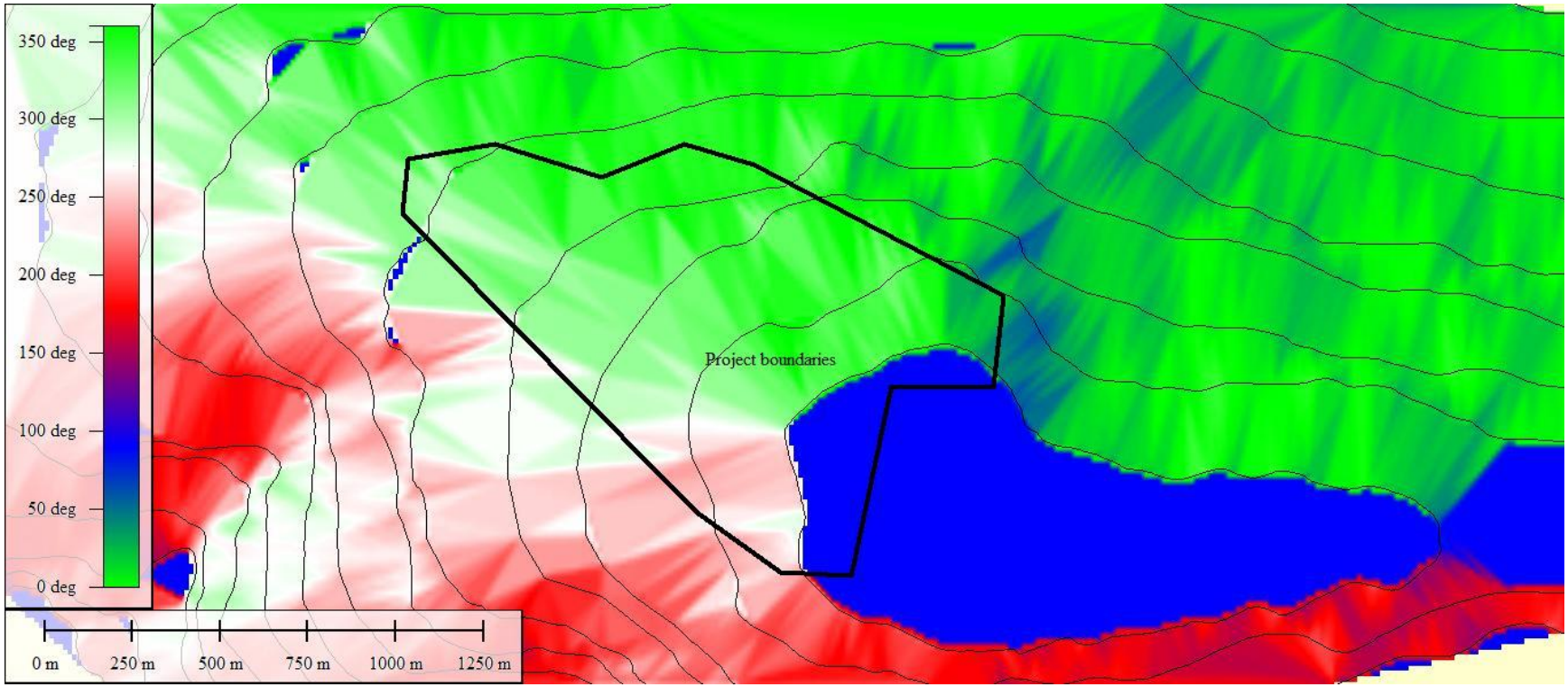


Figure 7: The Slope Aspect map for project area

6.3 Soils & Geology

According to the land type database (Land Type Survey Staff, 1972 - 2006) the project falls within the Ba5 land type. The dominant landscape position are the midslope (3) and crest (1) positions Figure 8. The slopes do not normally exceed 6%.

The soils are expected to be dominated by Hutton, Avalon, and Clovelly in the 1 and 3 positions. The clay percentages vary from 10% to 35%. The footslopes (4) and valley bottom (5) soils are expected to be dominated by Katspruit, Longlands, and Rensburg soils.

The geology is dominated by Quartzite ridges of the Witwatersrand Supergroup and the Pretoria Group as well as the Selons River Formation of the Rooiberg Group (last two are of the Transvaal Supergroup).

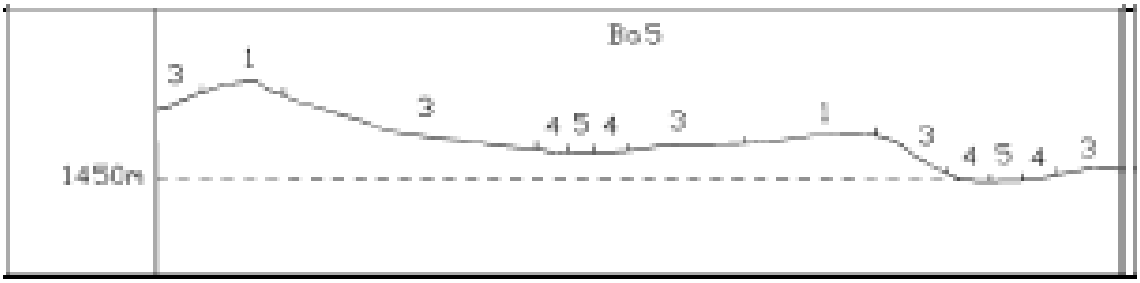


Figure 8: The hillslope catena of landtype Ba5

Figure 9: Land type map for the project area

6.4 Landscape and Vegetation Features

Highly variable landscape with extensive sloping plains and a series of ridges slightly elevated over undulating surrounding plains. The vegetation is species-rich, wiry, sour grassland alternating with low, sour shrubland on rocky outcrops and steeper slopes. Rocky hills and ridges carry sparse (savannoid) woodlands with *Protea caffra* subsp. *caffra, P. welwitschii, Acacia caffra* and *Celtis africana*, accompanied by a rich suite of shrubs among which the genus *Rhus* (especially *R. magalismonata*) is most prominent (Mucina & Rutherford, 2006).

7 Baseline Environment

7.1 Field Survey Findings

A detailed soil survey was conducted for the project site on the 31st of October 2017 using a hand-held auger and a GPS to log all information in the field. The soils were classified to the family level as per the "Soil Classification - A Taxonomic System for South Africa" (Soil Classification Working Group, 1991). The following information was recorded in the field:

- A horizon depth, colour and estimated clay percentage;
- B horizon depth, colour and estimated clay percentage;
- Signs of wetness;
- Rockiness of the profile;
- Surface crusting (if any); and
- Slope at the survey point.

7.1.1 Soil Summary

The project area is characterised by a relatively flat and uniform relief, Figure 5. The soils delineation is shown in Figure 10. The soil distribution is shown in Table 4. The areas assigned for soil classification during the desktop study is dominated in most parts by Clovelly soil forms. The Clovelly soil form is characterised by a rather weak-structured Orthic A-horizon consisting of 0% to 15% clay. The Clovelly soil form consist of a yellow-brown Apedal B-horizon with no structure at all. This soil form has a high infiltration rate accompanied by high permeability. The Orthic A-horizon of the Clovelly soil forms is approximately 250mm to 300mm. None of the Clovelly soil forms show any signs of wetness within a total profile depth of 1500mm. This soil form consists of a 5% to 10% average rockiness.

A Katspruit soil form has been classified next to a large disturbed area. This soil form is saturated and indicates a small wetland area. The disturbed area upslope from the wetland has been severely compacted. This compaction can be explained by a combination of heavy machinery and vehicles crossing this area over the past few years as well as probable salinization that has increased dispersion and ultimately crust formation of which the latter is well documented by

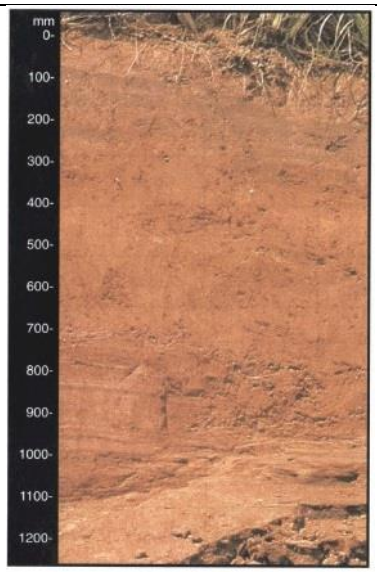
(Ghadiri et al., 2004). The compaction/crusting in the area has led to high amounts of run-off which ultimately accumulates in the small depression. Furthermore, run-off has ensured that fine clay particles (which are easily transported) has accumulated within this depression which ultimately adds to the water holding potential of the soil. The Katspruit soil form is characterised by an Orthic A-horizon with high amounts of clay (45% to 60%) which is approximately 100mm deep. This layer overlays a saturated G-horizon which is approximately 600mm deep. This soil profile is also characterised by a rather large amount of pebbles and rocks, approximately 30%.

Lastly, an Oakleaf soil form was classified surrounding the saturated Katspruit soils. This soil form consists of an Orthic A-horizon with a Neocutanic B-horizon, over an unspecified C-horizon without any signs of wetness. The Orthic A-horizon of the Oakleaf has a lower clay percentage than that of the Katspruit (approximately 15% to 30%) and is only 100mm deep. The Neocutanic B-horizon has no signs of wetness and is approximately 200mm deep. The entire soil profile consists of approximately 5-10% rockiness and is roughly 300mm deep.

Table 4: Shows the distribution of the soils surveyed

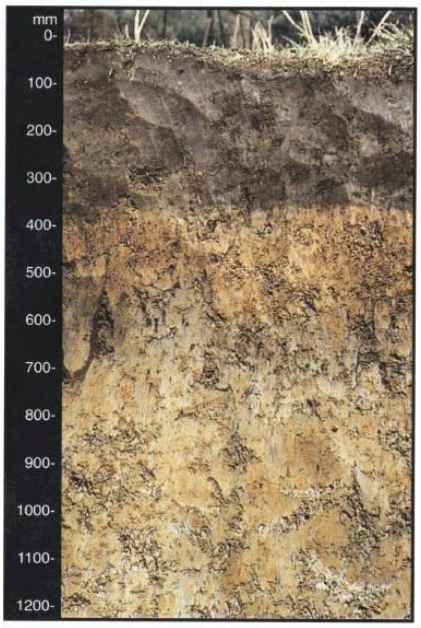
Soil Forms	Total Area (ha)
Clovelly	**13.9**
Oakleaf	**5.2**
Katspruit	**0.18**

Table 5: Clovelly soils in the project area

<table>
<tr><th colspan="3">Clovelly (Brereton 1200)</th></tr>
<tr><td rowspan="3">Horizons</td><td colspan="2">A typical cross section of a Clovelly soil (SASA, 1999).</td></tr>
<tr><td>Orthic A-Horizon</td><td rowspan="2"> 
</td></tr>
<tr><td>Yellow-brown B-Horizon</td></tr>
<tr><td>Description</td><td colspan="2">The Clovelly soil form is a relatively sandy soil form. The infiltration rates for these soils are moderate to high, depending on the structure and percentage clay. This soil form is moderately suited for agricultural purposes.</td></tr>
<tr><td>Site photos:

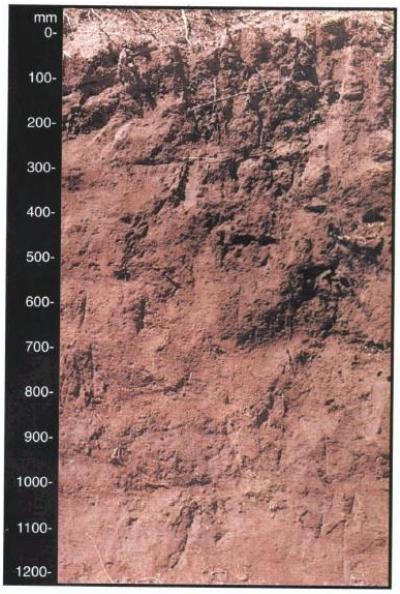
(Orthic A-horizon topsoil left and Yellow-brown Apedal B-horizon soil on the right)</td><td>  </td><td>  </td></tr>
</table>

Table 6: Katspruit soils in the project area

<table>
<tr><th colspan="3">Katspruit (Slangspruit 2000)</th></tr>
<tr><td rowspan="3">Horizons</td><td colspan="2">Typical Cross Section of a Katspruit soil (SASA, 1999).</td></tr>
<tr><td>Orthic A-Horizon</td><td rowspan="2"> 
</td></tr>
<tr><td>G-Horizon</td></tr>
<tr><td>Description</td><td colspan="2">The Katspruit soil form consists of an Orthic A-horizon on top of a saturated G-horizon. This soil form typically occurs at low lying areas where water tends to accumulate. A G-horizon is characterised by saturated conditions.</td></tr>
<tr><td>Site Photos:

left to right, Orthic A-Horizon and G-horizon.</td><td>  </td><td>  </td></tr>
</table>

Table 7: Oakleaf soils in the project area

<table>
<tr><th colspan="3">Oakleaf (Buchuberg 1120)</th></tr>
<tr><td rowspan="4">Horizons</td><td colspan="2">A typical cross section of a Oakleaf soil (SASA, 1999).</td></tr>
<tr><td>Orthic A-Horizon</td><td rowspan="3"> 
</td></tr>
<tr><td>Neocutanic B-Horizon</td></tr>
<tr><td>Unspecified material without signs of wetness

C-Horizon</td></tr>
<tr><td>Description</td><td colspan="2">The Oakleaf soil is labelled as a “newly formed” soil and often occurs in alluvial and colluvial deposits. This soil form has a relatively weak structure.</td></tr>
<tr><td>Site Photos:

From left to right, an Orthic A-horizon and a Neocutanic B-horizon.</td><td>  </td><td>  </td></tr>
</table>

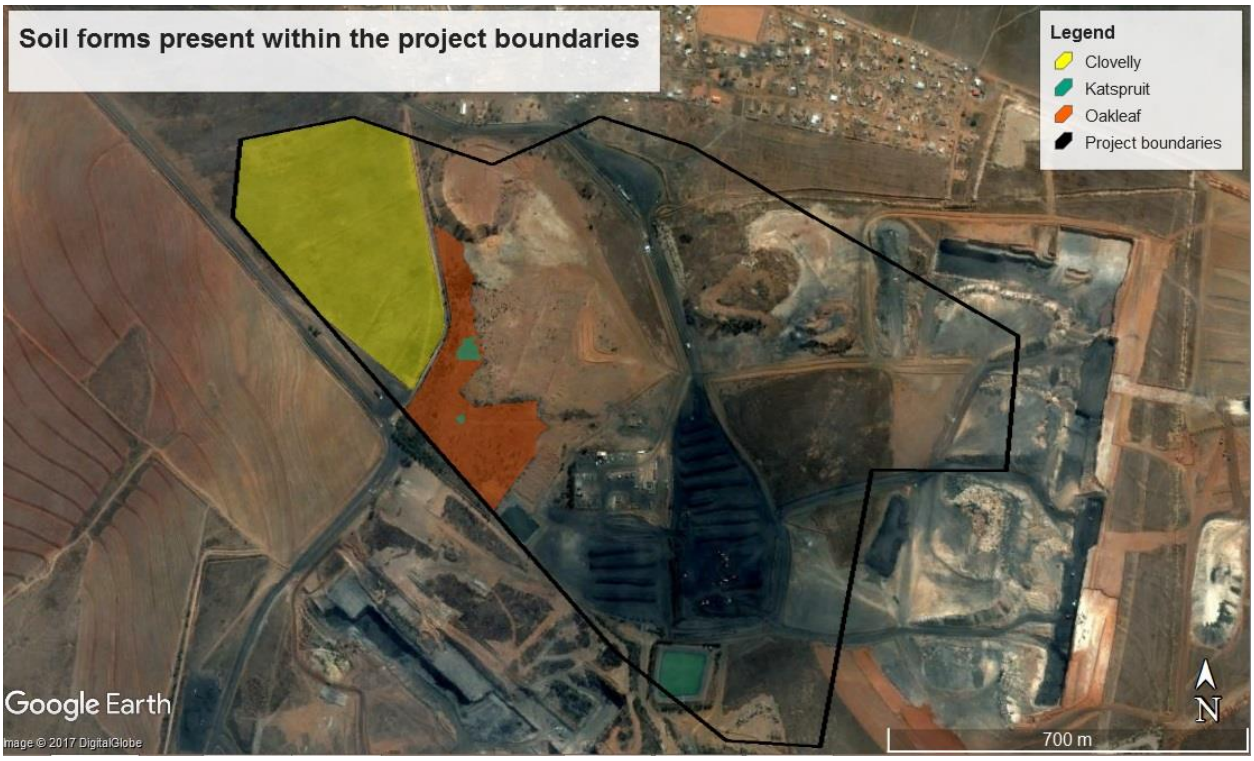


Figure 10: Soil forms for the Vlakvarkfontein Coal Mine

7.2 Agricultural Potential

Agricultural potential is determined by a combination of soil, terrain and climate features. Land capability classes reflect the most intensive long-term use of land under rain-fed conditions.

The land capability is determined by the physical features of the landscape including the soils present. The land potential or agricultural potential is determined by combining the land capability results and the climate capability for the region.

7.2.1 Current Situation

The area is dominated by mining to the east and south. The surveyed portion was covered by grass and no current agriculture is taking place, however agriculture is occurring on the neighbouring farm to the south west.

7.2.2 Verified Agricultural Potential

The Climate capability for this region was determined to be C7 classification. C7 (Severe to very severe limitation rating): Severely restricted growing season due to low temperatures, frost and/or moisture stress. Suitable crops at risk to yield loss (Smith, 2006).

The land capability was determined by using the guidelines described in “The farming handbook” (Smith, 2006). A breakdown of the land capability classes is shown in Table 1: Land capability class and intensity of use (Smith, 2006).

The Land Capability for the project area is shown in Figure 11. The Clovelly soil form has been classified as Class III. The Katspruit soil form has been classified as Class V (Vlei), due to signs of wetness within the first 200mm. The Oakleaf soil form was classified as land capability class IV.

The Land Potential of the project area is shown in Figure 12 and the land potential groups are described previously in Table 2.

The classes III and Class IV land capability was rated as L5 land potential. The Class V land capability was determined to be a **Vlei**.

Figure 11: Land capability classes of different soil forms present within the Vlakvarkfontein project areas

Figure 12: Land Potential Classes within the Vlakvarkfontein project boundaries

7.3 Current Land Use

The project area is approximately 103ha in size with mining and infrastructure being 83.72ha. The wetland areas are 0.18ha in size and the veld (grassland) accounts for the remaining 19.1ha. Figure 13 shows the grassland with the mining occurring in the background.

Figure 13: Tailings storage facility present within the project boundaries

8 Impact Assessment

From an agricultural perspective, the loss of high value farm land and / or food security production, as a result of the proposed activities, is the primary concern of this assessment. In South Africa there is a scarcity of high potential agricultural land, with less than 14% of the total area being suitable for dry land crop production (Smith, 2006).

8.1 Project Alternatives

The impact section will assess the impacts on soils and land capability for all the relevant alternatives shown in Table 8**.** These alternatives are described below along with their respective impact ratings. The two main aspects that was considered for all alternatives where:

- The loss of the land capability; and
- The loss of soil as a valuable resource.

Table 8: List of project alternatives that has been considered in the impact assessment

Alternative Category		Alternative description	Considered
Process Alternatives	Process alternatives - Mining methods.	Open Cast	Yes
	Filter cake	Stockpile for use as non-select product.	Yes
		Disposal	Yes
	Disposal of carboniferous wastes (wash plant waste rock and possibly filter cake)	Disposal to surface waste disposal facility-located on old rehabilitated mine area.	Yes
		Disposal to surface waste disposal facility-located on un-mined area.	Yes
		Disposal of beneficiation plant waste rocks and filter cake to pit.	Yes
	Old underground workings - Dewatering options	Pump-treat-discharge.	Yes
		Pump-store (in existing penstock area)-treat-discharge.	Yes
	Wash plant water supply	Water obtained from dirty water containment facilities (e.g. penstock storage area, PCD's etc).	Yes
Technology Alternatives	Coal Beneficiation -Washing processing technology	Wet washing	Yes
	Coal product transport options	Road	Yes
Activity Alternatives	Land-use Alternatives	Land used for mining	Yes
		No-go alternative	Yes
Location Alternatives	Micro siting alternatives	Maximum mining over entire area	Yes
		Sensitivity-based approach (avoid / buffer sensitive areas).	Yes
	Relocation alternatives	Relocation of highly impacted community members	Yes

8.1.1 Alternative P1a (open cast)

This would involve an extension of the current open pit in order to mine the pillars of the in-situ coal on both 4 and 2 seams. This is the current mining process presented in the MWP.

Planning Phase (Table 9): a detailed Mining Program, Soil Stripping Guideline, and Rehabilitation Plan must be completed before commencement. Poor planning of soil stripping stockpiling and rehabilitation will result in losses of land capability and soil as a valuable and irreplaceable resource.

Proper planning prior to construction would reduce the level of impacts from a Medium to a Low impact.

Table 9: Loss of land capability assessed for alternative P1a (Open Cast) during the planning phase

A. Loss of Land Capability - Alternative P1a – Open Cast Mining					
Impact Name	**Loss of Land Capability**				
Alternative	**Alternative P1a – Open Cast**				
Phase	**Planning**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	5	3
Extent of Impact	1	1	Reversibility of Impact	2	2
Duration of Impact	5	2	Probability	5	2
Environmental Risk (Pre-mitigation)					-16.25
Mitigation Measures					
• Proper planning of mining sequences; • stripping and stockpiling guidelines; and • rehabilitation and monitoring plans.					
Environmental Risk (Post-mitigation)					-4.00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					3
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).					
Prioritisation Factor					1.50
Final Significance					-6.00

Construction phase (Table 10): The impacts to consider are those relating to the disturbance of the natural soil state. When soil is stripped the physical properties are changed and this impacts on the soils health. When the soil is stockpiled, the soils chemical properties will deteriorate unless

properly managed. These all lead to the loss of the topsoil layer as a natural resource. Soil is considered a slowly regenerating resource due to the fact that it takes hundreds of years for a soil profile to gain 10cm of additional soil through natural processes. During a single rainfall event on unprotected bare soil erosion could remove that same amount of soil if not more.

Whilst the construction takes place vehicles will drive on the soil surface compacting it. This reduces infiltration rates as well as the ability for plant roots to penetrate the compacted soil. This then reduces vegetative cover and increases runoff potential. The increased runoff potential then leads to increased erosion hazards.

If the topsoil and subsoil are stripped and stockpiled as one unit, the topsoils seed bank and natural fertility balance is diluted. This will affect the regrowth of vegetation on the stockpiles as well as the regrowth when they have been replaced during the rehabilitation process, therefor soils should be handled with care from the construction phase through to the decommissioning phase.

Operational phase (Table 10): During the operational phase, similar scores are expected regarding the extent of the impacts than those scored for the construction phase. The operational phase describes the processes taking place during the extraction of coal within the open cast pit. The top soil is stripped during this process and stockpiled separately. It is of vital importance that the correct procedures be adhered to during this activity and that the different soil horizons be kept separate. During this phase, erosion is a major concern for these stockpiles, especially in cases where proper vegetation has not been established. Erosion within these sections will cause extensive sediment transport and ultimately pollution and degradation of healthy water courses and soil resources nearby.

These designated stockpiles often compact the soil underneath them due to their extremely high masses. Compaction of natural soil resources for extended time periods can cause irreversible degradation. Stockpiles themselves aren't the only aspect contributing to compaction. During the operational phase, a large degree of vehicle activity takes place to ensure that extracted minerals as well as additional waste material is transported to its designated storage areas. These heavy machinery vehicles compact the soil between the mining site and the mentioned storage areas severely. Additionally, such stockpiles tend to entail very fine sediment that is prone to be carried away by gusts of wind and ultimately contributes to dust pollution.

Table 10: Loss of land capability assessed for alternative P1a (Open Cast) for the Construction and Operational phase

B. Loss of Land Capability - Alternative P1a – Open cast mining					
Impact Name	**Loss of Land Capability**				
Alternative	**Alternative P1a- open cast**				
Phase	**Construction and Operational**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**

Nature of Impact	-1	-1	Magnitude of Impact	5	4
Extent of Impact	2	2	Reversibility of Impact	5	3
Duration of Impact	5	3	Probability	5	3
Environmental Risk (Pre-mitigation)					-21.25
Mitigation Measures					
• Bush clearing of all bushes and trees taller than one meter; Ensure proper storm water management designs are in place; • If any erosion occurs, corrective actions (erosion berms) must be taken to minimize any further erosion from taking place; • If erosion has occurred, topsoil should be sourced and replaced and shaped to reduce the recurrence of erosion; • Only the designated access routes are to be used to reduce any unnecessary compaction; • Compacted areas are to be ripped to loosen the soil structure; • The topsoil should be stripped by means of an excavator bucket, and loaded onto dump trucks; • Topsoil stockpiles are to be kept to a maximum height of 4m; • Topsoil is to be stripped when the soil is dry, as to reduce compaction; • Bush clearing contractors will only clear bushes and trees larger than 1m the remaining vegetation will be stripped with the top 0.3 m of topsoil to conserve as much of the nutrient cycle, organic matter and seed bank as possible; • The subsoil approximately 0.3 to the designated thickness in the stripping guidelines, will then be stripped and stockpiled separately; • The handling of the stripped topsoil will be minimized to ensure the soil's structure does not deteriorate significantly; • Compaction of the removed topsoil must be avoided by prohibiting traffic on stockpiles; • Stockpiles should only be used for their designated final purposes; • The stockpiles will be vegetated (details contained in rehabilitation plan) in order to reduce the risk of erosion, prevent weed growth and to reinstitute the ecological processes within the soil. • Place the above cleared vegetation were the topsoil stockpiles are to be placed; and • Strip the topsoil and the remaining vegetation as per the rehabilitation guideline and place in the allocated locations for the various soil types, on top of the previously cleared bushes and trees.					
Environmental Risk (Post-mitigation)					-9.00
Degree of confidence in impact prediction:					Medium
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					3
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).					
Prioritisation Factor					1.50
Final Significance					-13.50

Decommissioning phase (Table 11): During this phase, vehicle activity is likely to compact soils even further due to the necessary material. The infrastructure established during the construction phase is subsequently destroyed to ensure as little as possible is left after the relevant mining operations.

Table 11: Loss of land capability assessed for alternative P1a (Open Cast) for the Decommissioning phase

D. Loss of Land Capability - Alternative P1a – (open cast)					
Impact Name	**Loss of Land Capability**				
Alternative	**Alternative P1a- open cast**				
Phase	**Decommissioning**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	4	3
Extent of Impact	2	2	Reversibility of Impact	5	3
Duration of Impact	2	2	Probability	5	3
Environmental Risk (Pre-mitigation)					-16,25
Mitigation Measures					
• Ensure proper storm water management designs are in place; • If erosion occurs, corrective actions (erosion berms) must be taken to minimize any further erosion from taking place; • Ensure that proper phytostabilization takes place on top of the relevant stockpiles; • Only the designated access routes are to be used to reduce any unnecessary compaction; • Ensure proper storm water management designs are in place; • If erosion occurs, corrective actions (erosion berms) must be taken to minimize any further erosion from taking place; • If erosion has occurred, topsoil should be sourced and replaced and shaped to reduce the recurrence of erosion; • Only the designated access routes are to be used to reduce any unnecessary compaction; • Compacted areas are to be ripped to loosen the soil structure and vegetation cover re-instated; • Implement land rehabilitation measures as defined in rehabilitation report. • Follow rehabilitation guidelines; • The topsoil should be moved by means of an excavator bucket, and loaded onto dump trucks; • Topsoil is to be moved when the soil is dry, as to reduce compaction; • After the completion of the project the area is to be cleared of all infrastructure; • The foundations to be removed; • Topsoil to be replaced for rehabilitation purposes; • The handling of the stripped topsoil will be minimized to ensure the soil's structure does not deteriorate; and • Stockpiles should only be used for their designated final purposes. • Compacted areas are to be ripped to loosen the soil structure and vegetation cover re-instated; and • Stockpiles should be reduced to smaller piles to ensure the ease of continues rehabilitation as well as to decrease the sheer weight thereof.					
Environmental Risk (Post-mitigation)					-7,50
Degree of confidence in impact prediction:					Medium
Impact Prioritisation					
Public Response					2
Issue has received a meaningful and justifiable public response					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					3
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).					

Prioritisation Factor	1,67
Final Significance	-12,50

Rehabilitation and closure (Table 12): The responsibility of rehabilitating degraded (both direct and indirect) areas is allocated to the mine and is an absolute necessity to ensure that closure is given regarding the relevant mining operations. During this phase, monitoring and accompanied rehabilitation is the key concern for replaced soil, compacted soils, eroded areas, the quality of tailing storage facilities, and the different types of pollutions caused by these structures. The successful implementation of this phase will ensure a positive impact on the environment which is a significant improvement of the "pre-mitigation" risk rating.

The risk rating will be significantly improve to a positive from a negative state. The land capability will increase from nothing the what the rehabilitation guidelines have stipulated.

Table 12: Loss of land capability assessed for alternative P1a (Open Cast) for the rehabilitation and closure phase

E. Loss of Land Capability - Alternative P1a – Open cast					
Impact Name	**Loss of Land Capability**				
Alternative	**Alternative P1a – Copen cast**				
Phase	**Rehab and closure**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	1	Magnitude of Impact	4	2
Extent of Impact	2	2	Reversibility of Impact	5	4
Duration of Impact	5	4	Probability	5	2
Environmental Risk (Pre-mitigation)					-20,00
Mitigation Measures					
• The rehabilitated area must be assessed once a year for post mining land capability compaction, fertility, and erosion; • The soils fertility must be assessed by a soil specialist yearly (during the dry season so that recommendations can be implemented before the start of the wet season) as to correct any nutrient deficiencies; • Compacted areas are to be ripped to loosen the soil structure and vegetation cover re-instated; • If erosion occurs, corrective actions (erosion berms) must be taken to minimize any further erosion from taking place; • If erosion has occurred, topsoil should be sourced and replaced and shaped to reduce the recurrence of erosion; • Only the designated access routes are to be used to reduce any unnecessary compaction; and • Areas of subsidence must be reported and remediated as soon as possible with the best practises at the time of occurrence.					
Environmental Risk (Post-mitigation)					6,00
Degree of confidence in impact prediction:					Medium
Impact Prioritisation					
Public Response					3
Issue has received an intense meaningful and justifiable public response					
Cumulative Impacts					3

Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.	
Degree of potential irreplaceable loss of resources	3
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).	
Prioritisation Factor	2,00
Final Significance	12,00

8.1.2 Alternatives P2a, P2b, P3a, P3b, P3d, P4a, P4b, P5a, T1b, T2a

All the alternatives listed here will have a contamination risk if not managed, whether it is the inadiquet design of stormwater drains to separate clean and dirty water, possible spills or leaks. All these aspects could impact on the soil resources and land capability.

Planning (Table 13)**:** a detailed Mining Program/layout, and Rehabilitation Plan must be completed before commencement. Poor planning of placement, stormwater management, and rehabilitation will result in losses of land capability and soil as a valuable and irreplaceable resource.

Proper planning prior to construction would reduce the level of impacts from a Medium to a Low impact.

Table 13: Loss of Land Capability and Soil Resources - Alternative P2a, P2b, P3a, P3b, P3d, P4a, P4b, P5a, T1b, T2a during the Planning Phase

A. Loss of Land Capability and Soil Resources - Alternative P2a, P2b, P3a, P3b, P3d, P4a, P4b, P5a, T1b, T2a					
Impact Name	**Loss of Land Capability and Loss of soil Resource**				
Alternative	**Alternative P2a, P2b, P3a, P3b, P3d, P4a, P4b, P5a, T1b, T2a**				
Phase	**Planning**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	4	3
Extent of Impact	2	1	Reversibility of Impact	3	2
Duration of Impact	4	2	Probability	4	2
Environmental Risk (Pre-mitigation)					-13.00
Mitigation Measures					
• Prevent any spills from occurring. Machines must be parked within hardpark areas and must be checked daily for fluid leaks; • If a spill occurs it is to be cleaned up immediately and reported to the appropriate authorities; • All vehicles are to be serviced in a correctly bunded area or at an off-site location; • Leaking vehicles will have drip trays place under them where the leak is occurring; • Pipelines must be maintained; • Pipeline must be checked regularly for leaks; and • If there are leaks the pipelines must be repaired immediately.					
Environmental Risk (Post-mitigation)					-4.00
Degree of confidence in impact prediction:					High

Impact Prioritisation	
Public Response	1
Low: Issue not raised in public responses	
Cumulative Impacts	1
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is unlikely that the impact will result in spatial and temporal cumulative change.	
Degree of potential irreplaceable loss of resources	2
The impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.	
Prioritisation Factor	1.17
Final Significance	-4.67

Construction phase, Operation phase, and Decommissioning phase (Table 14): The impacts related to contamination will be the movement of heavy machinery, surface runoff from contaminated sources, and the possible leaks in piped contaminants.

Table 14: Loss of Land Capability and Soil Resources - Alternative P2a, P2b, P3a, P3b, P3d, P4a, P4b, P5a, T1b, T2a during the Construction, Operation and Decommissioning Phase

A. Loss of Land Capability and Soil Resources - Alternative P2a, P2b, P3a, P3b, P3d, P4a, P4b, P5a, T1b, T2a					
Impact Name	**Loss of Land Capability and Loss of soil Resource**				
Alternative	**Alternative P2a, P2b, P3a, P3b, P3d, P4a, P4b, P5a, T1b, T2a**				
Phase	**Planning**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	4	4
Extent of Impact	2	2	Reversibility of Impact	4	3
Duration of Impact	4	3	Probability	4	3
Environmental Risk (Pre-mitigation)					-14.00
Mitigation Measures					
• Prevent any spills from occurring. Machines must be parked within hardpark areas and must be checked daily for fluid leaks; • If a spill occurs it is to be cleaned up immediately and reported to the appropriate authorities; • All vehicles are to be serviced in a correctly bunded area or at an off-site location; • Leaking vehicles will have drip trays place under them where the leak is occurring; • Pipelines must be maintained; • Pipeline must be checked regularly for leaks; and • If there are leaks the pipelines must be repaired immediately.					
Environmental Risk (Post-mitigation)					-9.00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					1
Low: Issue not raised in public responses					
Cumulative Impacts					1
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is unlikely that the impact will result in spatial and temporal cumulative change.					

Degree of potential irreplaceable loss of resources	2
The impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.	
Prioritisation Factor	1.17
Final Significance	-10.50

8.2 Mitigation measures

Table 15 presents the recommended mitigation measures and the respective timeframes, targets and performance indicators.

Table 15: Mitigation measures including requirements for timeframes, roles and responsibilities

No	Activity	Mitigation Measures	Phase	Time Frame	Responsible party for implementation	Monitoring party (frequency)	Target	Performance indicator (Monitoring tool
	•	• Proper planning of mining sequences; • stripping and stockpiling guidelines; • rehabilitation and monitoring plans;	Planning	Prior to kick-off of construction	Applicant	Applicant	Ensure compliance with relevant legislation	No legal directives Legal compliance audit scores (Legal register) (ECO Monthly Checklist/Report)
	• Site clearance and topsoil removal prior to the commencement of physical construction activities. • Construction of surface infrastructure • The construction of stockpiles, including topsoil, overburden and coal stockpile	• Ensure proper storm water management designs are in place; • If any erosion occurs, corrective actions (erosion berms) must be taken to minimize any further erosion from taking place; • If erosion has occurred, topsoil should be sourced and replaced and shaped to reduce the recurrence of erosion; • Only the designated access routes are to be used to reduce any unnecessary compaction; • Compacted areas are to be ripped to loosen the soil structure; • The topsoil should be stripped by means of an excavator bucket, and loaded onto dump trucks; • Topsoil stockpiles are to be kept to a maximum height of 4m; • Topsoil is to be stripped when the soil is dry, as to reduce compaction;	Construction Operation	Ongoing	Applicant Contractor ECO	Contractors EO (Daily) Mine EO (Weekly) ECO (Monthly)	Ensure compliance with relevant legislation	No legal directives Legal compliance audit scores (Legal register) (ECO Monthly Checklist/Report)

		• Bush clearing contractors will only clear bushes and trees larger than 1m the remaining vegetation will be stripped with the top 0.3 m of topsoil to conserve as much of the nutrient cycle, organic matter and seed bank as possible; • The subsoil approximately 0.3 – 0.8 m thick will then be stripped and stockpiled separately; • The handling of the stripped topsoil will be minimized to ensure the soil's structure does not deteriorate significantly; • Compaction of the removed topsoil must be avoided by prohibiting traffic on stockpiles; • Stockpiles should only be sued for their designated final purposes; and • The stockpiles will be vegetated (details contained in rehabilitation plan) in order to reduce the risk of erosion, prevent weed growth and to reinstitute the ecological processes within the soil. • Prevent any spills from occurring. Machines must be parked within hardpark areas and must be checked daily for fluid leaks; • If a spill occurs it is to be cleaned up immediately and reported to the appropriate authorities; • All vehicles are to be serviced in a correctly bunded area or at an off-site location; • Leaking vehicles will have drip trays place under them where the leak is occurring; • Pipelines must be maintained; • Pipeline must be checked regularly for leaks; and						

		• If there are leaks the pipelines must be repaired immediately.						
	• Operation and maintenance of the topsoil stockpiles. • Demolition of infrastructure • Rehabilitation of the Project area will be undertaken. includes the ripping of the compacted soil surfaces, spreading of topsoil and establishment of vegetation.	• Ensure proper storm water management designs are in place; • If erosion occurs, corrective actions (erosion berms) must be taken to minimize any further erosion from taking place; • If erosion has occurred, topsoil should be sourced and replaced and shaped to reduce the recurrence of erosion; • Only the designated access routes are to be used to reduce any unnecessary compaction; • Compacted areas are to be ripped to loosen the soil structure and vegetation cover re-instated; • Implement land rehabilitation measures as defined in rehabilitation report. • Follow rehabilitation guidelines; • The topsoil should be moved by means of an excavator bucket, and loaded onto dump trucks; • Topsoil is to be moved when the soil is dry, as to reduce compaction; • After the completion of the project the area is to be cleared of all infrastructure; • The foundations to be removed; • Topsoil to be replaced for rehabilitation purposes; • The handling of the stripped topsoil will be minimized to ensure the soil's structure does not deteriorate; and • Stockpiles should only be used for their designated final purposes.	Operation, Decommissioning and Rehabilitation.	Ongoing	Applicant Contractor ECO	Contractors EO (Daily) Mine EO (Weekly) ECO (Monthly)	Ensure compliance with relevant legislation	No legal directives Legal compliance audit scores (Legal register) (ECO Monthly Checklist/Report)

		• Prevent any spills from occurring. Machines must be parked within hardpark areas and must be checked daily for fluid leaks; • If a spill occurs it is to be cleaned up immediately and reported to the appropriate authorities; • All vehicles are to be serviced in a correctly bunded area or at an off-site location; • Leaking vehicles will have drip trays place under them where the leak is occurring; • Pipelines must be maintained; • Pipeline must be checked regularly for leaks; and • If there are leaks the pipelines must be repaired immediately.						
	• Rehabilitation of the Project area will be undertaken. includes the ripping of the compacted soil surfaces, spreading of topsoil and establishment of vegetation. • Post-closure monitoring and rehabilitation will determine the level of success of the rehabilitation, as well as to identify any additional measures that have to be undertaken to ensure that the mining area is restored to an adequate state. Monitoring will include	• The rehabilitated area must be assessed once a year for compaction, fertility, and erosion; • The soils fertility must be assessed by a soil specialist yearly (during the dry season so that recommendations can be implemented before the start of the wet season) as to correct any nutrient deficiencies; • Compacted areas are to be ripped to loosen the soil structure and vegetation cover re-instated; • If erosion occurs, corrective actions (erosion berms) must be taken to minimize any further erosion from taking place; • If erosion has occurred, topsoil should be sourced and replaced and shaped to reduce the recurrence of erosion; • Only the designated access routes are to be used to reduce any unnecessary compaction; and	Rehabilitation, Closure and monitoring	During monitoring	Applicant ECO Soil Specialist	ECO (Yearly) Soil Specialist (Yearly)	Ensure compliance with relevant legislation	No legal directives Legal compliance audit scores (Legal register) (ECO Monthly Checklist/Report)

	soil fertility and erosion.	• Areas of subsidence must be reported and remediated as soon as possible with the best practises at the time of occurrence.						

9 Recommendations

It is recommended that the following be completed;

- A soil stripping guideline;
- Some fertility sampling to assess baseline conditions for rehabilitation.

10 Conclusion

During the survey three main soil forms were identified, namely the Clovelly, Oakleaf, and Katspruit soil forms.

The Climate capability for this region was determined to be C7 classification. C7 (Severe to very severe limitation rating): Severely restricted growing season due to low temperatures, frost and/or moisture stress. Suitable crops at risk to yield loss (Smith, 2006).

The Land Capability for the project area is shown in Figure 11. The Clovelly soil form has been classified as Class III. The Katspruit soil form has been classified as Class V (Vlei), due to signs of wetness within the first 200mm. The Oakleaf soil form was classified as land capability class IV.

The Land Potential of the project area is shown in Figure 12 and the land potential groups are described previously in Table 2.

The classes III and Class IV land capability was rated as L5 land potential. The Class V land capability was determined to be a **Vlei**.

The major impacts associated with mining are the disturbance of natural occurring soil profiles consisting of layers or soil horizons. Rehabilitation of disturbed areas aims to restore land capability but the South African experience is that post mining land capability usually decreases compared to pre-mining land capability. Soil formation is determined by a combination of five interacting main soil formation factors. These factors are time, climate, slope, organisms and parent material. Soil formation is an extremely slow process and soil can therefore be considered as a non-renewable resource.

Soil quality deteriorates during stockpiling and replacement of these soil materials into soil profiles during rehabilitation cannot imitate pre-mining soil quality properties. Depth however can be imitated but the combined soil quality deterioration and resultant compaction by the machines used in rehabilitation, leads to a net loss of land capability. A change in land capability then forces a change in land use.

The impact on soil is high because natural soil layers will bestripped and stockpiled for later use in rehabilitation. In addition, soil fertility is impacted because stripped soil layers are usually thicker than the defined topsoil layer.

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