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Environmental Authorisation for Proposed Additional Infrastructure at the Universal Coal Development III (Pty) Ltd, Ubuntu Colliery, Nkangala, Mpumalanga Province

Soil, Land Use and Land Capability Impact Assessment

Prepared for:

Universal Coal Development III (Pty) Ltd

Project Number:

UCD6097

DMRE Reference Number:

MP 30/5/1/1/2/10027 EM

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- 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 48 and is punishable in terms of section 24F of the Act.



Signature of the Specialist

January 2021

Date

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EXECUTIVE SUMMARY

Universal Coal Development III (Pty) Ltd (hereafter Universal Coal) secured a mining right (MP 30/5/1/1/2/10027 MR) for the formerly known Brakfontein Colliery in 2017. The Environmental Management Plan (EMP) was also approved at the same time. Subsequently, the Colliery name was amended in January 2019 to reflect the name change of the mine to Ubuntu Colliery.

The proposed development area falls within land types **Ab9** and **Bb3**. The dominant soil forms identified within the Project Area include Dresden, Witbank, Hutton, Glencoe, Clovelly, Pinedene, and Avalon. The dominant land use for the Project Area is commercial dryland cultivation, indicating the high agricultural potential of the soils. Low-lying areas within the Project Area showed increased clay content and soil wetness.

The Soil, Land Use and Land Capability Impact Assessment were assessed according to a previously conducted assessment done by Digby Wells (Digby Wells Environmental, 2012). The soils were desktop assessed and confirmed during a rapid site survey. The site survey was conducted in July 2020 to determine the current impacts on the soil, land use and land capability.

The pH in 2012 ranges from 5.5 to 7.2, whereas the pH in 2020 was measured as 5.34 to 6.25. The lower pH can be attributed to the sandy nature of the soils and high leaching potential. The CEC values in 2012 ranged from 4 to 9.3 cmol/kg and 3.14 to 4.68 cmol/kg in 2020. The low CEC in both sample years indicates the sandy nature of the soils, low organic material and low clay content soils. These soils measured low phosphorus, organic material, low soil fertility with low cations and are highly leachable.

The soils in the area are typically that of the plinthic catena. Sandy soils are common at the top of the catchment with increased clay content towards the low-lying areas. The sandy nature of the soils will contribute to increased infiltration and affect the lateral and interflow of water and groundwater in a catchment.

The potential impacts due to the additional infrastructure activities on the soil, land use, and land capability are major to moderate if mismanaged.

The potential impacts associated with the proposed additional infrastructure include:

- Geomorphological changes to the natural soils and landscape due to construction of infrastructure;
- Loss of habitat, vegetation and growth medium due to construction and operation of additional infrastructure;
- Erosion, destruction of high agricultural soils, loss of topsoil and organic material;
- Sedimentation, pollution and loss of watercourses (wetlands);
- Soil contamination from Hydrocarbon waste (lubricants, oil and fuels) due to spillage during construction and operation of the listed activities;

- Potential spillage of hydrocarbons, oils and waste during construction and operation of the infrastructure, may migrate through the soil profiles and by overland flow, contaminating the ground and surface water resources;
- Soil compaction, low vegetation growth, high runoff potential, increased erosion due to hardened surfaces from the additional infrastructure; and
- Impacts to natural wetlands and water resources thereby changing the use of water, increasing water contamination, and loss of water quality, and quantity. Contaminated water will affect the soils, land capability, and water use.

The impacts may have a significant effect on the soil resources and therefore impacting the long-term land use and land capability of the Project Area if mitigation measures are not implemented from the construction phase through to the decommissioning phase. Contaminated soils can directly impact the water quality as well as the vegetation in the area, the soils also have a high potential to erosion and therefore loss of soil and sedimentation in the low-lying areas. Section 9 and Section 10 of this report describes a management plan for the rehabilitation and monitoring during the construction, operational, and decommissioning phases of the additional activities. It is highly recommended that these management measures be followed to limit the impacts to the soil, land use, and land capability of the Project Area.

Based on the understanding of the Project while considering the results of the impact assessment, Digby Wells does not object to the Project; taken into consideration the provided management plan, monitoring program, and recommendations are adopted.

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Appendix A: Methodology

ACRONYMS, ABBREVIATIONS AND DEFINITION

°C	Degrees Celsius
ARC	Agricultural Research Council
CARA	The Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983)
CEC	Cation Exchange Capacity
Digby Wells	Digby Wells Environmental
EA	Environmental Authorisation
EC	Electrical Conductivity
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMPr	Environmental Management Programme
EP	Environmental Practitioner
GPS	Global Positioning System
ha	Hectare
I&APs	Interested and Affected Parties
ISCW	Institute for Soil, Climate and Water
IWULA	Integrated Water Use License Application
IWWMP	Integrated Water and Waste Management Plan
IXIA	Ixia Coal (Pty) Ltd
km	Kilometre
L	Litre
m	Metre
m.a.m.s.l.	Metres above mean sea level
mm	Millimetre
MM	Mine Manager
MOP	Mining Operations Plan
NDM	Nkangala District Municipality
NEM:WA	National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NWA	National Water Act, 1998 (Act No. 36 of 1998)
OC	Organic Carbon

OC1	Open Pit
PCSW	Potentially Contaminated Surface Water
PPP	Public Participation Process
RE	Remaining Extend
SANAS	South African National Accreditation System
SEP	Stakeholder Engagement Process
SSV	Soil Screening Values
STP	Sewage Treatment Plant
UCD	Universal Coal PLC
VKLM	Victor Khanye Local Municipality
WML	Water Management License
WUL	Water Use License

Legal Requirement		Section in Report
(1)	A specialist report prepared in terms of these Regulations must contain-	
(a)	details of-	(i)
	(i) the specialist who prepared the report; and	(ii)
	(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	
(b)	a declaration that the specialist is independent in a form as may be specified by the competent authority;	(iii)
(c)	an indication of the scope of, and the purpose for which, the report was prepared;	2
cA	And indication of the quality and age of the base data used for the specialist report;	7
cB	A description of existing impacts on site, cumulative impacts of the proposed development and levels of acceptable change;	8
(d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	7
(e)	a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of the equipment and modelling used;	6
(f)	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure inclusive of a site plan identifying site alternatives;	1

Legal Requirement		Section in Report
(g)	an identification of any areas to be avoided, including buffers;	N/A
(h)	a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	1.4
(i)	a description of any assumptions made and any uncertainties or gaps in knowledge;	4
(j)	a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	7
(k)	any mitigation measures for inclusion in the EMPr;	8
(l)	any conditions/aspects for inclusion in the environmental authorisation;	9
(m)	any monitoring requirements for inclusion in the EMPr or environmental authorisation;	10
(n)	a reasoned opinion (Environmental Impact Statement) -	13
	whether the proposed activity, activities or portions thereof should be authorised; and	13
	if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the Environmental Management Programme (EMPr), and where applicable, the closure plan;	9, 10, 12
(o)	a description of any consultation process that was undertaken during the course of preparing the specialist report;	11
(p)	a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	11
(q)	any other information requested by the competent authority.	N/A

1 Introduction

Universal Coal Development III (Pty) Ltd (hereafter Universal Coal) secured a mining right (MP 30/5/1/1/2/10027 MR) for the formerly known Brakfontein Colliery in 2017. The Environmental Management Plan (EMP) was also approved at the same time. Subsequently, the Colliery name was amended in January 2019 to reflect the name change of the mine to Ubuntu Colliery. The following approvals (Attached as Appendix A) exist for the Ubuntu Colliery:

- Mining Right and EMP issued by the Mpumalanga Department of Mineral Resources and Energy with reference number MP 30/5/1/1/2/10027 MR;
- The name change of the colliery from Brakfontein Colliery to Ubuntu Colliery on 29 January 2019; and
- Water Use License (WUL) issued by the Department of Water and Sanitation on 22 February 2019 with license number 03/B20E/ABCGIJ/4751.

This application focuses on the inclusion of additional infrastructure not previously considered in the original applications (i.e. Current EMP). This infrastructure triggers Listed Activities contemplated under the Environmental Impact Assessment (EIA) Regulations, 2014 (as amended) and thus the need for prior Environmental Authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA).

This Soil, Land Use and Land Capability Impact Assessment Report has been compiled in support of the NEMA application and will also form the basis for the EIA and the Environmental Management Programme (EMP) report.

Note: The Ubuntu Colliery holds a Mining Right and EMP approved for mining. The subject of this report and application is only for the additional infrastructure.

1.1 Project Locality

The proposed Ubuntu Colliery Project Area is located within the Western margins of the Witbank Coalfields under the jurisdiction of the Victor Khanye Local Municipality which is located in the Nkangala District Municipality, Mpumalanga Province (Table 1-1; Figure 1-1). The site is located approximately 16 kilometres (km) north-east of Delmas and 14 km and 17 km north of Devon and Leandra respectively.

Table 1-1: Summary of the Ubuntu Colliery Project Location Details

Province	Mpumalanga	
Magisterial District/Local Authority	Victor Khanye Magisterial District	
District Municipality	Nkangala District Municipality (NDM)	
Local Municipality	Victor Khanye Local Municipality (VKLM)	
Nearest Town	Devon (14 km), Delmas (16 km), Leandra (17 km)	
Property Name and Number	Farm Name	Farm Portion
	Brakfontein 264 IR/RE	0
	Brakfontein 264 IR	10
21 digit Surveyor General Code for each farm portion:	T0IR00000000026400000 T0IR00000000026400010	
GPS Co-ordinates (relative centre point of study area)	28°51'39.698"E	
	26°12'31.237"S	

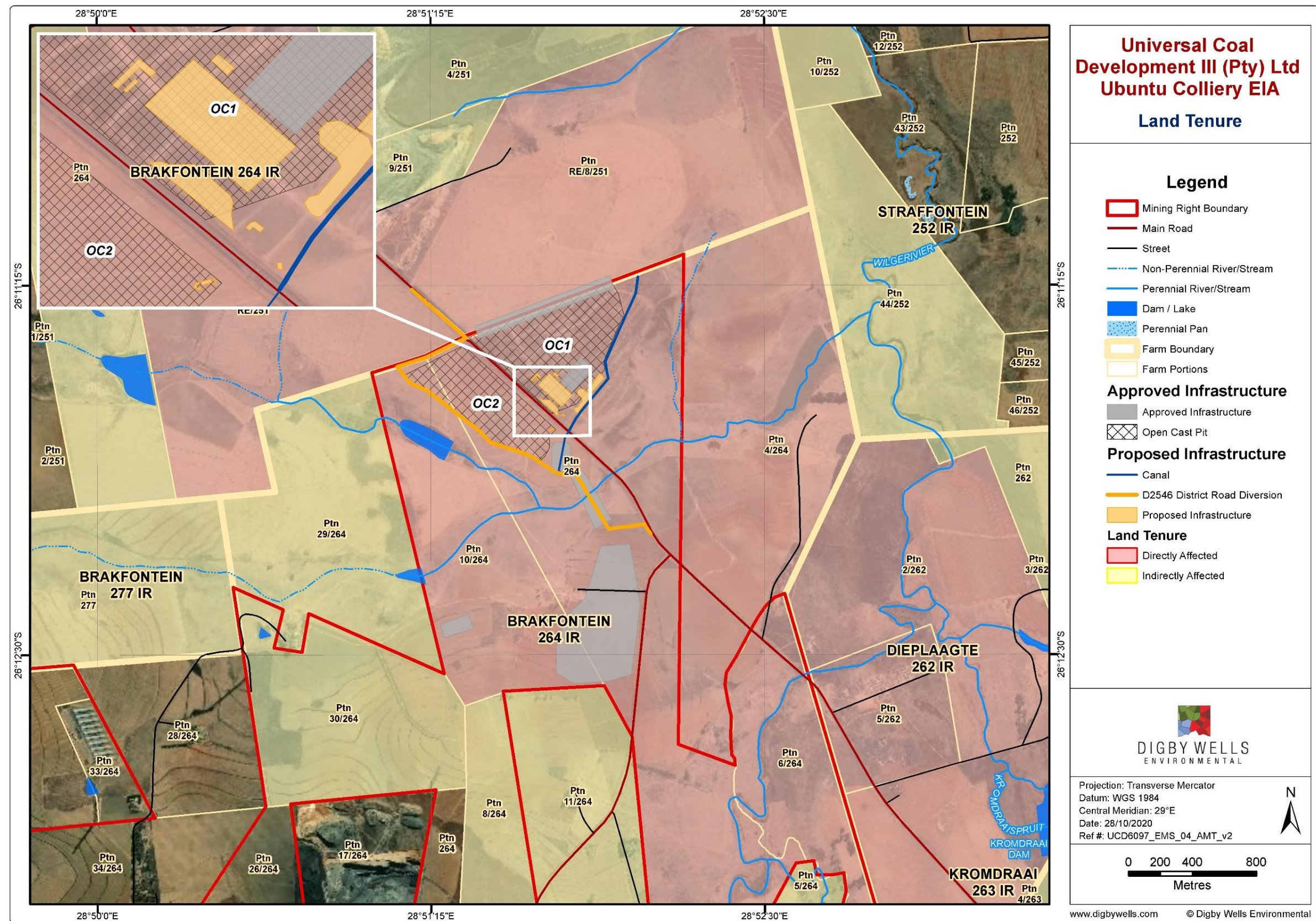


Figure 1-1 Land Tenure in the Project Area

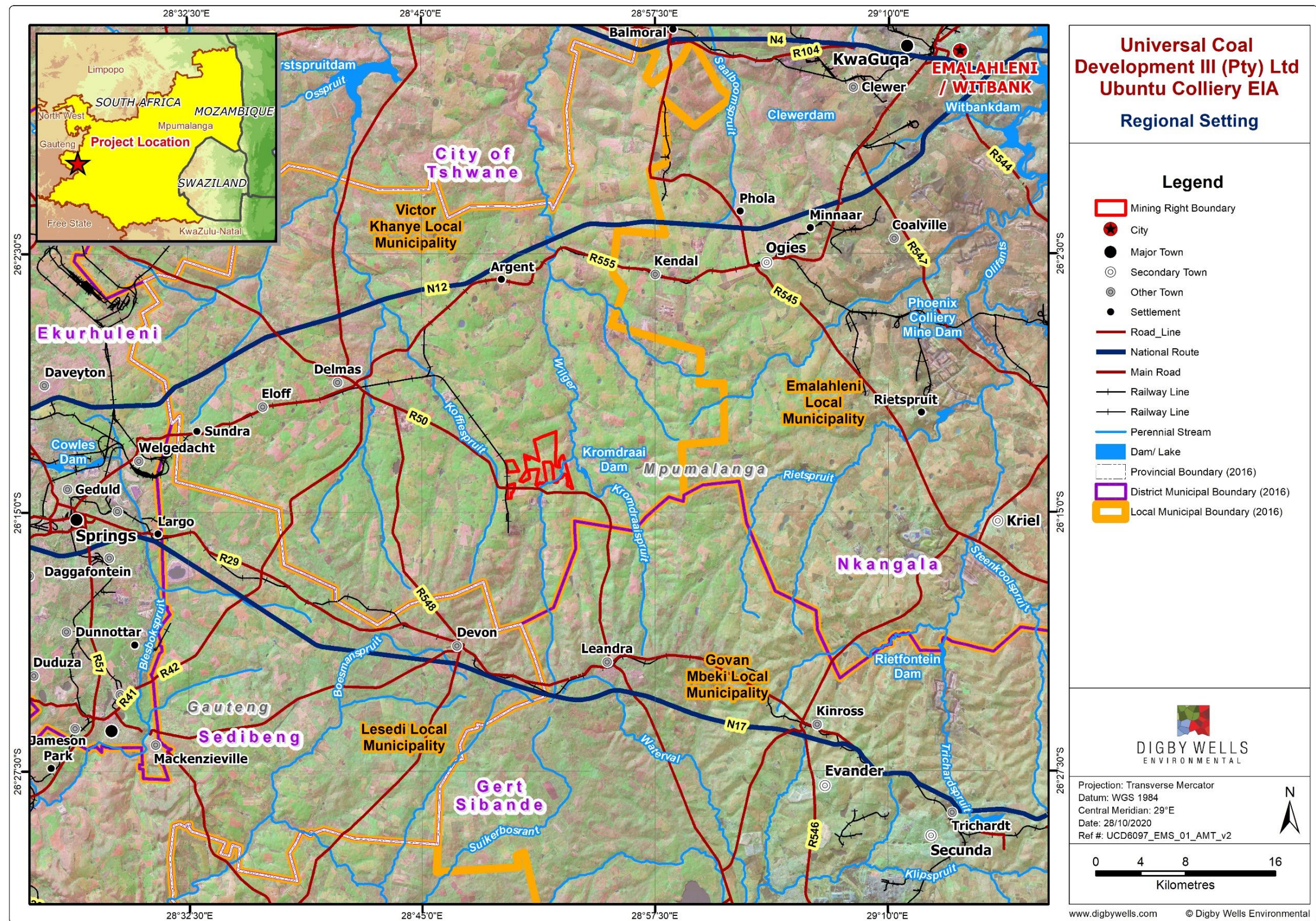


Figure 1-2: Regional Setting

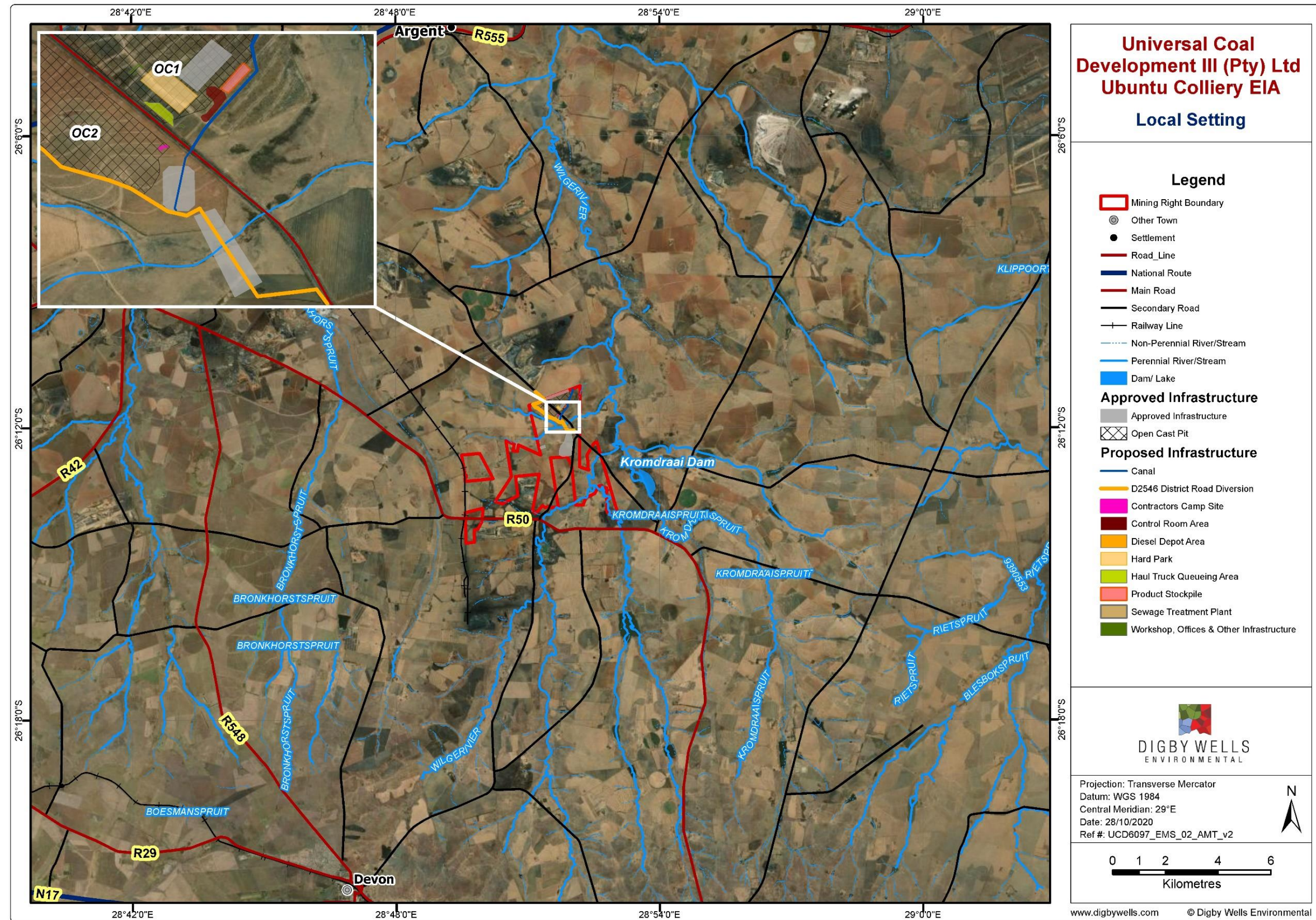


Figure 1-3: Local Setting

1.2 Project Background

Ubuntu Colliery is an operational mine. The purpose of this application is to authorise the establishment of additional infrastructure within the Mining Right Boundary. Section 1.3 provides a summary of the approved infrastructure, while Section 1.4 provides a description of what is required to be authorised in this application process, Section 1.5 provides a project activities, and lastly, the Listed and Specified activities are further discussed in Section 1.5 of this report.

The area pertaining to the infrastructure amendments is currently approved for opencast mining at the open pit (OC1 and OC2).

1.3 Approved Infrastructure

The authorised infrastructure (as per the approved EMP) includes the following:

- Parking and offices;
- Weighbridge;
- Run of Mine (RoM) pads;
- Pollution Control Dams (PCDs);
- Opencast mining;
- Culvert;
- Mine equipment workshop and stores; and
- Wash bay facility.

The original approval did not involve any processing infrastructure on site but to transfer the coal to Kangala Colliery for further processing (including crushing, screening and washing). This has subsequently proven to not be a practical solution and crushing, and screening is now taking place in the approved pit area with a mobile crushing and screening plant.

1.4 Additional Infrastructure (The Project)

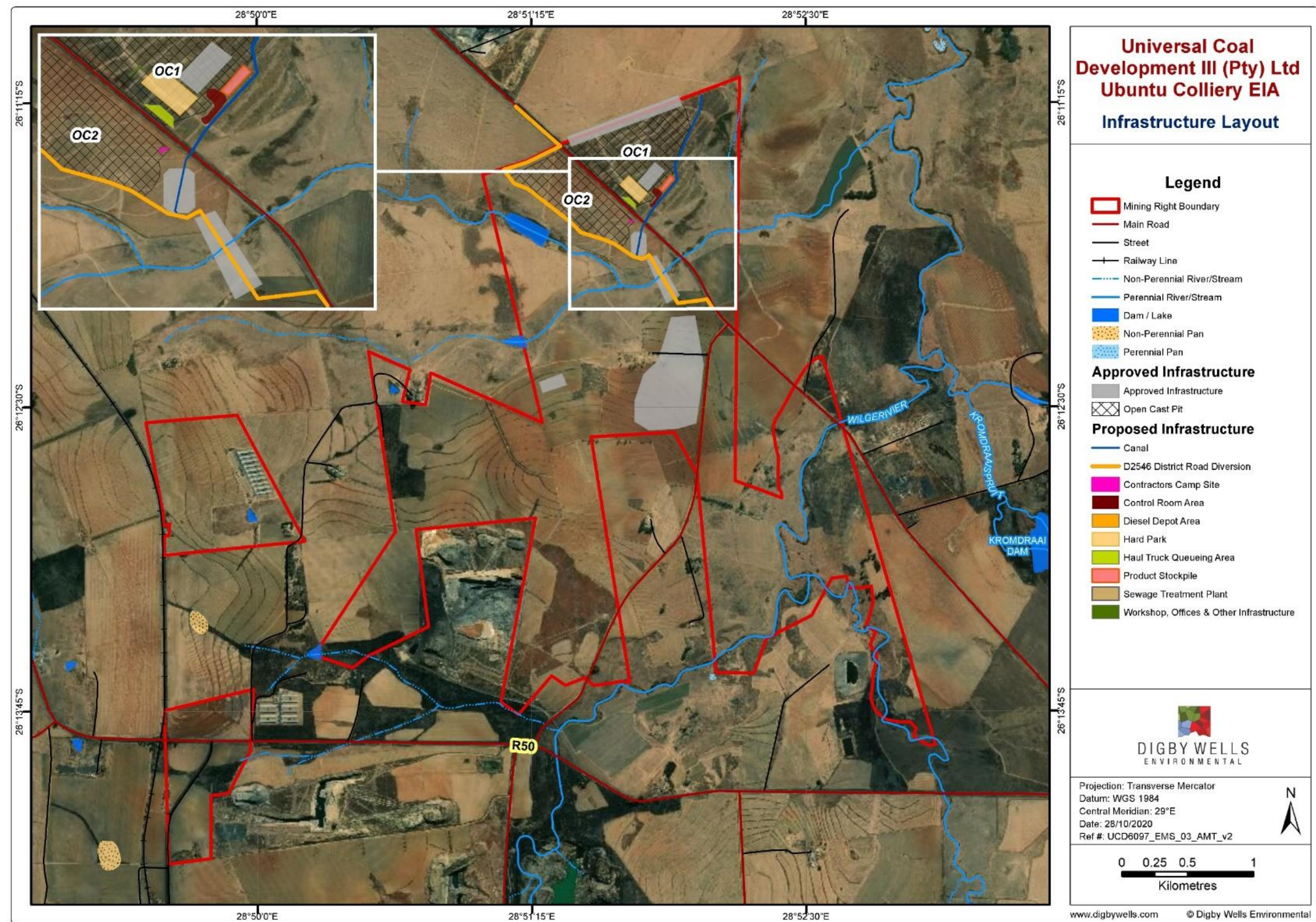
Further to on-site crushing and screening, the following additional infrastructure is required. However, only the diversion of the D2546 District road requires environmental authorisation (Figure 1-4):

- | | |
|---------------------------------------|-------------------------------------|
| • Guard house and access control gate | • LDV and main access road |
| • Control room | • Heavy duty truck access road |
| • Toilet facilities | • Storm water diversion berm/trench |
| • Haulage truck queueing area | • Access control and boom gate |
| • Hard park area | • Topsoil safety berm |
| • Brake test ramp area | • Lab office |

-
- | | |
|---|--------------------------------|
| • Diesel depot area | • Sewage Treatment Plant (STP) |
| • Product stockpile | • Contractors camp site |
| • Perimeter fencing | • Water Treatment Plant (WTP) |
| • Crushing facilities and stockpile area | • 45 000 litre silo tank |
| • Diversion of D2546 District road | |

The following should be further noted pertaining to the above infrastructure:

- The additional infrastructure shall be established on environmentally authorised land;
- The WTP will treat borehole water sourced from areas in the project footprint. The treated water will be for domestic use. The daily throughput of the WTP will be 12m³ p/day; and
- The specific designs for the diversion of district road D2546 will be confirmed. It is proposed to have a reserve of 30 m and length of 2,5 km.



1.5 Project Activities

The construction, operation and decommissioning phases of the Project shall comprise of the activities in Table 1-2. These Project activities will be used for the Soil, Land Use and Land Capability Impact Assessment.

Table 1-2: Project Phases and Associated Activities

Phase	Activity
Construction	Surface preparation for infrastructure
	Construction of surface infrastructure
Operational	Operation and maintenance of infrastructure
	Use and maintenance of haul roads (incl. transportation of coal to washing plant)
Decommissioning	Demolition and removal of all infrastructure (incl. transportation off site)
	Rehabilitation (spreading of soil, revegetation, and profiling/contouring)
	Installation of post-closure water management infrastructure

1.6 Alternatives Considered

Alternatives to be considered to ensure minimal impacts to the Soil, Land Use and Land Capability includes:

- Reduce surface infrastructure, and footprint on soils with high agricultural potential and wetland soils;
- Avoid construction, and movement in wetlands, high clayey soils, and high interflow soils;
- Reduce the amount of water, and land for operations, and associated infrastructure;
- Clean wastewater, and sewage before putting it back into the systems;
- Implement soil and erosion monitoring in areas where possible contamination accumulation might take place and areas of high erosion potential to ensure

maintenance, erosion control, concurrent rehabilitation is followed and waste management plans are in place;

- Reduce waste materials, and waste outputs; and
- After decommissioning of the additional infrastructure, ensure that the native soils are placed back in the correct way, depth and sequence for optimal rehabilitation.

2 Scope of Work

The Soil, Land Use, and Land Capability Impact Assessment comprised of the following activities:

- **Desktop Review:** Review of all existing data for the collation of available information about the site, and proposed work. Historical data of the Project Area was assessed with regards to operational history, and identification of incidents (risks) that may have occurred, and could have impacted on the soil, land use, and capability. Review of existing data relating to soil form, soil depth, soil texture, laboratory analysis data, and soil classification within the Project Area.
- **Soil Survey:** An initial soil desktop delineation was conducted before the site visit using historical data, and Google Earth imagery. Thereafter, soil verification was done during a two-day site visit. A hand soil auger was used to survey the soil depth, and soil types present, with survey positions being recorded as waypoints;
- **Land Use:** Existing land use data was verified during the site visit. This was mapped in conjunction with existing soil survey data, and land uses/cover data.
- **Land Capability:** Land Capability was assessed by using the soil classification, soil form, depth, drainage, terrain, and climatic features. A map delineating the areas was produced for a visual representation of the most suitable areas for crop production.
- **Impact Assessment:** Identification of historical, and current impacts on soils, land uses, and land capabilities of the Project Area.
- **Recommendations:** Mitigation recommendations to develop rehabilitation, and management plans for the ROM.

3 Relevant Legislation, Standards and Guidelines

The Project is required to comply with all the obligations in terms of the provisions of the NEMA and MPRDA. The additional guidelines directing the Soil, Land Use and Land Capability Impact Assessment are detailed in Table 3-1.

Table 3-1: Applicable Legislation, Regulations, Guidelines and By-Laws

Legislation, Regulation, Guideline or By-Law	Applicability
<p><u>National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA).</u></p> <p>NEMA (as amended) was set in place in accordance with Section 24 of the Constitution. Certain environmental principles under NEMA must be adhered to, to inform decision making for issues affecting the environment.</p> <p>Section 24(1)(a) and (b) of NEMA state that:</p> <p><i>The potential impact on the environment and socio-economic conditions of activities that require authorisation or permission by law and which may significantly affect the environment, must be considered, investigated and assessed prior to their implementation and reported to the organ of state charged by law with authorizing, permitting, or otherwise allowing the implementation of an activity.</i></p> <p>The NEMA requires that pollution and degradation of the environment be avoided, or, where it cannot be avoided be minimised and treated.</p>	<p>Activities that will influence the Soil, Land Use and Land Capability of the proposed Project Area have been identified as Listed Activities in the Listing Notices (as amended) and therefore require environmental authorisation prior to being undertaken.</p>
<p><u>National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) (NEM:WA).</u></p> <p>The NEM:WA seeks to regulate waste management to protect health and environment by providing reasonable measures, including the provision of the remediation of contaminated land. Section 7(2)(d) of the NEM:WA sets the National Norms and Standards for the remediation of contaminated land and soil quality.</p>	<p>A Soil, Land Use and Land Capability Impact Assessment will be undertaken as part of the EIA Phase. The Project activities will be set out to abide by the NEM: WA and the Soil Screening Values (SSV). The required mitigation measures will be included in the EMP as part of the EIA Phase.</p>
<p><u>The Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) (CARA).</u></p> <p>The CARA is to provide control over the utilization of the natural agricultural resources to promote the conservation of the soil, the water sources and the vegetation and the combating of weeds and invader plants, and the matters connecting therewith. CARA defines the environmental conservation regulations as the protection of land against soil erosion, the prevention of water logging and salinization of soils by means of suitable soil conservation works to be constructed and maintained.</p>	<p>A Soil, Land Use and Land Capability Impact Assessment will be undertaken as part of the EIA Phase. The required mitigation measures will be included in the EMP as part of the EIA Phase to provide control over the natural agricultural resources to promote conservation of the soil, land use and land capability.</p>

4 Assumptions, Limitations and Exclusions

The compilation of this Report is based on the following assumptions and limitations in Table 4-1.

Table 4-1: Limitations and Assumptions with Resultant Consequences of this Report

Assumptions and Limitations	Consequences
Soil characteristics and descriptions in the report were supported by data obtained from previously conducted studies done by Digby Wells for Brakfontein Colliery in 2012. For reference conditions, a total of six representative soil samples were collected from different proposed development areas to compare to the historical data.	Soil analysis was only used to confirm previously obtained data and not all previous soil sample points were reassessed. For reference conditions, a total of six soil samples were collected from different proposed development areas to compare to the historical data.
The area surveyed was based on the layout presented by the Universal Coal in June 2020.	The study focused on the Brakfontein 264 IR/RE portion 0 and Brakfontein 264 IR portion 10 only with relevance to the newly proposed infrastructure.
Land suited for crop production was assumed also be suitable for other, less intensive uses such as pasture, natural grazing, forestry and wildlife.	The land identified to be of Agricultural importance for crop production, are also suitable for lower land use classes.
Soils are contiguous hence differentiation is not abrupt, and the transition zone cannot be completely captured during any given soil survey.	The soil distribution map of the Project Area may not be absolutely accurate.
The soils within the capability classes are similar only with respect to the degree of limitations in soil use for agricultural purposes or with respect to the impact on the soils when they are so used.	Not all soils have the same land use and are used according to their capabilities, each soil will react differently to the land use and impacts to the soils.

5 Details of the Specialist

The following is a list of Digby Wells' staff who were involved in the Soil, Land Use and Land Capability Impact Assessment:

- **Arjan van 't Zelfde** is a Senior Consultant with 13 years' experience in soil science and hydrogeology. Arjan received a M.Sc. degree in Soil Science (SAQA approved) as part of the B.Sc./M.Sc. programme Soil, Water and Atmosphere, Wageningen University, The Netherlands. He specialises in soil capability assessments, soil contamination assessments and hydrogeological numerical groundwater flow modelling and has worked in multiple countries such as The Netherlands, Ireland, Senegal and South Africa. Arjan is a registered Professional Natural Scientist

(Pr.Sci.Nat) with the South African Council for Natural Scientific Professions (Registration Number: 115656).

- **Willnerie Janse van Rensburg** is a Soil Scientist in the Rehabilitation, Closure and Soils Division at Digby Wells. She received her Bachelor of Science in Environmental Geography as well as her Honours degree in Soil Science from the University of the Free State. She has four years' experience in the fields of Soil Science and Environmental Science. She has experience in completing soil surveys, land capability assessments, irrigation scheduling and provides recommendations on soil amelioration. Willnerie also completes wetland delineations and assessments. She has undertaken work in Lesotho, Botswana and throughout South Africa. Willnerie is registered as a Candidate Natural Scientist with the South African Council for Natural Scientific Professionals.
- **Aamirah Dramat** is an Assistant Rehabilitation Consultant in the Rehabilitation, Closure and Soils Department at Digby Wells. She received her Bachelor of Science Degree in Applied Biology and Environmental and Geographical Science (EGS) as well as her Honours Degree in Biological Sciences from the University of Cape Town. She joined Digby Wells in 2020 as a Rehabilitation Intern and has since gained experience in the environmental services sector with specialised focus in Soils, Wetlands and Rehabilitation, both locally and internationally. She has been involved in the report compilation and undertaking of Baseline Assessments, Environmental Impact Assessments (EIAs), Rehabilitation and Closure Plans (RCPs), Rehabilitation Strategy and Implementation Plans (RSIPs), Alien Invasive Plant (AIP) Assessments, Re-vegetation Trial Studies and Monitoring Assessments.

6 Methodology

This section provides the methodology used in the compilation of the Soil, Land Use and Land Capability Impact Assessment. A detailed methodology is described in Appendix A and is summarized in Figure 6-1 below.

A soil assessment on the proposed infrastructure areas was conducted during a field visit in July 2020.

Soil Classification

A hand soil auger was used to determine the soil properties to a maximum depth of 1.2 m or to the first restricting layer. Soils were classified using the Soil Classification: A Taxonomic System for South Africa (Soil Classification Working Group, 1991). Soil Properties included:

- Topography, aspect and slope;
- Soil form and family;
- Soil depth;
- Estimated soil texture;
- Soil structure, coarse fragments, calcareousness;
- Underlying material; and
- Vegetation.

Land Use

Land use was identified by aerial imagery during the desktop assessment and verified during the site-inspection. Land use maps indicate delineated areas of similar land use (Land Type Survey Staff, 1972 - 2006).

Land use categories are:

- Plantations;
- Natural;
- Waterbodies;
- Mines;
- Urban built-up; and
- Agriculture.

Land Suitability (Agricultural Potential)

Soil agricultural potential was determined by soil forms, land capability, soil analysis, hydrology and current land use. The process involved allocating terrain and soil factors to an area of land. The soil chemical analysis, was considered in determining the final suitability of the soil. The suitability guidelines according to Schoeman et al., (2000) were used.

Desktop Assessment and Literature Review

The following sources were used to obtain baseline soil information such as generalised soil patterns and terrain types for the Project site:

- South African land type data by the Institute for Soil, Climate and Water (ISCW) of the Agricultural Research Council (ARC) (ARC, 2006);
- Aerial imagery;
- Land use and land capability data;
- Existing Land Type data (Land Type Survey Staff, 1972 - 2006); and
- Existing studies conducted in the area.

Soil Physical and Chemical Analysis

Collection of representative soil samples with analysis at a SANAS accredited laboratory. In accordance with the Handbook of Standard Soil Testing Methods for Advisory Purposes (Soil Science Society of South Africa, 1990), the samples were tested for:

- Soil fertility; and
- Soil particle distribution (Clay, Sand and Silt).

Land Capability

Land capability is defined by the most suitable land use under rain-fed conditions. Land capability was determined by assessing a combination of soil, terrain and climate features. The land was rated into 8 classes with subgroups that have the same relative degree of limitation or potential.

Figure 6-1: Soil, Land Use and Land Capability Assessment Methodology

7 Findings and Discussion

The baseline soil assessment was conducted, followed by a site survey to verify the findings. Aerial imagery was analysed to determine areas that are most likely to be suitable for agriculture (high land capability potential) as per (Schoeman, et al., 2000). As part of the assessment, baseline soil information was obtained from the South African land type data published with maps at a scale of 1:250 000 by the Institute for Soil, Climate and Water (ISCW) of the Agricultural Research Council (ARC).

7.1 Baseline Environment





Table 7-1: Baseline Environment of the Ubuntu Colliery Project Area

Characteristics of the Highveld Ecoregion (Kleynhans, Thirion, & Moolman, 2005)		Plant Species Characteristic of the Eastern Highveld Grasslands (Mucina & Rutherford, 2012) (Figure 7-1)	
Terrain Morphology	Plains; Low Relief; Plains; Moderate Relief; Lowlands; Hills and Mountains; Moderate and High Relief; Open Hills; Lowlands; Mountains; Moderate to high Relief Closed Hills. Mountains; Moderate and High Relief.	Graminoid Species	<i>Aristida aequiglumis</i> , <i>A. congesta</i> , <i>A. junciformis</i> subsp. <i>galpinii</i> , <i>Brachiaria serrata</i> , <i>Cynodon dactylon</i> , <i>Digitaria monodactyla</i> , <i>D. tricholaenoides</i> , <i>Elionurus muticus</i> , <i>Eragrostis chloromelas</i> , <i>E. capensis</i> , <i>E. curvula</i> , <i>E. gummiflua</i> , <i>E. patentissima</i> , <i>E. plana</i> , <i>E. racemosa</i> , <i>E. sclerantha</i> , <i>Heteropogon contortus</i> , <i>Loudetia simplex</i> , <i>Microchloa caffra</i> , <i>Monocymbium ceresiiforme</i> , <i>Setaria sphacelata</i> , <i>Sporobolus africanus</i> , <i>S. pectinatus</i> , <i>Themeda triandra</i> , <i>Trachypogon spicatus</i> , <i>Tristachya leucothrix</i> , <i>T. rehmannii</i> , <i>Alloteropsis semialata</i> subsp. <i>eckloniana</i> , <i>Andropogon appendiculatus</i> , <i>A. schirensis</i> , <i>Bewsia biflora</i> , <i>Ctenium concinnum</i> , <i>Diheteropogon amplexans</i> , <i>Harpochloa falx</i> , <i>Panicum natalense</i> , <i>Rendlia altera</i> , <i>Schizachyrium sanguineum</i> , <i>Setaria nigrirostris</i> , <i>Urelytrum agropyroides</i> .
Vegetation Types	Mixed Bushveld (limited); Rocky Highveld Grassland; Dry Sandy Highveld Grassland; Dry Clay Highveld Grassland; Moist Cool Highveld Grassland; Moist Cold Highveld Grassland; North Eastern Mountain Grassland; Moist Sandy Highveld Grassland; Wet Cold Highveld Grassland (limited); Moist Clay Highveld Grassland; Patches Afromontane Forest (very limited).	Herb Species	<i>Berkheya setifera</i> , <i>Haplocarpha scaposa</i> , <i>Justicia anagalloides</i> , <i>Pelargonium luridum</i> , <i>Acalypha angustata</i> , <i>Chamaecrista mimosoides</i> , <i>Dicoma anomala</i> , <i>Euryops gilfillanii</i> , <i>E. transvaalensis</i> subsp. <i>setilobus</i> , <i>Helichrysum aureonitens</i> , <i>H. caespitium</i> , <i>H. callicomum</i> , <i>H. oreophilum</i> , <i>H. rugulosum</i> , <i>Ipomoea crassipes</i> , <i>Pentanisia prunelloides</i> subsp. <i>latifolia</i> , <i>Selago densiflora</i> , <i>Senecio coronatus</i> , <i>Vernonia oligocephala</i> , <i>Wahlenbergia undulata</i> .
Altitude (m.a.m.s.l.) (modifying)	1 100-2 100, 2 100-2 300 (very limited)	Geophytic Herb Species	<i>Gladiolus crassifolius</i> , <i>Haemanthus humilis</i> subsp. <i>hirsutus</i> , <i>Hypoxis rigidula</i> var. <i>pilosissima</i> , <i>Ledebouria ovatifolia</i> .
Mean Annual Precipitation (MAP) (mm) (Secondary)	400 to 1 000	Succulent Herb Species	<i>Aloe ecklonis</i> .
Coefficient of Variation (% MAP)	<20 to 35	Low Shrub Species	<i>Anthospermum rigidum</i> subsp. <i>pumilum</i> , <i>Seriphium plumosum</i> .
Rainfall Seasonality	Early to late summer	Status	Vulnerable.
Mean Annual Temp. (°C)	12 to 20	Topography and Slope (Figure 7-2 and Figure 7-3)	
Mean Daily Summer Temp. (°C): February	10 to 32	The topography of the Project Area, as depicted in Figure 7-2, ranges from high elevations on the western side of the Project Area to low lying areas in the north, east and south. The area can be described as very uneven slopes with moderate to high undulating grasslands and small depressions scattered throughout the landscape (Figure 7-3). The elevation of the Project Area ranges from 1 540-1 580 metres above mean sea level (m.a.m.s.l.) which equates to a range of 40 m between the lowest and highest points of elevation within the Project Area. The difference in elevation between these points gives rise to a slope percentage of between 0 and 5.5 (at isolated steeper areas). The average slope percentage for the entire Project Area is approximately 2.5.	
Mean Daily Winter Temp. (°C): July	-2 to 22	Geology (Figure 7-4)	

Median Annual Simulated Runoff (mm)	5 to >250	The proposed Ubuntu Colliery Project Area is situated within the Witbank Coal Field, which forms part of the Karoo Basin extensively covering the central areas of South Africa. The basement rocks within the Karoo Basin are overlain by the Karoo Super Group. The pre-Karoo basement in the proposed Project Area consists of Transvaal Group rocks (Figure 7-4). The lowermost part of the basement consists of Malmani dolomites and Cherts, which are overlain by ferruginous shale and ferruginous quartzites of the Timeball Hill Formation. Andesite of the Hekpoort Formation rests on the Timeball Hill Formation. Vaalian age diabase later intruded the Transvaal Sequence in the Project Area. The basement of the Karoo Super Group, the Dwyka tillites, overlies the pre-Karoo basement. Dwyka tillites are fairly regularly deposited over the basin with the exception of paleo-topographical highs. The Dwyka tillites are overlain by the Vryheid formation which hosts the coal seams. The Vryheid formation consists of various sequences of sandstones, shales and siltstones with the various coal seams located within them. Higher units of the Karoo Super Group are not present within the study area. Recent sedimentary deposits are found wherever surface water features occur.	
Land Types and Dominant Soil Forms (Figure 7-5)			
Land Type	Soil Form	Geology	Characteristics
Ab9	<ul style="list-style-type: none">• Cartref• Clovelly• Dundee• Fernwood• Glenrosa• Hutton• Inanda• Katspruit• Kranskop• Magwa• Mispah• Nomanci• Oakleaf	<ul style="list-style-type: none">• Sandstone of the Natal Group, with isolated occurrences of dolerite.	<ul style="list-style-type: none">• According to the Land Type Data (1972 - 2006), 85% of the landscape is dominated by crest and mid slope landscape positions;• 65% of the dominant soils occurring in these landscape positions are deep red well drained red and yellow soils occurring in these upper landscape positions;• The soils are predominantly sandy and are apedal (non-structured) in both the A and B horizons;• Rooting depth can be limited by a clay layer underneath the yellow soils or parent rock occurring below the B soil horizon;• The A horizon is likely to contain 12-20% clay due to the influence of the dominant sandstone parent material;• The texture represents a sandy loamy textured soil;• Foot slope and valley bottom positions occupy only 15% of the landscape;• Soils present in these landscape positions are dominated by high clay content soils; and• The clay content in the A horizon can be in the order of 50-70%.
Bb3	<ul style="list-style-type: none">• Arcadia• Avalon• Estcourt• Hutton• Glencoe• Katspruit• Kroonstad• Mispah• Longlands• Rensburg• Swartland• Valsrivier• Westleigh• Willowbrook	<ul style="list-style-type: none">• Shale, sandstone, clay, conglomerate, limestone and marl of the Eccia Group;• Shale and tillite of the Dwyka Formation;• Karoo Sequence;• Dolerite;• Occasional Ventersdorp lava, Witwatersrand quartzite and slate; and• Dolomite	<ul style="list-style-type: none">• Similar to Land Type Ab9, 90% of this land type consists of crest and mid slope landscape positions;• The dominant soils present in crest and mid slope positions are red and to a lesser extent yellow well drained soils;• The influence of parent rock (sandstone parent material) influenced the formation of very sandy non structured (apedal) soil;• The clay content in the A horizon is in the order of 8 – 12%. Soil texture is expected to represent a sandy loam soil;• Smaller areas in the foot slope and valley bottom positions of both the land types present in the Ubuntu Colliery Project Area might contain waterlogged high clay content soils;• These soils owing to their position in the landscape are seasonally or permanently wet;• Where lateral drainage is forced by slope steepness and the presence of underlying impermeable layers on these landscape positions, soils containing an E horizon (evidence of lateral drainage) can occur; and• The occurrence of the G and E subsoil horizons in this landscape, prove that seasonally wet conditions prevail.
Land Capability (Figure 7-6)			Land Use (Figure 7-7)
Class	Classification	Dominant Limitation Influencing the Physical Suitability for Agricultural Use	The current land use of the Ubuntu Colliery Project Area was identified by aerial imagery during the desktop assessment and was verified during an on-site inspection. The land use was described as (Figure 7-7):

II	Arable Land – Intensive Cultivation	Soils have moderate limitations that reduce the choice of plants or require moderate conservation practices.	<ul style="list-style-type: none">• Cultivation;• Grassland;• Forrest land;• Waterbodies; and• Wetlands. <p>The predominant present land use in the Ubuntu Colliery Project Area is arable crop production due to the presence of large areas being occupied by high potential soil (Fig xx). Current land use is estimated at 81% of the available land being used for arable farming. The leftover 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.</p> <p>Photo description (Table 7-2): A – Cultivated land and dirt roads. B – Cultivated land and large stands of AIPs. C – Wetlands. D – Cattle grazing and adjacent mining activities.</p>
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Table 7-2: Land Use Photos

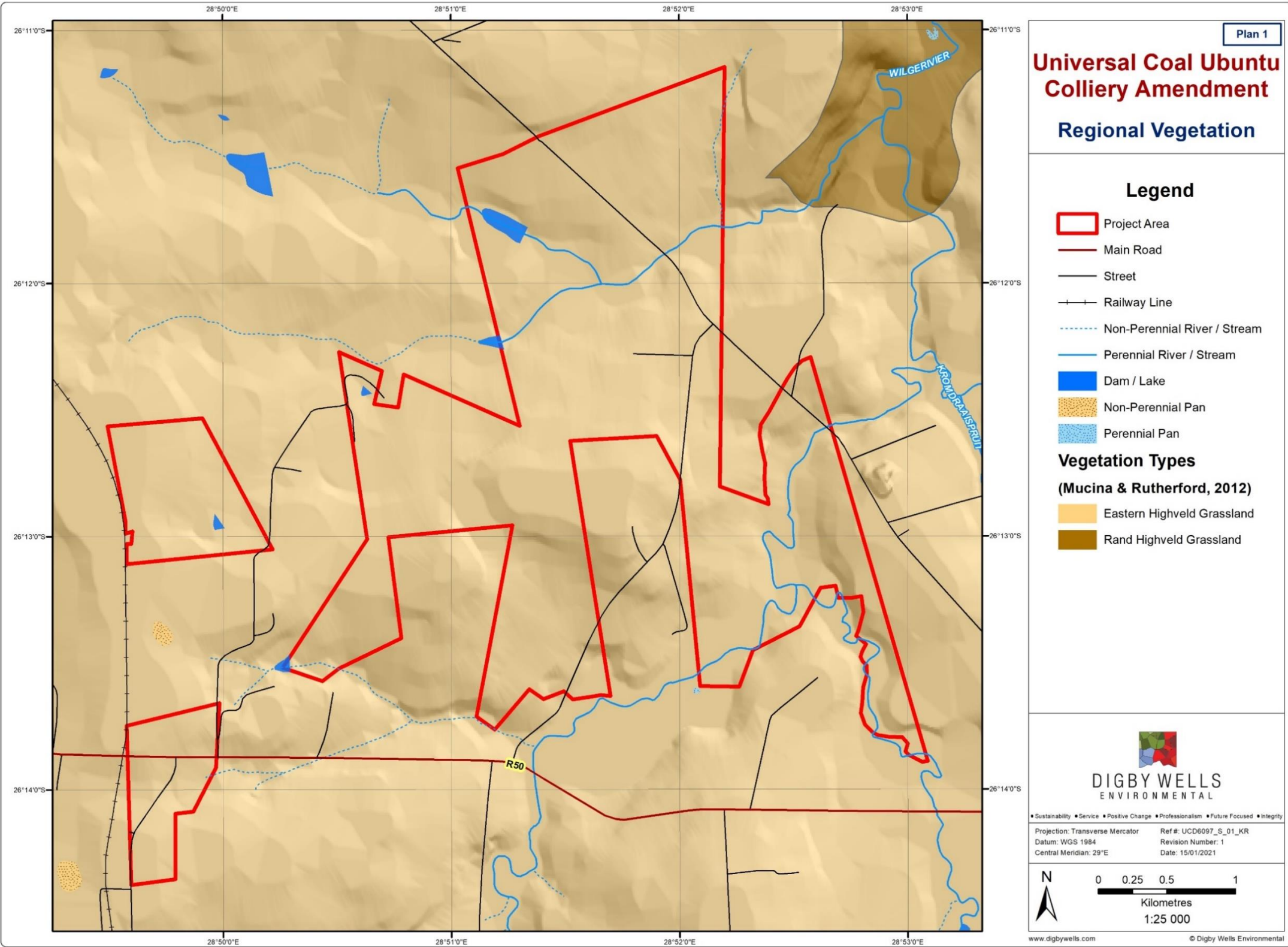


Figure 7-1: Regional Vegetation of Ubuntu Colliery

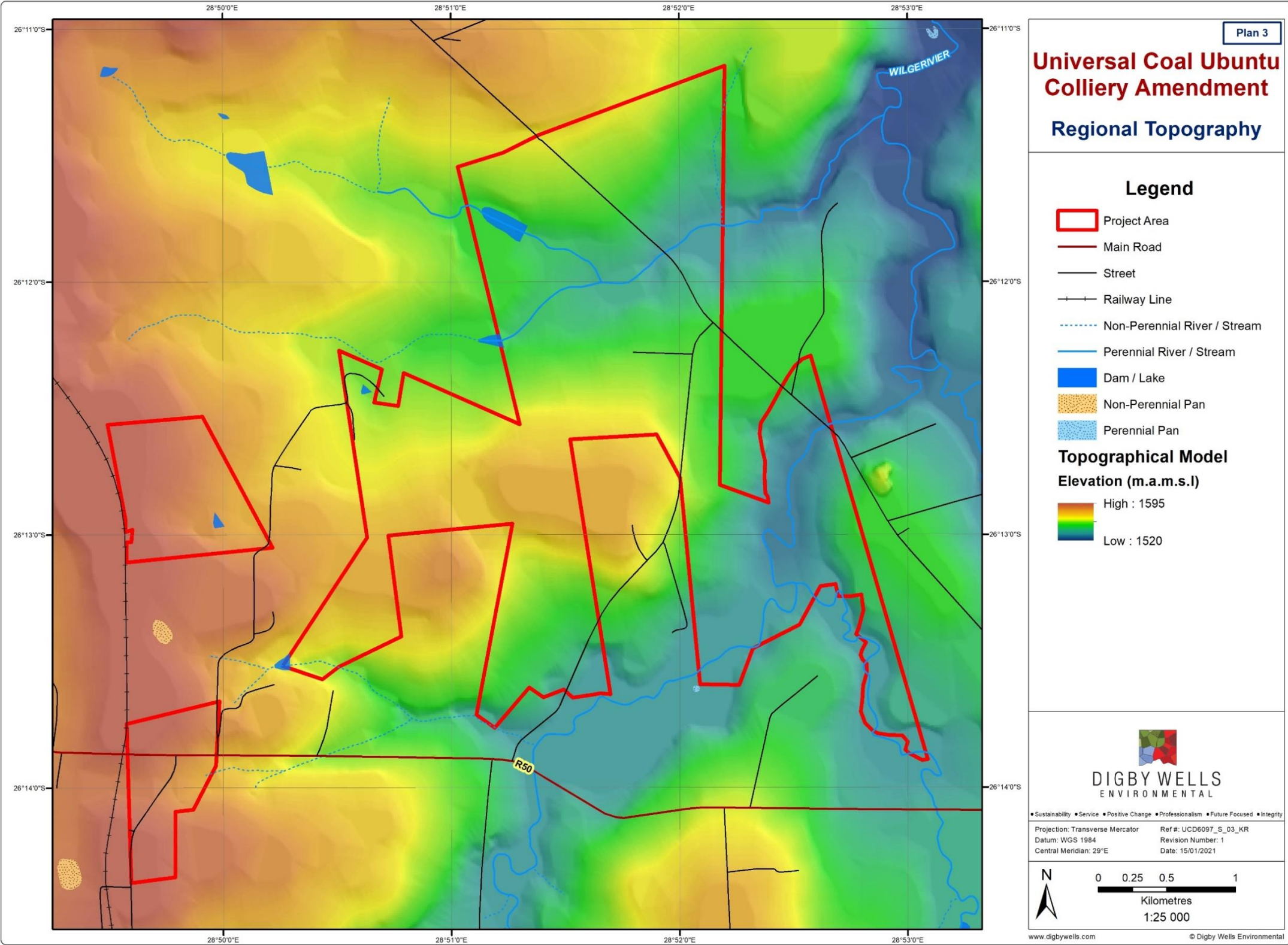


Figure 7-2: Topography of Ubuntu Colliery

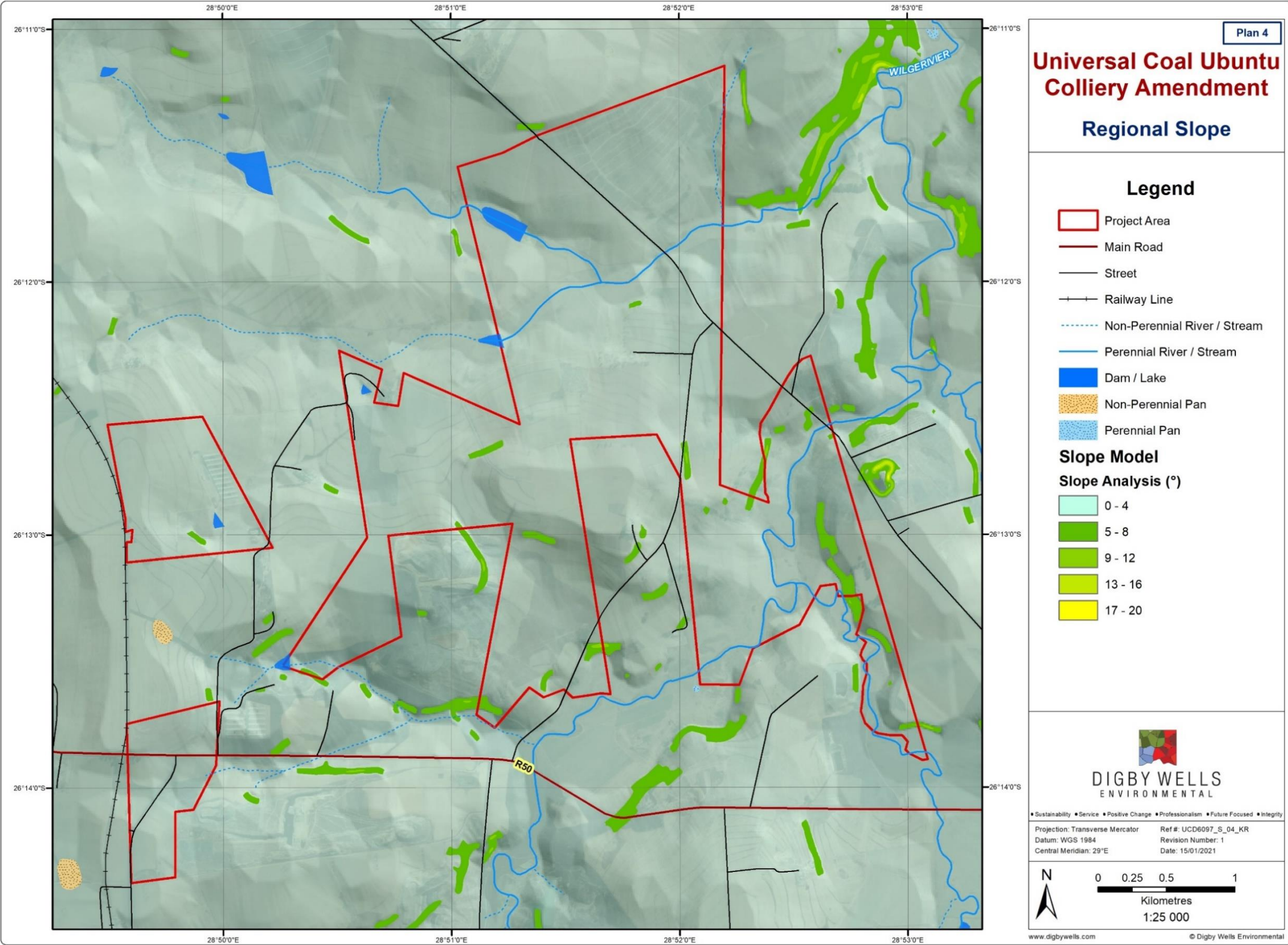


Figure 7-3: Slope of Ubuntu Colliery

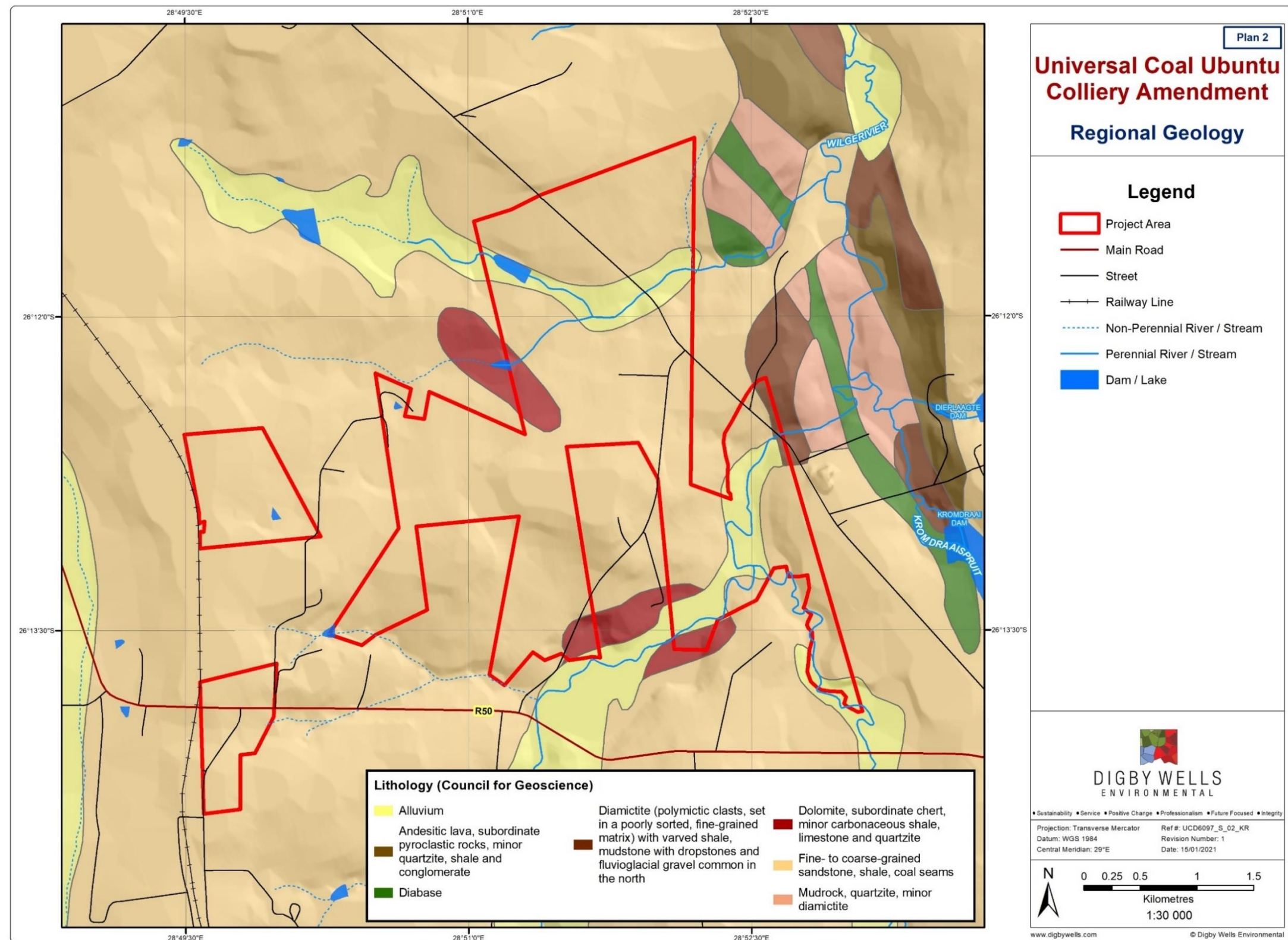


Figure 7-4: Geology of Ubuntu Colliery

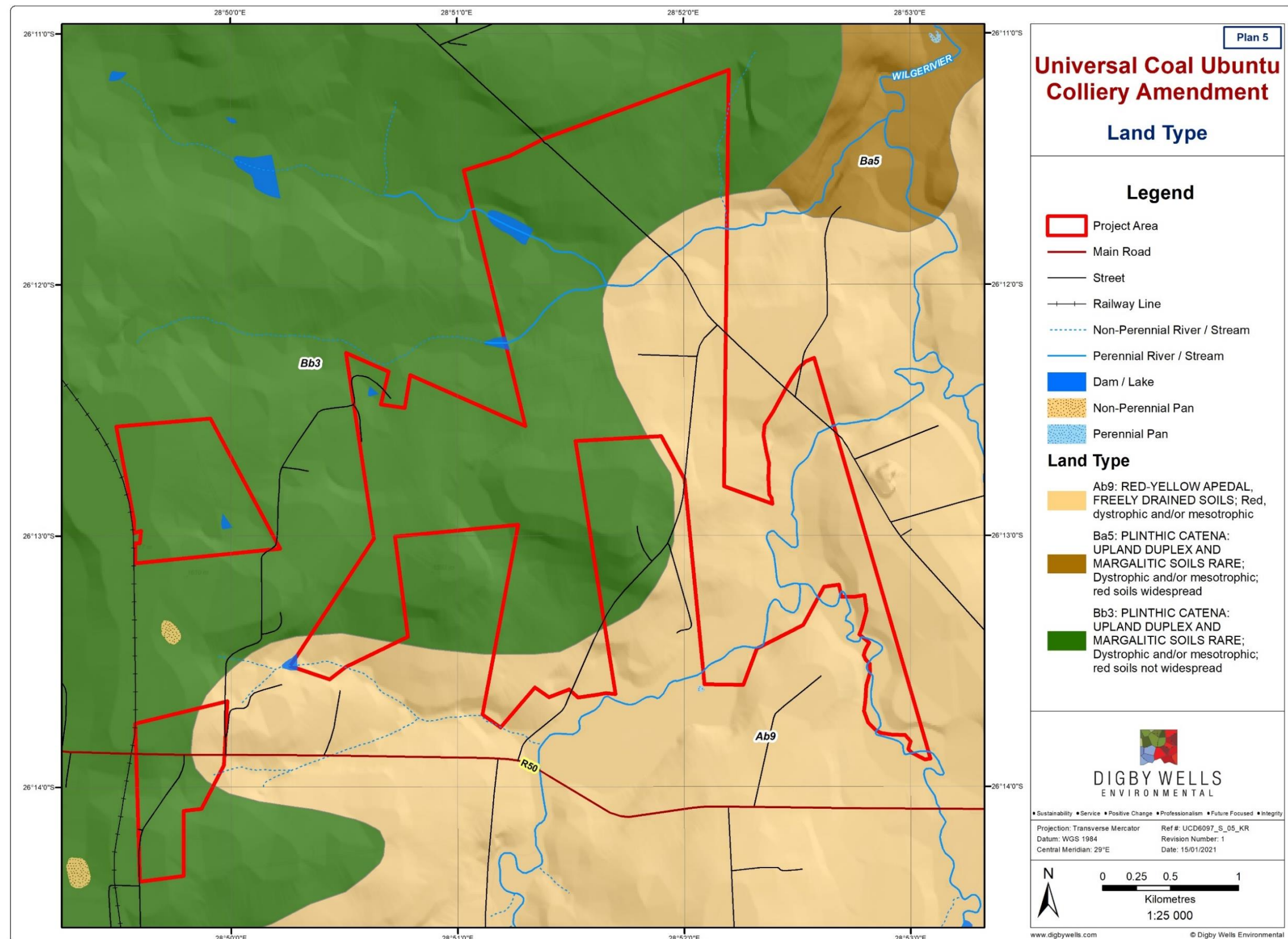


Figure 7-5: Land Types of Ubuntu Colliery

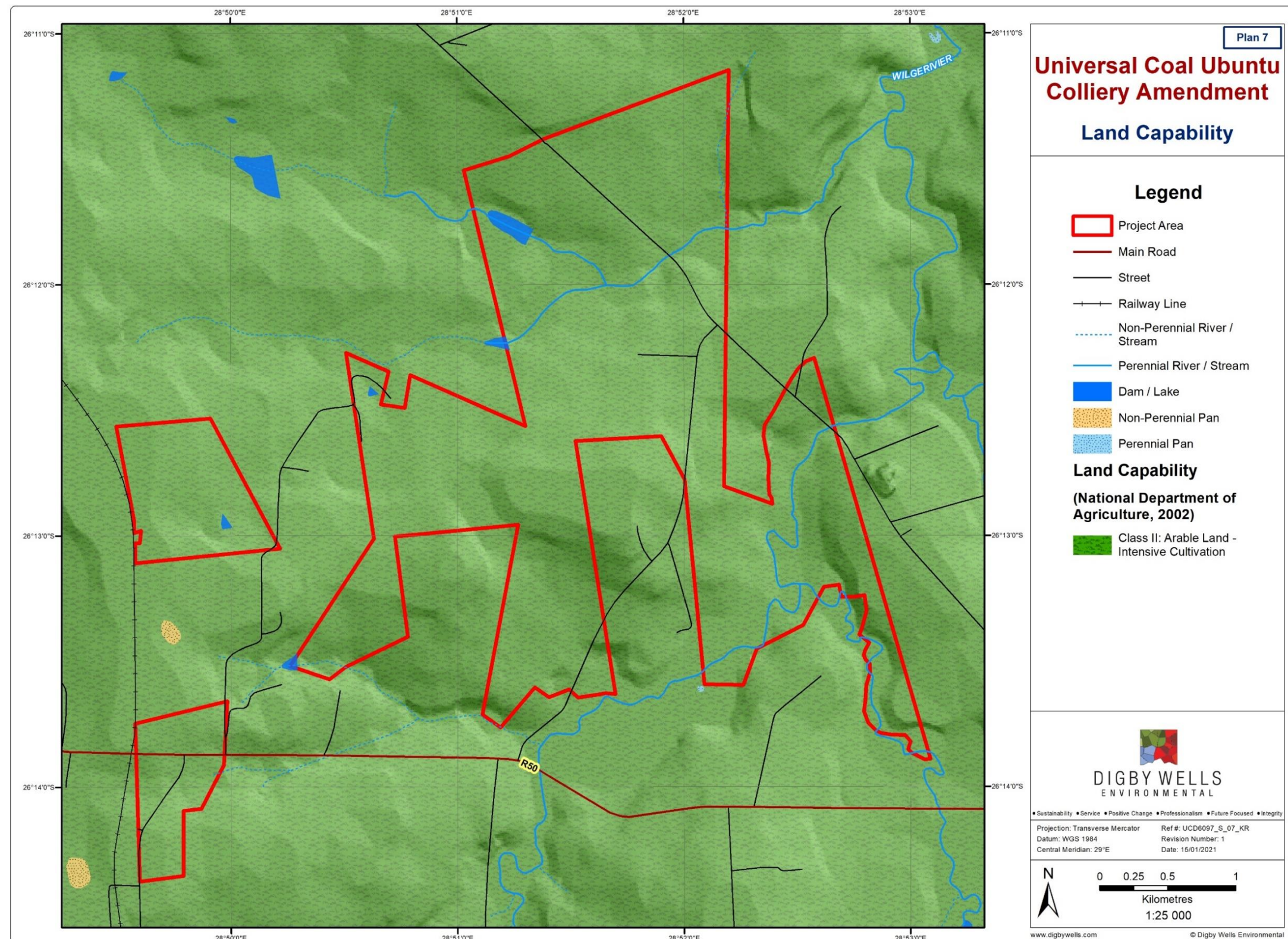


Figure 7-6: Land Capability of Ubuntu Colliery

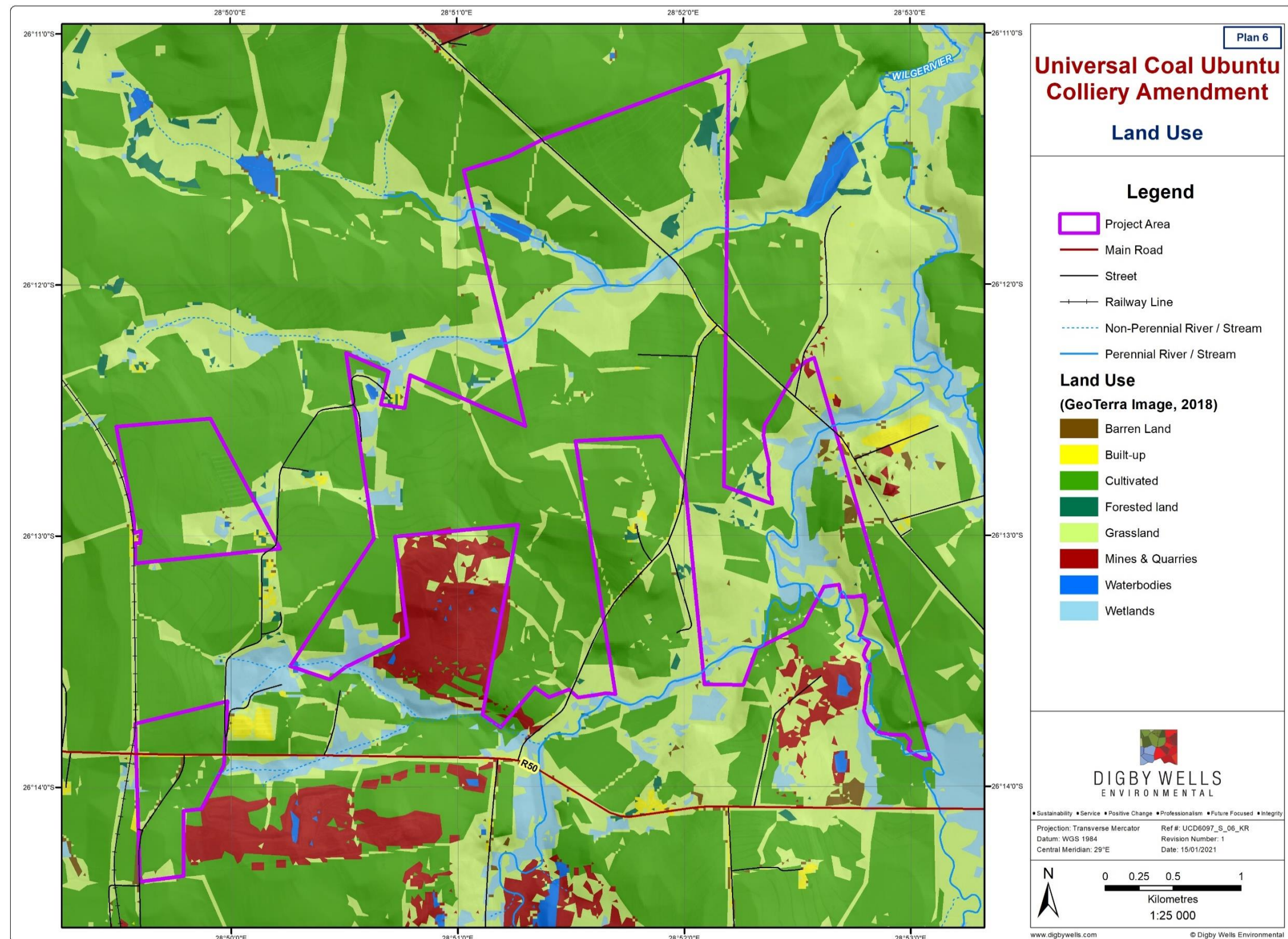


Figure 7-7: Land Use Map of Ubuntu Colliery

7.2 Soil Classification

The soil forms within the Ubuntu Project Area are described in the subsections below together with photos taken during the site visit. Avalon, Pinedene, Clovelly, Glencoe, and Hutton soil forms dominate the Project Area.

Soil forms are conceptual generalizations based on specific soil properties. Each soil form is made up of soil horizons, uniquely combined, and integrated. The typical augured soil horizons were identified as Orthic A-horizons, overlying Yellow-brown to Red Apedal B-horizons with a Plinthic B-horizon. The soils were very sandy, deep fertile soils, and are generally used for commercial agriculture, including dryland as well as irrigation agriculture.

Large areas of the Project Area are being used for commercial dryland cultivation, indicating the high agricultural potential of the soils. These deep, sandy soils are generally easily manageable and decent agricultural soils. Low-lying areas within the Project Area showed increased clay content and soil wetness. These soils were identified as wetland soils and are saturated for long periods with a fluctuating water table. The land use in these areas were generally wetlands and used for cattle grazing and perennial grasslands. These soils are somewhat limited for cultivation and highly mobile (high erosion probability).

Avalon, Pinedene, Hutton, and Clovelly soils are typically deep soils, dominated by a red to Yellow-brown apedal (non-structure), sandy B-horizons with a clayey underlying material such as Soft-Plinthic. The clayey horizon increases the water holding capacity, organic material, and Cation Exchange Capacity (CEC) of the soil therefore increasing the agricultural potential. Glencoe soils consist of sandy yellow-brown B-horizons indicating interflow soils, high drainage and high leaching potential and often low in soil organic material.

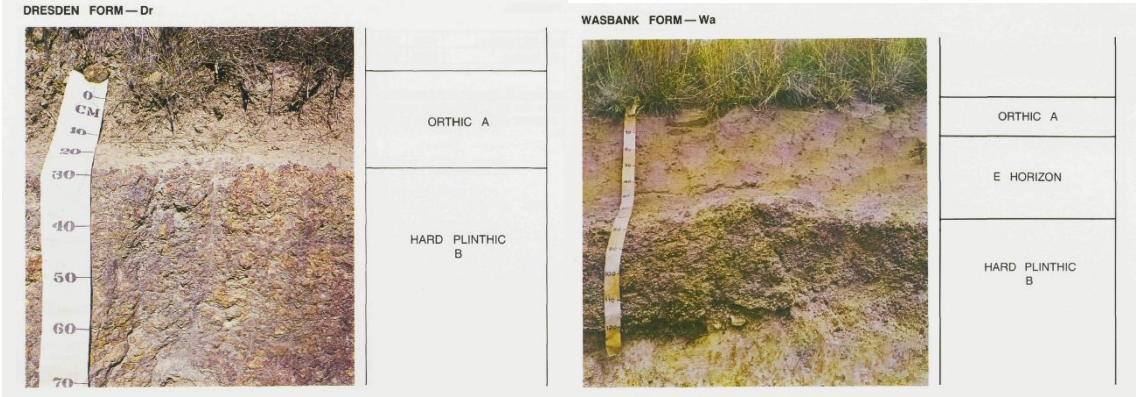
Table 7-3: Soil Forms, Capability, and Potential

Soil Form	Average Soil Depth (mm)	Land Capability Class	Land Use Potential
Hutton	>1 200	II	Cultivation
Clovelly	>1 200	II	Cultivation
Glencoe	400	II	Grazing
Avalon	>1 200	II	Cultivation
Pinedene	>1 200	II	Cultivation/Grazing/Wetland
Dresden/Wasbank	80	IV / VI	Grazing

7.2.1.1 Dresden/Wasbank

Soil Sequence	Orthic A-horizon	(E-horizon)	Hard Plinthic B
Master Horizons	A	(B)	B
Average Depth	0 – 20 mm	(20 – 40 mm)	>40 mm
Horizon Description	Shallow, light brown topsoil with few roots, sandy-loam, few roots, and abrupt transition towards B horizon. Iron and Manganese peds on the surface. Eroded.	(Light yellow to bleached (grey), coarse sandy soil, single grain, loose, many matrix pores, few roots, sandy-loam, gradual smooth transition.)	Hardened zone of accumulated iron and manganese oxides. Virtually no roots and water movement. Forms a restricted layer for hand-auger and agriculture.

Typical Dresden/Wasbank Soil Profile (Soil Classification Working Group, 1991)



Site Specific Soil Description

Dresden soils typically consist of a shallow Orthic A horizon overlying a hard plinthic layer. These soils are limiting for agriculture production due to shallow soils and restricted water and air movement. The plinthic horizon consists of the accumulation of iron and manganese oxides with a strong developed structure. These horizons cannot be augured.

Wasbank soils have the same characteristics as the Dresden soil form, however, if the E-horizon is deeper than 350 mm the soil form will be classified as a Wasbank.

Site Specific Dresden/Wasbank Soil Form (Field Survey Photos, July 2020)



Wasbank soil form. Orthic A-horizon overlying an E-horizon overlying a Hard Plinthic B

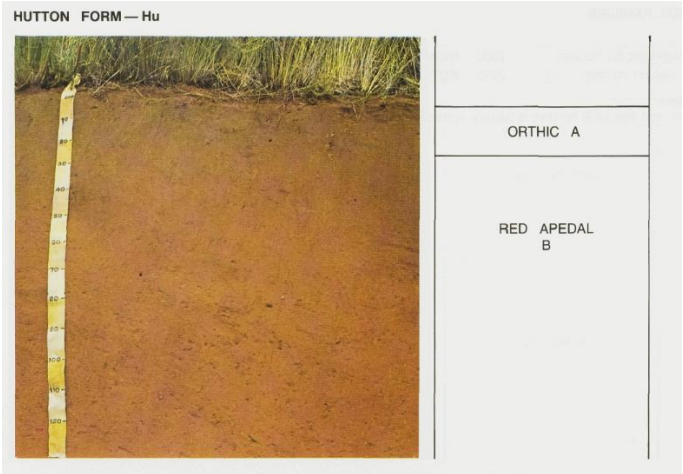


E-horizon has a weak structure overlying a low permeable layer with Fe-and Mn-oxides

7.2.1.2 Hutton

Soil Sequence	Orthic A-horizon	Red Apedal B-horizon	Red Apedal B-horizon
Master Horizons	A	B	B
Average Depth	0 – 150 mm	150 – 1200 mm	1200 mm +
Horizon Description	Dark reddish-brown, medium sandy loam, structureless massive, loose, many matrix pores, many roots, gradual smooth transition.	Red, coarse sandy loam, structureless, massive loose, many matrix pores, common roots, gradual transition.	Red (moist), coarse sandy loam, structureless, massive, friable, many matrix pores, few roots, gradual transition.

Typical Hutton Soil Profile (Soil Classification Working Group, 1991)



Site Specific Soil Description

Hutton soil forms are usually deep, uniformly red, sandy (apedal) soils that are well-drained, and has low organic carbon content, and cation exchange capacity (CEC) due to the low clay content. These soils developed from basic parent material (example basalt), and are in an advanced state of weathering, and leaching is indicative.

Site Specific Hutton Soil Form (Field Survey Photos, July 2020)



Hutton soil form. Orthic A-horizon overlying a Red Apedal B-horizon (>1.2 m).

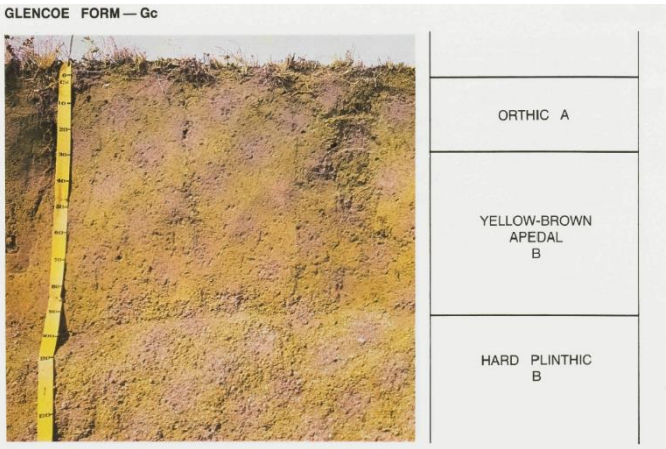


Dark, reddish-brown, loamy-sand soil, structureless with high drainage potential.

7.2.1.3 Glencoe

Soil Sequence	Orthic A-horizon	Yellow-brown Apedal B-horizon	Hard Plinthic B
Master Horizons	A	B	B
Average Depth	0 – 150 mm	150 – 600 mm	600 mm +
Horizon Description	Brown, coarse sandy, single grain, loose, many matrix pores, common roots, gradual smooth transition.	Reddish-brown, coarse sand single grain, loose, many matrix pores, common roots, gradual smooth transition.	Dark red with mottles (wet), clayey fine grain, few matrix pores, few roots.

Typical Glencoe Soil Profile (Soil Classification Working Group, 1991)



Site Specific Soil Description

Glencoe soil forms within the Project Area were predominantly shallow and had a restricting layer in some areas at 600 mm. These soils comprise of a Yellow-brown Apedal B-horizon overlying a Hard Plinthic layer containing an accumulation of iron-, and manganese oxides. These soils together with its high clay content and restricted rooting depth prevent free drainage and lower the agricultural potential of the soils.

Site Specific Glencoe Soil Form (Field Survey Photos, July 2020)



Glencoe soil form. Orthic A-horizon overlying a Yellow-brown Apedal B-horizon overlying a Hard Plinthic B.

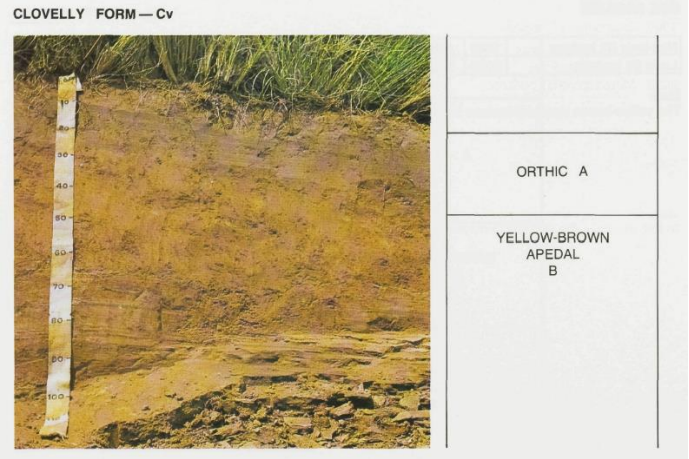


Weak structure overlying a low permeable Hard Plinthic layer with Fe-and Mn-oxides.

7.2.1.4 Clovelly

Soil Sequence	Orthic A-horizon	Yellow-brown Apedal B-horizon	Yellow-brown Apedal B-horizon
Master Horizons	A	B	B
Average Depth	0 – 150 mm	150 – 1200 mm	1200 mm +
Horizon Description	Brown, coarse sandy, single grain, loose, many matrix pores, common roots, gradual smooth transition.	Reddish yellow, coarse sand single grain, loose, many matrix pores, common roots, gradual smooth transition.	Reddish yellow, fine sand, single grain, loose, many matrix pores, few roots

Typical Clovelly Soil Profile (Soil Classification Working Group, 1991)



Site Specific Soil Description

Clovelly soil forms are frequently confused with Hutton soil forms as they share the same characteristics. Clovelly soil forms have a Yellow-brown Apedal B-horizon, whereas Hutton soil has a Red-apedal B-horizon. Both these soil forms have deep, sandy, well-drained characteristics. Yellow-brown Apedal B-horizons are formed from leached Red Apedal B-horizons. Yellow- Brown Apedal B-horizons are thus usually in lower-lying areas, more wet, has higher drainage than that of the red soils and are poorer in nutrients.

Site Specific Clovelly Soil Form (Field Survey Photos, July 2020)



Clovelly soil form. Orthic A-horizon overlying a Yellow-brown Apedal B-horizon (>1.2 m).

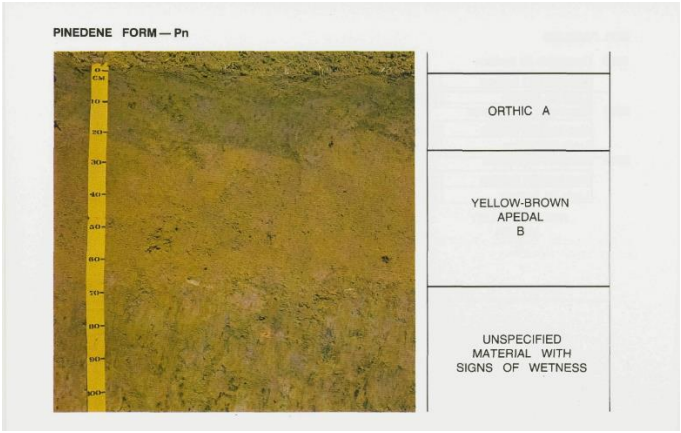


Greyish-brown, sandy-loam, structureless soil with high drainage potential.

7.2.1.5 Pinedene

Soil Sequence	Orthic A-horizon	Yellow-brown Apedal B-horizon	Unspecified material with signs of wetness
Master Horizons	A	B	B
Average Depth	0 – 150 mm	150 – 500 mm	>1 200 mm
Horizon Description	Light yellow-brown, coarse sandy-clay-loam, single grain, loose, many matrix pores, high root volume, sandy-loam texture, and gradual smooth transition towards B-horizon.	Light brown to yellow coarse sand single grain, loose, many matrix pores, few roots, sandy-clay-loam, gradual smooth transition to unspecified material.	Light grey-brown with mottles (wet), sandy-clay-loam, macro matrix pores, few roots.

Typical Pinedene Soil Profile (Soil Classification Working Group, 1991)



Site Specific Soil Description

These soils are generally fairly deep (70 – 120 centimetre (cm)) and have a loamy-sand texture with up to 8% clay content. The soils are yellow-brown with minor drainage limitations in the upper horizons, however, usually contains very high clayey underlying material, limiting free drainage. Due to these high clay sub-horizons, drainage is limited causing waterlogging and potential for wetland formation. These soils are associated with wetlands within the Project Area.

Site Specific Pinedene Soil Form (Field Survey Photos, July 2020)



Pinedene soil form. Orthic A-horizon overlying a Yellow-brown Apedal overlying Unspecified material with signs of wetness. Wetland Soil.

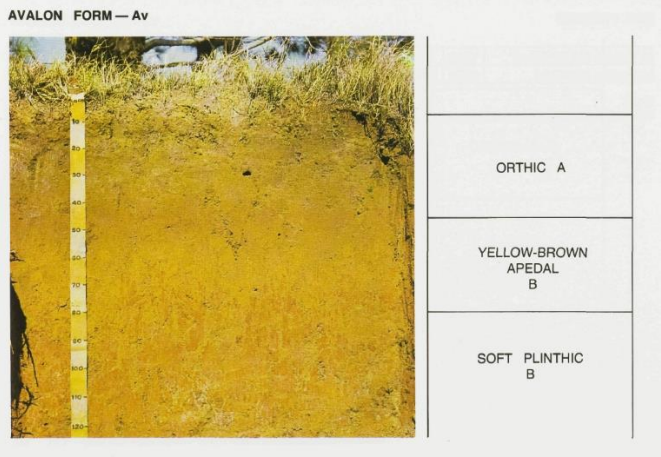


Weak B-horizon structure overlying a low permeable layer with Fe- and Mn-oxides and signs of wetness (mottles).

7.2.1.6 Avalon

Soil Sequence	Orthic A-horizon	Yellow-brown Apedal B-horizon	Soft Plinthic B
Master Horizons	A	B	B
Average Depth	0 – 200 mm	200 – 600 mm	>1 200 mm
Horizon Description	Light yellow-brown, coarse sandy, single grain, loose, many matrix pores, few roots, sandy-loam texture, and gradual smooth transition towards B1 horizon.	Reddish yellow, coarse sand single grain, loose, sandy-loam, many matrix pores, common roots, gradual smooth transition, interflow soils.	Accumulation and concretions of Fe and Mn oxides, loose crumbling structure, sandy-clay-loam, macro matrix pores, few roots.

Typical Avalon Soil Profile (Soil Classification Working Group, 1991)



Site Specific Soil Description

Avalon soils are free draining and chemically active. Manganese and iron oxides accumulate under conditions of a fluctuating water table forming localised mottles or soft iron concretions of the soft plinthic B horizon. The Avalon soils within the Project Area are associated with wetlands and are dominant in the low-lying areas and valley bottoms.

Site Specific Avalon Soil Form (Field Survey Photos, July 2020)



Avalon soil form. Orthic A-horizon overlying a Yellow-brown Apedal overlying a Soft Plinthic B horizon. Wetland Soil.



Soft Plinthic B horizon has a weak structure, however high in clay causing low permeability, water logging and wetland formation.

7.3 Soil Chemical and Physical Characteristics

The results of the soil analysis for six (6) representative samples taken during the July 2020 survey are presented in Table 7-5. Previous soil results from the Soil Assessment completed by Digby Wells in 2012 are also included in the table for comparison (Digby Wells Environmental, 2012a). As a basis for interpreting the data, Soil Screening Values (SSV) and local soil fertility guidelines are presented in Table 7-5, together with the pH guidelines. The results in yellow indicates levels below the SSV and the results in red indicates levels above the SSV. The pH scale with its colours is shown in Table 7-4 below.

Table 7-4 Soil Fertility Guidelines

Guidelines (mg per kg)			Source		
Macro Nutrient	Low	High			
Aluminium (Al)	<10	>50	Australian Guidelines, (Department of Agriculture and Rural Affairs, 1986)		
Boron (B)	<0.5	>1.5	USA Guidelines, (Allison, et al., 1954)		
Calcium (Ca)	<200	>3000	South Africa Guidelines, (NEM:WA 2008)		
Chlorides (Cl)	-	>12000	South Africa Guidelines, (NEM:WA 2008)		
Copper (Cu)	<36.0	>190	Dutch Guidelines, (Dutch VROM, 2000)		
Magnesium (Mg)	<50	>300	South Africa Guidelines, (NEM:WA 2008)		
Manganese (Mn)	-	>740	South Africa Guidelines, (NEM:WA 2008)		
Molybdenum (Mo)	<3.0	>200	Dutch Guidelines, (Dutch VROM, 2000)		
Nickel (Ni)	-	>45	Canadian Guidelines, (CCME, 2007)		
Organic Carbon (OC)	< 2 %	>3 %	South Africa Guidelines, (du Preez, Mkeni, & van Huyssteen, 2010)		
Phosphorus (P)	<5	>35	South Africa Guidelines, (NEM:WA 2008)		
Potassium (K)	<40	>250	South Africa Guidelines, (NEM:WA 2008)		
Sodium (Na)	<50	>200	South Africa Guidelines, (NEM:WA 2008)		
Zinc (Zn)	<140	>720	Dutch Guidelines, (Dutch VROM, 2000)		
Cation Exchange Capacity (CEC)	5%	25%	Australian Guidelines, (Department of Agriculture and Rural Affairs, 1986)		
pH					
Very Acid	Acid	Slightly Acid	Neutral	Slightly Alkaline	Alkaline
<4	4.1-5.9	6-6.7	6.8-7.2	7.3-8	>8

Table 7-5: Soil Physico-Chemical Properties

Sample ID	pH (H ₂ O)	Organic Carbon	CEC	P (Bray1 2012; Bray 2 2020)	K	Na	Ca	Mg	S	B	Mn	Fe	Cu	Cl	Al	Mo	Zn	Ni DTPA	Sand	Silt	Clay
		%	Cmol _c /kg	mg/kg															%		
2012 Results																					
1 TOP	6.7	0.85	8.3	21.1	97	0.64	140	40	-	-	-	-	-	-	-	-	-	-	74	6	20
2 SUB	7			6.2	52	12.4	165	64	-	-	-	-	-	-	-	-	-	-			
3 TOP	7.22	0.51	3.98	11.3	82	0.61	219	35	-	-	-	-	-	-	-	-	-	-	80	4	16
4 SUB	6.49			5.6	46	0.33	63	28	-	-	-	-	-	-	-	-	-	-			
5 TOP	6.03	0.84	4.97	6.7	122	0.38	89	24	-	-	-	-	-	-	-	-	-	-	72	4	24
6 SUB	6.39			2.3	55	0.34	105	28	-	-	-	-	-	-	-	-	-	-			
7 TOP	5.9	1.6	9.32	3.6	310	0.42	168	47	-	-	-	-	-	-	-	-	-	-	58	8	34
8 SUB	6.68			2.1	91	0.33	161	75	-	-	-	-	-	-	-	-	-	-			
9 TOP	5.53	0.85	4.43	18.3	90	0.21	77	13	-	-	-	-	-	-	-	-	-	-	70	6	24
10 SUB	5.88			3.2	32	0.16	75	12	-	-	-	-	-	-	-	-	-	-			
11 TOP	6.3	2.46	27.96	4.7	446	83.2	714	490	-	-	-	-	-	-	-	-	-	-	42	16	42
12 SUB	6.88			3.2	256	172.5	980	682	-	-	-	-	-	-	-	-	-	-			
13 TOP	6.4	1.74	10.26	14.3	406	26.9	349	116	-	-	-	-	-	-	-	-	-	-	56	10	34
14 SUB	6.64			4.8	167	15.4	191	63	-	-	-	-	-	-	-	-	-	-			
15 TOP	6.47	0.59	5.58	6.9	69	0.69	98	40	-	-	-	-	-	-	-	-	-	-	76	4	20
16 SUB	6.93			4.1	56	0.11	198	73	-	-	-	-	-	-	-	-	-	-			
17 TOP	6.41	0.88	7.53	5.5	60	11.7	145	71	-	-	-	-	-	-	-	-	-	-	58	10	32
17 SUB	6.2			3.2	33	0.42	100	39	-	-	-	-	-	-	-	-	-	-			
2020 Results																					
S1	5.34	0.29	3.14	2	15	33	313	209	5.74	0.21	4.77	236.93	4.81	25.6	565	28.24	0.59	0.47	73	12	15
S2	6.25	0.64	4.27	17	174	13	1 153	253	9.3	0.44	183.93	41.04	6.46	13.6	809	132.66	4.47	0.36	59	14	27
S3	5.46	0.46	3.59	23	151	12	511	120	5.74	0.25	39.45	54.48	1.65	14.69	430	80.07	3.22	0.34	69	12	19
S4	5.92	0.38	3.32	70	305	11	624	142	9.78	0.33	67.96	98.67	2.19	14.49	498	106.67	13.75	0.26	76	11	13
S5	5.67	0.45	4.29	23	141	11	603	142	6.61	0.26	40.67	34.27	2.07	8.14	495	79.13	3.17	0.33	66	13	21
S6	-	0.58	4.68	4	112	29	870	198	13.87	0.28	38.14	61.18	2.54	11.2	466	51.38	1.45	0.74	58	29	13

7.3.1 Soil pH

Guidance Note:

The measurement of soil acidity is referred to as soil pH. The soil pH is determined in the supernatant liquid of an aqueous suspension of soil after having allowed the sand fraction to settle out of suspension. Soil pH influences soil chemical, physical and biological properties.

The interaction between soil particles, soil solution and dissolved ions have an important role in holding cations such as calcium (Ca^{+2}), magnesium (Mg^{+2}), potassium (K^{+}) and ammonium (NH_4^{+}) in the soil. The cations are important plant nutrients that are taken up by plants from the soil solution. When the concentration of the solution is out of proportion it will directly impact the biology of the soil as well as the growth of the vegetation. When the concentration is increased, by means of adding lime and fertilizers, the nutrient will first be absorbed by the soil particles until dissolved and released into the soil solution for plant availability. When the holding capacity of the soil particles are low (sandy soil), the nutrient will just leach out of the profile, inherently known as infertile soils whereas clayey soils have a much higher holding capacity for nutrients and thus are more fertile (Neina, 2019).

In addition to the cations in the soil are acid ions. The acid ions include hydrogen protons (H^{+}) and aluminium ions (Al^{+3} and $\text{Al}(\text{OH})^{+2}$) which causes an acidic reaction and therefore lowers the pH of the soil solution (Farina & Channon, 1991).

Lime fertilizers used to increase soil pH depend on various factors, such as type of soil, CEC, clay content, crop production, infiltration rate and acidity of the soil (pH). Al^{+3} , Mn and Fe become more soluble with increased pH and may become toxic to plants at pH above 5.5, however many varieties of crops prefer higher pH soils. Low pH soils usually have low plant available P due to P tying up with Al and Fe to form insoluble compounds which is not plant available.

Low soil pH depresses soil bacteria and fungi used to convert unavailable nutrients (N, P and S) to plant available forms. The higher the amount of clay and organic material in soil, the greater the buffer capacity and the more lime will be required to increase the soil pH.

7.3.1.1 2012 Results

The topsoil pH is in the order of **5.5 to 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.

7.3.1.2 2020 Results

The pH of the soil samples collected ranged from **5.34 to 6.25**, indicating that the soils are acidic to slightly acidic. The optimal pH for agricultural crops range between 5.5 and 7.5. However, some crops have adapted to thrive outside the optimal range. Most of the soil samples are therefore within the optimal pH range, however liming would be required where Sample 1 was taken to increase the pH. Due to the sandy nature of the soils, high crop production and high rainfall in the vicinity of the Project Area, the pH tends to decrease over time and therefore would require a liming and fertilizer programme to optimize crop production.

7.3.2 Heavy Metals and Micronutrients

Guidance Note:

Heavy metal contamination is a serious form of inorganic pollution which has a long-term negative effect on the natural environment. These heavy metals include Aluminium (Al), Copper (Cu), Zinc (Zn), Boron (B), Fluorine (F), Manganese (Mn) and Nickel (Ni). To a greater or lesser extent, these elements are toxic to living organisms. **B, Cu, Zn** and **Mn** are relatively lower in toxicity to living organisms.

7.3.2.1 2012 Results

The 2012 soil analysis did not include heavy metal and micronutrient analysis as the Project Area was Greenfields and no soil pollution were expected.

7.3.2.2 2020 Results

The 2020 soil analysis did include heavy metals and micronutrients as mining activities have commenced within the proximity of the Project Area.

The heavy metal and micronutrient concentrations for the soil samples are presented in Table 7-5 above. All six samples indicated **B, Cu** and **Zn** to be below the standard SSVs, whereas **Al** in all six samples were above the SSVs. **Mn, Fe, Cl** and **Mo** were within the SSVs.

The **B, Cu** and **Zn** are trace elements and plants absorb minor amounts into their tissues. When these trace elements are found in high concentrations it could be highly toxic to plant and animal uptake. Shortages of these elements could however cause various plant growth deficiencies as well as influence the activity of microorganisms, breakdown of organic material and earthworms (Brady & Weil, 2013). However, most common fertilizers contain some of these elements and are therefore not recommended to apply in separate quantities.

The **Al** concentrations in all six soil samples exceeded the SSVs. However, the soil samples were taken outside mining areas and could therefore be a natural occurrence in the soil. **Al** toxicity in soils is most found in acidic soils (low pH) causing growth deficiencies and plant reduction. At higher pH concentrations, Al becomes soluble and unavailable to plants, however, when the pH drops below 5.5, **Al** is highly soluble and increases rapidly to toxic concentrations. **Al** toxicity inhibits the uptake of **Ca** and **Mg** as well as reducing the solubility of **P**. **P** deficiency in plants is often associated with toxic **Al** concentrations.

7.3.3 Exchangeable Cations

Guidance Note:

The higher the CEC value (>25) the higher the clay and/or organic material (OM) in the soil. Soils with a high clay and/ or OM content, with a high CEC will have high cation concentrations. Cations are adsorbed by the negatively charged clay and OM particles. Soils with a low CEC (<5) is usually an indication of sandy soils with low soil fertility and OM.

The levels of the basic cations (**Ca**, **Mg**, **K** and **Na**) are determined in soil samples for agronomic purposes through extraction with an ammonium acetate solution. In general, the amounts of exchangeable cations normally follow the same trend as outlined for soil pH and texture. For most soils, cations follow the typical trend **Ca>Mg>K>Na**, **Ca** being the most reactive and **Na** less reactive.

In soil, dispersion and flocculation of soil particles are a chemical phenomenon which is driven by the balance of the exchangeable cations. Excess **Na** and **K** causes dispersion (soil is broken down in very fine particles which is particularly sensitive to erosion), whereas high levels of **Ca** would rather cause flocculation (soil particles adhere to each other to form clusters/flakes or clumps). Dispersion and flocculation have several impacts on soil development and responses which in return affects root development and plant growth (Chibowski, 2011).

7.3.3.1 2012 Results

The soils in this area are considered to have a low CEC. A low CEC reflects low soil clay and organic matter content, because CEC is a property of both clay and organic material. The CEC generally ranges from 4 to 9.3 Cmol/kg in the topsoil. Low CEC implies low nutrient content while the opposite is true for high CEC. The Sepane soil form (11 TOP and 12 SUB) with a higher clay content has a CEC of 28 Cmol/kg indicating the influence of higher clay content in the topsoil.

7.3.3.2 2020 Results

The CEC values ranged from **3.14 to 4.68**. The values of all six samples were below 5, indicating sandy, low OM and low clay content soils. These soils usually have low cations, have a low fertility and are highly leachable.

The concentrations of cations in the soil samples varied extensively. **K** in Sample 1 were below the SSVs, whereas the **K** in Sample 4 exceeded the SSV. **Na** in all six samples were below the recommended SSV, whereas **Ca** and **Mg** were within the SSVs.

7.3.4 Phosphorus

Guidance Note:

Phosphorus (**P**) is required in plants for root development and promote plant sugars for more efficient ripening of fruits and promote larger flowers. Soil pH and depth are just as important to note as **P** is immobile in soil and will be higher at a depth where there is a free flow of water.

P deficiencies in soil causes low crop production, thin and weak stems of plants, stunted growth, and shorter, dark leaves.

Excessive levels of phosphorus in a growth medium are not particularly harmful to plant health, however, may impede the uptake of **Zn** and Iron (**Fe**) even when there are adequate amounts of these nutrients in the material. Excessive levels of **P** are not easily remedied and takes a long time to lower. It is therefore important to avoid fertilisers containing phosphorus, such as NPK and cattle manure as fertiliser.

7.3.4.1 2012 Results

P status, as contained in Table 7-5 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 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 Hutton (5 TOP and 6 SUB), Clovelly (1 TOP and 2 SUB) and Oakleaf (13 TOP and 13 SUB) but the **P** status should ideally be at 20-30 mg/kg.

7.3.4.2 2020 Results

The **P** concentrations varied in all six samples. Sample 1 and Sample 6 indicated **P** being below the SSVs, whereas Sample 4 indicated concentrations above the SSV. Samples 2, 3 and 5 were within the SSVs. This indicated that **P** was recently applied to the soils at Sample 4, whereas Sample 1 and Sample 4 requires P fertilisers. Compared to the previous results, the **P** concentrations increased in some areas of the Project Area, indicating **P** fertilizers were applied recently.

7.3.5 Organic Carbon

Guidance Note:

Soil Organic Carbon (OC) indicates organic material content in the soil, therefore soil fertility. OC releases nutrients to plants, promotes root development, soil structure, soil health and increases the buffer of the soil against harmful elements. The higher the level of OC, the higher the OM and thus the more fertile the soil. Levels above 2 - 3% OC are considered moderate to high for soils in South Africa according to du Preez et al., (2010)

7.3.5.1 2012 Results

The OC measurements indicated concentrations ranging from **0.59** to **2.46 %**. The majority of the samples were below 2 % indicating low OC and therefore low soil fertility. One of the samples (Sample 11 TOP) had high OC content indicating a higher percentage of OM in the soil and higher fertility.

7.3.5.2 2020 Results

The OC of all the samples taken during 2020 were below **2 %**. The samples ranged from **0.29** to **0.64 %**. The results indicate that the soils are low in carbon, OM and low fertility. This can be attributed to the sandy nature of the soils that promote leaching of nutrients and organic material.

7.3.6 Soil Texture

Guidance Note:

The particle size distribution of the soil sampled in the Project Area was classed into the percentages of sand, silt and clay present. The textural classes were obtained from plotting the three fractions on a textural triangle (Figure 16-1). 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.

Soil water retention characteristics are strongly affected by soil texture. A higher clay content results in greater water retention. Similarly, the higher the sand fraction, the less water is retained by the soil (Gebregiorgis, 2003). Soil macropores allow a greater volume of water to drain more rapidly than would be expected from a soil that is dominated by clay fractions. Generally, the ideal pore space is between 40-60% (NRCS-USDA, 2013).

The bulk density of soil is dependent on the sand-clay-silt ration. The higher the clay content the higher the bulk density. Bulk density represents the mass of dry soil (mass of solids) per unit volume of soil (White, 2003). A low bulk density implies a favourable soil structure for root penetration as it is not compacted (Karuku, et al., 2012). Generally, soils with bulk densities greater than 1.6 g/cm³ are considered as compacted soils (Twum & Nii-Annang, 2015).

7.3.6.1 2012 Results

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 (3 TOP and 4 SUB) are classified as sandy clay loam. The dominant Clovelly (1 TOP and 2 SUB), Pinedene (7 TOP and 8 SUB) and Constantia yellow soils in the area are classified as sandy to loamy sand soils.

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. The particle size distribution of the 2020 results are indicated in Table 7-6 and Figure 7-8 in red.

Table 7-6: Texture Classification of 2012 Samples

Sample Number	Texture Classification
1 TOP	Sandy Clay Loam
3 TOP	Sandy Loam
5 TOP	Sandy Clay Loam
7 TOP	Sandy Clay Loam
9 TOP	Sandy Clay Loam
11 TOP	Clay
13 TOP	Sandy Clay Loam
15 TOP	Sandy Clay Loam
17 TOP	Sandy Clay Loam

7.3.6.2 2020 Results

The clay content ranged from **13 – 27 %** in the topsoil. The soils are generally classed as Sandy-loam soils, typically used for cultivation. Sandy-loam soils are easily manageable therefore widely used in commercial cultivation. However, these soils generally have low fertility due to the high drainage and leaching potential. The particle size distribution of the 2020 results is indicated in Table 7-7 and Figure 7-8 in green.

There is a small structural difference within the 2012 and 2020 results. This can be attributed to the different sampling areas. The 2012 samples were taken in areas with higher clay content, whereas the 2020 samples had higher sand concentrations.

Table 7-7: Texture Classification of 2020 Samples

Sample Number	Texture Classification
S1	Sandy Loam
S2	Sandy Clay Loam
S3	Sandy Loam
S4	Sandy Loam
S5	Sandy Clay Loam
S6	Sandy Loam

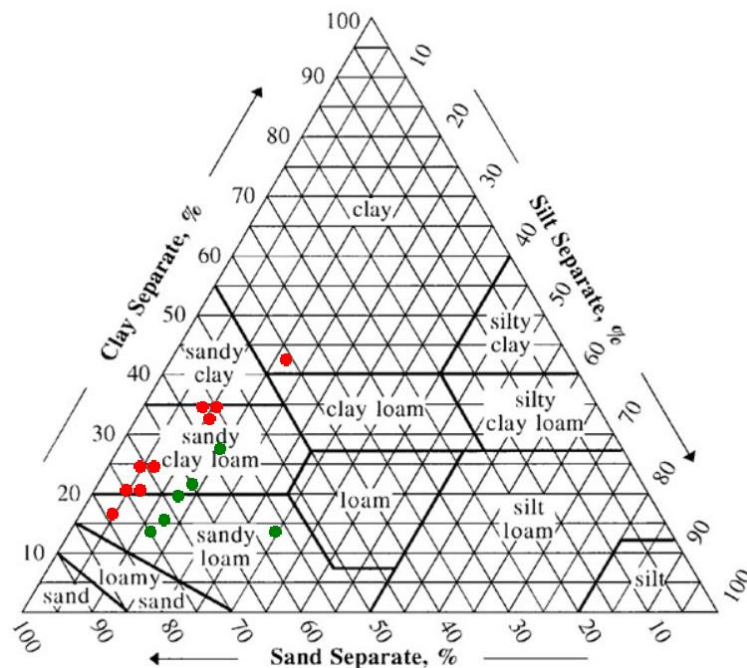


Figure 7-8 Texture Diagram Results (2012 in Red; 2020 in Green)

8 Soil Impact Assessment

The Soil, Land Use and Land Capability impacts were assessed for the three phases of the Project life, including the construction, operational and Decommissioning Phases. The impacts were assessed based on the impact's magnitude as well as the receiver's sensitivity, concluding in an impact significance rating which identifies the most important impacts that require management.

The impacts identified in this section are a result of both the environment in which the proposed Project activities will take place, as well as the actual activities. The impacts that could affect the soil and land capability are:

- Loss of the soil resource due to change in land use and removal of the soil. The construction of these facilities will change land utilization potential (land capability) resulting in the complete loss of the soils resource for the life of the activity;
- Loss of the soil resource due to wind and water erosion of unprotected soils;
- Change in soil characteristics (soil texture, structure, organic content, fertility) due to compaction of areas during construction;
- Contamination of the soil resource due to hydrocarbons spillages; and
- Loss of the soil resource due to the disturbance and clearing of vegetation.

8.1 Construction Phase

Activities during the Construction Phase that may have potential impacts on the soil, land use and land capability are described in Table 8-1 below.

Table 8-1: Construction Phase Interactions and Impacts of Activity

Interaction 1	Impact
Surface preparation for infrastructure	<ul style="list-style-type: none"> • Compaction of soil and therefore increased surface runoff; • Increased wind, and water erosion on unprotected soils and consequently sedimentation as these soils is highly erodible; • Removal of vegetation and basal cover, increasing the potential loss of topsoil, organic material and decreased soil fertility; • Compaction, ponding, and changes to the natural hydrological functioning of the landscape; • Loss of usable soil as a resource for agriculture – disturbance, low fertility, erosion and compaction; and • Loss of Land Capability and agricultural land due to complete restrictions to cattle grazing (current land use). Reduced area for cattle grazing.
Description	
<p>During the construction phase, site clearing is necessary for the preparation of surface infrastructure where vegetation will be removed along with topsoil. When soil is removed, the physical and chemical properties are changed, and the soils will deteriorate unless properly managed. When the organic material is removed, either by the clearing of an area for development of infrastructure or by erosion; the soil fertility status is reduced and may result in soil acidification. Vehicles will drive on the soil surface during the construction phase, thereby potentially causing compaction of the soils, and loss of basal cover. This reduces infiltration rates, and the ability for plant roots to penetrate the compacted soil. The soil may be exposed to erosion where vegetation has been removed during the construction phase. The loss of vegetation cover will aggravate runoff potential that may lead to increased erosion as well as the loss of organic material. Once the soil is eroded it reduces the overall soil depth, soil fertility rate, and as a result the land capability.</p> <p>If the topsoil and subsoil are excavated and stockpiled as one unit, the topsoil's seed bank and natural fertility balance is diluted. This will affect the regrowth of vegetation. Soils should therefore be handled with care from the construction phase through to the decommissioning phase. When usable soil is disturbed, compacted, or eroded, the soil profile is compromised and its ability to function as a growth medium is restricted.</p> <p>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 Ubuntu Colliery 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.</p> <p>The potential for contamination of soil resources exists during site preparation and construction because 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.</p>	
Interaction 2	Impact

Interaction 1	Impact
Construction of surface infrastructure	<ul style="list-style-type: none"> • Complete removal of the soil and change in land capability during the construction of the open-cast pit; • Soil contamination; • Migration of contaminants into groundwater and contaminate freshwater systems; and • Loss of land use and land capability (agricultural potential).
Description	
<p>Due to the sandy nature of the soils in the OC1 and OC2 areas, the infiltration rate is high, whereby any spills may lead to soil and water contamination in the lower catchment. The proposed D2546 District Road Diversion and the Canal are planned to be located within wetland systems. Due to the D2546 District Road Diversion and the Canal being in wetland systems and the mobile nature of the soils in these areas it is likely that the soils will become contaminated if any spills occur. The migration of contaminants may enter the groundwater and end up contaminating the freshwater systems and downstream soils.</p> <p>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 Ubuntu Colliery 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 Ubuntu Colliery Project footprint area from the land use change from agriculture to industrial use.</p>	

8.1.1 Management Objectives

The mitigation hierarchy includes firstly the avoidance of an impact. When it is not possible to avoid an impact, such as in the case of during the Construction Phase, the next step is or to minimize the impact and thereafter rectify or reduced the impact. When it is not possible to rectify or reduce the impact, offsets need to be implemented.

The aim during the Construction Phase is to:

- Keep the impact size to a minimal with as little changes to the natural state of the Project Area as far as possible; and
- Prevent the spillage, seepage and runoff of hydrocarbons and other hazardous materials on the soils.

The infrastructure areas need to be monitored for erosion. As soon as erosion occurs, corrective actions must be taken to limit and reduce the impact from spreading. Bare areas need to be assessed for compaction or contamination and ripped if required and reseeded. If contamination has occurred, these soils need to be remediated or removed and dumped in a licensed landfill site and replaced with good quality usable soil.

8.1.2 Impact Ratings

The Construction Phase impacts are rated in Table 8-2 below.

Table 8-2: Construction Phase Interactions and Impacts of Activity Rating

1. Activity and Interaction: Surface preparation for infrastructure			
Impacts: <ul style="list-style-type: none">• Compaction of soil and therefore increased surface runoff;• Increased wind, and water erosion on unprotected soils and consequently sedimentation as these soils is highly erodible;• Removal of vegetation and basal cover, increasing the potential loss of topsoil, organic material and decreased soil fertility;• Compaction, ponding, and changes to the natural hydrological functioning of the landscape;• Loss of usable soil as a resource for agriculture – disturbance, low fertility, erosion and compaction; and• Loss of Land Capability and agricultural land due to complete restrictions to cattle grazing (current land use). Reduced area for cattle grazing.			
Prior to Mitigation/Management			
Dimension	Rating	Motivation	Significance
Duration	Beyond project life (6)	Land use will change from agriculture to infrastructure, impacts could last beyond project life	Medium-high (negative) – 77
Extent	Local (1)	Loss of usable soil will only occur within and immediately around the Project site.	
Intensity	Medium (4)	Loss of usable soil may result in loss of land capability and land use. Soil regeneration takes a very long time.	
Probability	Certain (7)	By excavating and clearing the soil, it will certainly impact on the soil.	
Nature	Negative		
Mitigation Measures			
<ul style="list-style-type: none">• If any erosion occurs, corrective actions (erosion berms) must be taken to minimise any further erosion from taking place;• If erosion has occurred, topsoil should be sourced and replaced and shaped to reduce the recurrence of erosion;• The topsoil should be stripped by means of an excavator bucket and loaded onto dump trucks;• Plan site clearance and alteration activities for the dry season (May to October);• Restrict extent of disturbance within the Ubuntu Colliery Project Area and minimise activity within designated areas of disturbance;• Minimise the period of exposure of soil surfaces through dedicated planning;			

<ul style="list-style-type: none">• Aim to minimise (or even cease) workings on windy days; and• Soil surface can be loosened via tillage/ripping.			
Post-Mitigation			
Dimension	Rating	Motivation	Significance
Duration	Project life (5)	Loss of usable soil makes land less productive. Effects will occur during the life of the project if mitigated correctly	Minor (negative) – 45
Extent	Very Limited (1)	Loss of usable soil will only occur within and immediately around the Project infrastructure area.	
Intensity	Moderate loss (3)	Loss of usable soil may result in loss of land capability and land use.	
Probability	Likely (5)	If the mitigation is followed, then it is likely that the impacts will occur, however will be less.	
Nature	Negative		
2. Activity and Interaction: Construction of surface infrastructure.			
Impacts: <ul style="list-style-type: none">• Complete removal of the soil and change in land capability during the construction of infrastructure;• Soil contamination;• Migration of contaminants into groundwater and contaminate freshwater systems; and• Loss of land use and land capability (agricultural potential).			
Prior to Mitigation/Management			
Dimension	Rating	Motivation	Significance
Duration	Permanent (7)	The removal of soil and construction on the soils reduces the land capability from a rateable index to non-classifiable; this impact is permanent if not mitigated. Soil contamination may take place beyond the life of mine	Medium-high (negative) – 105
Extent	Local (4)	The impact can occur beyond the Project Area and infrastructure area.	
Intensity	Medium (4)	The land capability will be reduced	
Probability	Certain (7)	Soils will most definitely be impacted by contaminants from the infrastructure such as the STP, WTP, depot area, offices and stockpile area	

Nature	Negative		
Mitigation Measures			
<ul style="list-style-type: none"> • Ensure proper storm water management designs are in place; • If any erosion occurs, corrective actions (erosion berms) must be taken to minimise any further erosion from taking place; • If erosion has occurred, topsoil should be sourced and replaced and shaped to reduce the recurrence of erosion; • If any spillage occurs, clean up and remediate immediately; • 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; • Stabilise sides with vegetation and erosion berms to prevent head-cut erosion and loss of soil; and • Implement post-mitigation monitoring to ensure the well-functioning of the road diversion and canal. This should include a AIPs plan. 			
Post-Mitigation			
Dimension	Rating	Motivation	Significance
Duration	Project Life (5)	Soil contamination and destruction of land capability may take place beyond the life of mine	Minor (negative) – 36
Extent	Local (1)	The impact will only occur in the areas with infrastructure.	
Intensity	Moderate (3)	The land capability will be reduced in the areas with infrastructure, however, will be increased after decommissioning and rehabilitaiton	
Probability	Probable (4)	There is still a probability that impacts will occur even after mitigation	
Nature	Negative		

8.2 Operational Phase

Activities during the Operational Phase that may have potential impacts on the soil, land use and land capability are described in Table 8-3 below.

Table 8-3: Operational Phase Interactions and Impacts of Activity

Interaction 1	Impact
Operation and maintenance of infrastructure	<ul style="list-style-type: none"> • Soil compaction and topsoil loss leading to reduced fertility; • Soil erosion (and sediment release to land and water); • Soil contamination; and

	<ul style="list-style-type: none"> Loss of usable soil for agriculture – changing the land capability.
Description	
<p>During the operational phase, various activities may impact the soil, land use and land capability. This include changes to the natural soil physical, chemical and biological activities which therefore changes the land use and capability. Drilling, blasting, dumping of waste rock, crushing of ROM coal and the workshop CHP may cause contamination and sedimentation, changing the functionality of the soils. When the areas are not well maintained, soil contamination and erosion may occur and result in sedimentation and changes to the land uses, such as wetlands.</p> <p>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 Ubuntu Colliery Project footprint area from the land use change from agriculture to industrial use.</p>	
Interaction 2	Impact
Use and maintenance of haul roads (incl. transportation of coal to washing plant)	<ul style="list-style-type: none"> Compaction of soil and increased runoff potential; Reduced infiltration rate, reduced rooting depth (vegetation cover) and increased surface runoff; Increased erosion, and consequently sedimentation; Soil contamination from spills and leakages.
Description	
<p>Movement of vehicles creates compacted soil. Vehicles and transportation of materials have the potential for soil contamination by hydrocarbons (oils, fuels, grease) during construction, operational, and decommissioning phases. Soil contamination potentially could create large impacts on the downstream land users, such as cattle drinking water and human consumption.</p> <p>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 Ubuntu Colliery Project Area but infiltrate slow in clays imposing a risk of groundwater and contamination.</p> <p>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.</p> <p>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 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.</p> <p>Should soil be affected by an accidental spill or leak elsewhere in the Ubuntu Colliery Project Area where vehicles and machinery will be operating or where storage tanks are located, the land capability could be permanently compromised.</p>	

8.2.1 Management Objectives

The management objectives are to limit the impacts to the soil and land capability that could occur on the site.

The aim during the Operational Phase is to:

- Limit operational activities to the operational area and no areas outside of the operational area should be disturbed;
- Corrective actions must be taken as soon as erosion occurs to limit and reduce the impact from spreading;
- Bare areas need to be assessed for compaction or contamination and ripped if required and reseeded; and
- If contamination has occurred, these soils need to be removed and dumped in a licensed landfill site and replaced with good quality usable soil. Stripped soils are to be placed in the correct stockpile allocations to reduce cross contamination of soils. These soils must be monitored and maintained in a reasonably fertile state.

8.2.2 Impact Ratings

The Operational Phase impacts are rated in Table 8-4 below.

Table 8-4: Operational Phase Interactions and Impacts of Activity Rating

1. Activity and Interaction: Operation and maintenance of infrastructure			
Impacts: <ul style="list-style-type: none"> • Soil compaction and topsoil loss leading to reduced fertility; • Soil erosion (and sediment release to land and water); • Soil contamination; and • Loss of usable soil for agriculture – changing the land capability. 			
Prior to Mitigation/Management			
Dimension	Rating	Motivation	Significance
Duration	Beyond project Life (6)	Impacts could occur beyond project life, such as contamination	Moderate (negative) – 84
Extent	Local (3)	Loss of usable soil will only occur within and immediately around the Project site.	
Intensity	Serious loss (5)	Loss of usable soil may result in loss of land capability and land use. Soil regeneration takes a very long time.	
Probability	Almost certain (6)	Impact will almost certainly occur	
Nature	Negative		

Mitigation Measures

- 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;
- Soil stockpiles should be monitored for fertility via sampling and testing;
- 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 Ubuntu Colliery 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.
- If any erosion occurs, corrective actions (erosion berms) must be taken to minimise any further erosion from taking place;
- A Topsoil Management Plan (TMP) must be prepared to demonstrate how topsoil will be preserved in a condition as near as possible to its pre-mining condition to allow successful mine rehabilitation (Statham, 2014);
- Long term stockpiles should be revegetated to minimise loss of soil quality. This will minimise AIPs, maintain soil organic matter levels, maintain soil structure, and microbial activity; and
- Soil pollution monitoring should be conducted at selected locations on the project site to detect any high levels of pollutants.

Post-Mitigation

Dimension	Rating	Motivation	Significance
Duration	Project Life (5)	Impacts could occur during the project life	Minor (negative) – 40
Extent	Limited (2)	Impact will only be in specific areas, point source	
Intensity	Moderate loss (3)	Impacts may still cause moderate loss to the soils and biodiversity	
Probability	Probable (4)	There is still a probability that impacts may occur	
Nature	Negative		

2. Activity and Interaction: Use and maintenance of haul roads (incl. transportation of coal to washing plant)

Impacts:

- Compaction of soil and increased runoff potential;
- Reduced infiltration rate, reduced rooting depth (vegetation cover) and increased surface runoff;
- Increased erosion, and consequently sedimentation;
- Soil contamination from spills and leakages.

Prior to Mitigation/Management

Dimension	Rating	Motivation	Significance
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Duration	Project Life (5)	Transportation of coal will occur during the Life of mine	Moderate (negative) – 72
Extent	Local (3)	The impact will occur in the project infrastructure area and outside the Project Area such as on the national roads.	
Intensity	Serious medium-term impacts (4)	Impacts to the soils may be serious and have serious consequences to the impacted area and beyond	
Probability	Certain (6)	Vehicles will most certainly move on the soil and compact it and spills will occur	
Nature	Negative		
Mitigation Measures			
<ul style="list-style-type: none">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.Operations vehicles and equipment should be serviced regularly;Service and parking areas must be paved;Operation 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; andFuel and heavy hydrocarbon products storage on site should be secured by bunded facilities.			
Post-Mitigation			
Dimension	Rating	Motivation	Significance
Duration	Project Life (5)	Transportation of coal will occur during the Life of mine	Negligible (negative) - 27
Extent	Limited (2)	The impact will occur in the project infrastructure area or where impact, such as spillage has occurred	
Intensity	Minor loss (2)	Impacts to the soils may be minimal if managed and have low consequences to the area	
Probability	Unlikely (3)	Vehicles will most certainly move on the soil and compact it, however if managed, minimal spills will occur	
Nature	Negative		

8.3 Decommissioning Phase

Activities during the Decommissioning Phase that may have potential impacts on the soil, land use and land capability are described in Table 8-5 below.

The major impacts to consider in the decommissioning and rehabilitation of the site will be the loss of topsoil as a resource through compaction and erosion. Whilst the decommissioning and removal of the infrastructure 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.

Table 8-5: Decommissioning Phase Interactions and Impacts of Activity

Interaction 1	Impact
Demolition and removal of all infrastructure (incl. transportation off site)	<ul style="list-style-type: none"> • Soil contamination from decommissioning of infrastructure, such as the STP, WTP, depot area, offices and stockpile area; • Loss of usable soil as a resource – Erosion, sedimentation and Compaction; and • Loss of land capability.
Description	
<p>When usable soil is compacted or eroded, the soil profile loses effective rooting depth, water holding capacity and fertility. The movement of heavy machinery on the soil surface causes compaction, which reduces the vegetation's ability to grow and as a result erosion could be caused.</p> <p>The loss of usable soil as a resource is a serious impact as the natural regeneration of a few millimetres of usable soil takes hundreds of years.</p> <p>During the decommissioning, the contaminated material will have to be removed from areas such as the STP, WTP, depot area, offices and stockpile area, if it is left or not disposed of correctly, it will enter the freshwater systems (wetlands) and when removed, potential spills may occur.</p>	
Interaction 2	Impact
Rehabilitation (spreading of soil, revegetation, and profiling/contouring)	<ul style="list-style-type: none"> • Loss of usable soil as a resource – Erosion and Compaction; and • Loss of Land capability; and • Positive impact to the soil, land use and land capability.
Description	
<p>Rehabilitation activities will cover the extent of the infrastructure footprint areas and will include the ripping of the compacted soil surfaces, spreading of overburden and topsoil and establishment of vegetation. The first phase of the rehabilitation plan (demolishing of infrastructure) will have a negative effect on the soil, land use and land capability, however when rehabilitation of these areas commence, the soil, land use and land capability status will increase and have a positive effect. It would be the optimal to rehabilitate the Project Area back to Agriculture.</p>	
Interaction 3	Impact

Installation of post-closure water management infrastructure	<ul style="list-style-type: none"> • Soil compaction and topsoil loss leading to reduced fertility; • Soil erosion (and sediment release to land and water); • Soil contamination; and • Loss of usable soil for agriculture – changing the land capability.
Description	
<p>During the decommissioning phase, water management infrastructure will be installed to prevent contaminated water entering the freshwater systems. As the water management infrastructure will be permanent features, the impacts to the soil, land use and land capability will only occur during the construction of the infrastructure. However, it is advised to monitor the infrastructure for erosion, head-cut erosion, contamination, loss of soil and decreased land capability.</p>	

8.3.1 Management Objectives

The aim during the Decommissioning Phase is to:

- Rectify, reduce and rehabilitate the impacts to the soil of the Project Area;
- Rehabilitate the affected areas to near-natural conditions without resulting in additional impacts to the wetland ecology throughout the process; and
- To change the Land Capability from mining to agricultural pre-mining activities, including grazing and wildlife.

Impacts to the Project Area that cannot be rectified and reduced will lead to additional areas to be offset. Avoidance of impacts is not possible during the Decommissioning Phase, however the Decommissioning Phase will include the mitigation and monitoring of impacts which will in return have a positive consequence to the impact assessment.

The rehabilitation process needs to be monitored for erosion and soil contamination. As soon as erosion occurs corrective actions must be taken to limit and reduce the impact from spreading. Bare areas need to be assessed for compaction and ripped if required and reseeded. If contamination has occurred, these soils need to be removed and disposed of in a licensed landfill site and replaced with good quality usable soil.

After the infrastructure has been removed and rehabilitated, the areas must be assessed for compaction and possible erosion risk areas and corrected or protected immediately. Overburden should be backfilled, compacted and covered with topsoil there after reseeded to prevent loss of soil and soil fertility.

8.3.2 Impact Ratings

The Decommissioning Phase impacts described are rated in Table 8-6 below.

Table 8-6: Decommissioning Phase Interactions and Impacts of Activity Rating

1. Activity and Interaction: Demolition and removal of all infrastructure (incl. transportation off site)			
Impacts: <ul style="list-style-type: none">• Soil contamination from decommissioning of infrastructure such as the STP, WTP, depot area, offices and stockpile area;• Loss of usable soil as a resource – Erosion, sedimentation and Compaction; and• Loss of land capability.			
Prior to Mitigation/Management			
Dimension	Rating	Motivation	Significance
Duration	Long term (4)	As concurrent rehabilitation will take place, the impacts will occur through the life of the project as well as some infrastructure will remain and could impact the Project Area in the long term	Minor (negative) – 72
Extent	Local (3)	Impacts will occur within the Project Area	
Intensity	Serious loss (5)	If mismanaged, the intensity of the impacts will be serious	
Probability	Almost certain (6)	Impacts will almost certainly occur	
Nature	Negative		
Mitigation Measures			
<ul style="list-style-type: none">• Demolition and removal of infrastructure should be restricted to the dry season (May to October);• Minimize the period of exposure of soil surfaces through dedicated planning;• Foundation excavations should be filled, fertilised and re-vegetated using local vegetation;• Ensure proper storm water management designs are in place and should be kept in place until all infrastructure is removed. Where infrastructure will remain, stormwater and culverts should be maintained and monitored for erosion and AIPs;• Continue with Concurrent Rehabilitation, and implement land rehabilitation measures;• Address compacted areas by deep ripping to loosen the soil, and revegetate the area as soon as possible;• Only designated access routes are to be used to reduce any unnecessary compaction;• The backfilled, reprofiled landscape should be top soiled and revegetated to allow free drainage close to the pre-mining conditions;			

- Inventory of hazardous waste materials stored on-site should be compiled and arrange complete removal; and
- During the decommissioning of infrastructure such as the STP, WTP, depot area, offices and stockpile area, the contaminated material should be removed. The contaminated material should be disposed of at a registered landfill site.

Post-Mitigation

Dimension	Rating	Motivation	Significance
Duration	Medium term (3)	After decommissioning, impacts will still occur	Negligible (negative) – 32
Extent	Local (3)	Impacts will occur within the Project Area	
Intensity	Minor loss (2)	After mitigation and rehabilitation, impacts will be minor	
Probability	Probable (4)	Impacts will almost probably still occur	
Nature	Negative		

2. Activity and Interaction: Rehabilitation (spreading of soil, revegetation, and profiling/contouring)**Impacts:**

- Loss of usable soil as a resource – Erosion and Compaction; and
- Loss of Land capability; and
- Positive impact to the soil, land use and land capability.

Prior to Mitigation/Management

Dimension	Rating	Motivation	Significance
Duration	Long term (4)	Impacts may occur for a long term (6-15 years after rehabilitation)	Minor(negative) – 45
Extent	Limited (2)	The impact will only occur within the Project Area	
Intensity	Moderate loss (3)	Rehabilitation might have a moderate effect on the biodiversity and soils	
Probability	Likely (5)	It is likely that impact might occur	
Nature	Negative		

Mitigation Measures

- Continue with Concurrent Rehabilitation, and implement land rehabilitation measures;
- Address compacted areas by deep ripping to loosen the soil, and revegetate the area as soon as possible;

- Inventory of hazardous waste materials stored on-site should be compiled, and arrange complete removal;
- Ensure proper stormwater management designs are in place to ensure no excessive run-off or pooling occurs;
- Only designated access routes are to be used to reduce any unnecessary compaction; and
- The backfilled, reprofiled landscape should be top soiled and revegetated to allow free drainage close to the pre-mining conditions.

Post-Mitigation

Dimension	Rating	Motivation	Significance
Duration	Medium term (3)	Impacts may occur for a long term (6-15 years after rehabilitaiton)	Negligible (negative) - 28
Extent	Limited (2)	The impact will only occur within the Project Area	
Intensity	Minor loss (2)	Rehabilitation might have a minor effect on the biodiversity and soils	
Probability	Probable (4)	There is still a probability that impact might occur	
Nature	Negative		

3. Activity and Interaction: Installation of post-closure water management infrastructure**Impacts:**

- Soil compaction and topsoil loss leading to reduced fertility;
- Soil erosion (and sediment release to land and water);
- Soil contamination; and
- Loss of usable soil for agriculture – changing the land capability.

Prior to Mitigation/Management

Dimension	Rating	Motivation	Significance
Duration	Long term (4)	Instillation of infrastructure might have a long term effect on the soils	Minor (negative) – 45
Extent	Limited (2)	The impact will only occur within the Project Area	
Intensity	Moderate (3)	Construction could lead to moderate effects on the soils	
Probability	Likely (5)	Soil contamination and compaction will most likely occur	
Nature	Negative		

Mitigation Measures

- Revegetate cleared areas to avoid wind and water erosion losses;

- 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 Ubuntu Colliery Project Area;
- Water runoff from compacted road surfaces may cause erosion of road shoulders degrading the road surface;
- If any erosion occurs, corrective actions (erosion berms) must be taken to minimise any further erosion from taking place;
- Address compacted areas by deep ripping to loosen the soil, and revegetate the area as soon as possible; and
- Ensure proper stormwater management designs are in place to ensure no excessive run-off or pooling occurs.

Post-Mitigation

Dimension	Rating	Motivation	Significance
Duration	Short term (2)	If implemented and mitigation is correct, impacts should only be short term	Negligible (negative) - 24
Extent	Limited (2)	The impact will only occur within the Project Area	
Intensity	Minor loss (2)	Construction could lead to minor effects on the soils	
Probability	Probable (4)	Soil contamination and compaction will most probably still occur even with mitigation	
Nature	Negative		

8.4 Cumulative Impacts

Cumulative impacts on soil resources were viewed in the light of similar mining or related operations within the catchment that contribute similar or related pollutants to soil resources within or downstream of the Project Area.

The main impacts associated with the additional infrastructure is the disturbance of natural occurring soil profiles consisting of layers or soil horizons as well as the potential of erosion. Rehabilitation of disturbed areas aims to restore the soils and land capability, however the South African experience is that post-activities land capability usually decreases compared to pre-activities 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-activities 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 moderate because natural soil layers are stripped and stockpiled as well as compacted, eroded and potentially contaminated. In addition, soil fertility is impacted because excavated soil layers are usually thicker than the defined usable soil layer. The usable soil layer is the layer where most plant roots are found and is generally 0.3 m thick.

Mining and associated activities impacting the soil resources include changes to the physico-chemical properties of the soil. Impacts include:

- Geomorphological changes to the natural soils and landscape;
- Loss of habitat, vegetation and growth medium;
- Erosion, destruction of agricultural land, loss of topsoil and organic material;
- Sedimentation and pollution of water courses (wetlands);
- Soil contamination through accidental oil, hydrocarbons or sewage spills; and
- Soil contamination potentially could create large problems for the downstream land users, such as cattle drinking water and human consumption.

The cumulative impacts may therefore have a significant effect on the soil resources and therefore impacting the land use and land capability of the Project Area. Contaminated soil will directly impact the water quality and quantity as well as vegetation of the area. However, the area earmarked for the proposed infrastructure does, however, occur within an area approved for mining activities.

8.5 Unplanned and Low Risk Events

There is a risk of accidental spillages of hazardous substances, for example hydrocarbons or oils from vehicles or other construction machineries and from waste storage facilities during construction. Contamination is the result of accidental spillage of coal and leakage of oil and hydrocarbons from equipment used and it must be ensured that the requirements of South African legislation are met for minimisation of pollution.

Table 8-7: Unplanned Events and Associated Mitigation Measures

Unplanned Risk	Mitigation Measures
<ul style="list-style-type: none"> Erosion from the additional infrastructure. 	<ul style="list-style-type: none"> Ensure proper stormwater management, including culverts and road design; Monitor erosion; Maintain infrastructure; and Install silt traps, re-vegetate area after construction and ensure proper slopes (avoid water ponding and steep slopes).
<ul style="list-style-type: none"> Coal spillage from moving machinery and conveyor belt. 	<ul style="list-style-type: none"> Machines must be checked and maintained regularly; Access roads must be maintained; Ensure emergency response plans are in place; Contractors must ensure that all employees are aware of the procedure for dealing with spills and undergo training on site; and Contaminated soils must be disposed in a registered and licensed Waste Land Facility.
<ul style="list-style-type: none"> Hazardous substance spillage from pipelines or waste storage. 	<ul style="list-style-type: none"> Prevent any spills from occurring; If a spill occurs it is to be cleaned up (Drizit spill kit/ Zupazorbtype spill kit, oil or chemical spill kit) immediately and reported to the appropriate authorities; Pipelines and conveyor must be checked regularly for leaks; Pipelines and conveyor must be maintained; Ensure emergency response plans are in place; Contractors must ensure that all employees are aware of the procedure for dealing with spills and leaks and undergo training on site; Ensure that emergency spill equipment is available; All machines are to be serviced and refuelled in demarcated bunded areas, workshops or at appropriate off-site locations; If a significant (> 5 litres (L)) spill occurs, it is to be cleaned up immediately, reported to the appropriate authorities and recorded; and Contaminated soils must be disposed in a registered and licensed Waste Land Facility.

9 Environmental Management Plan

An Environmental management Plan (EMP) is generally considered an environmental management tool that is implemented with the objective of mitigating the undue, or reasonably avoidable adverse impacts, associated with the development of a project. The EMP is described in Table 9-1 below.

The EMP must consider each activity and its potential impacts during the construction, operational, decommissioning and post closure phases. The EMP must address all potentially significant impacts during these phases.

Table 9-1: Environmental Management Plan

Phase	Activities	Potential Impacts	Mitigation Measure	Mitigation Type	The period for implementation
Construction	Surface preparation for infrastructure: Site clearing, including the removal of vegetation and topsoil. Surface preparation for infrastructure; and Stripping topsoil and soft overburden; Loading, hauling and stockpiling.	<ul style="list-style-type: none"> • Compaction of soil and therefore increased surface runoff; • Increased wind, and water erosion on unprotected soils and consequently sedimentation as these soils are highly erodible; • Removal of vegetation and basal cover, increasing the potential loss of topsoil, organic material and decreased soil fertility; • Compaction, ponding, and changes to the natural hydrological functioning of the landscape; • Loss of usable soil as a resource for agriculture – disturbance, low fertility, erosion and compaction; and • Loss of Land Capability and agricultural land due to complete restrictions to cattle grazing (current land use). Reduced area for cattle grazing. 	<ul style="list-style-type: none"> • Control through design, management, maintenance and mitigation; and • Remedy through concurrent rehabilitation and monitoring. 	Modify, remedy, control, or stop Concurrent rehabilitation through the life of mine	Life of Construction Phase
	Construction of surface infrastructure: Construction of mine related infrastructure including roads (excluding pits).	<ul style="list-style-type: none"> • Complete removal of the soil and change in land capability during the construction of the open-cast pit; • Soil contamination; • Migration of contaminants into groundwater and contaminate freshwater systems; and • Loss of land use and land capability (agricultural potential). 	<ul style="list-style-type: none"> • Control through design, management, maintenance and mitigation; • Remedy through concurrent rehabilitation and monitoring; and • Remediate using commercially available emergency clean up kits. 		
Operational	Operation and maintenance of infrastructure	<ul style="list-style-type: none"> • Soil compaction and topsoil loss leading to reduced fertility; • Soil erosion (and sediment release to land and water); • Soil contamination; and • Loss of usable soil for agriculture – changing the land capability. 	<ul style="list-style-type: none"> • Control through design, management, maintenance and mitigation; • Remedy through concurrent rehabilitation and monitoring; • All erosion observed within the operational footprint should be remedied immediately and included as part of an ongoing rehabilitation plan; and • All soils compacted as a result of operational activities should be ripped/scarified (<300 mm) and profiled. 	Modify, remedy, control, or stop Concurrent rehabilitation through the life of mine	Life of Operational Phase
	Use and maintenance of haul roads (incl. transportation of coal to washing plant)	<ul style="list-style-type: none"> • Compaction of soil and increased runoff potential; • Reduced infiltration rate, reduced rooting depth (vegetation cover) and increased surface runoff; • Increased erosion, and consequently sedimentation; • Soil contamination from spills and leakages. 	<ul style="list-style-type: none"> • Control through design, management, maintenance and mitigation; • Remedy through concurrent rehabilitation and monitoring; • Remediate using commercially available emergency clean up kits. • Monitor the Storm water diversion berm/trench, culvert and road. Ensure that no contaminants are entering the wetland from the road and that no erosion is taking place. If contamination/erosion is discovered, this must be remedied immediately; • All spills should be immediately cleaned up and treated accordingly; • Erosion berms should be installed downgradient of the pit areas to prevent gully formation and siltation of the wetland resources; • Ensure a soil management programme is implemented and maintained to minimise erosion and sedimentation; • Concurrent rehabilitation is recommended, and pit areas should be backfilled and suitably rehabilitated on an ongoing basis for the life of the proposed operation; • All vehicles must be regularly inspected for leaks; 		

Phase	Activities	Potential Impacts	Mitigation Measure	Mitigation Type	The period for implementation
			<ul style="list-style-type: none"> Re-fuelling must take place on a sealed surface area away from wetlands to prevent ingress of hydrocarbons into topsoil; and Allow only essential personnel within the buffer areas for all wetland features identified. 		
Decommissioning	Demolition and removal of all infrastructure (incl. transportation off site)	<ul style="list-style-type: none"> Soil contamination from decommissioning of infrastructure such as the STP, WTP, depot area, offices and stockpile area; Loss of usable soil as a resource – Erosion, sedimentation and Compaction; and Loss of land capability. 	<ul style="list-style-type: none"> Actively re-vegetate disturbed areas immediately after decommissioning; No material will be dumped within any rivers, tributaries or drainage lines; All soils compacted as a result of mining activities should be ripped/scarified (<300 mm), profiled and re-seeded with indigenous vegetation; No vehicles or heavy machinery will be allowed to drive indiscriminately within any wetland areas or their buffer areas. All vehicles must remain on demarcated roads; All vehicles must be regularly inspected for leaks; Re-fuelling must take place on a sealed surface area away from wetlands to prevent ingress of hydrocarbons into topsoil; and All spills should be immediately cleaned up and treated accordingly. 	Modify, remedy, control, or stop Concurrent rehabilitation through the life of mine	Life of Decommissioning Phase
	Rehabilitation (spreading of soil, re-vegetation and profiling/contouring)	<ul style="list-style-type: none"> Loss of usable soil as a resource – Erosion and Compaction; and Loss of Land capability; and Positive impact to the soil, land use and land capability. 	<ul style="list-style-type: none"> Ensure no erosion, incision and canalisation takes place; Erosion berms should be installed downstream of areas to be re-profiled and contoured to prevent gully formation; All erosion observed within the operational footprint should be remedied immediately and included as part of an ongoing rehabilitation plan; All soils compacted as a result of rehabilitation activities should be ripped/scarified (<300 mm) and profiled; Active re-vegetation of exposed soils should take place to prevent the onset of erosion; No vehicles or heavy machinery will be allowed to drive indiscriminately within any wetland areas and their associated buffer areas. All vehicles must remain on demarcated roads and within the rehabilitation footprint; All vehicles will be regularly inspected for leaks; Re-fuelling must take place on a sealed surface area away from wetlands to prevent ingress of hydrocarbons into topsoil; and All spills should be immediately cleaned up and treated accordingly. 		
	Installation of post-closure water management infrastructure	<ul style="list-style-type: none"> Soil compaction and topsoil loss leading to reduced fertility; Soil erosion (and sediment release to land and water); Soil contamination; and Loss of usable soil for agriculture – changing the land capability. 	<ul style="list-style-type: none"> Ensure proper stormwater management infrastructure to avoid erosion, head cut erosion, increased flow, water ponding etc.; Erosion berms should be installed downstream of areas to be re-profiled and contoured to prevent gully formation; No vehicles or heavy machinery will be allowed to drive indiscriminately within any wetland areas and their associated buffer areas. All vehicles must remain on demarcated roads and within the rehabilitation footprint; and Investigation into the water quality and the most appropriate treatment measures must be conducted. 		

10 Monitoring Programme

A monitoring programme is essential as a management tool to detect negative impacts as they arise and to ensure that the necessary mitigation measures are implemented together with ensuring effectiveness of the management measures in place. Table 10-1 describes the monitoring plan which should be followed from the Construction Phase through to the Decommissioning and Monitoring phase of the additional infrastructure. The table includes each element of monitoring together with the frequency of monitoring and person responsible thereof.

Monitoring should be done in terms of:

- Appendix 6 of the NEMA EIA Regulations, 2014, (as amended);
- National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA);
- National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) (NEM:WA);
- The Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) (CARA); and
- Results of chemical analyses of soils obtained must be measured against the SSV listed in Section 7.3 and clearly demonstrate that the selection of guideline values is consistent with the principles of the Framework.

Table 10-1: Monitoring Plan

Monitoring Element	Comment	Requirement	Frequency	Responsibility
<u>Vegetation Cover</u> <ul style="list-style-type: none"> Vegetation cover; Soil depth; and Soil fertility. 	<ul style="list-style-type: none"> Contractor is responsible to undertake the clearing of vegetation and rehabilitation of impacted areas. 	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> Vegetation cover assessments, soil depth and soil fertility testing should be carried out as a combined operation annually, at least one month after rain has fallen. 	<ul style="list-style-type: none"> The MM and the EP should ensure soil contamination monitoring on site, especially where hydrocarbons are stored and applied; EP to give training to sub-contractors and all workers on the operational procedures and mitigation measures; and The MM and the EP should be responsible to determine effectiveness of erosion control structures.
<u>Erosion</u> <ul style="list-style-type: none"> Erosion status; and Runoff. 	<ul style="list-style-type: none"> Environmental officer is responsible to determine effectiveness of the erosion control structures. 	<ul style="list-style-type: none"> 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 rainwater runoff, as indicated by the specific site conditions. 	<ul style="list-style-type: none"> Erosion assessments should be carried out to visually check for erosion channels. This should be done annually, during the summer growing season, or after large rain events. 	
<u>Soil Contamination</u> <ul style="list-style-type: none"> Potential harmful elements; and Heavy metals 	<ul style="list-style-type: none"> An independent soil scientist should assess the area after a spill has occurred 	<ul style="list-style-type: none"> In the case of an accidental spillage, a soil monitoring program should be implemented to assess the contamination plume as well 	<ul style="list-style-type: none"> Soil monitoring should only take place after an accidental spill. Depending on the size of the spill, monitoring should be done 	

		as assessing the soil remediation success.	regularly until the effect of the impact is resolved.	hydrocarbons are stored and applied; <ul style="list-style-type: none"> • An independent soil scientist should conduct the monitoring and provide a remediation plan.
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11 Stakeholder Engagement Comments Received

The consultation process affords Interested and Affected Parties (I&APs) opportunities to engage in the EIA process. The objectives of the Stakeholder Engagement Process (SEP) include the following:

- To ensure that I&APs are informed about the Project;
- To provide I&APs with an opportunity to engage and provide comment on the Project;
- To draw on local knowledge by identifying environmental and social concerns associated with the Project;
- To involve I&APs in identifying methods in which concerns can be addressed;
- To verify that stakeholder comments have been accurately recorded; and
- To comply with the legal requirements.

The Public Participation Process (PPP) has been completed in part, as a process separate to the Soil, Land Use and Land Capability Impact Assessment. No formal consultation was undertaken as part of this assessment. I&AP comments submitted in relevance to soil resources during the PPP are listed in Table 11-1 below and was considered in the final EIA phase.

Table 11-1 Comments and Responses Received During Scoping Phase

Date of Receipt	Method	Contributor	Organization/Community	Comment	Response
25-Nov-20	Registration and Comment form received by Email correspondence	Frans Venter	Brakfontein Farm 264 IR Portion 4,29 &30	A dam exists downstream that is used for irrigation. What will be the effect on quality and runoff water?	During the EIA Phase, the Surface Water Impact Assessment will consider the impact on surface water quality and quantity that may be caused as a result of the proposed project. The preliminary water quality impacts identified during the Scoping Phase relate to spillages and leaks of fuels, oils and other potentially hazardous chemicals and sedimentation of downstream watercourses. Mitigation measures will be proposed to mitigate these risks, including the implementation of a stormwater management plan during the EIA Phase. The stormwater management plan to be compiled will ensure that all dirty water and runoff that is generated within the mine is contained as per the government regulations on the stormwater management in mines. Furthermore, ongoing water quality monitoring will be undertaken to assess any potential impacts on water quality as a result of the proposed project. With regards to water quantity, the Scoping Phase surface water assessment estimated approximately less than 0.09% loss of the runoff-contributing catchment area in proportion to the total catchment area. This is not anticipated to result in significant reduction in the water quantity reporting downstream. On this basis, the project is not likely to have significant impacts on the downstream dam.
				Is concerned that farming activities (maize and cattle) will be affected by the mine activities and will be non-profitable.	Universal Coal have obtained ownership of the farm portions on which they will develop the infrastructure. The farm owner, Frans Venter has been compensated for the land. Additionally, farming activities will be allowed to continue on portions that will not have commenced with the establishment of the infrastructure until such a time that the construction begins. After which these need to cease.
				Requests clarity and more information on the road diversion of D2546 road.	The designs for the road will be finalised during the EIA Phase. The existing road will be decommissioned for the portion where it goes through the mining area and diverted around the pit to allow traffic to flow around the mine.

12 Recommendations

The following actions are recommended to reduce adverse effects on the soil resources of the Project Area (Table 12-1):

Table 12-1: Possible Impacts and Recommendations

Possible Impacts	Recommendations
Loss of the soil resource due to change in land use, and removal of the soil	<ul style="list-style-type: none"> If any erosion occurs, corrective actions must be taken to minimise any further erosion from taking place at regular intervals or after high rainfall events. Such as revegetation, erosion berms, culverts or gabions.
Loss of the soil resource due to the wind, and water erosion of unprotected soils	<ul style="list-style-type: none"> The impacted and rehabilitated areas must be fenced, and animals should be kept off the area until the vegetation is self-sustaining; and Runoff must be controlled and managed using proper stormwater management measures.
Change in soil characteristics (soil texture) due to compaction of areas, and associated mine infrastructure	<ul style="list-style-type: none"> Restriction of vehicle movement over sensitive and rehabilitated areas to reduce compaction.
Contamination of the soil resource due to chemicals such as hydrocarbons spillages, oil spills and coal contamination	<ul style="list-style-type: none"> If soil is polluted, treat the soil using in-situ bioremediation; If in-situ treatment is not possible then the polluted soil must be classified according to the Minimum Requirements for the Handling, Classification, and Disposal of Hazardous Material, and disposed at an appropriate, permitted or licensed disposal facility; All vehicles and machines must be parked within hard park areas, and must be checked daily for fluid leaks; Re-fuelling must take place on a sealed surface area away from soils to prevent seepage of hydrocarbons into the soil; Place drip trays where vehicles or machinery leaks are occurring; Fuel, grease, and oil spills should be remediated using a commercially available emergency clean up kits; Any contractors on site must ensure that all employees are aware of the procedure for dealing with spills, and leaks, and undergo training on-site; and Soil pollution monitoring should be conducted at selected locations on the project site to detect any extreme levels of pollutants.

Possible Impacts	Recommendations
Loss of the soil resource due to the disturbance, and clearing of vegetation	<ul style="list-style-type: none"> Establishment of effective soil cover such as lawn grass around constructed infrastructure for adequate protection from wind, and water erosion; and Minimise unnecessary removal of the natural vegetation cover outside the development footprint.

13 Reasoned Opinion Whether Project Should Proceed

Based on the baseline information and impact assessment significance ratings, it is the opinion of the specialist that this project will have moderate impacts on the soils, land use and land capability. However, when the mitigation measures and recommendations are incorporated, the impacts will be reduced to minor and negligible. It is highly recommended that concurrent rehabilitation, management, and mitigation measures are correctly implemented to minimise potential impacts on soils to maintain the land capability for future land use.

Soil management measures and monitoring requirements as set out in Section 9 should form part of the conditions for environmental authorisation, especially in areas of high land capability and in wetlands as these soils are highly erodible and has a potential to deteriorate rapidly.

14 Conclusion

The Project Area is characterized by a climate that is typical of that of the Mpumalanga climatic zone characterized by warm, rainy summers and dry winters (South African Weather Bureau, 1986) whereas the topography of the Project Area ranges from high elevations on the western side to low lying areas in the north, east and south of the Project Area. The geology falls within the Karoo Basin and are overlain by the Karoo Super Group. The lowermost part of the basement consists of Malmani dolomites and Cherts, which are overlain by ferruginous shale and ferruginous quartzites of the Timeball Hill Formation. Andesite of the Hekpoort Formation rests on the Timeball Hill Formation.

Existing Land Type and soil data was used to obtain generalised soil patterns and terrain types. Baseline data suggested that the land types are predominantly of the **Ab9** and **Bb3** types, consisting of sandstone, isolated occurrences of dolerite, shale, clay, conglomerate, limestone, tillite, occasional Ventersdorp lava, Witwatersrand quartzite and slate lithologies.

The dominant soil forms identified within the Project Area include Dresden, Witbank, Hutton, Glencoe, Clovelly, Pinedene and Avalon. Large areas of the Project Area are being used for commercial dryland cultivation, indicating the high agricultural potential of the soils. Low-lying areas within the Project Area showed increased clay content and soil wetness. These soils were identified as wetland soils and are saturated for long periods with a fluctuating water table. The land use in these areas were generally wetlands and used for cattle grazing and perennial grasslands. These soils are somewhat limited for cultivation and highly mobile (high erosion probability).

The impacts associated with the proposed development include:

- Geomorphological changes to the natural soils and landscape due to construction of infrastructure;
- Loss of habitat, vegetation and growth medium due to construction and operation of additional infrastructure;
- Erosion, destruction of high agricultural soils, loss of topsoil and organic material;
- Sedimentation, pollution and loss of watercourses (wetlands);
- Soil contamination from Hydrocarbon waste (lubricants, oil and fuels) due to spillage during construction and operation of the listed activities;
- Potential spillage of hydrocarbons, oils and waste during construction and operation of the infrastructure, may migrate through the soil profiles and by overland flow, contaminating the ground and surface water resources;
- Soil compaction, low vegetation growth, high runoff potential, increased erosion due to hardened surfaces from the additional infrastructure; and
- Impacts to natural wetlands and water resources thereby changing the use of water, increasing water contamination, and loss of water quality, and quantity. Contaminated water will affect the soils, land capability, and water use.

Recommendations are made to ensure that the rehabilitation plan, mitigation measures, and continuous monitoring measures are in place, and encourage a concurrent rehabilitation and monitoring plan.

Based on the baseline information, and impact assessment significance ratings, it is the opinion of the specialist that this project will have medium impacts on the land use and land capability if managed and mitigated correctly. However, it is highly recommended that concurrent rehabilitation, mitigation measures, the monitoring program and mitigation measures are implemented to minimise potential impacts on soils to maintain the land capability for future land use.

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Appendix A: Methodology

16 Methodology

This section provides the methodology used in the compilation of the Soil, Land Use and Land Capability Impact Assessment. To complete the proposed scope of work, there were several tasks which needed to be completed and these tasks are explained separately below.

16.1 Desktop Assessment and Literature Review

Digby Wells conducted a desktop review of the baseline data and findings related to the soil surveys and other relevant existing documentation:

- Baseline soil information was obtained from the South African land type data published with maps at a scale of 1:250 000 by the Institute for Soil, Climate and Water (ISCW) of the Agricultural Research Council (ARC) (ARC, 2006). These maps indicate delineated areas of relatively uniform terrain, soil pattern, and climate (Land Type Survey Staff, 1972 - 2006). These maps and their accompanying reports provide a statistical estimate of the different soils that can be expected in the area;
- Rainfall, evaporation, and runoff data obtained was evaluated to determine the Mean Annual Precipitation (MAP), Mean Annual Runoff (MAR), and Mean Annual Evaporation (MAE) for the site. Understanding of the variables was useful in broadly determining soil characteristics that are influenced by incident rainfall, evaporation, and water movement through the soil matrix;
- Aerial imagery was analysed to determine areas that are most likely to be suitable for agriculture. The aerial imagery analysis focused on lower lying areas where suitable soils for agriculture are more likely to occur; and
- Land use and land capability were described with specific reference to the interaction between water and land use through a review of existing studies conducted in the area as well as publicly available information.

The following sources of information were reviewed and utilised for the compilation of this report:

- Soil Assessment for the Brakfontein Colliery (Digby Wells Environmental, 2012a);
- Environmental Impact Assessment Report for the Proposed Brakfontein Coal Mine (Digby Wells Environmental, 2012b); and
- Existing Land Type data was used to obtain generalised soil patterns and terrain types for the Project site (Land Type Survey Staff, 1972 - 2006).

16.2 Soil Classification

A soil assessment on the proposed infrastructure areas was conducted during a field visit in July 2020.

The site was traversed by vehicle and on foot. A hand soil auger was used to determine the soil type and depth. Soils were investigated using a Bucket and Cradle auger to a maximum depth of 1.2 metres (m) or to the first restricting layer. Survey positions were recorded as waypoints using a handheld Global Positioning System (GPS). Other features such as existing open trenches and diggings were helpful to determine soil form and depth. Mapping unit boundaries were determined by changes in topography with subsidiary indications from vegetation and parent material.

The soils were classified using the Soil Classification: A Taxonomic System for South Africa (Soil Classification Working Group, 1991). The following attributes were included at each observation:

- Topography, aspect and slope;
- Soil form and family;
- Soil depth;
- Estimated soil texture;
- Soil structure, coarse fragments, calcareousness;
- Underlying material; and
- Vegetation.

16.2.1 Soil Physical and Chemical Analysis

Six (6) representative soil samples (0 to 0.6 m) were collected from the proposed areas for soil chemical and physical analysis. The soil samples were stored in plastic bags and sent for analysis at a South African National Accreditation System (SANAS) accredited laboratory. In accordance with the methodology given in the Handbook of Standard Soil Testing Methods for Advisory Purposes (Soil Science Society of South Africa, 1990), the soil samples were tested for the following parameters:

- pH;
- Carbon Content;
- Cation Exchange Capacity (CEC);
- Exchangeable Cations: Calcium (Ca), Magnesium (Mg), Potassium (K) and Sodium (Na) (Ammonium acetate extraction);
- Phosphorus (P);
- Heavy Metals and Micronutrients: Copper (Cu), Zinc (Zn), Iron (Fe), Manganese (Mn), Boron (B), Sulphur (S), Aluminium (Al), Iron (Fe), Molybdenum (Mo) and Nickel (Ni); and
- Soil texture (Sand, Silt and Clay fractions).

Fertility and baseline chemical analysis was conducted to provide baseline information prior construction of the additional infrastructure.

Soil texture is defined as the relative proportion of sand, silt and clay particles found in the soil. The relative proportions of these 3 fractions (clay, sand and silt) as illustrated in Figure 16-1, determines 1 of 12 soil texture classes, for example sandy loam, loam, sand, sandy clay loam etc. The different texture class zones are demarcated by the thick black line in the diagram.

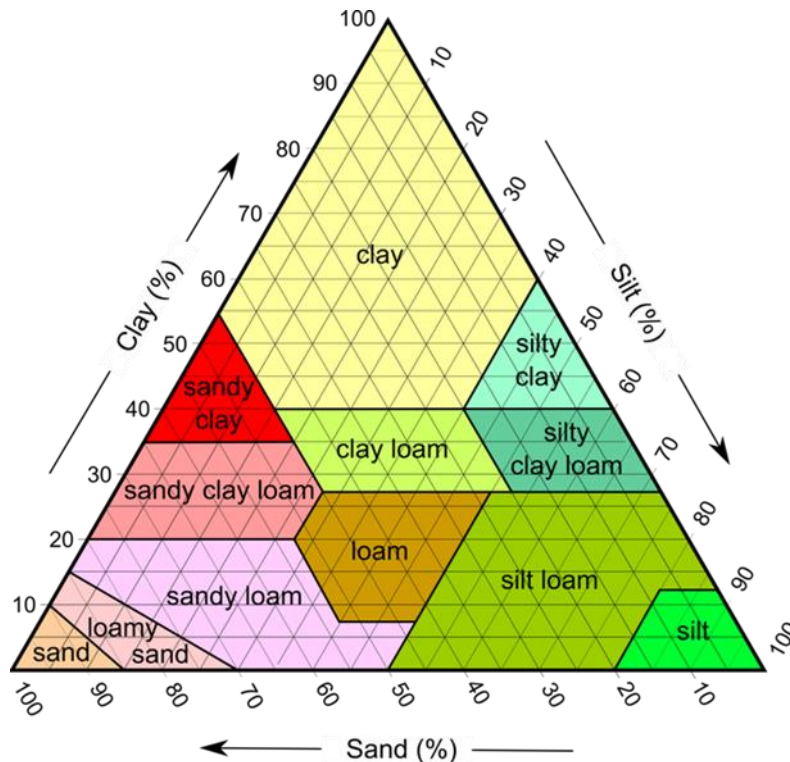


Figure 16-1: Soil Textural Diagram

Source: (South African Sugar Association, 1999)

16.3 Land Use

The current land use was identified by aerial imagery during the desktop assessment and by on-site inspection during the EIA phase. The maps indicate delineated areas of similar land use (Land Type Survey Staff, 1972 - 2006). Land use categories are split into:

- Plantations;
- Natural;
- Waterbodies;
- Mines;
- Urban built-up; and
- Agriculture.

16.4 Land Capability

Land capability was determined by assessing a combination of soil, terrain and climate features. Land capability is defined by the most suitable land use under rain-fed conditions. The approach by U.S. Department of Agriculture (1973) and Schoeman et al. (2000) was used to assess the land capability. The classification system is made up of land capability classes and land capability groups (Table 16-1). The land will be rated into eight classes which include group of capability units or subgroups that have the same relative degree of limitation or potential. These classes range from I to VIII in order of decreasing agricultural potential based on limiting factors that include erosion hazard (e), excess water (w), soil root zone (s) and climatic (c) limitations. Classes I-IV represent arable land and Classes V-VIII represent non-arable land according to the guidelines (Soil Conservation Service: U.S. Department of Agriculture, 1973; Schoeman, et al., 2000).

Table 16-1: Land Capability Classes

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	-	LG	MG	-	-	-	-	-	Grazing Land
VI	W	F	LG	MG	-	-	-	-	-	
VII	W	F	LG	-	-	-	-	-	-	Wildlife
VIII	W	-	-	-	-	-	-	-	-	

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

16.4.1 Land Suitability (Agricultural Potential)

The process of land suitability classification is the grouping of specific areas of land in terms of their suitability for a defined land use. Soil agricultural potential or suitability mapping was determined by considering the soil forms, land capability classes, soil analysis results, the hydrology of the site and the current land use. The process involved allocating terrain factors (topography and slope) and soil factors (depth, texture, internal drainage and mechanical limitations) which define soil forms, to an area of land. The soil chemical analysis, which includes pH, cations and Phosphorus compositions, was considered in determining the final suitability of the soil. The suitability guidelines according to Schoeman et al., (2000) were used.

Soil chemical, physical and biological processes depends on five soil forming factors, including time, topography, organic material, climate and parent material. These soil forming factors changes the soil characteristics and therefore are considered when soils are grouped into land

capability and suitability. Depending on which of these are limiting, the soils fall under one of the following suitability classes (Table 16-2):

Table 16-2: Land Classes - Descriptions and Suitability

Class	Definition	Conservation Need	Use-Suitability
I	<ul style="list-style-type: none"> No or few limitations. Very high arable potential. Very low erosion hazard. 	Good agronomic practice.	Annual cropping.
II	<ul style="list-style-type: none"> Slight limitations. High arable potential. Low erosion hazard. 	Adequate run-off control.	Annual cropping with special tillage or ley (25%).
III	<ul style="list-style-type: none"> Moderate limitations. Some erosion hazards. 	Special conservation practice and tillage methods.	Rotation of crops and ley (50%).
IV	<ul style="list-style-type: none"> Severe limitations. Low arable potential. High erosion hazard. 	Intensive conservation practice.	Long term leys (75%).
V	<ul style="list-style-type: none"> Watercourse and land with wetness limitations. 	Protection and control of water table.	Improved pastures or Wildlife.
VI	<ul style="list-style-type: none"> Limitations preclude cultivation. Suitable for perennial vegetation. 	Protection measures for establishment e.g. Sod-seeding.	Veld and/or afforestation.
VII	<ul style="list-style-type: none"> Very severe limitations. Suitable only for natural vegetation. 	Adequate management for natural vegetation.	Natural veld grazing and afforestation.
VIII	<ul style="list-style-type: none"> Extremely severe limitations. Not suitable for grazing or afforestation. 	Total protection from agriculture.	Wildlife.

16.5 Impact Assessment

The soil impacts were assessed based on the impact's magnitude as well as the receiving environment's sensitivity, resulting in an impact significance rating which identified the most important impacts that require management. Based on national guidelines and legislation, the following criteria were taken into consideration when potentially significant impacts were examined relating to Soil, Land Use and Land Capability:

- Nature of impacts (direct/indirect and positive/negative);
- Duration (short/medium/long-term; permanent (irreversible)/temporary (reversible) and frequent/seldom);

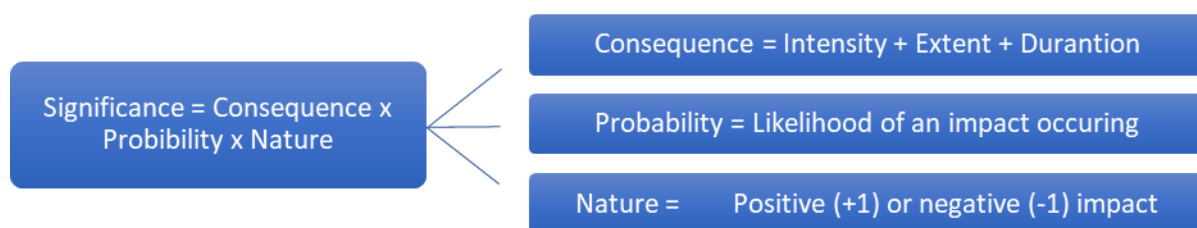
- Extent (geographical area and size of affected population/species);
- Intensity (minimal, severe, replaceable/irreplaceable);
- Probability (high/medium/low probability); and
- Measures to mitigate avoid or offset significant adverse impacts.

16.5.1 Significance Rating

Impacts and risks will be identified based on a description of the activities to be undertaken. Once impacts are identified, a numerical environmental significance rating process will be undertaken that utilizes the probability of an event occurring and the severity of the impact as factors to determine the significance of an environmental impact.

The severity of an impact will then be determined by taking the spatial extent, the duration and the severity of the impacts into consideration. Thereafter, the probability of an impact will be determined by the frequency at which the activity takes place or is likely to take place and by how often the type of impact in question has taken place in similar circumstances.

Following the identification and significance ratings of potential impacts, mitigation and management measures were incorporated into the EMP. Details of the impact assessment methodology used to determine the significance of physical, bio-physical and socio-economic impacts are provided below. The significance rating process follows the established impact/risk assessment formula:



Note: In the formula for calculating consequence, the type of impact is multiplied by +1 for positive impacts and -1 for negative impacts

The matrix calculated the rating out of 147, whereby intensity, extent, duration and probability were each rated out of seven as indicated in Table 16-5. The weight assigned to the various parameters was then multiplied by +1 for positive and -1 for negative impacts.

16.5.2 Parameter Rating

Impacts are rated prior to mitigation and again after consideration of the mitigation proposed in this report. The significance of an impact is then determined and categorised into one of seven categories, as indicated in Table 16-4, which is extracted from Table 16-5. The description of the significance ratings is discussed in Table 16-6.

It is important to note that the pre-mitigation rating takes into consideration the activity as proposed, i.e. there may already be certain types of mitigation measures included in the design

(for example due to legal requirements). If the potential impact is still considered too high, additional mitigation measures are proposed.

16.5.3 Mitigation Hierarchy

The aim of the Impact Assessment is to strive to avoid damage to or loss of ecosystems and services that they provide, and where they cannot be avoided, to reduce and mitigate these impacts (Department of Environmental Affairs, Department of Mineral Resources, Chamber of Mines, South African Mining and Biodiversity Forum, & South African National Biodiversity Institute, 2013). Offsets to compensate for loss of habitat are regarded as a last resort, after all efforts have been made to avoid, reduce and mitigate. The mitigation hierarchy is represented in Table 16-3.

Table 16-3: Mitigation Hierarchy


	Avoid or Prevent	Refers to considering options in project location, sitting, scale, layout, technology and phasing to avoid impacts on biodiversity, associated ecosystem services and people. This is the best option but is not always possible. Where environmental and social factors give rise to unacceptable negative impacts, mining should not take place. In such cases, it is unlikely to be possible or appropriate to rely on the other steps in the mitigation.
	Minimize	Refers to considering alternatives in the project location, sitting, scale, layout, technology and phasing that would minimize impacts on biodiversity, associated ecosystem services. In cases where there are environmental constraints, every effort should be made to minimize impacts.
	Rehabilitate	Refers to rehabilitation of areas where impacts are unavoidable, and measures are provided to return impacted areas to near natural state or an agreed land use after mine closure. Rehabilitation can, however, fall short of replicating the diversity and complexity of natural systems.
	Offset	Refers to measures over and above rehabilitation to compensate for the residual negative impacts on biodiversity after every effort has been made to minimize and then rehabilitate the impacts. Biodiversity offsets can provide a mechanism to compensate for significant residual impacts on biodiversity.

Table 16-4: Impact Assessment Parameter Ratings

Rating	Intensity/Replicability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	Positive Impacts (Nature = +1)			
7	Irreplaceable loss or damage to biological or physical resources or highly sensitive environments. Irreplaceable damage to highly sensitive cultural/social resources.	Noticeable, on-going natural and/or social benefits which have improved the overall conditions of the baseline.	<u>International</u> The effect will occur across international borders.	Permanent: The impact is irreversible, even with management, and will remain after the life of the Project.	Definite: There are sound scientific reasons to expect that the impact will definitely occur. >80% probability.
6	Irreplaceable loss or damage to biological or physical resources or moderate to highly sensitive environments. Irreplaceable damage to cultural/social resources of moderate to highly sensitivity.	Great improvement to the overall conditions of a large percentage of the baseline.	<u>National</u> Will affect the entire country.	Beyond Project Life: The impact will remain for some time after the life of the Project and is potentially irreversible even with management.	Almost Certain/Highly Probable: It is most likely that the impact will occur. >65 but <80% probability.
5	Serious loss and/or damage to physical or biological resources or highly sensitive environments, limiting ecosystem function. Very serious widespread social impacts. Irreparable damage to highly valued items.	On-going and widespread benefits to local communities and natural features of the landscape.	<u>Province/Region</u> Will affect the entire province or region.	Project Life (>15 years): The impact will cease after the operational life span of the Project and can be reversed with sufficient management.	Likely: The impact may occur. <65% probability.
4	Serious loss and/or damage to physical or biological resources or moderately sensitive environments, limiting ecosystem function. On-going serious social issues. Significant damage to structures/items of cultural significance.	Average to intense natural and/or social benefits to some elements of the baseline.	<u>Municipal Area</u> Will affect the whole municipal area.	Long Term: 6-15 years and impact can be reversed with management.	Probable: Has occurred here or elsewhere and could therefore occur. <50% probability.
3	Moderate loss and/or damage to biological or physical resources of low to moderately sensitive environments and, limiting ecosystem function. On-going social issues. Damage to items of cultural significance.	Average, on-going positive benefits, not widespread but felt by some elements of the baseline.	<u>Local</u> Local including the site and its immediate surrounding area.	Medium Term: 1-5 years and impact can be reversed with minimal management.	Unlikely: Has not happened yet but could happen once in the lifetime of the Project, therefore there is a possibility that the impact will occur. <25% probability.
2	Minor loss and/or effects to biological or physical resources or low sensitive environments, not affecting ecosystem functioning. Minor medium-term social impacts on local population. Mostly repairable. Cultural functions and processes not affected.	Low positive impacts experience by a small percentage of the baseline.	<u>Limited</u> Limited extending only as far as the development site area.	Short Term: Less than 1 year and is reversible.	Rare/Improbable: Conceivable, but only in extreme circumstances. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures. <10% probability.
1	Minimal to no loss and/or effect to biological or physical resources, not affecting ecosystem functioning. Minimal social impacts, low-level repairable damage to commonplace structures.	Some low-level natural and/or social benefits felt by a very small percentage of the baseline.	<u>Very Limited/Isolated</u> Limited to specific isolated parts of the site.	Immediate: Less than 1 month and is completely reversible without management.	Highly Unlikely/None: Expected never to happen. <1% probability.

Table 16-5: Probability/Consequence Matrix

Probability	Significance																																						
	7	-147	-140	-133	-126	-119	-112	-105	-98	-91	-84	-77	-70	-63	-56	-49	-42	-35	-28	-21	21	28	35	42	49	56	63	70	77	84	91	98	105	112	119	126	133	140	147
	6	-126	-120	-114	-108	-102	-96	-90	-84	-78	-72	-66	-60	-54	-48	-42	-36	-30	-24	-18	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120	126
	5	-105	-100	-95	-90	-85	-80	-75	-70	-65	-60	-55	-50	-45	-40	-35	-30	-25	-20	-15	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105
	4	-84	-80	-76	-72	-68	-64	-60	-56	-52	-48	-44	-40	-36	-32	-28	-24	-20	-16	-12	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84
	3	-63	-60	-57	-54	-51	-48	-45	-42	-39	-36	-33	-30	-27	-24	-21	-18	-15	-12	-9	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60	63
	2	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42
	1	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
		-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Consequence																																							

Table 16-6: Significance Rating Description

Score	Description	Rating
109 to 147	A very beneficial impact that may be sufficient by itself to justify implementation of the Project. The impact may result in permanent positive change.	Major (positive) (+)
73 to 108	A beneficial impact which may help to justify the implementation of the Project. These impacts would be considered by society as constituting a major and usually a long-term positive change to the (natural and/or social) environment.	Moderate (positive) (+)
36 to 72	A positive impact. These impacts will usually result in positive medium to long-term effect on the natural and/or social environment.	Minor (positive) (+)
3 to 35	A small positive impact. The impact will result in medium to short term effects on the natural and/or social environment.	Negligible (positive) (+)
-3 to -35	An acceptable negative impact for which mitigation is desirable. The impact by itself is insufficient even in combination with other low impacts to prevent the development being approved. These impacts will result in negative medium to short term effects on the natural and/or social environment.	Negligible (negative) (-)
-36 to -72	A minor negative impact requires mitigation. The impact is insufficient by itself to prevent the implementation of the Project but which in conjunction with other impacts may prevent its implementation. These impacts will usually result in negative medium to long-term effect on the natural and/or social environment.	Minor (negative) (-)
-73 to -108	A moderate negative impact may prevent the implementation of the Project. These impacts would be considered as constituting a major and usually a long-term change to the (natural and/or social) environment and result in severe changes.	Moderate (negative) (-)
-109 to -147	A major negative impact may be sufficient by itself to prevent implementation of the Project. The impact may result in permanent change. Very often these impacts are immitigable and usually result in very severe effects. The impacts are likely to be irreversible and/or irreplaceable.	Major (negative) (-)