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Proposed Dalyshope Coal Mining Project, Situated in the Magisterial District of Lephalale, Limpopo Province

Soils, Land Use, and Land Capability Impact Assessment

Prepared for:
Anglo Operations (Pty) Ltd

Project Number:
UCD6170

October 2020

DMRE Reference Number: LP30/1/2/3/2/1(10183) MR

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This document has been prepared by Digby Wells Environmental.

Report Type:	Soils, Land Use, and Land Capability Impact Assessment
Project Name:	Proposed Dalyshope Coal Mining Project, Situated in the Magisterial District of Lephalale, Limpopo Province
Project Code:	UCD6170

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

Date: August 2020

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EXECUTIVE SUMMARY

Anglo Operations Pty) Ltd (Anglo), who has partnered with Universal Coal Development IV (Pty) Ltd (Universal), has appointed Digby Wells Environmental (Digby Wells) to undertake the environmental authorisations required for the proposed development of Dalyshope Coal Mining Project Anglo, Ellisras, Limpopo Province. This report constitutes the Soil, Land Use, and Land Capability Impact Assessment to form part of the Environmental Impact Assessment (EIA) on the Farms Dalyshope 232 LQ, and Klaarwater 231 LQ.

The Open Cast Pit 1 (OC1) area and associated infrastructure areas (hereinafter Project Area) falls within the Limpopo Sweet Bushveld vegetation type, and the Limpopo Climatic Zone; characterized by warm, wet summers, and dry winters. The topography is generally flat with small depressions and alluvial deposits in low-lying areas of the landscape. Terrain-morphological units in the landscape are not easy to distinguish, however, two small pans were identified. The regional geology falls within the Ellisras Basin coal fields forming part of the Karoo Supergroup.

The land type data gathered indicated **Ah86** type with a small portion of the **Ae257**. Soils as part of these land types are red to yellow apedal sandy soils which are generally freely drained and have a high base status. The red, sandy nature of the soils in the location of the proposed Project Area is commonly an indication of moderate potential soils for agriculture. The dominant soils in the Project Area have a low clay content and therefore a low water holding capacity and low base saturation, whereas the soils in the pan areas have a high clay content, promoting saturated conditions for long enough periods to change the soil morphology (creating mottles) and promoting a different habitat and vegetation composition. The dominant soil forms of the Project Area are Hutton, Clovelly, Oakleaf, Glencoe, and Kroonstad soil forms.

The land capability was determined by assessing the combination of soil, terrain, and climate features. The land capability class was **Class V**, defined as moderate grazing. This is due to the dry climate, and high evaporative demand present. The dominant land use is agriculture, dominated by cattle grazing, and game farming. This can be attributed to the low agricultural potential of the soils, low rainfall, and high evapotranspiration demand. The site consists of natural open woodland, and grassland, with small seasonal pans, herbaceous wetlands, eroded lands, and sparsely wooded grassland.

Impacts on the soil, land use, and land capability associated with the proposed opencast mining activities, and associated infrastructure are the disturbance of the naturally occurring vegetation, and soil profiles. The impacts on the soil will be high as the topsoil will be stripped, and stockpiled during the Construction, and Operational Phase. Mining and associated activities impacting the soil resources include changes to the physicochemical 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 watercourses (wetlands); and
- Soil Contamination from Hydrocarbon waste (lubricants, explosives, and fuels) and mine impacted water (decant water).

The impacts may 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 the vegetation of the area. Section 9, and section 10 of this report describes a management plan for the rehabilitation and monitoring during the Construction, Operational, and Decommissioning Phase of the Project. It is highly recommended to ensure that these management measures be followed to limit the impacts to the soil, land use, and land capability.

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 EMP, Monitoring Programme, and Recommendations are adopted.

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LIST OF ACRONYMS, ABBREVIATIONS, AND DEFINITIONS

Anglo	Anglo Operations Pty) Ltd
CARA	Conservation of Agricultural Resources Act
°C	Degree Celsius
CEC	Cation Exchange Capacity
Digby Wells	Digby Wells Environmental
EA	Environmental Assessment
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
GIS	Geographic Information System
GPS	Global Positioning System
ha	Hectare
IWUL	Integrated Water Use License
K_{sat}	Saturated Hydraulic Conductivity
km	Kilometers
L	Litre
LOM	Life of Mine

m	Metre
mg	Milligrams
mm	Millimetre
MAE	Mean Annual Evaporation
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
MRA	Mining Rights Area (defines the farms included in the Mining Right boundary)
MPRDA	Mineral and Petroleum Resources Development Amendment Act, No. 49 of 2008
Mtpa	Million tonnes per annum
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 Cast Pit 1
Project Area	Proposed Dalyshope Coal Mine Development Footprint Area, OC 1, and proposed infrastructure area, on the farm portions, Klaarwater 231 LQ, and Dalyshope 232 LQ
ROM	Run of Mine
SANAS	South African National Accreditation System
Universal	Universal Coal Development IV (Pty) Ltd
WUL	Water Use License
WRC	Water Research Commission

Legal Requirement		**Section in Report**
(1)	A specialist report prepared in terms of these Regulations must contain details of:	
(a)	(i) the specialist who prepared the report, and (ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	Section 0
(b)	a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page I to II
(c)	an indication of the scope of, and the purpose for which, the report was prepared;	Section 2
c-A	And an indication of the quality, and age of the base data used for the specialist report;	Section 5
c-B	A description of existing impacts on site, cumulative impacts of the proposed development, and levels of acceptable change;	Section 8

Legal Requirement		Section in Report
(d)	The duration, date, and season of the site investigation, and the relevance of the season to the outcome of the assessment;	Section 5.2
(e)	a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of the equipment, and modeling used;	Section 5
(f)	Details of an assessment of the specifically 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 alternative;	Section 9
(g)	an identification of any areas to be avoided, including buffers;	Section 9
(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;	N/A
(i)	a description of any assumptions made, and any uncertainties or gaps in knowledge;	Section 4
(j)	a description of the findings, and potential implications of such findings on the impact of the proposed activity or activities;	Section 8
(k)	any mitigation measures for inclusion in the EMPr;	Section 10
(l)	any conditions/aspects for inclusion in the environmental authorisation;	Section 10
(m)	any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 10
(n)	a reasoned opinion (Environmental Impact Statement) -	Section 13
	whether the proposed activity, activities or portions thereof should be authorised; and	
	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 EMPr, and where applicable, the closure plan;	
(o)	a description of any consultation process that was undertaken during preparing the specialist report;	Section 10
(p)	a summary and copies of any comments received during any consultation process, and where applicable all responses thereto; and	
(q)	any other information requested by the competent authority.	Section 12

1 Introduction

Anglo Operations Pty) Ltd (Anglo) has partnered with Universal Coal Development IV (Pty) Ltd (Universal) to participate in the proposed Dalyshope Coal Mining Project (the Project) through funding and managing the Project development, including the Mining Right application. Anglo is the holder of two Prospecting Rights approved by the Department of Mineral Resource and Energy (DMRE), reference numbers LP 30/5/1/1/2/10648 PR (as renewed) and 30/5/1/1/2/ 10649 PR (as renewed), and authorised in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA) to prospect for coal.

This report constitutes the Soil, Land Use, and Land Capability Impact Assessment to form part of the Environmental Impact Assessment (EIA). The Soil, Land Use, and Land Capability Assessment Report has been compiled in terms of Appendix 6 of the NEMA EIA Regulations, 2014, (as amended) in terms of the Scoping, and EIA process which is being followed in applying for Environmental Authorisation (EA).

1.1 Project Locality

The Prospecting Rights cover approximately 4 957.7 hectares (ha) of numerous farm portions, the boundaries of which have since been realigned, and renamed.

The Project Area is approximately 1 630.5 ha in size and located in the Limpopo Province, approximately 60 km west of Lephalale. The Project Area falls within the Lephalale Local Municipality District, and is adjacent to the R175 secondary road, and bordering the Limpopo River, adjoining South Africa, and Botswana (Figure 1-1). The nearest settlement, as measured from the location of the mining activities, is Steenbokpan situated approximately 20 km south-south-east of the Project Area.

1.2 Area of Investigation

Anglo proposes to develop the coal mine on the Farms Dalyshope 232 LQ, and Klaarwater 231 LQ. The Soil, Land Use, and Land Capability Impact Assessment will therefore focus on these two properties only. The area of investigation and the focus area of the study is indicated on the maps as OC1 or the black gridded lines together with the infrastructure areas (Figure 1-1).

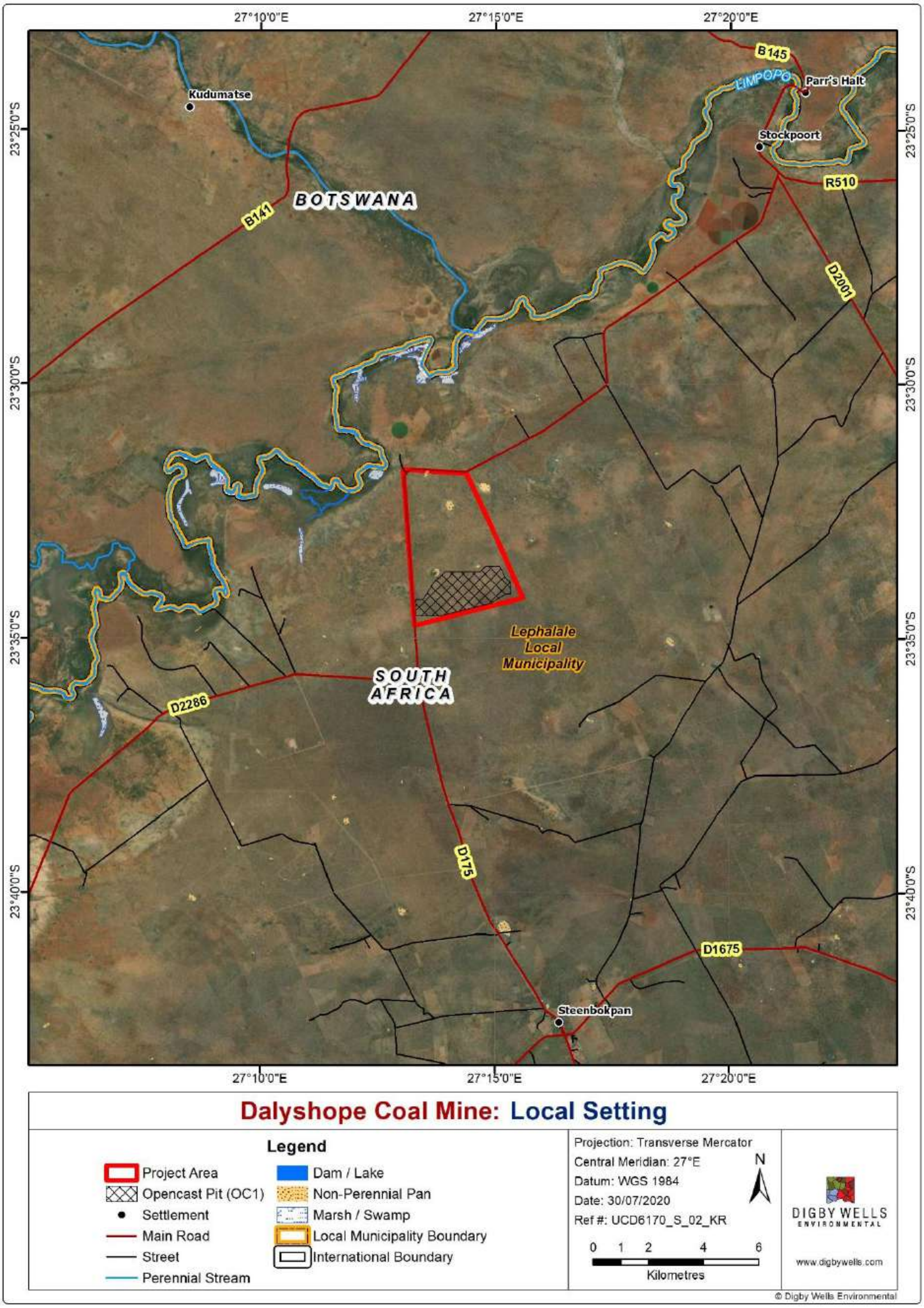


Figure 1-1: Local Setting

1.3 Project Background

The Dalyshope Project considers the establishment of a contractor-operated, truck, and shovel opencast mine producing approximately 2.4 million tonnes per annum (Mtpa) of thermal coal products for the first five years of operation. After five years, the mine will increase production to approximately 12 Mtpa of product for approximately 25 years from a single open pit (OC1), giving a total Life f Mine (LOM) of approximately 30 years.

The preferred mining method is opencast strip mining using selective mining techniques due to the coal seam having a flat-lying orientation and being relatively close to the surface. The mine will be accessed by a box-cut, and ramp arrangement located in the north-east corner of the farm Dalyshope. The overburden material will be stockpiled until a sufficient void has been created within the pit to allow for in-pit tipping. The Run of Mine (ROM) coal will be transported to a pit-head primary crusher from where it will be transported by conveyor belt to the ROM stockpile before the washing plant. Selective mining of the coal seams is not required due to the specification of the product required but selective mining of the partings will be conducted.

Coal from the stockpile will be screened to remove -50 millimetre (mm) coal and fed into the cyclone plant whereby it will be washed at a density of 1.80 to produce the product and discard. Oversize coal will be crushed in a secondary crusher before re-joining the -50 mm coal. The product will be stockpiled before being transported to market by either road haulers on the district/provincial road or utilizing rail should a rail line prove economically viable. The discard will be taken by conveyor belt back to the pithead where it will be loaded into trucks to be deposited back into the bottom of the pit.

1.4 Proposed Infrastructure and Activities

The proposed infrastructure, and activities expected to impact the soil, land use and land capability, as well as the listed activities listed in terms of NEMA EIA Regulations (2014) are in Table 1-1 below. These activities are divided into the Construction, Operational, and Decommissioning Phases.

The main infrastructure includes:

- Contractors laydown yard;
- Temporary stockpiles for construction;
- Temporary Pollution Control Dam (PCD) for construction;
- OC1 pit
- ROM stockpiles;
- Slew product stockpiles;
- Discard facility;
- Topsoil, and subsoil stockpiles;
- Overburden (Hards/Softs) stockpiles
- Weighbridges;
- Conveyers belts;
- Workshop;
- Laboratory;
- Laundry facility
- Water tanks;
- Potable water Pipeline, and distribution;
- Dirty water pipeline;
- Sewage Treatment Plant
- Water Treatment Plant;
- Brine Pond
- Diesel/wash bay, and oil separator;
- Explosives magazine;
- Stormwater management infrastructure
- Powerline/s

- Two PCDs;
- Washing plant;
- Crush, and Screen plant;
- Offices;
- Change-house;
- Stores;
- Substation
- Rail link, and Rail loadout facility
- Brake-test ramp;
- LDV, and light vehicle access road;
- Truck access road; and
- Road upgrade (Steenbokpan to the site)

Table 1-1: Project Phases, and Associated Activities

Project Phase	Project Activity
Construction Phase	Site/vegetation clearance.
	Access, and haul road construction.
	Infrastructure construction.
	Topsoil stripping.
	Temporary PCD.
	Contractors laydown yard.
	Diesel storage, and explosives magazine.
Operational Phase	Open-pit establishment.
	Removal of rock (blasting).
	Diesel storage, and explosives magazine.
	Stockpiling (rock dumps, soils, ROM, discard dump) establishment, and operation.
	Operation of the open pit workings.
	Operating crush, and screen, and coal washing plant.
	Operating sewage, and water treatment plants.
	Water use, and storage on-site – during the operation water will be required for various domestic, and industrial uses. Water Management infrastructure including Two PCDs will be constructed that capture water from the mining area, which will be stored, and used accordingly. The workshop, and storage of chemicals; Laundry, and Laboratory services; Backfilling, and concurrent rehabilitation; Weighing of coal trucks; Coal transportation through trucking, rail, and conveyor belts; Washing of mine vehicles; and Fuelling of diesel on site.

Project Phase	Project Activity
	Storage, handling, and treatment of hazardous products (including fuel, explosives, and oil), and waste.
	Maintenance activities – through the operations maintenance will need to be undertaken to ensure that all infrastructure is operating optimally and does not pose a threat to human or environmental health. Maintenance will include, but not limited to haul roads, crushing, and washing plant, machinery, water, and stormwater management infrastructure, stockpile areas, and dumps.
Decommissioning Phase	Demolition, and removal of infrastructure – once mining activities have been concluded infrastructure will be demolished in preparation for the final land rehabilitation.
	Rehabilitation – rehabilitation mainly consists of spreading, and landscaping of the preserved subsoil, and topsoil, profiling of the land, and re-vegetation.
	Post-closure monitoring, and rehabilitation.

1.5 Alternatives Considered

Alternatives to be considered to ensure minimal impacts to the soil, land use, and land capability includes:

- Reduce surface infrastructure, and footprints on soils with high agricultural potential;
- Avoid construction and movement within 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 monitoring to ensure maintenance, concurrent rehabilitation is followed, and waste management plans are in place;
- Reduce waste materials, and waste outputs; and
- Replenish native soils after decommissioning.

2 Scope of Work

The Soil, Land Use, and Land Capability Impact Assessment comprised 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 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 predicted impacts on soils, land uses, and land capabilities due to implementation of the proposed Project.
- **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 National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA), and Mineral and Petroleum Resources Development Amendment Act, No. 49 of 2008 (MPRDA). The additional guidelines directing the Soil, Land Use and Land Capability Impact Assessment are detailed Table 3-1.

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

Legislation, Regulation, Guideline or By-Law	Applicability
National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). NEMA (as amended) was set in place following Section 24 of the Constitution. Certain environmental principles under NEMA must be adhered to, to inform decision making for issues affecting the environment. Section 24 (1)(a), and (b) of NEMA state that: *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 before their implementation, and reported to the organ of state charged by law with authorizing, permitting, or otherwise allowing the implementation of an activity.*	Activities that will influence the Soil, Land Use, and Land Capability of the proposed Project Area are listed in Section 1.4 and have been identified as Listed Activities in the Listing Notices (as amended), and therefore require environmental authorisation before being undertaken.

Legislation, Regulation, Guideline or By-Law	Applicability
The NEMA requires that pollution and degradation of the environment be avoided, or, where it cannot be avoided be minimised, and treated.	
National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) (NEM: WA). The NEM: WA seeks to regulate waste management to protect the health, and the 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.	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.
The Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) (CARA). 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 waterlogging, and the salinization of soils utilizing suitable soil conservation works to be constructed and maintained.	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.

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: Assumptions and Limitations

Assumptions, and Limitations	Consequences
A detailed soil chemical and physical analysis was not completed as per the scope. Soil characteristics and descriptions in the report were supported by data obtained from the Soil Survey Report (Digby Wells, 2013).	No updated soil baseline analysis data to use for rehabilitation, and soil remediation purposes.
The area surveyed during a 2-day site visit was based on the initial layout plan provided by UCD.	The Project Area was focused on the proposed pit area (OC1), and the infrastructure areas. Only the farms Klaarwater and Dalyshope were assessed.

Assumptions, and Limitations	Consequences
Land suited for crop production was assumed to be suitable for other, less intensive uses such as pasture, natural grazing, forestry, and wildlife.	No consequence. Land identified to be of agricultural importance for crop production is 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 fully accurate.
The soils within the capability classes are similar only concerning the degree of limitations in soil used for agricultural purposes or concerning 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 on the soils.

5 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, several tasks needed to be completed, and these tasks are explained separately below.

5.1 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. This included:

- 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). 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.
- 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.
- 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 the publicly available information.
- 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.

- Background information, and historically conducted reports, including:
  - Universal Coal, 2020. Dalyshope CHPP, Process Description. Rev A.
  - Digby Wells Environmental, 2014. Soil Survey Report for the Proposed Dalyshope Coal Mine, VEN1590; 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).

5.2 Soil Classification

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

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 m or 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 South African Soil Classification Taxonomic System (Soil Classification Working Group, 1991). The following attributes were noted 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.

5.3 Land Suitability (Agricultural Potential)

The process of land suitability classification is the grouping of specific areas of land in terms of their suitability for defined a land use. Soil agricultural potential and suitability mapping was completed 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.*, (2002) were used.

Soil chemical, physical, and biological processes depend on five soil-forming factors: time, topography, organic material, climate, and parent material. These soil-forming factors change 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 described in Table 5-1:

Table 5-1: Land Classes - Descriptions, and Suitability

Class	Definition	Conservation Need	Use-Suitability
I	• No or few limitations. • Very high arable potential. • Very low erosion hazard.	Good agronomic practice.	Annual cropping.
II	• Slight limitations. • High arable potential. • Low erosion hazard.	Adequate run-off control	Annual cropping with special tillage or ley (25 %).
III	• Moderate limitations. • Some erosion hazards.	Special conservation practice, and tillage methods.	Rotation of crops, and ley (50 %).
IV	• Severe limitations. • Low arable potential. • High erosion hazard.	Intensive conservation practice.	Long term leys (75 %).
V	• Watercourse, and land with wetness limitations.	Protection, and control of water table	Improved pastures or Wildlife
VI	• Limitations preclude cultivation. • Suitable for perennial vegetation.	Protection measures for establishment e.g. Sod-seeding	Veld, and/or afforestation
VII	• Very severe limitations. • Suitable only for natural vegetation.	Adequate management for natural vegetation.	Natural veld grazing, and afforestation.
VIII	• Extremely severe limitations. • Not suitable for grazing or afforestation.	Total protection from agriculture.	Wildlife.

5.4 Land Capability

The 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 Schoeman *et al*. (2000) was used to assess land capability. The classification system is made up of land capability classes, and land capability groups (Table 5-2). The land will be rated into eight classes which include a 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 (Schoeman *et al.,* 2002).

Table 5-2: Land Capability Classes

<table>
<tr><th>Class</th><th colspan="9">Increased Intensity of Use</th><th>Land Capability Groups</th><td rowspan="9">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</td></tr>
<tr><td>I</td><td>W</td><td>F</td><td>LG</td><td>MG</td><td>IG</td><td>LC</td><td>MC</td><td>IC</td><td>VIC</td><td rowspan="4">Arable land</td></tr>
<tr><td>II</td><td>W</td><td>F</td><td>LG</td><td>MG</td><td>IG</td><td>LC</td><td>MC</td><td>IC</td><td>-</td></tr>
<tr><td>III</td><td>W</td><td>F</td><td>LG</td><td>MG</td><td>IG</td><td>LC</td><td>MC</td><td>-</td><td>-</td></tr>
<tr><td>IV</td><td>W</td><td>F</td><td>LG</td><td>MG</td><td>IG</td><td>LC</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>V</td><td>W</td><td>-</td><td>LG</td><td>MG</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Grazing land</td></tr>
<tr><td>VI</td><td>W</td><td>F</td><td>LG</td><td>MG</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>VII</td><td>W</td><td>F</td><td>LG</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Wildlife</td></tr>
<tr><td>VIII</td><td>W</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
</table>

5.5 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.

5.6 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 international 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.

A detailed methodology is described in Appendix A.

6 Details of the Specialist

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

- **Arjan van 't Zelfde** is a Senior Consultant with 13 years' experience in soil science and hydrogeology. Arjan received an MSc. degree in Soil Science (SAQA approved) as part of the BSc/MSc program 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 Department 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 joined Digby Wells in 2019. She has four years of experience in Soil Science and Environmental Sciences and currently focuses on soils in the Closure, Rehabilitation, and Soils Department where she will be doing site surveys, compiling soil reports, assist with compiling rehabilitation, and closure plans as well as assisting within the Wetlands Department with report writing, and wetland work. Willnerie previously worked as a Soil Scientist and Wetland Consultant where she mainly focused on wetland delineations, compiling reports, EIA's, and water use licensing. She then worked for two years in the Agricultural sector, specializing in irrigation scheduling.
- **Aamirah Dramat** is a Rehabilitation Intern in the Rehabilitation, Closure, and Soils Department at Digby Wells. She received her Bachelor of Science in Biology, and Environmental, and Geographical Science as well as her Honours degree in Biological Sciences from the University of Cape Town. She joined Digby Wells in 2020.

7 Findings and Discussion

The baseline and background information describing the Project Area is described in the subsections below.

7.1 Climate, and Rainfall

Climate refers to the precipitation and temperature conditions of an area over a specific period. Climate has a significant influence on soil properties and are therefore one of the five soil-forming factors. All biological, physical, and chemical reactions are reliant on soil moisture and soil temperature. Soils with higher moisture content and higher temperature tend to be more developed than cooler, drier soils. Climate, therefore, is important to consider due to the influences on the soils, land uses and land capabilities.

The Project Area falls within the Limpopo Climatic Zone characterized by warm, wet summers, and dry winters (South Africa Weather Bureau, 1986) with rainfall predominantly occurring in the summer months (November to February). Lephalale, which is approximately 60 kilometres (km) away from the proposed Project Area is generally dry, due to low rainfall per annum, and warm to hot summers with an average daily temperature of 21.1 Degrees Celsius (°C). The mean annual precipitation (MAP) is approximately 437 mm with the bulk of precipitation being experienced during the summer months (October to April). Annual average maximum, minimum, and mean temperatures for the Project Area are given in the figure below (Figure 7-1).

Lephalale lies on 829 meters above mean sea level (m.a.m.s.l.) and is influenced by the local steppe climate. The climate is considered BSh (hot semi-arid) according to the Köppen-Geiger climate classification. The driest month is July with an average of 2 mm of rainfall, whereas in January the rainfall peaks with an average of 91 (mm).

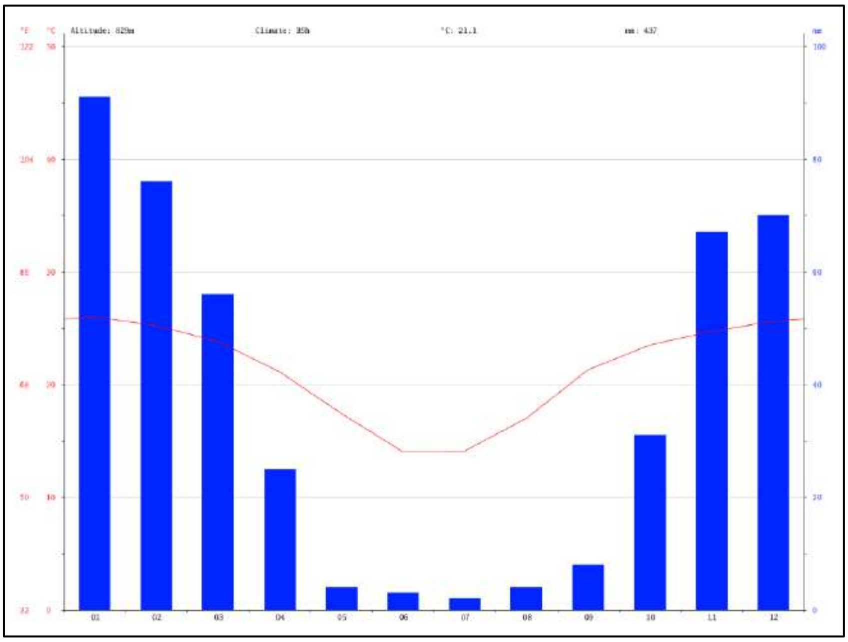


Figure 7-1: Annual Climate Trends in Lephalale

(Source: Climate-data.org, 2019)

Climate can alter the land use, and land capability of an area through higher mean annual temperatures, altered precipitation patterns, and frequent weather events. As climate patterns change over a season, vegetation, hydrological functioning, and geomorphological changes take place. Climate directly impacts the growth of vegetation, and crops, therefore directly influencing the land capability. Climate data are therefore considered during the compilation of a Soil, Land Use, and Land Capability Assessment as well as in all rehabilitation and mitigation plans.

7.2 Topography

The topography and slope of the Project Area, as depicted in Figure 7-2 and Figure 7-3, can be described as flat with slight to moderate undulating plains with some small depressions scattered throughout the landscape, containing alluvial deposits. The Project Area is on gentle slopes, averaging from 0 to 0.7 °, with elevations ranging between approximately 789 to 850 m.a.m.s.l.. Drainage predominantly flows in a northern direction towards the Limpopo River. Activities related to change to the natural topography include:

- Agro-pastoral activities;
- Roads, powerlines, and fence lines; and
- Infrastructure, including buildings, and dams.

Terrain-morphological units in the landscape were not easily distinguished, however, two small pans were identified within the Project Area. Clear signs of water accumulation take place in the identified depression areas during the rainy season (September to April), however, dries up during the rest of the year. As such, these pans can be described as seasonal pans.

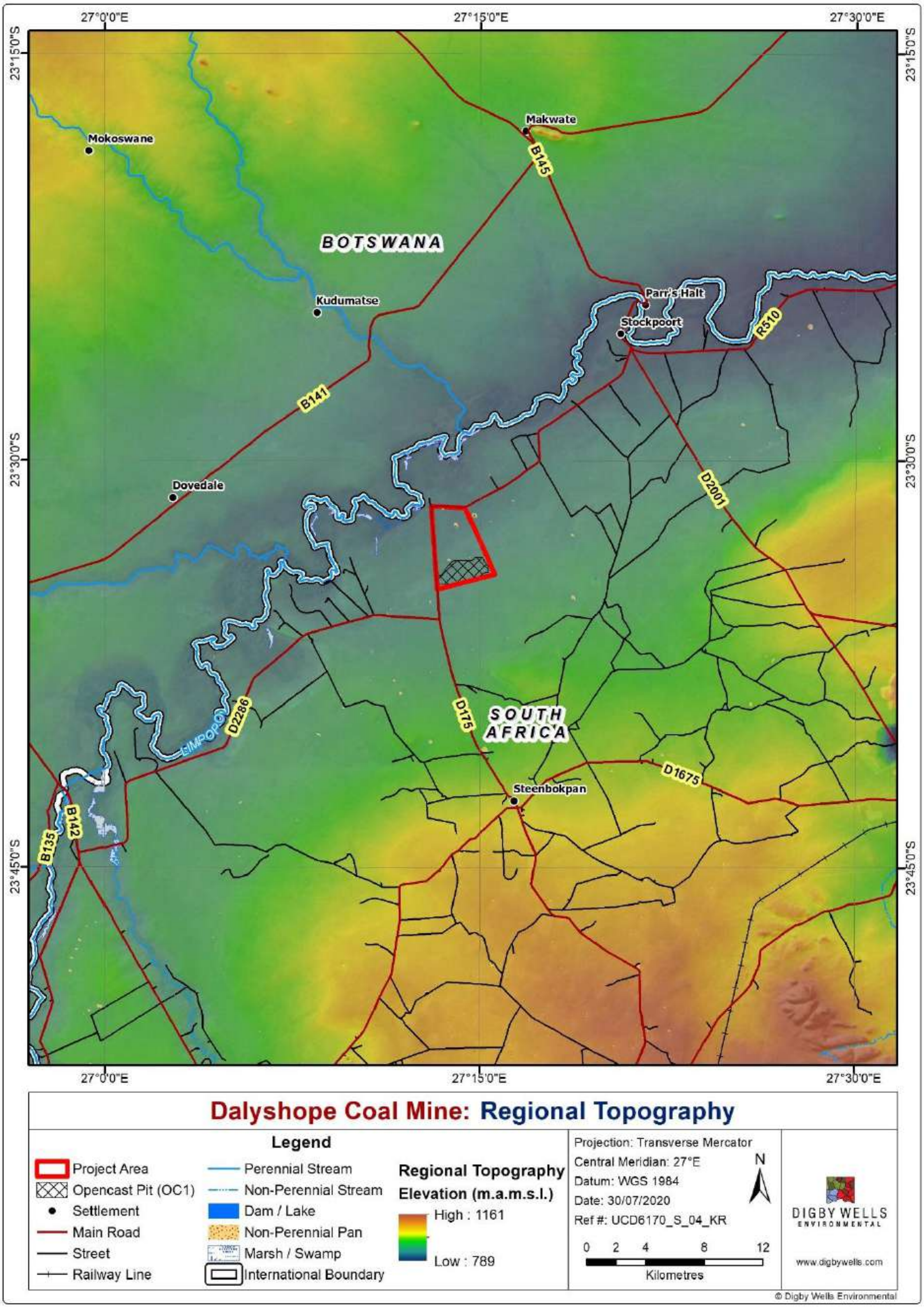


Figure 7-2: Topography

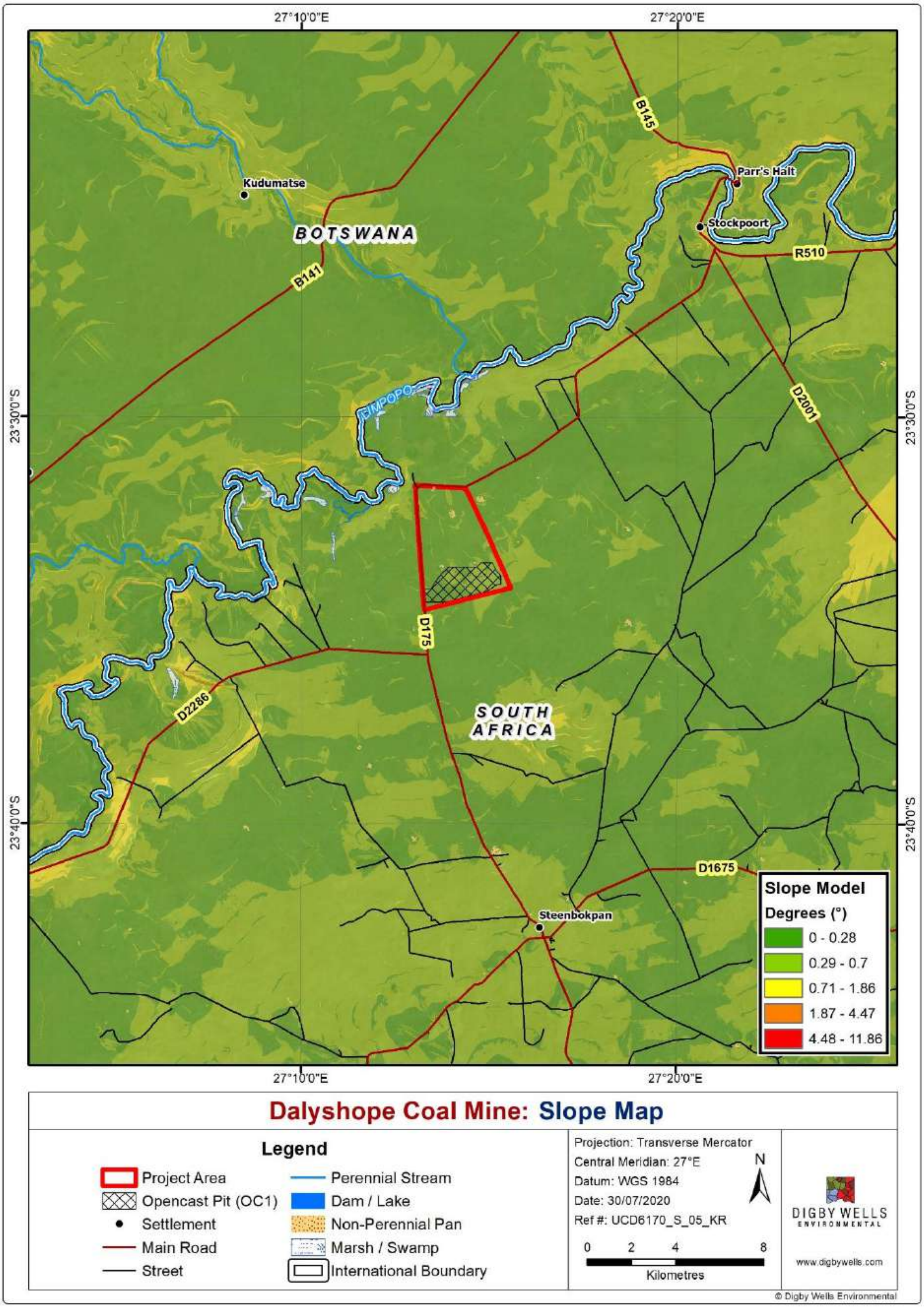


Figure 7-3: Slope

7.3 Geology

7.3.1 Regional Geology

The coal resources of South Africa are hosted within the Karoo Supergroup, which has been divided into 19 coal fields. The Project Area falls within the Ellisras Basin coal fields. Coal extracted from the Karoo Supergroup varies significantly in grade, type, thickness, and lateral extent due to climate, biomes, environments, and structural disturbances (Johnson *et al*., 2006) (Figure 7-4).

The main structural disturbances to the Karoo Supergroup are associated with the intrusion of dolerite dykes, and sills, which displace the coal resource (Johnson *et al.,* 2006), however, there are no dolerite exposures in the Ellisras Basin. The Ellisras Basin is bounded by the Eenzaamheid, and Zoetfontein faults, as well as the Daarby fault on the eastern boundary with extensive minor faulting, and magnetic lineaments present within the Ellisras Basin itself.

Swartrant and Grootegeluk Formations form part of the Ellisras Basin consisting of depositional features accepted by the meandering river, and floodplain environment. The lithology of the Project Area is Siliciclastic Rock (Figure 7-5). Siliciclastic rock can be described as non-carbonaceous sedimentary rock with a high silica content, either as forms of quartz or other silicate minerals. These sedimentary rocks form from precipitation from fluids or through a biochemical process of living organisms by processes such as erosion, transportation, lithification, or deposition.

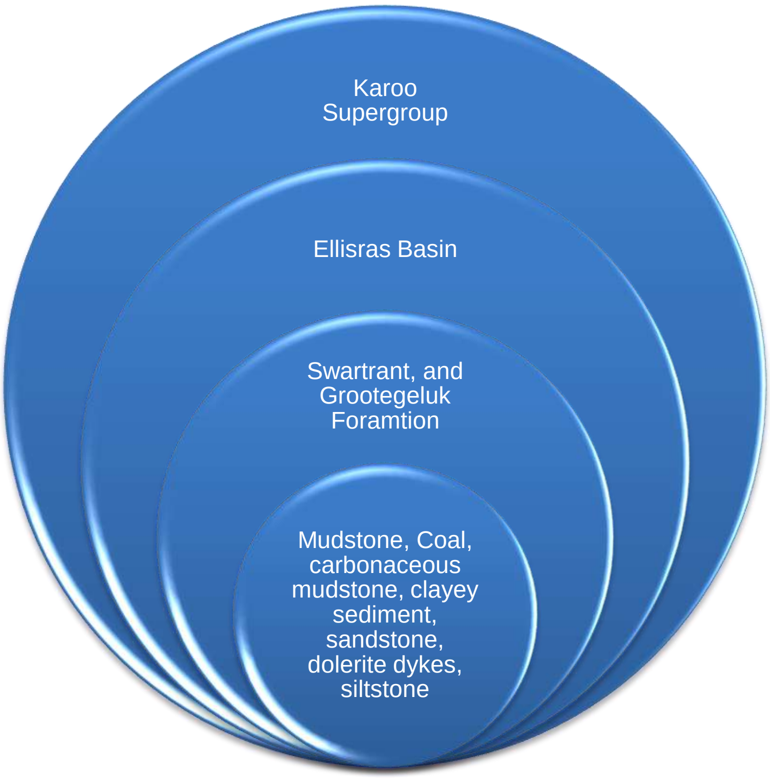
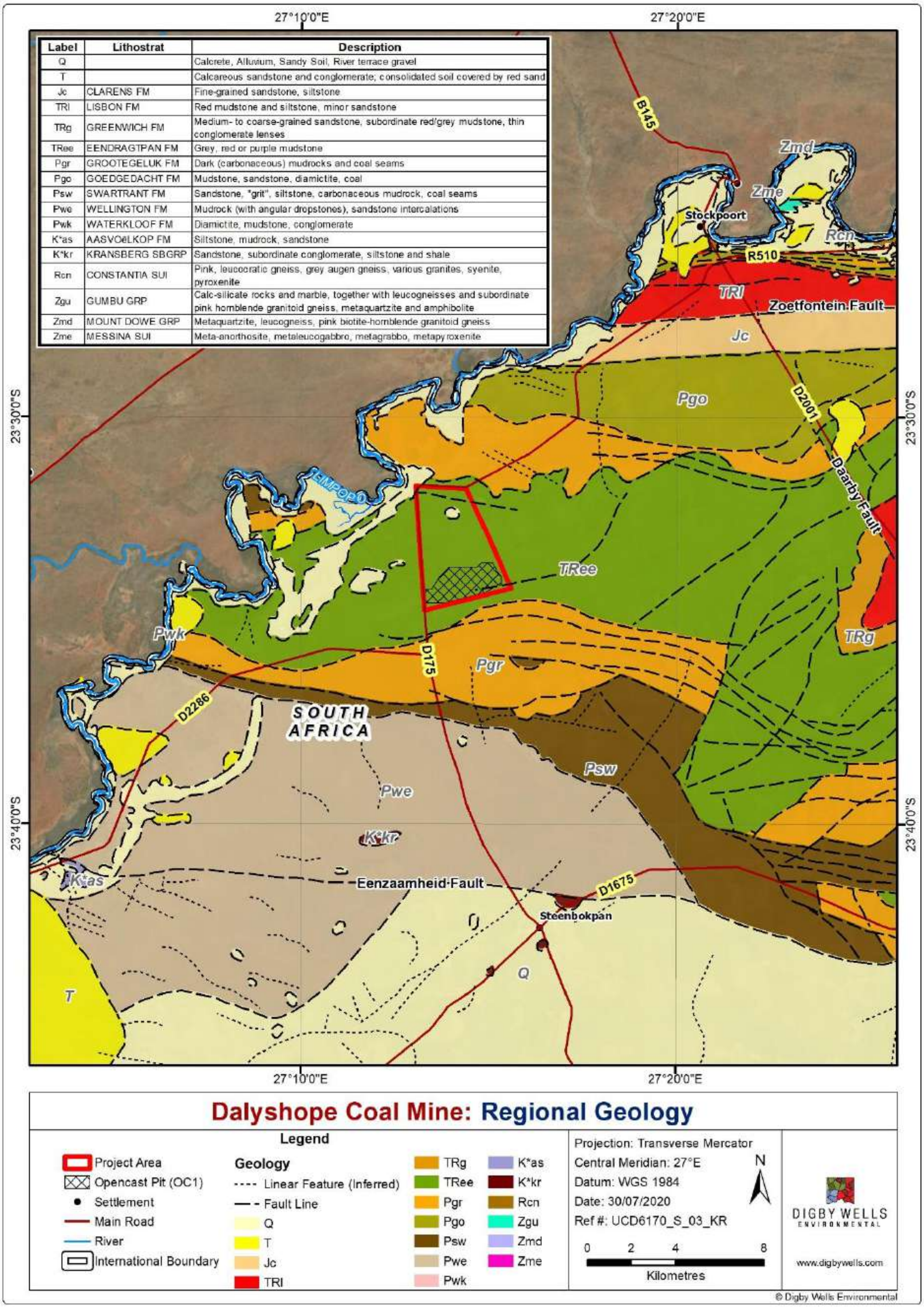


Figure 7-4: Geology

7.3.2 Local Geology

The Ellisras Basin consists of deposits representing formations of the Karoo Supergroup, and different depositional environments. The Grootegeluk Formation is an economically important formation within the Ellisras Basin containing an approximate 80 m thick coal deposit. The coal seams of the Swartrant Formation, adjacent to the Project Area, comprised three distinct seams varying in thickness from 0.5 m to 8 m, which are separated by sandstone, siltstone, and mudstone inter-burden (Universal Coal, 2020).

The Grootegeluk Formation is covered by the Eendragtpan Formation comprising of variegated mudstones (Johnson *et al.*, 2006). The weathered profile consists of calcareous material forming drainage channels and small pans.



Label	Lithostrat	Description
Q		Calcrete, Alluvium, Sandy Soil, River terrace gravel
T		Calcareous sandstone and conglomerate; consolidated soil covered by red sand
Jc	CLARENS FM	Fine-grained sandstone, siltstone
TRl	LISBON FM	Red mudstone and siltstone, minor sandstone
TRg	GREENWICH FM	Medium- to coarse-grained sandstone, subordinate red/grey mudstone, thin conglomerate lenses
TRee	EENDRAGTPAN FM	Grey, red or purple mudstone
Pgr	GROOTEGELUK FM	Dark (carbonaceous) mudrocks and coal seams
Pgo	GOEDGEDACHT FM	Mudstone, sandstone, diamictite, coal
Psw	SWARTRANT FM	Sandstone, "grit", siltstone, carbonaceous mudrock, coal seams
Pwe	WELLINGTON FM	Mudrock (with angular dropstones), sandstone intercalations
Pwk	WATERKLOOF FM	Diamictite, mudstone, conglomerate
K*as	AASVOëLKOP FM	Siltstone, mudrock, sandstone
K*kr	KRANSBERG SBGRP	Sandstone, subordinate conglomerate, siltstone and shale
Rcn	CONSTANTIA SUI	Pink, leucocratic gneiss, grey augen gneiss, various granites, syenite, pyroxenite
Zgu	GUMBU GRP	Calc-silicate rocks and marble, together with leucogneisses and subordinate pink hornblende granitoid gneiss, metaquartzite and amphibolite
Zmd	MOUNT DOWE GRP	Metaquartzite, leucogneiss, pink biotite-hornblende granitoid gneiss
Zme	MESSINA SUI	Meta-anorthosite, metaleucogabbro, metagrabbo, metapyroxenite

Figure 7-5: Regional Geology

7.4 Vegetation

7.4.1 Regional Vegetation

The regional vegetation of the Project Area consists of Limpopo Sweet Bushveld forming part of the Savanna Biome, illustrated in Figure 7-6 (Mucina & Rutherford, 2006).

The Limpopo Sweet Bushveld consists of plains, sometimes undulating or irregular, traversed by various tributaries of the Limpopo River. The landscape contains short open woodland, and thickets of *Senegalia erubescens* distributed over the area. The Limpopo Sweet Bushveld extends from the lower reaches of the Crocodile, and Marico Rivers, down the Limpopo River Valley including Lephalale, and into the tropics, past Tom Burke to the Usutu border post and Taaiboschgroet area in the north. The vegetation unit also extends over the border into Botswana.

The conservation status of the unit is **Least Threatened**, with approximately 5% of the area being transformed, mainly by cultivation. This can be attributed to the overall low rainfall of the area. These areas have the potential for game and cattle farming due to the high grazing capacity of the sweet veld. The spectrum of soil types ranges from high drainage apedal sandy soils to poorly drained, dark clayey soils (SANBI, 2006).

7.4.2 Local Vegetation

The vegetation was similar to the description provided by Mucina, and Rutherford (2006). Dominant species included *Boscia sp. and Grewia sp*. Various portions of the Project Area were dominated by smaller trees of *S. erubescens, Terminalia cinerea, Dichrostachys cinerea, Combretum apiculatum*, and interspersed with *Commiphora pyracanthoides*, and numerous forbs such as *Crotalaria sp., Tephrosia multijuga, and Tribulus terrestris*. No Red Data species were observed within the Project Area, however, four Species of Special Concern were identified, including, *Boscia albitrunca, Combretum imberbe, Vachellia erioloba, and Grewia rogersii* (Digby Wells, 2020).Table 7-1 illustrates the vegetation types observed during the site visit.

Table 7-1: Vegetation Types (Field survey photos, February 2020)

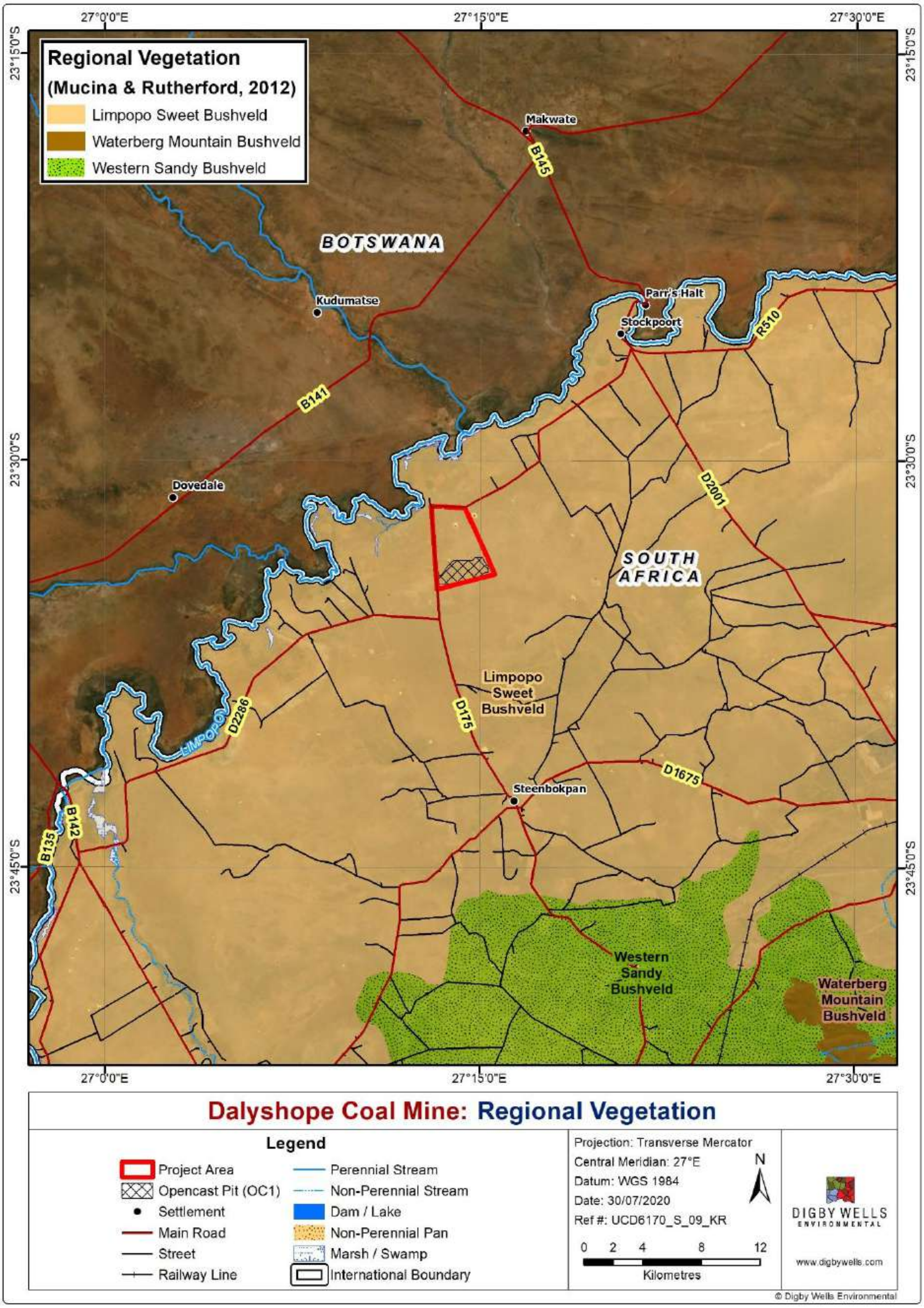


Figure 7-6: Regional Vegetation

7.5 Land Type

Baseline data suggested that the land types for the Project Area are predominantly of the **Ah86** type with a small portion of the **Ae257** type. The dominant land types and dominant soil forms are briefly described below in Table 7-2 as per the Land Type Survey Staff, (1972 – 2006), and illustrated in Figure 7-7.

Table 7-2: Land Type, and Dominant Soil Forms

Land Type	Soil Forms	Geology	Characteristics
Ae257	• Hutton • Shortlands • Valsrivier • Oakleaf • Clovelly • Arcadia • Mispah • Glenrosa	• Sandstone, and siltstone of the Clarens Formation; and • Undifferentiated shale, sandstone, mudstone, alluvium, and coal of the Karoo Sequence.	• 500 ha estimated area unavailable for agriculture; • Slopes are between 0, and 4%; • Depths mainly deeper than 1200 mm, with some areas with shallow soils of 50 mm; • 93% of the soils occurring in the foot slope terrain; • Dominant soil types are well-drained, sandy, red apedal soils; and • Clay content varying between 8, and 25 % in the B-horizon.
Ah86	• Hutton • Clovelly • Fernwood • Kroonstad • Avalon • Glencoe • Valsrivier • Oakleaf • Katspruit	• Sandstone, alluvium, and mudstone of the Waterberg Group (Matlabas subgroup); and • Undifferentiated shale, sandstone, and coal of the Karoo Sequence.	• 1000 ha estimated area unavailable for agriculture; • Slopes are between 1, and 3%; • Depths mainly deeper than 1200 mm; • 83% of the Ah86 occurs in the foot slope terrain; and • Dominant soil types are well-drained, sandy, red apedal soils.

Soils as part of these land types are red to yellow apedal sandy soils which are generally freely drained and have a high base status. As per the Land Type Survey Staff, (1972 – 2006) soils under land type **Ah86** have greater than 15% clay content while Ae257 land type indicates deep, sandy soils with depths usually deeper than 300 mm (Figure 7-7). The red, sandy nature of the soils in the Project Area is commonly an indication of moderate potential soils for agriculture. The soils are susceptible to leaching, and possible sodification increasing the pH of the soil. The dominant soils in the Project Area have a low clay content thus low water holding capacity and base saturation, whereas the soils within the pan areas have a very high clay content, causing saturation conditions for long enough periods to alter the vegetation, and soil morphology (mottles).

Maintaining the productivity of such soils requires control of flocculation-dispersion behaviours. Poor land management of these soils can also lead to induced secondary salinity.

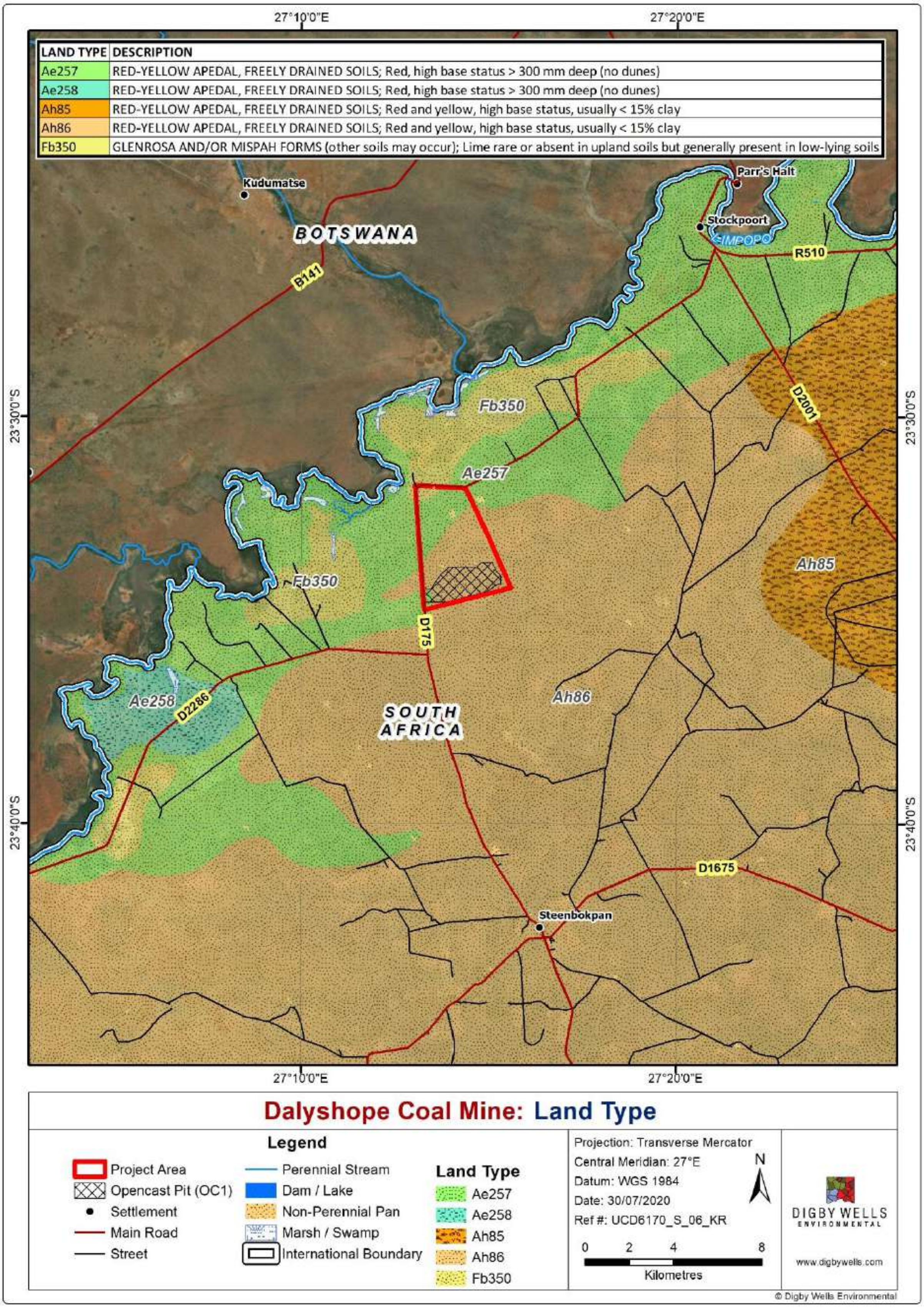


Figure 7-7: Land Type

7.6 Soil Forms

The soil forms within the Project Area are described in the subsections below together with photos taken during the field survey. Hutton, Clovelly, Oakleaf, Glencoe, and Kroonstad soil forms dominate the Project Area (Figure 7-8).

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 Hard-Plinthic B-horizon; and
- Soft Plinthic, G, and Neo-cutanic B-horizons were dominant in the pan regions. These soils are high clay, young soils with clear evidence of emerging soil development in the form of colour variations and clay lamellae.

The Orthic A-horizons are generally low in organic carbon while the Apedal B-horizons consist of uniform yellow-brown to red, iron-rich pigmented chroma soils. The Apedal soils identified on-site are deep, sandy, well-drained soils that are generally low in organic carbon but are rather easily manageable soils for cultivation. Carbonaceous soils were evident in some parts of the Project Area with lime concretions on the surface and within the soil matrix. This suggests soils with high pH levels that may lead to brackish soils when mismanaged, this in return can lead to vegetation, and basal cover restrictions, and land capability deterioration.

Some areas within the Project Area showed limited soil depths with high volumes of peds (an individual, natural soil aggregate), gravel, and stones. These characteristics caused restricted handheld auguring, and will restrict rooting depth, and root development. This may limit the cultivation potential (decrease land capability) of the area and can lead to underestimated volumes of calculated soil volumes.

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, and therefore increasing the agricultural potential. Oakleaf soils consist of a neo-cutanic B-horizon, indicating unconsolidated material from alluvial or colluvial origin typically found within the pans or low-lying areas in the topography. Kroonstad and Glencoe soils consist of sandy, from yellow-brown B-horizons to bleached B-horizons indicating interflow soils, high drainage, and high leaching potential, however, these soils have a high leachability, and often low in soil organic material.

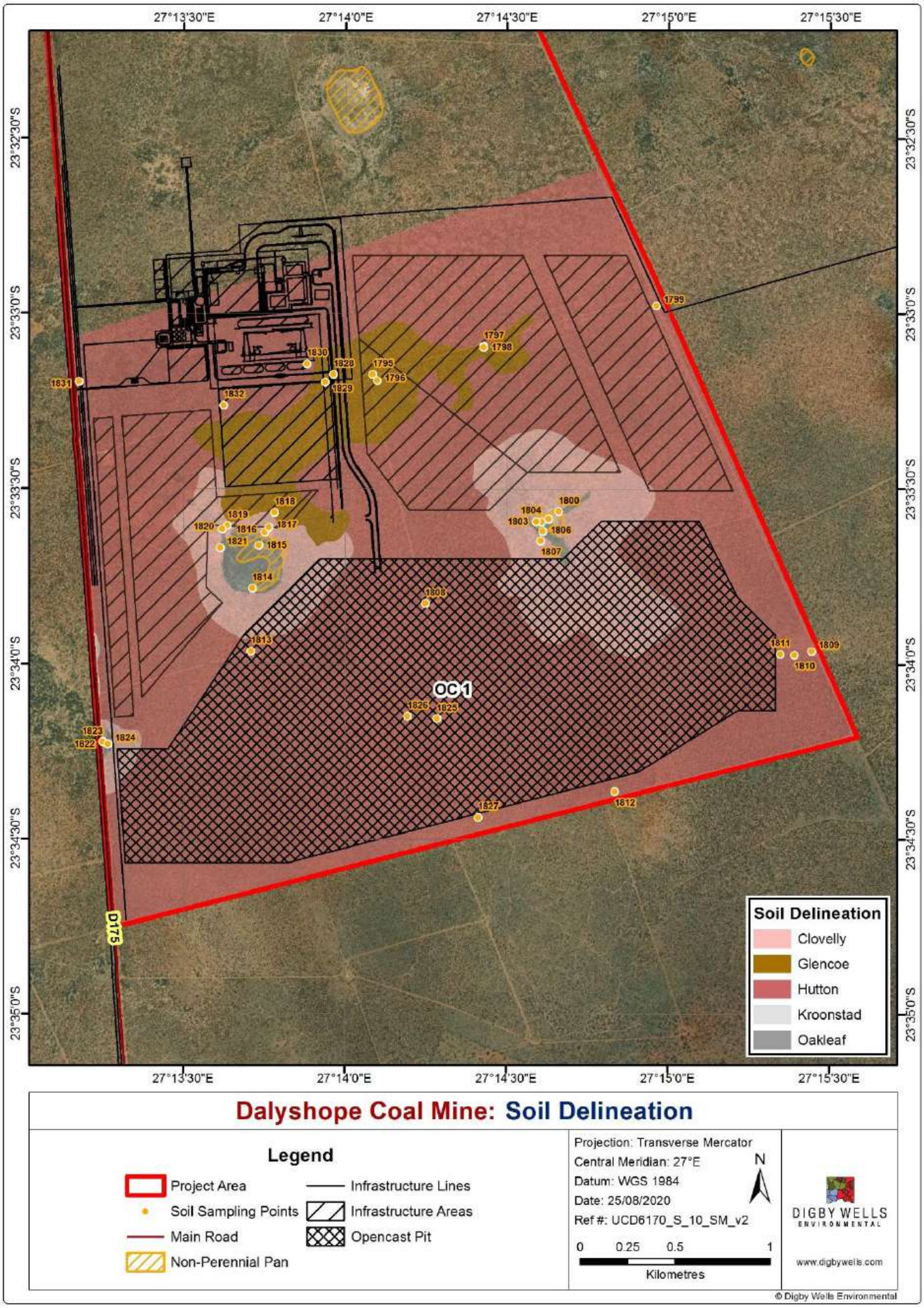


Figure 7-8: Soil Delineation

7.6.1 Hutton Soil Form

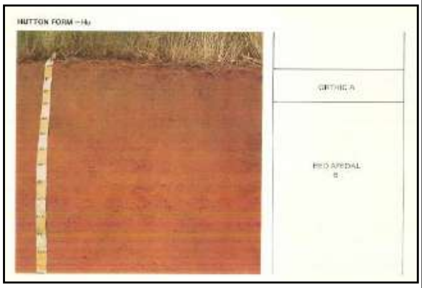
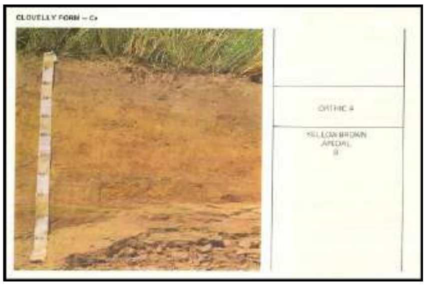
<table>
<tr><td>Soil Sequence</td><td>Orthic A-horizon</td><td colspan="2">Red Apedal B-horizon</td><td colspan="2">Red Apedal B-horizon</td><td rowspan="2">

Figure 7-9: Typical profile for the Hutton Soil Form</td></tr>
<tr><td>Master Horizons</td><td>A</td><td colspan="2">B</td><td colspan="2">B</td></tr>
<tr><td>Average Depth</td><td colspan="2">0 – 150 mm</td><td colspan="2">150 – 1200 mm</td><td colspan="2">1200 mm +</td></tr>
<tr><td>Horizon Description</td><td colspan="2">Dark reddish-brown, medium sandy loam, structureless massive, loose, many matrix pores, many roots, gradual smooth transition.</td><td colspan="2">Red, coarse sandy loam, structureless, massive loose, many matrix pores, common roots, gradual transition.</td><td colspan="2">Red (moist), coarse sandy loam, structureless, massive, friable, many matrix pores, few roots, gradual transition.</td></tr>
<tr><td>Site Specific Soil Description</td><td colspan="6">Hutton soil forms are usually deep, uniformly red, sandy (apedal) soils that are well-drained, and has low organic carbon content, and 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.</td></tr>
<tr><td colspan="7">Hutton Soil Form (Field Survey Photos, February 2020)</td></tr>
<tr><td colspan="4">
Hutton soil form. Orthic A-horizon overlying a Red Apedal B-horizon (>1.2m).</td><td colspan="3">
Dark, reddish-brown, loamy-sand soil, structureless with high drainage potential.</td></tr>
</table>

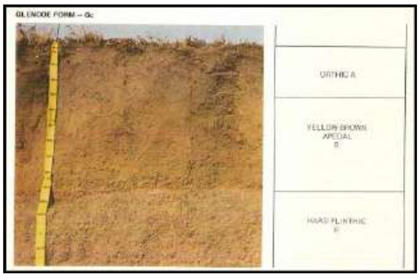
7.6.2 Clovelly Soil Form

<table>
<tr><td>Soil Sequence</td><td>Orthic A-horizon</td><td>Yellow-brown Apedal B-horizon</td><td>Yellow-brown Apedal B-horizon</td><td rowspan="2">
Figure 7-10: Typical profile for the Clovelly Soil Form</td></tr>
<tr><td>Master Horizons</td><td>A</td><td>B</td><td>B</td></tr>
<tr><td>Average Depth</td><td>0 – 150 mm</td><td colspan="2">150 – 1200 mm</td><td>1200 mm +</td></tr>
<tr><td>Horizon Description</td><td>Brown, coarse sandy, single grain, loose, many matrix pores, common roots, gradual smooth transition.</td><td colspan="2">Reddish yellow, coarse sand single grain, loose, many matrix pores, common roots, gradual smooth transition.</td><td>Reddish yellow, fine sand, single grain, loose, many matrix pores, few roots</td></tr>
<tr><td>Site Specific Soil Description</td><td colspan="4">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 leached, and has higher drainage than that of the red soils and are poorer in nutrients.</td></tr>
<tr><td colspan="5">Clovelly Soil Form (Field Survey Photos, February 2020)</td></tr>
<tr><td colspan="2">
Clovelly soil form. Orthic A-horizon overlying a Yellow-brown Apedal B-horizon (>1.2 m).</td><td colspan="3">
Greyish-brown, sandy-loam, structureless soil with high drainage potential.</td></tr>
</table>

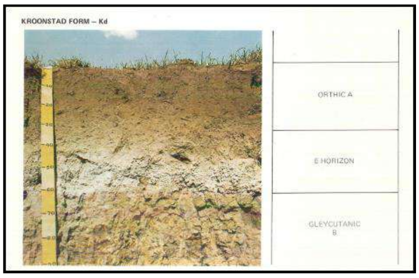
7.6.3 Oakleaf

<table>
<tr><td>Soil Sequence</td><td>Orthic A-horizon</td><td>Neo-cutanic B-horizon</td><td colspan="2">Unspecified (Hard rock)</td><td rowspan="2">
Figure 7-11: Typical profile for the Oakleaf Soil Form</td></tr>
<tr><td>Master Horizons</td><td>A</td><td>B</td><td colspan="2">R</td></tr>
<tr><td>Average Depth</td><td colspan="2">0 – 100 mm</td><td colspan="2">100 – 650 mm</td><td>650 mm +</td></tr>
<tr><td>Horizon Description</td><td colspan="2">Reddish-brown, clay loam, weak structure, medium subangular blocky, few matrix pores, common roots, gradual smooth transition, lime concretions on the surface.</td><td colspan="2">Brown to dark brown, clay loam, weak structure, medium granular, slightly firm, few matrix pores, few fine lime concretions, few roots, wavy transition.</td><td>Hard rock, restricted layer.</td></tr>
<tr><td>Site Specific Soil Description</td><td colspan="5">Oakleaf soil forms consist of a neo-cutanic B-horizon which contains traces of calcium, and calcium-magnesium however, not enough to test for in the field with cold 10% hydrochloric acid. These soils have an unconsolidated material and have an aggregation of soil particles, and somewhat structure in the B-horizon. These soils were mainly found in the lower-lying areas in the proximity of the pans. Neo-cutanic B-horizons typically form from alluvial or colluvial processes and are typically found in foot-slope and riverbed landscape areas.</td></tr>
<tr><td colspan="6">Oakleaf Soil Form (Field Survey Photos, February 2020)</td></tr>
<tr><td colspan="3">
Oakleaf soil form. Orthic A-horizon overlying a Neo-cutanic B-horizon (>1.2 m).</td><td colspan="3">
Weak structure, aggregation of peds, and cutans present, sandy-clay-loam soil.</td></tr>
</table>

7.6.4 Glencoe

<table>
<tr><td>Soil Sequence</td><td>Orthic A-horizon</td><td>Yellow-brown Apedal B-horizon</td><td>Hard Plinthic B</td><td rowspan="2">
Figure 7-12: Typical profile for the Glencoe Soil Form</td></tr>
<tr><td>Master Horizons</td><td>A</td><td>B</td><td>B</td></tr>
<tr><td>Average Depth</td><td>0 – 150 mm</td><td colspan="2">150 – 1000 mm</td><td>1000 mm +</td></tr>
<tr><td>Horizon Description</td><td>Brown, coarse sandy, single grain, loose, many matrix pores, common roots, gradual smooth transition.</td><td colspan="2">Reddish-brown, coarse sand single grain, loose, many matrix pores, common roots, gradual smooth transition.</td><td>Dark red with mottles (wet), clayey fine grain, few matrix pores, few roots.</td></tr>
<tr><td>Site Specific Soil Description</td><td colspan="4">Glencoe soil forms within the Project Area were predominantly shallow and had a restricting layer at 800 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.</td></tr>
<tr><td colspan="5">Glencoe Soil Form (Field Survey Photos, February 2020)</td></tr>
<tr><td colspan="2">
Glencoe soil form. Orthic A-horizon overlying a Yellow-brown Apedal B-horizon overlying a Hard Plinthic B.</td><td colspan="3">
Weak structure overlying a low permeable Hard Plinthic layer with Fe-and Mn-oxides.</td></tr>
</table>

7.6.5 Kroonstad

<table>
<tr><td>Soil Sequence</td><td>Orthic A-horizon</td><td>E-horizon</td><td>G-horizon</td><td rowspan="2">
Figure 7-13: Typical profile for the Kroonstad Soil Form</td></tr>
<tr><td>Master Horizons</td><td>A</td><td>B1</td><td>B2</td></tr>
<tr><td>Average Depth</td><td>0 – 100 mm</td><td colspan="2">100 - 200 mm</td><td>200 mm +</td></tr>
<tr><td>Horizon Description</td><td>Light yellow-brown, coarse sandy, single grain, loose, many matrix pores, few roots, gradual smooth transition.</td><td colspan="2">Light yellow to bleached (grey), coarse sand single grain, loose, many matrix pores, few roots, gradual smooth transition.</td><td>Light grey-brown with mottles (wet), sandy-clay-loam, macro matrix pores, few roots.</td></tr>
<tr><td>Site Specific Soil Description</td><td colspan="4">Kroonstad soil forms were identified within the pans or in the proximity of the pans. These soils are higher in clay content with clear signs of mottles within the first 500 mm of the profile. E-horizons are grey, leached, sandy soils with low structure. They are grey and has a loose consistency. The G horizon has a higher clay content with an accumulation of iron, and manganese oxides, forming mottles. These horizons are saturated for long periods and have noticeable clay accumulation.</td></tr>
<tr><td colspan="5">Kroonstad Soil Form (Field Survey Photos, February 2020)</td></tr>
<tr><td colspan="2">
Kroonstad soil form. Orthic A-horizon overlying an E-horizon overlying a Soft Plinthic B. Wetland Soil.</td><td colspan="3">
E-horizon has a weak structure overlying a low permeable G-horizon layer with Fe-and Mn-oxides, and signs of wetness.</td></tr>
</table>

7.7 Land Capability

The land capability was determined by assessing the combination of soil type, terrain, and climate features. Land capability is defined as the most intensive long-term sustainable use of land under rain-fed conditions (Schoeman et al., 2000). The land capability of the entire Project Area is **Class V** (Grazing – Moderate Grazing) (Figure 7-14). The Project Area is not yet disturbed by mining activities but currently used for wildlife and cattle grazing. The dominant land capability is grazing due to the dry climate and high evaporative demand present. The Lephalale area falls in the summer rainfall region. During the summer seasons, the average sunshine duration is 65%, and the temperature varies around 32 °C. The summer evening temperatures are moderate. The sunshine duration throughout the winter months is as high as 80% while the temperature varies around 21 °C (www.weathersa.co.za).

Class V (Grazing – moderate) is described as:

Generally, not suitable for cultivation. The soils have little or no erosion hazard but have other limitations. They are impractical to remove thus limiting their use. The areas are generally used for pasture, range, forestland, or wildlife for food, and cover.

The soils in this class have restrictions regarding cultivations which can limit plant growth and prevent normal tillage of cultivated crops lands. Some limitations include that the soils are frequently wet, and overflowed by streams, are stony, and have climate limitations. These soils are nearly level, and created ponding, and prevent drainage of cultivated crops. The soils are not feasible to cultivate, and mainly suitable for grasses or trees.

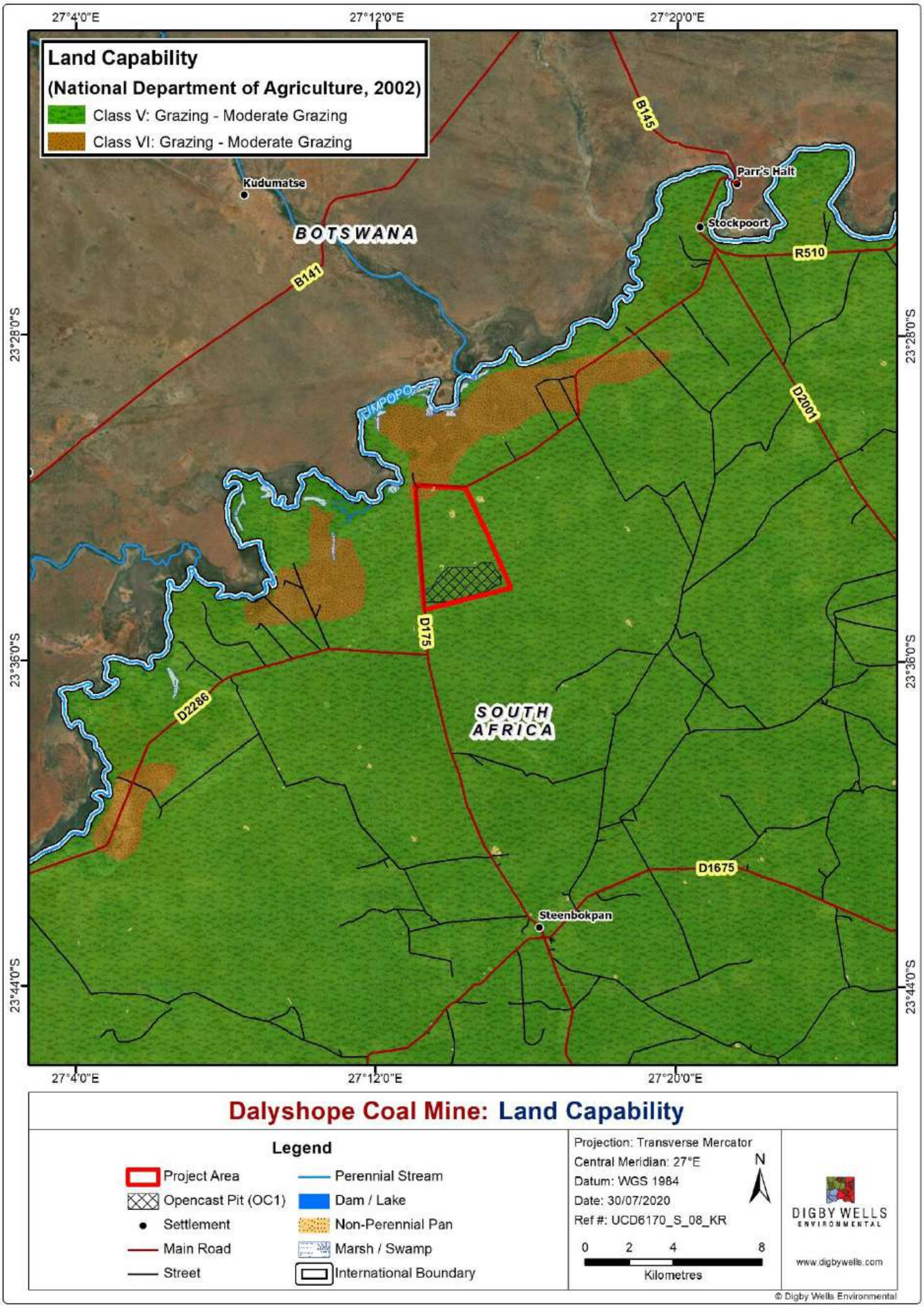


Figure 7-14: Land Capability of Dalyshope Mine

7.8 Land Use

The dominant land use in the Project Area is agriculture, dominated by cattle grazing, and game farming (Figure 7-15). This can be attributed to the low agricultural potential of the soils, low rainfall, and high evapotranspiration demand. The site consists of natural open woodland, and grassland, with small seasonal pans, herbaceous wetlands, eroded lands, and sparsely wooded grassland (Figure 7-16). The dominant land use in the Steenbokpan region is Game farming, cattle grazing, and cultivation.

Figure 7-15: Land Use (Field survey photos, February 2020)

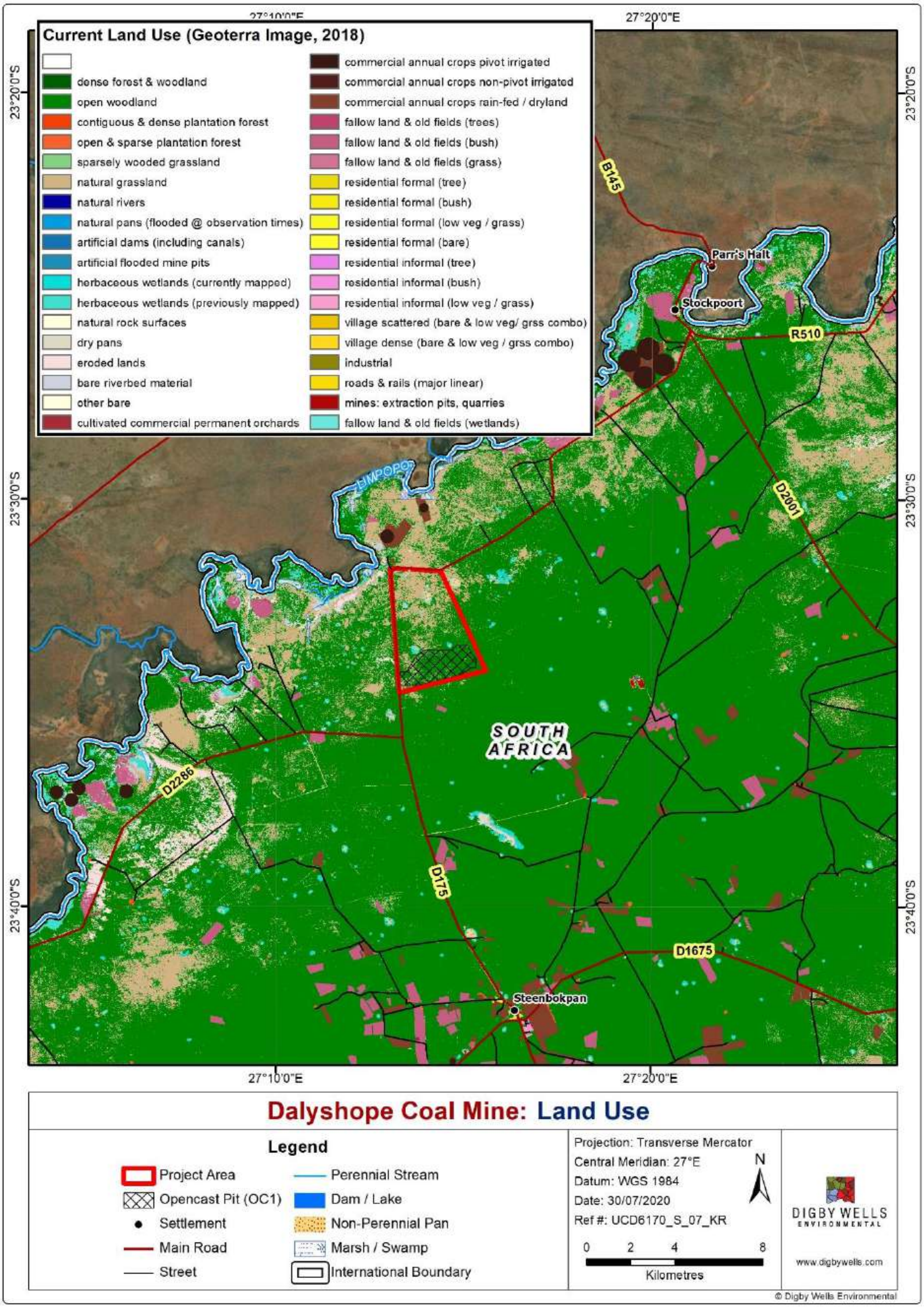


Figure 7-16: Land Use

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 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 possibly will affect the soil, and land capability are:

- Alteration of the current land use (mainly cattle grazing, wildlife, natural grassland, and fallow land) to mining, and infrastructure, resulting in a loss of grazing and game farming land which will impact the economy of the region;
- The dominant soil forms of the region (Hutton, Clovelly, Oakleaf) has a high drainage potential, which could lead to leaching and migration of contaminants into the groundwater and associated water courses, causing water contamination and chemical soil pollution. Contamination could be a result of:
  - Hydrocarbons spillages from the workshop, and access roads (heavy machinery);
  - Coal residue and sedimentation from the ROM Stockpile conveyor; and
  - Sewer and wastewater spillages.
- Change in soil characteristics (soil texture) due to compaction of areas during construction. Soil compaction causes vegetation growth restrictions, high runoff potential and increased erosion;
- 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, potential land use, and water use;
- Especially the soils within the pans (high silt and clay content) has a high susceptibility to erosion. Soil erosion caused by wind, and water movement over the soil surface, increasing sedimentation within the lower areas and overall loss of topsoil and organic material;
- Major disturbance to the functionality, and productivity of the soil which may also result in a loss of topsoil, erosion, losing organic material from the topsoil;
- Changes to the natural soil forms, organic material content, loss of soil depth and changes to the natural hydrology will result in the loss of basal cover, increased AIPs, loss of organic material and decreased soil fertility; and

- The land capability will change from cattle grazing and wildlife (Class V) to industrial, and infrastructure. Should the area not be rehabilitated to pre-mining land capability after mining operations, the land capability may be reduced and have significant economic impacts to the local agricultural community.

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, Impacts, and Description

Interaction	Impact	Description
Site clearing, and preparation by the removal of vegetation, and topsoil, leading to the exposure of soils.	• Compaction of soil; • Increased runoff potential; • Increased wind, and water erosion, and consequently sedimentation potential; • Removal of vegetation, basal cover, and thus increasing the potential of loss of topsoil, organic material, and increased erosion potential; and • Compaction, ponding, and landscaping of the area.	During the Construction Phase, site clearing is necessary for the preparation of surface infrastructure where vegetation will be removed along with topsoil. This includes the construction of pollution control dams, offices, and workshops, clearance for discard dumps, and topsoil stockpiles. When soil is removed, the physical and chemical properties are changed, and the soils will deteriorate unless properly managed. When the organic matter has been 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 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 will be exposed to erosion where vegetation has been removed during the Construction Phase. The loss of vegetation cover will exacerbate runoff potential that will 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.
Movement of vehicles, and heavy machinery including for hauling, and transportation of waste material, transportation of product coal, and disposal of waste material.	• Compaction and increased runoff potential; • Increased erosion, and consequently sedimentation potential; • Impacting agricultural activities in short, medium and long term (lowering of land use and land capability); and • Soil contamination.	Potential contamination by hydrocarbons (oils, fuels, grease) from vehicles or other machinery during Construction, Operational, and Decommissioning Phases which could contaminate soils. Compaction of the soils, and loss of basal cover and the resultant increase in erosion as well as the loss of organic material is also an issue as described above.
Temporary PCD.	• Soil Contamination from PCD spills.	The temporary PCD may leak, and cause soil contamination which will in return impact the ground, and surface water. When the PCD is not lined correctly, migration of contaminants may occur, and lead to soil contamination.
Construction of infrastructure, including access, and haul roads, contractor's laydown yard, diesel storage, and explosive magazine, and infrastructure, Offices.	• Increased vehicle movement in the area, increasing soil compaction, and runoff potential; • Potential spillage of hydrocarbons such as oils, fuels, and grease, thus contamination of the soils; • Increased dust, erosion, and sedimentation; • Removal of natural vegetation, and loss of basal cover; and • Impacting agricultural activities in short, medium and long term (lowering of land use and land capability).	
Waste management activities, including handling of hydrocarbon chemicals.	• Soil Contamination from Hydrocarbon waste (lubricants, explosives, and fuels); and • Soil compaction resulting from the movement of heavy machinery within the Project Area.	

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 reduce the impact. When it is not possible to rectify or reduce the impact, offsetting may need to be implemented.

The aim during the Construction Phase is to minimize the impact footprint on the soils as it is not possible to avoid the impacts. The impact size should be kept minimal with as little changes to the natural state of the Project Area as far as possible.

8.1.2 Impact Ratings

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

Table 8-2: Construction Phase Impact Rating Table

<table>
<tr><td colspan="4">1. Activity, and Interaction: Movement of vehicles, and heavy machinery</td></tr>
<tr><td colspan="4">Impact Description:
• Compaction of soil;
• Increased runoff potential;
• Increased erosion, and consequently sedimentation potential; and
• Impacting agricultural activities in short, medium and long term (lowering of land use and land capability).</td></tr>
<tr><td colspan="4">Prior Mitigation</td></tr>
<tr><td>Dimension</td><td>Rating</td><td>Motivation</td><td>Significance</td></tr>
<tr><td>Duration</td><td>Project Life (5)</td><td>The impact of soil compaction will occur during the life of the Project, although reduced during the Decommissioning Phase.</td><td rowspan="5">Minor (negative) - 60</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>Soil compaction will occur within the Project Area.</td></tr>
<tr><td>Intensity</td><td>Serious Loss (4)</td><td>Increased erosion, and loss of organic material due to increased runoff from compacted areas.</td></tr>
<tr><td>Probability</td><td>Likely (5)</td><td>Site clearance, and the movement of vehicles, and heavy mine machinery will result in soil compaction.</td></tr>
<tr><td>Nature</td><td>Negative</td><td></td></tr>
<tr><td colspan="4">Mitigation Measures</td></tr>
<tr><td colspan="4">• Keep site clearing to a minimal, and restrict vehicle movement outside of dedicated areas, specifically close to wetlands (pans);
• Keep site clearing and impacts to the Dalyshope MRA;
• Make use of existing roads to encourage minimal impacts/footprint to the Project Area; and
• Runoff must be controlled and managed by the use of proper stormwater management measures.</td></tr>
</table>

Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Long Term (4)	The impact will occur on a long-term basis, specifically during the Construction, and Operational Phases.	Negligible (negative) - 32
Extent	Limited (2)	Soil compaction is limited only to smaller areas, provided that soil management measures are implemented.	
Intensity	Minor Loss (2)	Minor loss, and/or effects to biological or physical resources or low sensitive environments, not affecting ecosystem functioning.	
Probability	Probable (4)	There is a probability that the impact will occur if mitigation measures are not implemented.	
Nature	Negative		

2. Activity, and Interaction: Site clearing, and preparation by the removal of vegetation, and topsoil, leading to the exposure of soils

Impact Description:

- Soil loss by wind and water erosion from cleared land surfaces;
- Compaction of soil;
- Increased runoff potential;
- Increased wind, and water erosion, and consequently sedimentation potential;
- Removal of vegetation, basal cover, and thus increasing the potential of loss of topsoil, organic material, and increased erosion potential; and
- Compaction, ponding, and landscaping of the area.

Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Project Life (5)	The impact of soil erosion will occur during the life of the Project.	Moderate (negative) - 82
Extent	Municipal Area (4)	Loss of soil will only occur within the impacted area and its near surroundings.	
Intensity	Serious Loss (5)	Loss of soil, and organic material to erosion. Once the resource has been lost from the landscape it cannot be recovered.	
Probability	Highly Probable (6)	Site clearance has to take place for construction of the various infrastructures which will expose the soil.	
Nature	Negative		

Mitigation Measures

- Keep site clearing to a minimum;
- While soils are being stockpiled, the soils should be revegetated to limit erosion and loss of organic material;
- Establishment of effective vegetation around constructed infrastructure for adequate soil protection from wind and water erosion;
- 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; and
- Runoff must be controlled and managed by the use of proper stormwater management measures.

Post-Mitigation

Dimension	Rating	Motivation	Significance
Duration	Long Term (4)	The impact will occur during the life of the Project.	Negligible (negative) - 30
Extent	Limited (2)	Loss of soil is limited only to exposed areas due to soil management measures being implemented, such as limit vehicle movement, and restrict movement to specific sites.	
Intensity	Minor Loss (2)	Minor loss, and/or effects to biological or physical resources or low sensitive environments, not affecting ecosystem functioning.	
Probability	Probable (4)	There is a probability that the impact will continue to occur.	
Nature	Negative		

3. **Activity, and Interaction:** Construction of infrastructure, including, workshop, PCD's, offices, stores, water distribution, diesel farm, brake-test ramp, heavy, and light vehicle access roads, truck access roads, and provincial road upgrade from Steenbokpan to the mining site.

Impact Description:

- Increased vehicle movement in the area, increasing soil compaction, and runoff potential;
- Increased hardened surfaces resulting in increased hydrological functioning;
- Potential spillage of hydrocarbons such as oils, fuels, and grease, thus contamination of the soils;
- Impacting agricultural activities in short, medium and long term (lowering of land use and land capability);
- Increased dust, erosion, and sedimentation; and
- Removal of natural vegetation, and loss of basal cover.

Prior Mitigation

Dimension	Rating	Motivation	Significance
Duration	Project Life (5)	The impact of soil erosion will occur during the life of the Project.	

Extent	Municipal Area (4)	Loss of soil will only occur within the impacted area and its near surroundings.	Moderate (negative) - 82
Intensity	Serious Loss (5)	Loss of soil, and organic material to erosion. Once the resource has been lost from the landscape it cannot be recovered.	
Probability	Highly Probable (6)	Site clearance has to take place for construction of the various infrastructures which will expose the soil.	
Nature	Negative		

Mitigation Measures

- Keep site clearing to a minimal and within the Dalyshope MRA;
- While soils are being stockpiled, the soils should be revegetated to limit erosion and loss of organic material;
- Establishment of effective vegetation around constructed infrastructure for adequate soil protection from wind, and water erosion;
- 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; and
- Runoff must be controlled and managed by the use of proper stormwater management measures.

Post-Mitigation

Dimension	Rating	Motivation	Significance
Duration	Long Term (4)	The impact will occur during the life of the Project.	Negligible (negative) - 30
Extent	Limited (2)	Loss of soil is limited only to exposed areas due to soil management measures being implemented, such as limit vehicle movement, and restrict movement to specific sites.	
Intensity	Minor Loss (2)	Minor loss, and/or effects to biological or physical resources or low sensitive environments, not affecting ecosystem functioning.	
Probability	Probable (4)	There is a probability that the impact will continue to occur.	
Nature	Negative		

4. **Activity, and Interaction:** Waste management activities, including handling of hydrocarbon chemicals, hauling, and transportation of waste material, transportation of product coal, and disposal of waste material.

Impact Description:

- Soil Contamination from Hydrocarbon waste (lubricants, explosives, and fuels); and
- Soil compaction resulting from the movement of heavy machinery.

Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Project Life (5)	The impact on soils will occur during the life of the Project.	Minor (negative) - 64
Extent	Local (3)	The impact may extend across the Project Area as well as to nearby environments.	
Intensity	Moderate Loss (3)	Loss, and/or damage to biological or physical resources of low to moderately sensitive environments, and, limiting ecosystem function.	
Probability	Highly Probable (6)	It is highly probable that oil, grease, or fuel spillages will occur during the Project life.	
Nature	Negative		

Mitigation Measures

- Runoff must be controlled, and managed by use of proper stormwater management measures;
- Vehicles should regularly be surveyed and checked that oils spill and other contaminants are not exposed to the soils;
- Re-fuelling must take place on bunded impervious surfaces to prevent seepage of hydrocarbons into the soil;
- All vehicles and machines must be parked within hard park areas, and must be checked daily for fluid leaks; and
- Fuel, grease, and oil spills should be remediated using a commercially available emergency clean up kits. However, for major spills (>5L), if soils are contaminated, they must be stripped and disposed of at a licensed waste disposal site.

Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Long Term (4)	The impact should only occur during the Construction and Operational Phases. The impact can be reversed with proper management and mitigation.	Negligible (negative) - 29
Extent	Limited (2)	Localised to the incident area, although it can extend to a larger area if not managed.	
Intensity	Minimal Loss (1)	Minimal loss, and/or effect to biological or physical resources, not affecting ecosystem functioning.	
Probability	Probable (4)	The impact on soil resources will likely occur if not managed.	
Nature	Negative		

5. Activity, and Interaction: Temporary PCD

<table>
<tr><td colspan="4">Impact Description:
• Soil Contamination from PCD spillage or leakages</td></tr>
<tr><td colspan="4">Prior Mitigation</td></tr>
<tr><th>Dimension</th><th>Rating</th><th>Motivation</th><th>Significance</th></tr>
<tr><td>Duration</td><td>Project Life (5)</td><td>The impact on soils will occur during the life of the Project.</td><td rowspan="5">Minor (negative) - 64</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>The impact may extend across the Project Area as well as to nearby environments.</td></tr>
<tr><td>Intensity</td><td>Moderate Loss (3)</td><td>Loss, and/or damage to biological or physical resources of low to moderately sensitive environments, and, limiting ecosystem function.</td></tr>
<tr><td>Probability</td><td>Highly Probable (6)</td><td>It is highly probable that spillages could occur during the Project life.</td></tr>
<tr><td>Nature</td><td>Negative</td><td></td></tr>
<tr><td colspan="4">Mitigation Measures</td></tr>
<tr><td colspan="4">• Ensure proper lining of the temporary PCD as per the engineering design and maintenance to prevent spillage, and leakages into the soils and water resources; and
• Spills should be remediated using a commercially available emergency clean up kits. However, for major spills (>5L), if soils are contaminated, they must be stripped and disposed of at a licensed waste disposal site.</td></tr>
<tr><td colspan="4">Post-Mitigation</td></tr>
<tr><th>Dimension</th><th>Rating</th><th>Motivation</th><th>Significance</th></tr>
<tr><td>Duration</td><td>Long Term (4)</td><td>The impact should only occur during the Construction Phase. The impact can be reversed with proper management and mitigation.</td><td rowspan="5">Negligible (negative) - 29</td></tr>
<tr><td>Extent</td><td>Limited (2)</td><td>Localised to the incident area, although it can extend to a larger area if not managed.</td></tr>
<tr><td>Intensity</td><td>Minimal Loss (1)</td><td>Minimal loss, and/or effect to biological or physical resources, not affecting ecosystem functioning.</td></tr>
<tr><td>Probability</td><td>Probable (4)</td><td>The impact on soil resources will likely occur if not managed.</td></tr>
<tr><td>Nature</td><td>Negative</td><td></td></tr>
</table>

8.2 Operational Phase

Activities during the Operational Phase that may have a potential impact (Table 8-3).

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

Interaction	Impact	Description
Vehicle, and heavy machinery movement.	• Compaction of soil; • Increased runoff potential; • Increased erosion, and consequently sedimentation potential; and • Impacting agricultural activities in short, medium and long term (lowering of land use and land capability).	The vehicle movement during the Operational Phase will increase rapidly. This will have various impacts on the soil. Compaction of the soil leads to hardened surfaces, and loss of vegetation cover which may result in erosion, and loss of sediment. The increased vehicle movement may affect agricultural activities in the area and cause traffic, compaction, dust and erosion from the access roads. Blasting has the potential for changing the soil strata and causing changes to the natural topography. This could lead to areas of water ponding, waterlogging, and changes to the natural water table thus impacting the soils, land uses, and land capability. Stockpiling may lead to soil contamination when stockpiles are eroding and leaching of chemicals. These chemicals have the potential to leach into the groundwater, and contaminate the natural water systems, and affect soil fertility. Contaminated soil has a very low agricultural potential and will decrease the Land Capability significantly. Contaminated soil will impact the groundwater, vegetation growth, agricultural potential, grazing potential, and may lead to sedimentation into the wetlands. Migration of contaminants in the soil may end up in the freshwater systems and affect agro-pastoral and human consumption water uses. Storage of fuel, lubricants, and explosives can have an impact on soil quality while hydrocarbon spills can occur when heavy mining machinery is used as large machines contain large volumes of oils and diesel. Furthermore, when the soils are stockpiled, they are exposed to excess oxygen, water, and wind which may lead to chemical, and physical properties deteriorating unless properly managed. This may lead to the loss of topsoil, and organic material if stockpiling is not managed properly.
OC1 establishment.	• Removal of soil, and decreased soil depth; • Increased erosion, and sedimentation potential; and • Soil compaction, and increased surface runoff.	
Removal of rock (blasting).	• Movement of the soil strata; and • Changes to the landscape, causing ponding, and undulating topographies.	
Stockpiling (rock dumps, soils, ROM, discard dump) establishment, and operation.	• Increased vehicle movement in the area, increasing soil compaction, and runoff potential; • Potential spillage of hydrocarbons such as oils, fuels, and grease, thus contamination of the soils; and • Unexpected changes in the depth, and the nature of the soil.	
Waste management activities.	• Soil Contamination from Hydrocarbon waste (lubricants, explosives, and fuels); • Soil contamination from sewage; and • Impacting agricultural activities in short, medium and long term (lowering of land use and land capability).	
Diesel storage, explosives magazine, and handling, and treatment of hazardous products (including fuel, explosives, and oil).	• Soil Contamination; • Soil contamination from Hydrocarbon waste/spills (lubricants, oil, explosives, and fuels); • Soil contamination from sewage, and wastewater; and • Impacting agricultural activities in short, medium and long term (lowering of land use and land capability).	
Operating crush, and screen, and coal washing plant.	• Soil Contamination from wastewater, and spillages.	

8.2.1 Management Objectives

The objectives during the Operational Phase is to minimize impacts to the Soil, Land Use, and Land Capability by undertaking concurrent rehabilitation.

Impacts during the Operational Phase are unavoidable and are therefore proposed to attempt to minimize the risks as far as possible. Impacts that are not able to be minimized should be rectified and reduced. The impact size should be kept minimal with as little changes to the natural state of the Project Area as far as possible.

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: Vehicle, and heavy machinery movement			
Impacts: • Compaction of soil; • Increased runoff potential; • Increased erosion, and consequently sedimentation potential; and • Impacting agricultural activities in short, medium and long term (lowering of land use and land capability).			
Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Project Life (5)	The impact of soil compaction will occur during the life of the Project, although reduced during the Decommissioning Phase.	Minor (negative) - 60
Extent	Local (3)	Soil compaction will occur within the Project Area	
Intensity	Serious Loss (4)	Increased erosion, and loss of organic material due to increased runoff from compacted areas.	
Probability	Likely (5)	Movement of vehicles and heavy mine machinery will result in soil compaction.	
Nature	Negative		
Mitigation Measures			
• Keep site clearing to a minimal, and restrict vehicle movement outside of dedicated areas, specifically close to wetlands (pans); • Make use of existing roads to encourage minimal impacts/footprint to the Project Area; and • Topsoil should be stockpiled separate from the subsoil to enhance the rehabilitation process.			
Post-Mitigation			

Dimension	Rating	Motivation	Significance
Duration	Long Term (4)	The impact will occur on a long-term basis, specifically during the Construction, and Operational Phases.	Negligible (negative) - 32
Extent	Limited (2)	Soil compaction is limited only to limited areas, provided that soil management measures are implemented.	
Intensity	Minor Loss (2)	Minor loss, and/or effects to biological or physical resources or low sensitive environments, not affecting ecosystem functioning.	
Probability	Probable (4)	There is a probability that the impact will occur if mitigation measures are not implemented.	
Nature	Negative		

2. Activity, and Interaction: OC1 establishment.

Impacts:

- Removal of soil, and decreased soil depth;
- Increased erosion, and sedimentation potential; and
- Soil compaction, and increased surface runoff.

Prior Mitigation

Dimension	Rating	Motivation	Significance
Duration	Permanent (7)	The impact will occur during the life of the Project and result in permanent changes to the soil.	Major negative (-133)
Extent	Province/Region (5)	Complete removal of soil will take place and can impact beyond the local development.	
Intensity	Irreplaceable Loss (7)	Serious environmental effects. These activities will result in an irreplaceable loss of soil.	
Probability	Definite (7)	The probability is very high.	
Nature	Negative		

Mitigation Measures

- Keep site clearing to a minimal, and restrict vehicle movement outside of dedicated areas, specifically close to wetlands (pans);
- All areas not proposed to be mined of high land capability, should be demarcated as “No-Go” areas, and avoided as far as possible (including vehicle movement, infrastructure, roads and mining related activities
- Ensure proper soil stripping, and stockpiling for optimum rehabilitation; and
- Vegetate stockpiles to prevent soil loss, organic material loss, erosion, and sedimentation.

Post-Mitigation			
Duration	Beyond Project Life (6)	The impact will occur on a long-term basis, specifically during the Construction, and Operational Phases.	Minor negative (-65)
Extent	Local (3)	Soil stripping, and stockpiling is limited only to current mine areas, provided that soil management measures are implemented.	
Intensity	Serious Loss (4)	Serious environmental effects if stockpiles, and soil stripping are not done properly/monitored.	
Probability	Likely (5)	There is a probability that the impact will occur if mitigation measures are not implemented.	
Nature	Negative		
Activity, and Interaction 1 Blasting (only when dikes and other geological features are encountered)			
Impact Description: • Movement of the soil strata; and • Changes to the landscape, causing ponding, and undulating topographies.			
Before Mitigation/Management			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Permanent (7)	The impacts caused during the Operational Phase will result in permanent changes to the landscape.	Major negative (-133)
Extent	Province/Region (5)	The impact could spread beyond the local development boundaries due to the ability of degraded water quality, sediments, or alien invasive species to travel significant distances; especially downstream.	
Intensity	Irreplaceable Loss (7)	These activities will result in an irreplaceable loss of soil	
Probability	Definite (7)	These impacts are highly probable.	
Nature	Negative		
Mitigation Measures			
• All areas not proposed to be mined of high land capability, should be demarcated as “No-Go” areas, and avoided as far as possible (including vehicle movement, infrastructure, roads and mining related activities; • Monitoring must be carried out during the Operational Phase to ensure no unnecessary impact to the soil resources present, and if so that a remedy is put in place as soon as possible; and			

• The disturbance must be minimised, and suitably rehabilitated.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Beyond Project Life (6)	The operational activities will result in a permanent change to the soil and are potentially irreversible.	Minor negative (-65)
Extent	Local (3)	Management and mitigation measures have the potential to prevent the impacts from spreading beyond the development site.	
Intensity	Serious Loss (4)	These activities will result in an irreplaceable loss of soil if soil stripping, and stockpiling are not in place for the rehabilitation of these areas.	
Probability	Likely (5)	Despite all intentions to prevent impacts, likely, impacts will still be realized due to the nature of the activity. These potential residual impacts must be managed accordingly.	
Nature	Negative		
3. **Activity, and Interaction:** Stockpiling (rock dumps, soils, ROM, discard dump) establishment, and operation.			
Impacts: • Removal of topsoil, stockpiling, and exposed soil which may lead to unexpected changes in the depth and the nature of the soil. • Increased vehicle movement in the area, increasing soil compaction, runoff, and erosion potential; • Potential spillage of hydrocarbons such as oils, fuels, and grease, thus contamination of the soils; and • Unexpected changes in the depth, and the nature of the soil.			
Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Project Life (5)	The impact will occur during the life of the Project, although reduced during the Decommissioning Phase.	Minor (negative) - 65
Extent	Municipal Area (4)	Soil stripping, and stockpiling will occur within the Project Area.	
Intensity	Serious Loss (4)	Serious medium-term environmental effects. Environmental damage can be reversed in less than a year.	
Probability	Likely (5)	The probability is very high.	

Nature	Negative		
Mitigation Measures			
• 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; • Topsoil stripping should be scheduled for the dry season, where possible; and • All long-term topsoil material stockpiles should be located outside the active mine path, and away from drainage lines.			
Post-Mitigation			
Duration	Long Term (4)	The impact will occur on a long-term basis, specifically during the Construction, and Operational Phases.	Negligible (negative) - 32
Extent	Limited (2)	Soil stripping, and stockpiling is limited only to current mine areas, provided that soil management measures are implemented.	
Intensity	Minor Loss (2)	Amelioration of topsoil before rehabilitation will restore soil fertility hence impact intensity will be low after mitigation.	
Probability	Probable (4)	There is a probability that the impact will occur if mitigation measures are not implemented.	
Nature	Negative		
4. Activity, and Interaction: Waste management activities			
Impacts: • Soil Contamination from Hydrocarbon waste (lubricants, explosives, and fuels); • Soil contamination from sewage; and • Impacting agricultural activities in short, medium and long term (soil and water contamination, lowering of land use and land capability).			
Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Project Life (5)	The impact on soils will occur during the life of the Project.	Minor (negative) - 66
Extent	Local (3)	The impact may extend across the site, and to nearby environments.	

Intensity	Moderate Loss (3)	Moderate loss, and/or damage to biological or physical resources of low to moderately sensitive environments, and, limiting ecosystem function.	
Probability	Highly Probable (6)	It is highly probable that oil, grease or fuel spillages will occur during the Project life.	
Nature	Negative		
Mitigation Measures			
• Soil pollution monitoring should be conducted at selected locations on the Project site to detect any extreme levels of pollutants; and • Any spillages of sewage effluent from the treatment plant or ablution facilities should be cleaned up immediately, and the removed contaminated soils should be disposed of at accredited disposal sites.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Long Term (4)	Long term: 6-15 years, and impact can be reversed with proper management	Negligible (negative) - 28
Extent	Limited (2)	Impact on soils will occur through accidental spillages localised to the incident area.	
Intensity	Minimal Loss (1)	Minimal to no loss, and/or effect to biological or physical resources, not affecting ecosystem functioning.	
Probability	Probable (4)	The impact on soil resources can occur.	
Nature	Negative		
5. Activity, and Interaction: Diesel storage, explosives magazine, and handling, and treatment of hazardous products (including fuel, explosives, and oil).			
Impacts: • Soil Contamination; • Soil contamination from Hydrocarbon waste/spills (lubricants, oil, explosives, and fuels); • Soil contamination from sewage, and wastewater; and • Impacting agricultural activities in short, medium and long term (lowering of land use and land capability).			
Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Project Life (5)	The impact will occur during the life of the Project, although reduced during the Decommissioning Phase.	Minor (negative)

<table>
<tr><td>Extent</td><td>Municipal Area (4)</td><td>Soil contamination will occur within the Project Area.</td><td rowspan="4">- 65</td></tr>
<tr><td>Intensity</td><td>Serious Loss (4)</td><td>Serious medium-term environmental effects. Environmental damage can be reversed in less than a year.</td></tr>
<tr><td>Probability</td><td>Likely (5)</td><td>The probability is very high.</td></tr>
<tr><td>Nature</td><td>Negative</td><td></td></tr>
<tr><td colspan="4">Mitigation Measures</td></tr>
<tr><td colspan="4">Chemicals, such as paints, and hydrocarbons, should be used in an environmentally safe manner with correct storage as per each chemical’s specific storage descriptions;
All spills should be immediately cleaned up, and treated accordingly; and
Re-fuelling must take place on a sealed surface area away from wetlands to prevent the ingress of hydrocarbons into the topsoil.</td></tr>
<tr><td colspan="4">Post-Mitigation</td></tr>
<tr><td>Duration</td><td>Long Term (4)</td><td>The impact will occur on a long-term basis, specifically during the Construction, and Operational Phases.</td><td rowspan="5">Negligible (negative)
- 32</td></tr>
<tr><td>Extent</td><td>Limited (2)</td><td>Soil contamination is limited only to storage areas, provided that management measures are implemented.</td></tr>
<tr><td>Intensity</td><td>Minor Loss (2)</td><td>Medium-term environmental effects due to soil remediation, and rehabilitation.</td></tr>
<tr><td>Probability</td><td>Probable (4)</td><td>There is a probability that the impact will occur if mitigation measures are not implemented.</td></tr>
<tr><td>Nature</td><td>Negative</td><td></td></tr>
<tr><td colspan="4">6. Activity, and Interaction: Operating crush, and screen, and coal washing plant.</td></tr>
<tr><td colspan="4">Impacts:
Soil Contamination from wastewater, and spillages; and
Impacting agricultural activities in short, medium and long term (Soil and water contamination, lowering of land use and land capability).</td></tr>
<tr><td colspan="4">Prior Mitigation</td></tr>
<tr><td>Dimension</td><td>Rating</td><td>Motivation</td><td>Significance</td></tr>
<tr><td>Duration</td><td>Permanent (7)</td><td>The impact will occur during the life of the Project and result in permanent changes to the soil.</td><td rowspan="2">Major negative
(-133)</td></tr>
<tr><td>Extent</td><td>Province/Region (5)</td><td>Soil contamination will take place and can impact beyond the local development.</td></tr>
</table>

Intensity	Irreplaceable Loss (7)	Serious environmental effects. These activities will result in an irreplaceable loss of soil.	
Probability	Definite (7)	The probability is very high.	
Nature	Negative		
Mitigation Measures			
- Stormwater must be diverted from construction activities and managed in such a manner to disperse runoff and prevent the concentration of stormwater flow; - Water used at construction sites should be utilised in such a manner that it is kept on-site, and not allowed to run freely into nearby watercourses (i.e. installation of clean, and dirty water separation systems); and - A Storm Water Management Plan (SWMP) should already be implemented. This should consider all high land capability area, high potential erosion areas, wetlands, and other watercourses associated with the new developments/infrastructure which should divert stormwater away from the surface infrastructure, and back into natural watercourses to maintain catchment yield as far as possible. The SWMP should also convey stormwater to silt traps to limit erosion and the subsequent increase of suspended solids in downstream watercourses.			
Post-Mitigation			
Duration	Beyond Project Life (6)	The impact will occur on a long-term basis, specifically during the Construction, and Operational Phases.	Negligible (negative) - 32
Extent	Local (3)	Soil contamination is limited only to specific areas, provided that soil management measures are implemented.	
Intensity	Serious Loss (4)	Serious environmental effects if monitoring and maintenance are not done properly.	
Probability	Likely (5)	There is a probability that the impact will occur if mitigation measures are not implemented.	
Nature	Negative		

8.3 Decommissioning Phase

Activities during the Decommissioning Phase that may have a potential impact are described in Table 8-5 below.

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

Interaction	Impact	Description
Movement of vehicles, and heavy machinery removing infrastructure.	• Compaction of soil; • Increased runoff potential; and • Increased erosion, and consequently sedimentation potential.	The major impacts to consider during the Decommissioning and Rehabilitation Phases of the site will be the loss of topsoil as a resource to rehabilitate through erosion, compaction, and contamination by hydrocarbon waste. When the decommissioning, and removal of infrastructure take place, vehicles will drive on the surface, compacting it, and this will reduce infiltration, and vegetation cover. The runoff potential will thus increase, leading to increased erosion. When concurrent rehabilitation was introduced since the Construction Phase, it will only be necessary for the infrastructure areas to be rehabilitated during the decommissioning phase. As a result, the impact may be reduced if mitigation measures are implemented early enough. After the infrastructure removal, and rehabilitation, the areas must be assessed for compaction, and possible erosion risk, and corrected immediately if necessary. Additionally, subsidence and cracking of soils must be monitored closely. Waste or discard that may be expected from the Project Area must be classified and should be disposed of in an appropriate landfill facility. The rehabilitation, and mitigation during the Decommissioning Phase will have a positive impact on the impact assessment. A rehabilitation and monitoring plan should be implemented for at least three (3) years after decommissioning to ensure no unexpected, and undulated impacts on the environment, Soil, Land Use, and Land Capability.
Demolition, and removal of infrastructure – once mining activities have been concluded infrastructure will be demolished in preparation for the final land rehabilitation.	• Disturbance of soils, and subsequent erosion by wind, and water; • Increased vehicle movement in the area, increasing soil compaction, and runoff potential; • Potential spillage of hydrocarbons such as oils, fuels, and grease, thus contamination of the soils; • Unexpected changes in the depth, and the nature of the soil; and • Ponding of water, and creation of drainage channels.	
Rehabilitation – rehabilitation mainly consists of spreading, and landscaping of the preserved subsoil, and topsoil, profiling of the land, and re-vegetation.	• Exposure of soils, and subsequent compaction, erosion, and sedimentation; • Soil compaction, and increased runoff potential due to vehicle movement during rehabilitation programs; • Loss of organic material, and vegetation cover; and • Potential spillage of hydrocarbons such as oils, fuels, and grease, thus contamination of soil.	
Post-closure monitoring, and rehabilitation	• Minimal negative impacts on the environment; and • Soil Monitoring Plan.	

8.3.1 Management Objectives

The objectives during the Decommissioning Phase are to rectify, reduce, and rehabilitate the impacts to the Soil, Land Use, and Land Capability of the Project Area. The aim will be to change the Land Capability from mining, back to agricultural pre-mining activities, including grazing, and wildlife.

The Decommissioning Phase will include the mitigation, and monitoring of impacts which will in return have a positive consequence on the impact assessment.

8.3.2 Impact Ratings

The rehabilitation impacts described are rated in Table 8-6.

Table 8-6: Decommissioning Phase Impact Rating

<table>
<tr><th colspan="4">1. Activity, and Interaction: Movement of vehicles, and heavy machinery removing infrastructure</th></tr>
<tr><td colspan="4">Impact Description:
• Soil compaction, and increased hardened surfaces, excess waste material;
• Compaction of soil;
• Increased runoff potential;
• Increased waste material, and potential hard waste material; and
• Increased erosion, and consequently sedimentation potential.</td></tr>
<tr><td colspan="4">Prior Mitigation</td></tr>
<tr><td>Dimension</td><td>Rating</td><td>Motivation</td><td>Significance</td></tr>
<tr><td>Duration</td><td>Medium Term (3)</td><td>Reduces soil compaction during the Decommissioning Phase.</td><td rowspan="5">Minor (negative) - 55</td></tr>
<tr><td>Extent</td><td>Local (3)</td><td>Soil compaction will occur within the Project Area.</td></tr>
<tr><td>Intensity</td><td>Serious Loss (4)</td><td>Erosion, and loss of organic material due to increased runoff from compacted areas.</td></tr>
<tr><td>Probability</td><td>Likely (5)</td><td>Movement of vehicles and heavy mine machinery will result in soil compaction.</td></tr>
<tr><td>Nature</td><td>Negative</td><td></td></tr>
<tr><td colspan="4">Mitigation Measures</td></tr>
<tr><td colspan="4">• 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;
• Ensure proper stormwater management designs are in place to ensure no run-off or pooling occurs;
• Only designated access routes are to be used to reduce any unnecessary compaction; and</td></tr>
</table>

• 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	Long Term (4)	The impact will occur on a small scale, specifically during rehabilitation, and monitoring.	Negligible (negative) - 32
Extent	Limited (2)	The impact is limited only to specific areas, provided that soil management measures are implemented	
Intensity	Minor Loss (2)	Minor loss, and/or effects to biological or physical resources not affecting ecosystem functioning.	
Probability	Probable (4)	There is a probability that the impact will occur if mitigation measures are not implemented.	
Nature	Negative		
2. Activity, and Interaction: Demolition of infrastructure, and rehabilitation of affected areas			
Impact Description: • Disturbance of soils, and subsequent erosion by wind, and water; • Increased vehicle movement in the area, increasing soil compaction, and runoff potential; • Potential spillage of hydrocarbons such as oils, fuels, and grease, thus contamination of the soils; • Unexpected changes in the depth, and the nature of the soil; and • Ponding of water, and creation of drainage channels.			
Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Beyond Project Life (6)	The impact will remain for some time after the life of a Project.	Minor (negative) - 65
Extent	Local (3)	Extending across the Project Area, and to neighbouring environments.	
Intensity	Serious Loss (4)	Serious medium-term environmental effects.	
Probability	Likely (5)	The impact may likely 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 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	Short Term (2)	The impact will be less than a year if rehabilitation measures are implemented correctly.	Negligible (negative) - 24
Extent	Limited (2)	The impact will be limited to the site due to the implementation of mitigation measures.	
Intensity	Minor Loss (2)	Minor effects on the biological or physical environment. Environmental damage can be rehabilitated internally with/ without the help of external consultants.	
Probability	Probable (4)	The impact can occur.	
Nature	Negative		

3. Activity, and Interaction: Rehabilitation – rehabilitation mainly consists of spreading, and landscaping of the preserved subsoil, and topsoil, profiling of the land, and re-vegetation

Impact Description:

- Exposure of soils, and subsequent compaction, erosion, and sedimentation;
- Soil compaction, and increased runoff potential due to vehicle movement during rehabilitation programs;
- Loss of organic material, and vegetation cover; and
- Potential spillage of hydrocarbons such as oils, fuels, and grease, thus contamination of soil.

Prior Mitigation

Dimension	Rating	Motivation	Significance
Duration	Long Term (4)	The impacts caused during the rehabilitation activities will have a long-lasting effect if not managed.	Minor negative (-56)
Extent	Municipal Area (4)	The impact could spread beyond the local development boundaries due to the ability of degraded soil quality or alien invasive species impacting the soil health.	
Intensity	Serious Loss (5)	These impacts are serious threats soil health, and land capability.	
Probability	Likely (5)	These are commonly observed impacts for the rehabilitation phase.	

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 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	Short Term (2)	The impact will be less than a year if rehabilitation measures are implemented correctly.	Negligible (negative) - 24
Extent	Limited (2)	The impact will be limited to the site due to the implementation of mitigation measures.	
Intensity	Minor Loss (2)	Minor effects on the biological or physical environment. Environmental damage can be rehabilitated internally with/ without the help of external consultants.	
Probability	Probable (4)	The impact can occur.	
Nature	Negative		
4. Activity, and Interaction: Post-closure monitoring, and rehabilitation.			
Impact Description: • Minimal negative impacts on the environment; and • Soil Monitoring Plan.			
Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Project Life (5)	The impact will remain for the Project life.	Minor (negative) -55
Extent	Municipal Area (4)	Will affect the whole municipal area.	
Intensity	Minor Loss (2)	Minor loss, and/or effects to biological or physical resources or low sensitive environments, not affecting ecosystem functioning.	
Probability	Likely (5)	The impact may occur. <65% probability.	

Nature	Negative		
Mitigation Measures			
• The backfilled, reprofiled landscape should be top soiled, and revegetated to allow free drainage close to the pre-mining conditions; • Continue with Concurrent Rehabilitation, and implement land rehabilitation measures; and • Rehabilitation, and Monitoring Plan.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	Beyond Project Life (6)	The impact will remain for some time after the life of the Project and is potentially irreversible even with management.	Major (Positive) 119
Extent	Municipal Area (4)	Will affect the whole municipal area.	
Intensity	Noticeable Improvements (+7)	Noticeable, on-going natural, and/or social benefits which have improved the overall conditions of the baseline.	
Probability	Definite (7)	Definite: There are sound scientific reasons to expect that the impact will occur. >80% probability.	
Nature	Positive		

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.

Mining and associated activities impacting the soil resources include changes to the physicochemical 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 watercourses (wetlands); and
- Soil contamination through acid, and sulphate, mine impacted water (decant water), and heavy metals.

The cumulative impacts may, therefore, have a significant effect on the soil resources, and therefore impacting the land use, and land capability. The effect of mining in the region will result in a loss of cattle and game farming land which will result in economical agricultural and hunting income losses. Contaminated soil will directly impact the water quality, and quantity as well as the vegetation and land capability of the area.

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 machinery, and 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
Coal spillage from moving machinery, and conveyor belt.	• Machines and conveyor must be checked, and maintained regularly; • The access road 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 undergo training on-site; and • Contaminated soils must be disposed of in a registered, and licensed Waste Facility.
Hydrocarbon leaks from vehicles, and machinery or hazardous materials.	• Place drip trays where the leak is occurring if vehicles are leaking; • All vehicles are to be serviced in a correctly concrete area or at an off-site location; and • Machines must be parked within hard park areas and must be checked daily for fluid leaks.
Hazardous substance spillage from pipelines or waste storage.	• 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; • 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 (> 5L) spill occurs, it is to be cleaned up immediately, reported to the appropriate authorities, and recorded; and • Contaminated soils must be disposed of in a registered, and licensed Waste Land Facility.

9 Environmental Management Plan

The Environmental Management Plan (EMP) are described in Table 9-1 below.

Table 9-1: Environmental Management Plan

Activities		Potential Impacts	Mitigation Measure	Mitigation Type	The period for implementation
Construction Phase	• Movement of vehicles, and heavy machinery; • Site clearing, and preparation by the removal of vegetation, and topsoil, leading to the exposure of soils; • Construction of infrastructure, including access, and haul roads, contractor's laydown yard, diesel storage, and explosive magazine, and infrastructure, offices; • Waste management activities, including handling of hydrocarbon chemicals, hauling, and transportation of waste material, transportation of product coal, and disposal of waste material; and • Temporary PCD.	• Compaction of soil; • Increased runoff potential; • Increased erosion, and consequently sedimentation potential; • Compaction of soil; • Increased runoff potential; • Increased wind, and water erosion, and consequently sedimentation potential; • Removal of vegetation, basal cover, and thus increasing the potential of loss of topsoil, organic material, and increased erosion potential; • Compaction, ponding, and landscaping of the area; • Increased vehicle movement in the area, increasing soil compaction, and runoff potential; • Increased hardened surfaces resulting in increased hydrological functioning; • Potential spillage of hydrocarbons such as oils, fuels, and grease, thus contamination of the soils; • Increased dust, erosion, and sedimentation; • Removal of natural vegetation, and loss of basal cover; • Soil Contamination from Hydrocarbon waste (lubricants, explosives, and fuels); • Soil compaction resulting from the movement of heavy machinery within the Project Area; and • Soil Contamination from PCD spills.	• Keep site clearing to a minimal, and restrict vehicle movement outside of dedicated areas, specifically close to wetlands (pans); • Make use of existing roads to encourage minimal impacts/footprint to the Project Area; • Runoff must be controlled, and managed by use of proper stormwater management measures; • After topsoil is stockpiled, it should be revegetated to limit erosion and loss of organic material; • Topsoil stockpile height should not exceed three meters; • Establishment of effective vegetation around constructed infrastructure for adequate soil protection from wind, and water erosion; • 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; • Vehicles should regularly be surveyed and checked that oils spill and other contaminants are not exposed to the soils; • Re-fuelling must take place on bunded impervious surfaces to prevent seepage of hydrocarbons into the soil; • All vehicles and machines must be parked within hard park areas, and must be checked daily for fluid leaks; • Fuel, grease, and oil spills should be remediated using a commercially available emergency clean up kits. However, for major spills (>5L), if soils are contaminated, they must be stripped, and disposed of at a licensed waste disposal site; • Ensure proper lining of the temporary PCD as per the engineering design, and maintenance to prevent spillage, and leakages into the soils, and water resources; and • Spills should be remediated using a commercially available emergency clean up kits. However, for major spills (>5L), if soils are contaminated, they must be stripped and disposed of at a licensed waste disposal site.	***Modify, remedy, control, or stop*** Concurrent rehabilitation through the life of mine.	Life of Construction Phase

Operational Phase	• Vehicle, and heavy machinery movement; • Open-pit establishment; • Removal of rock (blasting); • Stockpiling (rock dumps, soils, ROM, discard dump) establishment, and operation; • Waste management activities; • Diesel storage, explosives magazine, and handling, and treatment of hazardous products (including fuel, explosives, and oil); and • Operating crush, and screen, and coal washing plant.	• Compaction of soil; • Increased runoff potential; • Increased erosion, and consequently sedimentation potential; • Removal of soil, and decreased soil depth; • Increased erosion, and sedimentation potential; • Soil compaction, and increased surface runoff; • Movement of the soil strata; • Changes to the landscape, causing ponding, and undulating topographies; • Increased vehicle movement in the area, increasing soil compaction, and runoff potential; • Potential spillage of hydrocarbons such as oils, fuels, and grease, thus contamination of the soils; • Unexpected changes in the depth, and the nature of the soil; • Soil Contamination from Hydrocarbon waste (lubricants, explosives, and fuels); • Soil contamination from sewage; • Soil Contamination; • Soil contamination from Hydrocarbon waste/spills (lubricants, oil, explosives, and fuels); • Soil contamination from sewage, and wastewater; and • Soil Contamination from wastewater, and spillages.	• Keep site clearing to a minimal, and restrict vehicle movement outside of dedicated areas, specifically close to wetlands (pans); • Make use of existing roads to encourage minimal impacts/footprint to the Project Area; • Topsoil should be stockpiled separate from the subsoil to enhance the rehabilitation process; • Keep site clearing to a minimal, and restrict vehicle movement outside of dedicated areas, specifically close to wetlands (pans); • All areas not proposed to be mined of high land capability, should be demarcated as “No-Go” areas, and avoided as far as possible (including vehicle movement, infrastructure, roads and mining related activities; • • Ensure proper soil stripping, and stockpiling for optimum rehabilitation; • Vegetate stockpiles to prevent soil loss, organic material loss, erosion, and sedimentation; • All areas not proposed to be mined of high land capability, should be demarcated as “No-Go” areas, and avoided as far as possible (including vehicle movement, infrastructure, roads and mining related activities; • Monitoring must be carried out during the Operational Phase to ensure no unnecessary impact to the soil resources present, and if so that a remedy is put in place as soon as possible; • The disturbance must be minimised, and suitably rehabilitated; • 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; • All long-term topsoil material stockpiles should be located outside the active mine path, and away from drainage lines; • Soil pollution monitoring should be conducted at selected locations on the Project site to detect any extreme levels of pollutants; • Any spillages of sewage effluent from the treatment plant or ablution facilities should be cleaned up immediately, and the removed contaminated soils should be disposed of at accredited disposal sites; • Chemicals, such as paints, and hydrocarbons, should be used in an environmentally safe manner with correct storage as per each chemical’s specific storage descriptions; • All spills should be immediately cleaned up, and treated accordingly; • Re-fuelling must take place on a sealed surface area away from wetlands to prevent the ingress of hydrocarbons into the topsoil; • Stormwater must be diverted from construction activities, and managed in such a manner to disperse runoff, and prevent the concentration of stormwater flow; • Water used at construction sites should be utilised in such a manner that it is kept on-site, and not allowed to run freely into nearby watercourses (i.e. installation of clean, and dirty water separation systems); and • A Storm Water Management Plan (SWMP) should already be implemented. This should consider all high land capability area, high potential erosion areas, wetlands, and other watercourses associated with the new developments/infrastructure which should divert stormwater away from the surface infrastructure, and back into natural watercourses to maintain catchment yield as far as possible. The SWMP should also	***Modify, remedy, control, or stop*** Concurrent rehabilitation through the life of mine	Life of Operational Phase

Activities		Potential Impacts	Mitigation Measure	Mitigation Type	The period for implementation
			convey stormwater to silt traps to limit erosion and the subsequent increase of suspended solids in downstream watercourses.		
Decommissioning Phase	• Movement of vehicles, and heavy machinery removing infrastructure; • Demolition, and removal of infrastructure – once mining activities have been concluded infrastructure will be demolished in preparation for the final land rehabilitation; • Rehabilitation – rehabilitation mainly consists of spreading, and landscaping of the preserved subsoil, and topsoil, profiling of the land, and re-vegetation; and • Post-closure monitoring, and rehabilitation.	• Compaction of soil; • Increased runoff potential; • Increased erosion, and consequently sedimentation potential; • Disturbance of soils, and subsequent erosion by wind, and water; • Increased vehicle movement in the area, increasing soil compaction, and runoff potential; • Potential spillage of hydrocarbons such as oils, fuels, and grease, thus contamination of the soils; • Unexpected changes in the depth, and the nature of the soil; • Ponding of water, and creation of drainage channels; • Exposure of soils, and subsequent compaction, erosion, and sedimentation; • Soil compaction, and increased runoff potential due to vehicle movement during rehabilitation programs; • Loss of organic material, and vegetation cover; • Potential spillage of hydrocarbons such as oils, fuels, and grease, thus contamination of wetlands; • Minimal negative impacts on the environment; and • Soil Monitoring Plan.	• 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; • Ensure proper stormwater management designs are in place to ensure no run-off or pooling occurs; • 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 • Rehabilitation and Monitoring Plan should be implemented.	***Modify, remedy, control, or stop*** Concurrent rehabilitation through the life of mine	Life of Decommissioning Phase

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 the effectiveness of the management measures in place. Table 10-1 describes the monitoring plan that must be implemented from the Construction Phase through to monitoring after decommissioning. The program includes each element, frequency of monitoring, and the person responsible thereof.

Monitoring should be done in terms of:

- EIA Regulations, 2014 (GN R 982 of 4 December 2014 as amended by GN R326 of 7 April 2017) promulgated under the NEMA;
- NEMA, 1998 (Act No. 107 of 1998);
- NEM:WA, 2008 (Act No. 59 of 2008); and
- CARA, 1983 (Act No. 43 of 1983).

Soil sample results must be measured against the Soil Screening Values (SSV) listed in the NEM: WA, and demarcate values exceeding the SSV. The Soil Specialist is responsible to inform the Environmental Practitioner (EP) of the results in a Memo and provide possible mitigation measures. The EP is responsible to report to the Mine Manager (MM). Internal monitoring reports should be required, reporting on the progress on the state of the monitoring, and rehabilitation program. This should be completed after each external monitoring report.

Soil monitoring points will only be selected during the Construction Phase. The monitoring points will be based on infrastructure layout, areas of high erosion potential, topsoil stockpiles, potential soil contamination areas, and areas with low vegetation cover, and increased AIPs.

Table 10-1: Monitoring Plan

Monitoring Element Soils	Comment	Requirements	Frequency	Responsibility
• Erosion status; • Preferential flow paths; • Compaction; • Increased runoff; • Soil contamination; and • Vegetation cover.	• Soil laboratory analysis should include soil fertility, potential harmful elements, and heavy metals; • Soil impacts should be recorded, and addressed as soon as possible to prevent further deterioration; • EP is responsible to determine the effectiveness of the mitigation measures such as erosion control structures, spillage clean-ups, and revegetation; and • The contractor is responsible to undertake the clearing of vegetation, and rehabilitation of impacted areas.	• Areas of concern must be inspected in the wet, and dry season, specifically after a large rainfall event; • 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 of at an appropriate, permitted or licensed disposal facility; • Repair any damage caused by erosion; • The deposition of eroded materials and the understanding of volumes moved concerning the plan should be assessed monthly by the EP; • Continuous erosion monitoring of rehabilitated areas should be undertaken, and zones with excessive erosion should be identified. Erosion can either be quantified or the occurrence there-of simply recorded for the specific location; • Revegetate bare areas, and remove AIPs where necessary; • Monitor long term stockpiles of vegetation cover to avoid increased AIPs, erosion and loss of soil fertility; • There must be no planting of alien plants (e.g. black wattle, eucalyptus, and pampas grass) anywhere within the Project Area; • The transportation of soils or other substrates infested with AIPs should be strictly controlled; • Traffic should be limited where possible while the vegetation is establishing; • Implement grazing control to prevent overgrazing, and allow pastures to establish; • The area must be fenced, and animals should be kept off the area until the vegetation is self-sustaining; and • Implement annual monitoring to identify areas of concern early and implement rehabilitation as soon as possible, such as long term stockpiles	• Annual (one-yearly) soil monitoring during the Construction Phase; • Biannual (two-yearly) soil monitoring during the Operational Phase, preferable one survey after the rainy season (March to May), and one after the dry season (July to September); • Biannual (two-yearly) soil monitoring during the Decommissioning Phase, preferable one survey after the rainy season (March to May), and one after the dry season (July to September); and • Annual (one-yearly) soil monitoring after Decommissioning, and Rehabilitation until Closure is achieved.	• The EP can be trained to take soil samples, and send it to a SANAS accredited laboratory; • Results must be sent to a Soil Specialist to assess the results and write a short memo regarding soil fertility, and contamination including possible mitigation measures; • The Mine Manager and the Environmental Practitioner (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 Mine Manager and the EP should be responsible to determine the effectiveness of erosion control structures.

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 from the Soil, Land Use, and Land Capability Impact Assessment. I&AP comments submitted in relevance to soil resources during the SEP, were considered in the Impact Assessment Section (Section 8) and is stipulated in Table 11-1 below.

Table 11-1: Stakeholder Engagement Comments

Category Are there any environmental, social or heritage features on the proposed Project Area we need to be aware of?	
Comment Raised	Impact on local communities and agricultural activities in short, medium and long term.
Contributor	Dr Llew Taylor
Organisation / Community	WESSA (the Wildlife and Environment Society of South Africa)
Date	29-Apr-2020
Method	Registration and Comment sheet
Response	Recommendations are made to ensure that the rehabilitation plan, mitigation measures, and continuous monitoring measures are in place, and encourage a concurrent rehabilitation plan. Therefore: • Impacts to Agricultural activities will be restricted the Dalyshope MRA and access road. However, if the proposed mitigation, rehabilitation and continuous monitoring are not followed it can lead to, but not limited to: • Degradation of agricultural potential; • Soil contamination by hydrocarbons;

	• Sedimentation and erosion of the wetlands; • Loss of soil depth; • Water quality and quantity degradation; and • Changes from a high land capability to a low land capability (from agriculture to wilderness).
Category How do you think the Project might (affect) you?	
Comment Raised	The Project has the potential to contaminate the soil which might negatively impact on agricultural activities and the wellbeing of the community.
Contributor	Ditiro Jan Majapholo
Organisation / Community	Community Member
Date	24-Jul-20
Method	Registration and Comment sheet
Response	Recommendations are made to ensure that the rehabilitation plan, mitigation measures, and continuous monitoring measures are in place, and encourage a concurrent rehabilitation plan. Recommendations include, but is not limited to: • Runoff must be controlled, and managed by use of proper stormwater management measures; • Vehicles should regularly be serviced and checked that oils spill and other contaminants are not exposed to the soils; • Fuel, grease, and oil spills should be remediated using a commercially available emergency clean up kits. However, for major spills (>5L), if soils are contaminated, they must be stripped, and disposed of at a licensed waste disposal site; • Ensure proper lining of the temporary PCD as per the engineering design, and maintenance to prevent spillage, and leakages into the soils, and water resources; • Soil pollution monitoring should be conducted at selected locations on the Project site to detect any extreme levels of pollutants; • Monitor decant of AMD and implement management measures which include in-situ passive treatment or neutralisation, and electrolytic treatment using a Water Treatment Plant (WTP) to get purified water for discharge to the natural environment or other beneficial uses; and • Seal the shaft by placing concrete plugs as well as implement a monitoring plan to ensure no decant. Therefore:

	• Impacts to Agricultural activities and the wellbeing of the local community will be restricted the Dalyshope MRA and access road and will be rehabilitated and monitored through and beyond the Life of 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	Person Responsible
Loss of the soil resource due to change in land use, and removal of the soil.	• 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.	Independent Soil Scientist, and PM
Loss of the soil resource due to the wind, and water erosion of unprotected soils.	• The area 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.	Independent Soil Scientist, and PM
Change in soil characteristics (soil texture) due to compaction of areas and associated mine infrastructure.	• Restriction of vehicle movement over sensitive areas to reduce compaction.	PM
Contamination of the soil resource due to hydrocarbons spillages.	• 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;	Independent Soil Scientist, and PM

	• 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.	
Loss of the soil resource due to the disturbance, and clearing of vegetation.	• 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.	PM

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 negligible/minor impacts on the land use and land capability. However, it is highly recommended that concurrent rehabilitation, management, and mitigation measures are correctly implemented to minimise potential impacts on soils (as set out in Section 8) to maintain the land capability for future land use.

Soil management measures and monitoring requirements as set out in Section 10 should form part of the conditions for environmental authorisation. It is highly recommended that wetland areas, and dams are not impacted on by keeping at least a 500 m zone of regulation buffer from any construction and infrastructure. By impacting the wetlands, the land capability will deteriorate due to loss of vegetation cover, sedimentation, loss of soil and water quality and quantity changes.

Soil management measures and monitoring requirements as set out in this report should form part of the conditions of an environmental authorisation and be included in the EMPr.

14 Conclusion

The Soil, Land Use, and Land Capability Assessment Report has been compiled in terms of Appendix 6 of the NEMA EIA Regulations, 2014, (as amended) in terms of the Scoping, and EIA process which is being followed in applying for Environmental Authorisation.

The proposed development area falls within land type **Ah86** (dominantly), and a small portion of **Ae257**. Soils under these land types are red to yellow apedal sandy soils which are generally freely drained and have a high base status. The soil forms identified on site were Hutton, Clovelly, Oakleaf, Glencoe, and Kroonstad. The land capability is dominated by **Class V**, which is generally not suitable for agriculture but has a high use potential for pastures, rangeland, forest land or wildlife for food, and cover. The current land use is wildlife and cattle grazing. The effect of mining in the region will result in a loss of cattle and game farming land which will result in economical agricultural and hunting income losses.

The potential impact due to the opencast mining activities on the soil, land use, and land capability is major to moderate if mismanaged. However, the effects of mining will be limited to the Project Area.

The impacts associated with the proposed development include:

- Alteration of the current land use (mainly cattle grazing, wildlife, natural grassland, and fallow land) to mining, and infrastructure, resulting in a loss of grazing and game farming land which will impact the economy of the region;
- The dominant soil forms of the region (Hutton, Clovelly, Oakleaf) has a high drainage potential, which could lead to leaching and migration of contaminants into the groundwater and associated water courses, causing water contamination and chemical soil pollution;
- Soil compaction, low vegetation growth, high runoff potential, increased erosion;
- 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, potential land use, and water use;
- Especially the soils within the pans (high silt and clay content) has a high susceptibility to erosion. Soil erosion caused by wind, and water movement over the soil surface, increasing sedimentation within the lower areas and overall loss of topsoil and organic material;
- Major disturbance to the functionality, and productivity of the soil which may also result in a loss of topsoil, erosion, losing organic material from the topsoil;
- Changes to the natural soil forms, organic material content, loss of soil depth and changes to the natural hydrology will result in the loss of basal cover, increased AIPs, loss of organic material and decreased soil fertility; and
- The land capability will change from cattle grazing and wildlife (Class V) to industrial, and infrastructure. Should the area not be rehabilitated to pre-mining land capability after mining operations, the land capability may be reduced and have significant economic impacts to the local agricultural community.

Recommendations are made for the EIA phase 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 negligible/minor impacts on the land use and land capability. However, it is highly recommended that concurrent rehabilitation, the EMP, a 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 Impact Assessment Methodology

The wetland 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 international guidelines and legislation, the following criteria were taken into consideration when potentially significant impacts were examined relating to wetlands:

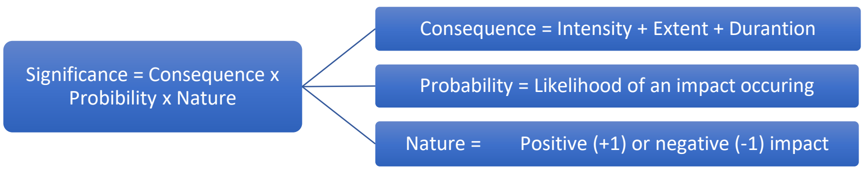
- Nature of impacts (direct/indirect and positive/negative);
- Duration (short/medium/long-term; permanent (irreversible)/temporary (reversible) and frequent/seldom);
- Extent (geographical area and size of affected population/species);
- Intensity (minimal, severe, replaceable/irreplaceable);
- Probability (high/medium/low probability); and
- Measures to mitigate avoid or offset significant adverse impacts.

16.1 Significance Rating

Impacts and risks have been identified based on the description of the activities to be undertaken. Once the impacts were identified, a numerical environmental significance rating process was undertaken that utilises the probability of an event occurring and the severity of the impact as factors to determine the significance of a specific environmental impact.

The severity of an impact was determined by taking the spatial extent, the duration and the severity of the impacts into consideration. The probability of an impact was then 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 16-3. The weight assigned to the various parameters was then multiplied by +1 for positive and -1 for negative impacts.

16.1.1 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 16-2, which is extracted from Table 16-3. The description of the significance ratings is discussed in Table 16-4.

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.

16.1.2 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 16-1.

Table 16-1: 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 16-2: 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.	International 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.	National 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.	Province/Region 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.	Municipal Area 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.	Local 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.	Limited 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.	Very Limited/Isolated 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 16-3: Probability/Consequence Matrix

Significance

Probability																																						
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
Consequence	-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

Table 16-4: 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) (-)