SOIL ASSESSMENT

FOR THE

BRAKFONTEIN COAL PROJECT

UNIVERSAL COAL (PTY) LTD

AUGUST 2012

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EXECUTIVE SUMMARY

Digby Wells Environmental (Digby Wells) has been appointed by Universal Coal (Pty) Ltd (Universal Coal) to conduct an Environmental Impact Assessment (EIA) for the Brakfontein Coal Project. A soil assessment forms part of this EIA process.

The aim of the soil assessment was to survey the proposed opencast coal mine areas at the Brakfontein Coal Project site. Dominant soil types occupying the landscape were determined while the land capability and land use were also investigated.

The Brakfontein Coal Project is located within the Victor Khanye Local and Nkangala District Municipalities of the Mpumalanga Province of South Africa within the Western margins of the Witbank Coalfields. The site is located approximately 16 km north-east of Delmas, 14 km and 17 km north of Devon and Leandra respectively, on the farm of Brakfontein 264 IR. The approximate size of the project area is 1,065 hectares (ha).

A study of the soils present at the site was conducted during field visits in June 2012. The site was traversed by vehicle and on foot. A hand soil auger was used to determine the soil type and depth. Survey positions were recorded as waypoints using a handheld GPS. The soil forms (types of soil) found in the landscape was identified using the South African soil classification system namely; Soil Classification: A Taxonomic System for South Africa (Soil Classification working group, 1991. Typical plinthic catena is present at the Brakfontein Coap Project site. A plinthic catena is represented by (in order from highest to lowest in the upland landscape) by red and yellow well drained soils for example Hutton and Clovelly. Low landscape positions (valley bottom) are occupied by permanent waterlogged (gley) soil such as the Katspruit soil form.

The land capability of the Brakfontein Coal Project site is dominated by arable, Class I while the wetland areas used for grazing is classified as Grazing Class V, see appendix B for details regarding the land capability classification system by Schoeman *et al*, 2000 and Plan 1 for the land capability, land use and soil type assessments.

The dominant present land use in the Brakfontein Coal Project site is arable crop production due to the presence of large areas of high potential soil in the Brakfontein Coal Project area. Soil fertility is generally well managed by the farmers. The topsoil of 0.35 m thickness is therefore a valuable resource of nutrients.

The returns of agricultural intensification are decreasing (Conway, 1997), so opencast coal mine degraded high potential agricultural land cannot easily be offset. The difficulty in trying to offset agricultural production comprises of two problems: firstly, the occurrence of high potential agricultural land, especially in South Africa, is limited. Secondly, science cannot improve (increase) crop production on other available high potential land enough to offset loss of high potential agricultural land due to opencast mining. The Brakfontein coal project area is an example of prime agricultural land. This land produced a maize crop in excess of 7 000 tons of maize in the 2011/2012 rainy season while an estimated 600 head of cattle is permanently grazed successfully.

The environmental risk to permanently losing this high potential productive land to opencast coal mining is high. It is recommended that a resource economic study is initiated as a

matter of urgency in order to investigate and compare short term opencast coal mining objectively with long term agriculture.

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1 INTRODUCTION

Digby Wells Environmental (Digby Wells) has been appointed by Universal Coal (Pty) Ltd (Universal Coal) to conduct a Soil Assessment as part of an Environmental Impact Assessment (EIA) for the Brakfontein Coal project.

Project description

Universal Coal has submitted a Mining Right Application (MRA) to the Department of Mineral Resources (DMR) in November 2011 for proposed coal mining on the farm Brakfontein 264 IR, portions, 8, 9, 10, 20, 26, 30 and the remaining extent 6.

The Brakfontein Thermal Coal Mine project will be mined in two phases. Phase 1 will entail opencast mining, which will be undertaken during the continued exploration of the underground resources. This phase is proposed to take place over a period of 2 years. Phase 2 will entail underground mining methods and it is proposed to take place over a period of 8 years. The project site consists of 4 seams for open pit mining and 2 seams for underground mining.

2 TERMS OF REFERENCE

2.1 South African soil related legislation protecting mine impacted project sites.

The following section outlines a summary of the most recent South African Environmental legislation that deals with the management of soil (summary and interpretations by Viljoen and Associates):

- The law on Conservation of Agricultural Resources (Act 43 of 1983) states that degradation of agricultural potential of land (soil) is illegal;
- The Bill of Rights states that environmental rights exist primarily to ensure good health and well-being, and secondarily to protect the environment through reasonable legislation, ensuring the prevention of the degradation of resources;
- The Environmental right is furthered in the National Environmental Management Act (No. 107 of 1998), which prescribes three principles, namely the precautionary principle, the "polluter pays" principle and the preventive principle. It is stated in the above-mentioned Act that the individual/group responsible for the degradation/pollution of natural resources is required to rehabilitate the polluted source;
- Soils and land capability are protected under the National Environmental Management Act 107 of 1998, the Environmental Conservation Act 73 of1989, the Minerals Act 50 of 1991 and the Conservation of Agricultural Resources Act 43 of 1983;
- The National Environmental Management Act 107 of 1998 requires that pollution and degradation of the environment be avoided or where it cannot be avoided, minimized and remedied;
- The Minerals Act of 1991 requires an EMPR, in which the soils and land capability be described; and

- The Conservation of Agriculture Resources Act 43 of 1983 requires the protection of land against soil erosion and the prevention of water logging and salinisation of soils by means of suitable soil conservation works to be constructed and maintained.

2.2 International Equator Principles applicable to environmental soil protection

The Equator Principles (or EP in short), based on the IFC Environmental and Social Performance Standards (IFC PS), have become the accepted standard for environmental assessments. The following principles apply to soil:

- Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts;
- Performance Standard 3: Pollution Prevention and Abatement; and
- Performance Standard 6: Biodiversity Conservation and Sustainable Natural Resource Management.

2.3 Legislation recommendation

South African guidelines and regulations concerning soil management are more detailed than the IFC Performance Standards. Applying the South African Guidelines and legislation will therefore ensure IFC compliance.

2.4 Aims

The aim of the soil assessment was to survey the proposed opencast coal mine areas at the Brakfontein Coal Project site. Dominant soil types occupying the landscape were determined while the land capability and land use were also investigated.

3 KNOWLEDGE GAPS

3.1 Discussion

The impacts of mining, especially opencast coal mining on high potential soil, is receiving more and more attention by interested and affected parties. This increased attention is brought about by increasing numbers of mining right applications where the present dominant land uses are agriculture. Two main agricultural activities are normally at stake, these are arable and grazing. Due to the long history of agriculture in South Africa most marginal arable areas are used for grazing while the arable areas are well established commercial agricultural areas. The Brakfontein Coal Project area is a prime example of high potential mixed arable agricultural and grazing land.

There is a general perception that although attempts are made by mining houses to rehabilitate mined areas, these attempts are generally less than satisfying where arable land capability is concerned. Soil capability and therefore land capability and suitability of reclaimed land is generally degraded from arable to mainly grazing needing special management and care.

Both mining and agricultural activities impact on soil and environmental quality. Agricultural activities are less destructive and are relatively easily rehabilitated compared to opencast mining. Opencast mining activities are much more destructive because the natural sequence of soil horizons is disturbed. Arable agricultural land capability is very difficult to reclaim, especially due to compaction once soil has been replaced in the correct sequence. The result is that less and less arable high potential soil is available for food production. In the case of South Africa less arable maize producing areas are available as these have been impacted by opencast mining. This has multiplier impacts as most preferred staple food for millions of people in South Africa is maize.

3.2 Risks

The returns of agricultural intensification are decreasing (Conway, 1997) so opencast coal mine degraded high potential agricultural land cannot easily be offset. The difficulty in trying to offset agricultural production comprises of two problems, firstly, the occurrence of high potential agricultural land, especially in South Africa, is limited. Secondly, science cannot improve (increase) crop production on other available high potential land enough to offset loss of high potential agricultural land due to opencast mining.

The Brakfontein coal project area is an example of prime agricultural land. This land produced a maize crop in excess of 7 000 tons of maize in the 2011/2012 rainy season while an estimated 600 head of cattle is permanently grazed successfully.

The environmental risk to permanently losing this high potential productive land to opencast coal mining is high.

3.3 Recommendations

It is recommended that a resource economic study is initiated as a matter of urgency in order to investigate and compare short term opencast coal mining objectively with long term agriculture.

4 STUDY AREA

The Brakfontein Coal Project is located within the Victor Khanye Local and Nkangala District Municipalities of the Mpumalanga Province of South Africa within the Western margins of the Witbank Coalfields. The site is located approximately 16 km north-east of Delmas, 14 km and 17 km north of Devon and Leandra respectively, on the farm of Brakfontein 264 IR. The approximate size of the project area is 1,065 ha.

The study area is located south east of Ermelo in the Mpumalanga Province. The landscape is relatively flat as is depicted in Figure 4-1. Higher parts are occupied by well drained yellow soil such as the Clovelly soil depicted in Figure 4-2, while the lower part of the landscape is occupied by wetland areas. Examples of wetland soils are presented in Figure 4-3 and Figure 4-4.

Figure 4-1: The landscape is relatively flat in the proposed Brakfontein coal project area.

A very large area of Mpumalanga Province is underlain by sandstone parent material occupied by a soil plinthic catena. In its perfect form a plinthic catena is represented by (in order from highest to lowest in the upland landscape) by red and yellow well drained soils for example Hutton and Clovelly. Low landscape positions (valley bottom) are occupied by permanent waterlogged (gley) soil such as the Katspruit soil form.

Figure 4-2: Deep well drained soil such as the Clovelly soil form occupies large areas of the Brakfontein coal project area.

Figure 4-3: Lower landscape positions are occupied by prominent wetland soil types for example Katspruit.

Topsoil is generally very sandy and exhibits a high erosion potential as depicted in Figure 4-2.

Figure 4-4: More wetland soil such as Fernwood occupying low landscape positions.

5 EXPERTISE OF THE SPECIALIST

Hendrik Smith is a registered Professional Natural Scientist (Soil Science) with the South African Council for Natural Scientific Professions. His present area of focus is soil surveying. He also assists with the relevant sections of EIAs and EMPs. He is part of the Biophysical Department at Digby Wells Environmental which focuses on combining and actively promoting the utilisation of various disciplines within the field of environmental management which include fauna, flaura and aquatics.

6 METHODOLOGY

6.1 Soil identification and mapping

A study of the soils present at the site was conducted during field visits in June 2012. The site was traversed by vehicle and on foot. A hand soil auger was used to determine the soil type and depth. Survey positions were recorded as waypoints using a handheld GPS. Other features such as existing open erosion trenches were also helpful to determine the soil type and depth.

The soil forms (types of soil) found in the landscape was identified using the South African soil classification system namely; Soil Classification: A Taxonomic System for South Africa (Soil Classification working group, 1991). Several photographs were taken as reference information.

Soils, both top (0 – 300 mm) and sub-soils (300 – 600 mm) were sampled from dominating soil forms during the field visit. The soil samples were analysed for physical and chemical properties as follows:

- pH (water);
- Extractable cations and Na, K, Ca, Mg (Ammonium Acetate);
- Cation Exchange Capacity;
- Carbon content;
- Phosphorus (Bray1) soil texture namely sand, silt and clay were also determined; and
- Soil texture namely sand, silt and clay were also determined.

7 FINDINGS

The high agricultural potential of the soil in the survey area is determined by a combination of favourable soil depth and high rainfall conditions. High potential arable agricultural soil dominates the Brakfontein Coal Project site. Plan 1 contains the overview of the land capability, land use and soils present at the Brakfontein Coal project site. Table 7-1 contains information of the dominant soil types occupying the arable areas. However a small area potentially earmarked for opencast coal mining in the far east of the Brakfontein Coal Project area contains shallow cultivated soil.

There is also an irrigation system present used to produce crops under irrigation, see Figure 7-1. The presence of this permanent irrigation system accentuates the high agricultural potential of the Brakfontein Coal Project site.

Figure 7-1: A centre pivot irrigation system is used for crop production.

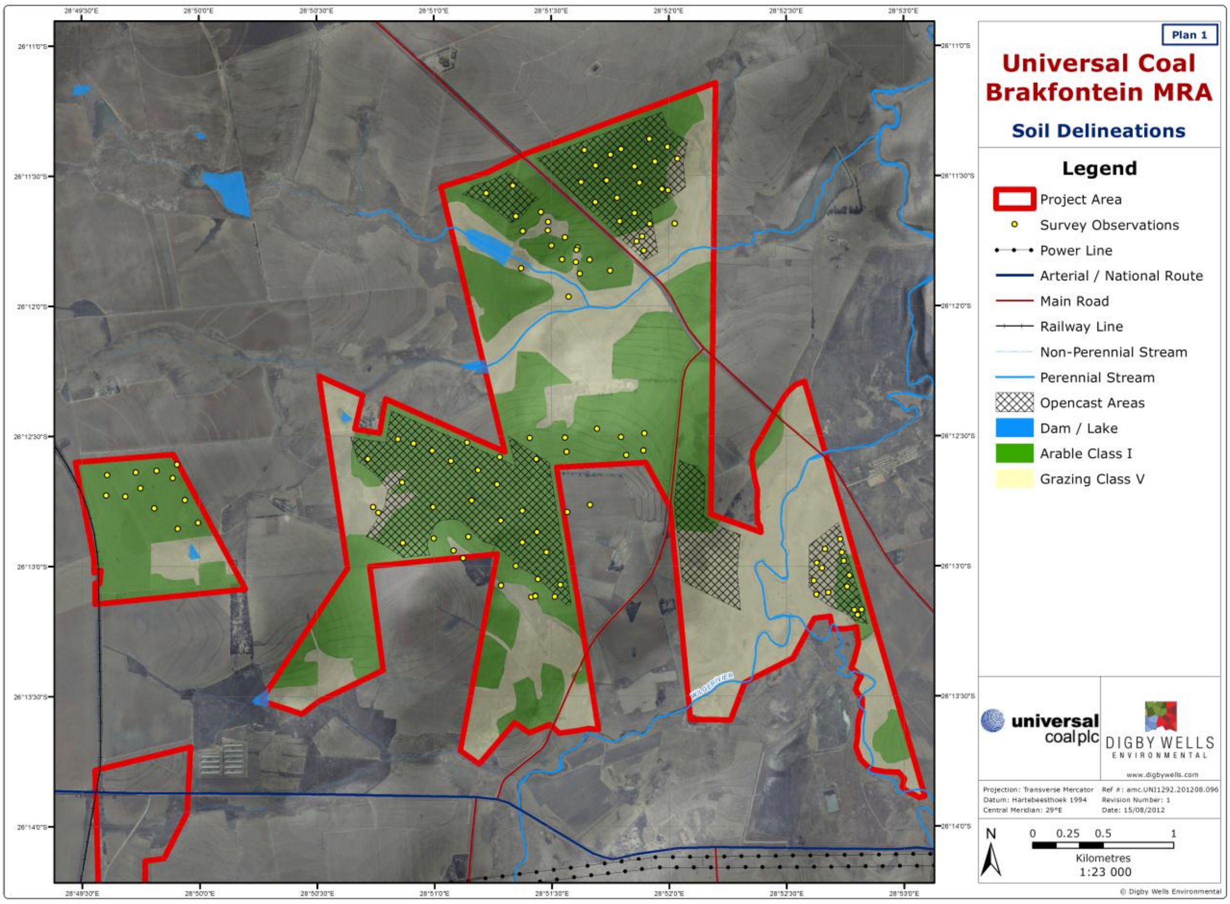
Plan 1
Universal Coal
Brakfontein MRA
Soil Delineations
Legend
Project Area
Survey Observations
Power Line
Arterial / National Route
Main Road
Railway Line
Non-Perennial Stream
Perennial Stream
Opencast Areas
Dam / Lake
Arable Class I
Grazing Class V
universal coal plc
DIGBY WELLS ENVIRONMENTAL
www.digbywells.com
Projection: Transverse Mercator
Datum: Hartebeesthoek 1994
Central Meridian: 29°E
Ref #: amc.UNI1292.201208.096
Revision Number: 1
Date: 15/08/2012
N
0 0.25 0.5 1
Kilometres
1:23 000
© Digby Wells Environmental

Table 7-1: Dominant soil forms found in the Brakfontein Coal Project site.

Soil Form	Average Depth (m)	General Characteristics	Agricultural Potential
Hutton (arable)	0.8 – 1.5	Orthic topsoil A horizon overlying a deep, red, well drained, structure less, B horizon underlain by hard or weathered rock.	High due to high rainfall in the region well drained status and high water holding capacity of the soil.
Clovelly, Pinedene (arable)	1.5	Orthic topsoil A horizon overlying a deep, yellow, well drained, structure less, B horizon underlain by hard or weathered rock and signs of wetness.	High
Oakleaf (arable)	0.8 -1.2	Orthic topsoil A horizon overlying a deep, structured neocutanic, B horizon.	High
Longlands, Constantia and Kroonstad (grazing)	0.5 – 1.0	Orthic topsoil A horizon overlying an E horizon underlain by a yellow brown or soft plinthite or G horizon clay layers.	Low, due to high rainfall in the region and, poorly drained status of these interflow soils.
Katspruit (grazing)	0.5	Orthic topsoil A horison overlying a waterlogged G horizon.	Low due to clayey nature and water logged soil conditions.

8 SOIL FERTILITY AND SOIL TEXTURE PROPERTIES

Table 8-1 contains the soil analytical data of the dominant soil forms. Organic carbon (C) in the topsoil ranges from 0.51 – 2.46 %. Generally South African cultivated soils contain a C content of around 1%. A C content of 1% is considered to be low but expected for soil under South African climatic conditions.

Phosphorus (P) status, as contained in **Table 8-1** shows that the P status varies a lot. P is an important macro nutrient and the P content with a low of 3.6 and a high of 21.1 mg kg^{-1} is low and indicative of poor P soil status for highly productive soil. There is a clear indication of P addition through fertilisation in the cultivated soils namely Hu, Cv and Oa but the P status should ideally be at 20 – 30 mg kg^{-1}.

The topsoil pH is in the order of 5.5 – 7.2. This pH range is indicative of well managed acidic soil conditions. This is a clear indication that lime was incorporated into the soils. A liming programme is normally needed for cultivated sandy soils due to annual natural acidification in addition to acidity caused by fertilisers added in the past.

The soils in this area are considered to have a low cation exchange capacity (CEC). A low CEC reflects low soil clay and organic matter content, because CEC is a property of both clay and organic material. The cation exchange capacity (CEC) generally ranges from 4 to 9.3 cmol(+)kg^{-1} in the topsoil. Low CEC implies low nutrient content while the opposite is true for high CEC. The topsoil CEC of the higher clay content Se soil is 28 cmol(+)kg^{-1} indicating the influence of higher clay content in the topsoil.

The size limits for sand, silt and clay used in the determination of soil texture classes are sand: 2.0 – 0.05 mm, silt: 0.05 – 0.002 mm and clay: < 0.002 mm. The clay content range is from 16 – 42 % in the topsoil. Generally this type of soil texture indicates that the soils can be cultivated easily using normal farm machinery. The red Hutton soils are classified as sandy clay loam. The dominant Cv, Pn and Ct yellow soils in the area are classified as sandy to loamy sand soils.

Table 8-1: Soil laboratory results, chemical and physical analytical data.

Sample Point	Soil Form	Org C %	CEC cmol(+) kg^{-1}	K mg kg^{-1}	Ca mg kg^{-1}	Mg mg kg^{-1}	Na mg kg^{-1}	P (Bray1) mg kg^{-1}	pH (H_2O)	Sand %	Silt %	Clay %
1 TOP	Cv	0.85	8.3	97	140	40	0.64	21.1	6.7	74	6	20
2 SUB				52	165	64	12.4	6.2	7			
3 TOP	Hu	0.51	3.98	82	219	35	0.61	11.3	7.22	80	4	16
4 SUB				46	63	28	0.33	5.6	6.49			
5 TOP	Hu	0.84	4.97	122	89	24	0.38	6.7	6.03	72	4	24
6 SUB				55	105	28	0.34	2.3	6.39			
7 TOP	Pn/Av	1.6	9.32	310	168	47	0.42	3.6	5.9	58	8	34
8 SUB				91	161	75	0.33	2.1	6.68			
9 TOP	Hu	0.85	4.43	90	77	13	0.21	18.3	5.53	70	6	24

10 SUB				**32**	**75**	**12**	**0.16**	**3.2**	**5.88**			
11 TOP	**Se**	**2.46**	**27.96**	**446**	**714**	**490**	**83.2**	**4.7**	**6.3**	**42**	**16**	**42**
12 SUB				**256**	**980**	**682**	**172.5**	**3.2**	**6.88**			
13 TOP	**Oa**	**1.74**	**10.26**	**406**	**349**	**116**	**26.9**	**14.3**	**6.4**	**56**	**10**	**34**
14 SUB				**167**	**191**	**63**	**15.4**	**4.8**	**6.64**			
15 TOP	**Cv**	**0.59**	**5.58**	**69**	**98**	**40**	**0.69**	**6.9**	**6.47**	**76**	**4**	**20**
16 SUB				**56**	**198**	**73**	**0.11**	**4.1**	**6.93**			
17 TOP	**Hu**	**0.88**	**7.53**	**60**	**145**	**71**	**11.7**	**5.5**	**6.41**	**58**	**10**	**32**
17 SUB				**33**	**100**	**39**	**0.42**	**3.2**	**6.2**			

The texture properties of the soils analysed allow the cultivated soils to be classed as sandy clay loam soils. Sandy clay loam soils are easily cultivated.

9 LAND CAPABILITY

Arable crop farming activities dominate at the farm Brakfontein. During the time of the field survey the fields were harvested but uncultivated in anticipation of the rainy season. Only the wetland areas contain perennial vegetation potentially available for grazing. The wetland areas at Brakfontein are not fenced off but used for grazing. The land capability was classified using the classification system by Schoeman *et al*, 2000.

The land capability of the Brakfontein Coal Project site is dominated by arable, Class I while the wetland areas used for grazing is classified as Grazing Class V, see appendix B for details regarding the land capability system by Schoeman *et al*, 2000 and Plan 1.

10 LAND USE

The predominant present land use in the Brakfontein region is arable crop production due to the presence of large areas being occupied by high potential soil. Plan 1 contains the land use information. Current land use is estimated at 81 % of the available land being used for arable farming. 19 % of the total available farmland is un-used due to shallow soils and wetland areas. The area is well serviced by tar roads as well as farm roads.

11 IMPACT ASSESSMENT

This section presents the findings of the assessment of potential impacts to the soil environment associated with the proposed development of the Brakfontein Coal Project.

The results of the impact assessment are presented as follows:

- *Sensitive and no-go areas* – The process to delineate areas that are considered sensitive in terms of the soil environment and will therefore have to be avoided, as well as maps delineating these areas are presented;

- *Significance assessment* – An assessment of the significance of anticipated positive and negative impacts to the soil environment associated with project activities is provided; and
- *Cumulative impacts* – The results of a high-level qualitative assessment of the potential cumulative impacts of the proposed project and existing and proposed developments in the reasonable future, such as the coal mining and industrial developments in the Mpumalanga Coalfields of South Africa is presented.
- Recommended measures to enhance the positive impacts and to mitigate negative impacts have been detailed in this report.

11.1 Sensitive and no-go areas

In terms of the soil environment, sensitive or no-go areas were identified such as the wetland areas present on the Brakfontein Coal project area, see Plan 1.

11.2 Impact significance assessment

Activities associated with the construction, operation and decommissioning of each component of the MOP will result in impacts on the soil environment.

In order to assess the significance of these impacts, use was made of a semi-quantitative impact assessment methodology which is based on an assessment of the following parameters:

- *Severity* – The magnitude of change from the current baseline status of the affected environmental, socio-economic or heritage aspect;
- *Spatial scale* – The physical area which is impacted on by the potential impact;
- *Duration* – The expected time period during which a potential impact will be experienced; and
- *Probability* – The likelihood of occurrence of the impact, based on knowledge of the operating conditions and the type of activities that will be undertaken.

This Section identifies potential impacts to soil resource and the subsequent direct impacts to land capability. Secondary impacts caused by degradation of soil, such as impacts to habitat affecting flora and fauna, are covered in the relevant EIA sections, and are not considered further in this section.

11.3 Impact of soil stripping activities on soil and land capability

11.3.1 Impact Description

Activities during early works and construction in the Brakfontein Coal Project area could lead to the following impacts on soils:

- Soil compaction and topsoil loss leading to reduced fertility;
- Soil erosion (and sediment release to land and water); and
- Alteration of natural drainage lines.

Large areas will be cleared of vegetation to ground level and stripped to a general depth of 0.7 m. The general depth of topsoil however to be stripped is 0.35 m within the opencast mine site areas, large infrastructure sites and discard dumps. The topsoil and subsoil will be stockpiled separately for future use in rehabilitation and re-vegetation.

Compaction and increased erosion from increased exposure to wind and water are likely to cause changes in the soil structure and degradation of soil quality. The extent to which these occur is dependent on the properties of the soils. In the case of Brakfontein the extent will be significant due to the presence of sandy topsoil.

Vegetation cover is the most important physical factor influencing soil erosion by water and wind. The vegetation cover acts as protection against soil erosion. The sandy soils within the Brakfontein Coal project Area will be particularly vulnerable to wind erosion where exposed during site clearance and stockpiling. An intact vegetation cover is needed to reduce impact from rain-drops on the soil, slows down surface run-off, filters sediment and binds the soil together for more stability.

Intensity of potential erosion is also influenced by precipitation, which is generally high in the Delmas region at approximately 750 mm per annum. Water erosion may come about when water (for example runoff) comes in contact with bare soil on cleared patches, especially on sloped terrain or running down insufficiently sloped stockpiles. An occasional heavy rainstorm during the rainy season can initiate erosion on bare patches. The impact of erosion through water runoff can play a significant role because the annual rainfall is high. Most of the erosion is expected to occur along main unpaved compacted roads.

The compaction of the subsoil through site grading and levelling and the presence of heavy vehicles and machinery during construction will result in lower permeability of the soil and therefore decrease infiltration and increased runoff altering the natural drainage characteristics of the soil. Without appropriate measures, runoff from compacted areas (roads in the Brakfontein Coal Project footprint area) in addition to erosion by wind may increase erosion and increase the sediment load entering the drainage lines and streams.

The Project activities during construction will result in the change of land use from natural vegetation and agriculture (primarily mixed arable and grazing) to industrial within the Brakfontein Coal project area. If heavy vehicles and machinery are not confined to the permanent roads, widespread erosion may take place. Land capability and productivity will be lost within the Brakfontein Coal Project footprint area from the land use change from agriculture to industrial use.

The impacts of stripping, compaction and erosion of soils will be negative and restricted to on-site. Limited impacts are expected outside of the Brakfontein Coal Project area, with the exception along unpaved roads within the region, where erosion can impact on adjacent areas. Much of the impacts to soil and land capability cannot be mitigated further because they derive from the land-take footprint from the physical presence of the development, however measures can be implemented to help minimise impacts. Impacts will definitely occur. They will be permanent in duration, but significance of the impact will decrease when disturbed areas are rehabilitated and re-vegetated during decommissioning of the Brakfontein Coal Project. Intensity will range from low to high as natural functions of the soil will be altered. Impact magnitude will be medium to high given the extent of the area affected. Impact significance to soil resources and land capability pre-mitigation is expected to be high.

Table 11-1: Impact of soil stripping activities on soil and land capability.

Parameter	Impact Pre-Mitigation		Impact Post-Mitigation	
Duration (7)	Permanent without mitigation	7	Permanent with mitigation	7
Scale (7)	Local	3	Local	3
Severity (7)	Very significant	7	Significant	6
Likelihood (7)	Certain	7	Certain	7
Significance	High	119	High	112

11.3.2 Mitigation

Construction (including site preparation)

- Plan site clearance and alteration activities for the dry season (May to October);
- Restrict extent of disturbance within the Brakfontein Coal Project area and minimise activity within designated areas of disturbance;
- Minimise the period of exposure of soil surfaces through dedicated planning;
- Stripping operations should only be executed when soil moisture content will minimise the risk of compaction (during dry season);
- Aim to minimise (or even cease) workings on windy days;
- During stockpiling, preferably use the ‘end-tipping’ method to keep the stockpiled soils loose;
- Ensure stockpiles are placed on a free draining location to limit erosion loss and waterlogging;
- Limit stockpile height – a safe height can be regarded as the height at which material can be placed without repeated traffic over already placed material; and
- Soil surface (only where top soil is partially removed) can be loosened via tillage/ripping.

Operations

- Re-vegetate cleared areas and stockpiles to avoid wind and water erosion losses;
- Preserve looseness of stockpiled soil by executing fertilisation and seeding operations by hand; and
- Soil stockpiles should be monitored for fertility via sampling and testing; and
- Monitoring of the condition of all unpaved roads is necessary due to the high rainfall and potential water runoff and erosion of the soils present in the Brakfontein Coal Project

area. Water runoff from compacted road surfaces may cause erosion of road shoulders degrading the road surface. Weekly inspections need to be carried out of all unpaved roads especially during the rainy season.

11.3.3 Residual Impact

The potential for impacts to soils resources and land capability will remain present, as they typically derive from the land-take footprint from the physical presence of the development. With the implementation of the above control and mitigation measure impact significance is likely to be reduced from moderate, to minor- moderate.

11.4 Impact of Accidental Spills or Leaks of Fuel or Oil on Soil

11.4.1 Impact Description

Impacts to soil resources are dependent on the size of the spill and the speed with which it is addressed and cleaned up. If contaminated, the ability of soil to carry out its essential functions can be compromised thus affecting the land capability of the soil. Contaminants transported by water would very rapidly infiltrate into sandy soils which are dominant across the Brakfontein Coal Project area, but infiltrate slow in clays imposing a risk of groundwater and contamination.

The potential for contamination of soil resources exists during site preparation and construction as a result of spills or leaks of fuels, oils and lubricants from construction or operational vehicles or machinery. Fluids used for vehicles and machinery may spill during filling, or leak directly in the event that damage to the fluid system goes unnoticed. Soil contamination associated with leaks and spills from machinery are reduced during the operation phase since site activities will be reduced.

The likelihood of a spill is also associated with the volume of product that may be stored onsite. For a development of this nature, above ground storage tanks for diesel and varying amounts of hydraulic oils and used oils will be required during the construction and operational phases. Leakage of a storage tank may cause contamination should the contaminants come into contact with soil. A potentially contaminated surface water (PCSW) system will be in place to capture potentially contaminated surface water and wash down from “dirty” areas (pollution control dam) during the operational phase for treatment before re-use or discharge.

Should soil be affected by an accidental spill or leak elsewhere in the Brakfontein project area where vehicles and machinery will be operating or where storage tanks are located, the land capability could be permanently compromised. The intensity of the impact on soil resource is dependent on the existing land use of area affected from the spill and may be medium. Given the magnitude of the impact is medium and the probability of a spill affecting soil resources is unlikely, impact significance is minor for both phases considered.

Table 11-2: Impact assessment of accidental spills or leaks of fuel and or oil on soil.

Parameter	Impact Pre-Mitigation		Impact Post-Mitigation	
Duration (7)	Project Life	5	Project Life	5
Scale (7)	Limited	2	Limited	2
Severity (7)	Moderate	3	Moderate	3
Likelihood (7)	Almost certain	6	Almost certain	6
Significance	Medium/low	60	Medium/low	60

11.4.2 Mitigation

Construction

- Construction vehicles and equipment should be serviced regularly;
- Service areas must be paved;
- Construction vehicles should remain on designated and prepared compacted gravel roads; and
- Spill containment and clean up kits should be available onsite and clean-up from any spill must be in place and executed at the time of a spillage with appropriate disposal as necessary.

Operation

- Operations vehicles and equipment should be serviced regularly;
- Service and parking areas must be paved;
- Operations vehicles should remain on designated and prepared compacted gravel roads;
- Spill containment and clean up kits should be available onsite and clean-up from any spill must be in place and executed at the time of a spillage with appropriate disposal as necessary;
- Fuel and heavy hydrocarbon products storage on site should be secured by bunded facilities; and
- It is advisable to develop a soil monitoring plan and implement it after construction through collecting and analysis of soil samples within the MOP area.

11.4.3 Residual Impact

Based upon the integrated mitigation measures and procedures which will be put in place to prevent, contain, clean-up and dispose of any spillage, significant effects to soil resources are unlikely to arise and impacts are expected to be of low magnitude should they occur and of negligible significance during both phases of the Project considered.

11.5 Impact of site rehabilitation on soil and land capability

11.5.1 Impact Description

The decommissioning of the Brakfontein Coal Project infrastructure will entail the demolition of buildings and removal of infrastructure. During the decommissioning activities, impacts to soil resources may include compaction and contamination and impacts may be significant in the short term. Stockpiled ttopsoil will be replaced and subsequent rehabilitation and re-vegetation of the disturbed areas will allow a return to pre-impact land capability for agricultural land use namely grazing or arable. Overall rehabilitation of the site will have a positive, permanent direct impact on the land capability within the Brakfontein Coal project area. The intensity and magnitude is likely to be high as the land capability will be compromised from industrial to a combination of arable and grazing land capability.

Table 11-3: Impact of site rehabilitation on soil and land capability.

Parameter	**Impact Pre-Mitigation**		**Impact Post-Mitigation**	
Duration (7)	Permanent without mitigation	7	Permanent with mitigation	7
Scale (7)	Local	3	Local	3
Severity (7)	Very significant	7	Very serious	5
Likelihood (7)	Certain/Definite	7	Certain/Definite	7
Significance	High (Negative)	119	Medium high (Negative)	105

11.5.2 Mitigation/ Enhancement

Decommissioning

The following mitigation or enhancement measures should be implemented during the decommissioning phase to increase the success of the rehabilitation of the soil resource and land capability:

- Demolition and removal of infrastructure should be restricted to the dry season (May to October);
- Opencast mine areas must be reshaped and the soil replaced. Subsoil first then topsoil;
- Total soil thickness must at least be 1 m (including 0.3 m topsoil) for the arable areas and 0.35 m (topsoil) for grazing land;
- Minimize the period of exposure of soil surfaces through dedicated planning; and

- Foundation excavations should be filled, fertilised and re-vegetated using local vegetation.

11.5.3 Residual Impact

Residual impact significance is likely to be enhanced by the measures outlined above. When implemented, these measures will ensure that the magnitude is increased to high and thus the impact is predicted to be a positive impact.

12 MONITORING PROGRAMME

The opencast coal mine rehabilitation operation requires a high level of monitoring, as many elements are changing on a regular basis. Both during rehabilitation and once they are completed, routine maintenance of structures such as down drains, collection dams and fences is required. In addition the actual re-vegetation operation needs to be monitored as especially performance and completion criteria need to be met. The following should also be undertaken:

- Measurement of soil depth on rehabilitated areas and discard dumps on a regular basis (Chamber of Mines of South Africa, 1981);
  - Most practical to measure when the vegetation monitoring is carried is done. This can be carried out using a soil auger and will establish that the placing of topsoil has been done to the correct depth.
- Soil analyses to ensure that the fertility of the soil is correct for the vegetation being grown. This is also required to calculate the fertiliser required for the next season;
- The basal cover of the vegetation should be measured together with a species composition assessment as well as the biomass of representative sample plots;
- Monitor movement and stability of the topsoil stockpile; and
- Monitor topsoil balance annually for volumes of soil.

Vegetation cover assessments, soil depth and soil fertility testing should be carried out as a combined operation annually, during the growing season and at least one month after rain has fallen.

Erosion assessments should be carried out in the rehabilitated areas to visually check for erosion channels. This should be done twice a year, during the summer growing season, and again after rain events.

Where fresh erosion channels are found, indicating that active erosion is occurring, remediation work will need to be programmed to improve the vegetation cover or divert rain water runoff, as indicated by the specific site conditions.

During the vegetation cover monitoring, the presence of **invasive weeds** should be detected. An active program of weed management, to control the presence and spread of invasive weeds, will need to be instituted, so that any weeds encroaching because of the disturbed conditions are controlled.

13 CONCLUSION

The Brakfontein Coal Project area is located within prime agricultural land. The soil and land capability of the cultivated areas is classified as arable Class I while the areas used as grazing are classified as grazing Class V. The land use is dominated by agriculture, mixed arable and grazing but arable is dominating the land use. The affected farms have been cultivated for generations and are producing higher than average maize yields. The 2011/2012 season generated in excess of 7 000 tons of maize crop while approximately 600 head of cattle is grazed.

It is recommended that a natural resource economical study is carried out to ensure the correct evaluation and comparison of the environmental impacts of short term mining of a non –renewable resource to long term sustainable agriculture.

14 REFERENCES

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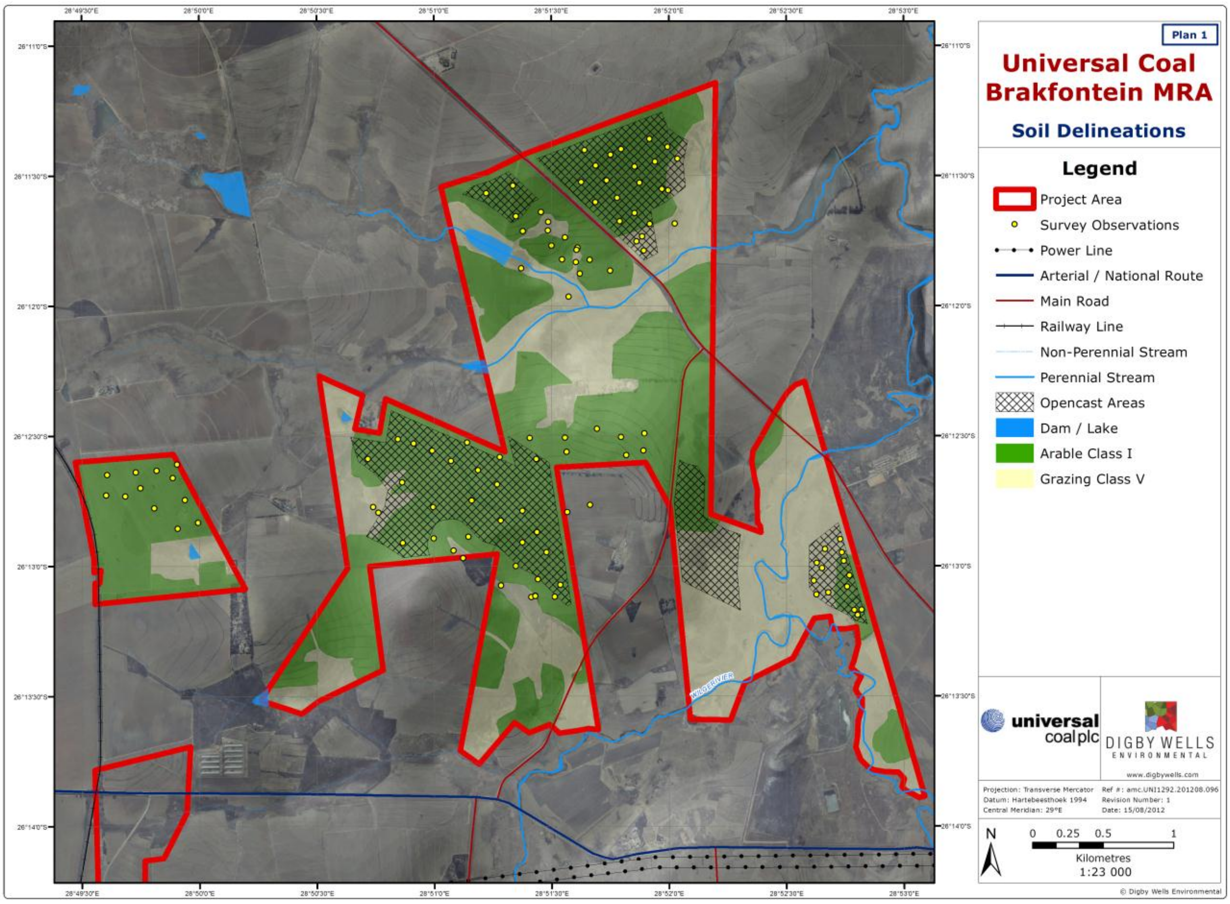
Soil Classification Working Group, 1991. Soil Classification – A taxonomic system for South Africa. ARC-Institute for Soil, Climate and Water, Pretoria.

Appendix A: Plan 1


Plan 1
Universal Coal
Brakfontein MRA
Soil Delineations
Legend
Project Area
Survey Observations
Power Line
Arterial / National Route
Main Road
Railway Line
Non-Perennial Stream
Perennial Stream
Opencast Areas
Dam / Lake
Arable Class I
Grazing Class V
universal coal plc
DIGBY WELLS ENVIRONMENTAL
www.digbywells.com
Projection: Transverse Mercator
Datum: Hartebeesthoek 1994
Central Meridian: 29°E
Ref #: amc.UNI1292.201208.096
Revision Number: 1
Date: 15/08/2012
N
0 0.25 0.5 1
Kilometres
1:23 000
© Digby Wells Environmental

Appendix B: Land Capability Classification

www.agis.agric.za accessed on 29 may 2012

ARABLE LAND

Class I | Class II | Class III | Class IV

Class I

- Land in Class I has few limitations that restrict its use.
- It may be used safely and profitably for cultivated crops.
- The soils are nearly level and deep.
- They hold water well and are generally well drained.
- They are easily worked, and are either fairly well supplied with plant nutrients or are highly responsive to inputs of fertilizer.
- When used for crops, the soils need ordinary management practices to maintain productivity.
- The climate is favourable for growing many of the common field crops.

Note: "Highly responsive to inputs of fertilizer" is taken to imply that strongly acid soils in need of liming are excluded from Class I.

Class II

- Land in Class II has some limitations that reduce the choice of plants or require moderate conservation practices.
- It may be used for cultivated crops, but with less latitude in the choice of crops or management practices than Class I.
- The limitations are few and the practices are easy to apply.
- Limitations may include singly or in combination the effects of:
  - Gentle slopes.
  - Moderate susceptibility to wind and water erosion.
  - Less than ideal soil depth.

- Somewhat unfavourable soil structure and workability.
- Slight to moderate salinity or sodicity easily corrected but likely to recur.
- Occasional damaging flooding.
- Wetness correctable by drainage but existing permanently as a moderate limitation.
- Slight climatic limitations on soil use and management.
- Limitations may cause special soil-conserving cropping systems, soil conservation practices, water-control devices or tillage methods to be required when used for cultivated crops.

Note: "Slight to moderate salinity or sodicity, easily corrected, but likely to recur" is taken to imply that strong subsoil acidity, costly to correct and likely to recur, would disqualify land from Class II.

Class III

- Land in Class III has severe limitations that reduce the choice of plants or require special conservation practices, or both.
- It may be used for cultivated crops, but has more restrictions than Class II. When used for cultivated crops, the conservation practices are usually more difficult to apply and to maintain.
- The number of practical alternatives for average farmers is less than that for soils in Class II.
- Limitations restrict, singly or in combination, the amount of clean cultivation, time of planting, tillage, harvesting, and choice of crops.
- Limitations may result from the effects of one or more of the following:
    - Moderately steep slopes.
    - High susceptibility to water or wind erosion or severe adverse effects of past erosion.
    - Frequent flooding accompanied by some crop damage.
    - Very slow permeability of the subsoil.

- Wetness or some continuing waterlogging after drainage.
- Shallow soil depth to bedrock, hardpan, fragipan or clay pan that limit the rooting zone and the water storage.
- Low water-holding capacity.
- Low fertility not easily corrected.
- Moderate salinity or sodicity.
- Moderate climatic limitations.

Note: "Severe limitations" and "Low fertility not easily corrected" are taken to imply that land dominated by soils with severe subsoil acidity belongs in Class III.

Class IV

- Land in Class IV has very severe limitations that restrict the choice of plants, require very careful management, or both.
- It may be used for cultivated crops, but more careful management is required than for Class III and conservation practices are more difficult to apply and maintain.
- Restrictions to land use are greater than those in Class III and the choice of plants is more limited.
- It may be well suited to only two or three of the common crops or the harvest produced may be low in relation to inputs over long period of time.
- In sub-humid and semiarid areas, land in Class IV may produce good yields of adapted cultivated crops during years of above average rainfall and failures during years of below average rainfall.
- Use for cultivated crops is limited as a result of the effects of one or more permanent features such as:
  - Steep slopes.
  - Severe susceptibility to water or wind erosion or severe effects of past erosion.
  - Shallow soils.

- Low water-holding capacity.
- Frequent flooding accompanied by severe crop damage.
- Excessive wetness with continuing hazard of waterlogging after drainage.
- Severe salinity or sodicity.
- Moderately adverse climate.

GRAZING

Class V | Class VI | Class VII

Class V

- Land in Class V has little or no erosion hazard but have other limitations impractical to remove that limit its use largely to pasture, range, woodland or wildlife food and cover. These limitations restrict the kind of plants that can be grown and prevent normal tillage of cultivated crops. Pastures can be improved and benefits from proper management can be expected.

- It is nearly level. Some occurrences are wet or frequently flooded. Other is stony, have climatic limitations, or have some combination of these limitations.

- Examples of Class V are:

  - Bottomlands subject to frequent flooding that prevent the normal production of cultivated crops.

  - Nearly level land with a growing season that prevents the normal production of cultivated crops.

  - Level or nearly level stony or rocky land.

  - Ponded areas where drainage for cultivated crops is not feasible but which are suitable for grasses or trees.

Class VI

- Land in Class VI has severe limitations that make it generally unsuited to cultivation and limits its use largely to pasture and range, woodland or wildlife food and cover.

- Land in Class VI has continuing limitations that cannot be corrected, such as:

  - Steep slope.

  - Severe erosion hazard.

- Effects of past erosion.
- Stoniness.
- Shallow rooting zone.
- Excessive wetness or flooding.
- Low water-holding capacity.
- Salinity or sodicity.
- Severe climate.

Physical conditions are such that it is practical to apply range or pasture improvements, if needed, such as seeding, liming and fertilizing.

Some occurrences can be safely used for the common crops, provided unusually intensive management is used. Some occurrences are adapted to special crops. Depending on soil features and climate, land in Class VI may be well to poorly suited to woodlands.

Class VII

- Land in Class VII has very severe limitations that makes it unsuited to cultivation and that restrict its use largely to grazing, woodland or wildlife.
- Restrictions are more severe than those for Class VI because of one or more continuing limitations that cannot be corrected, such as:
  - Very steep slopes.
  - Erosion.
  - Shallow soil.
  - Stones.
  - Wet soil.
  - Salts or sodicity.

- Unfavourable climate.

Physical conditions are such that it is impractical to apply such pasture or range improvements as seeding, liming and fertilizing.

Depending on soil characteristics and climate, land in Class VII may be well or poorly suited to woodland.

In unusual instances some occurrences may be used for special crops under unusual management practices.