APPENDIX E: SOIL, LAND CAPABILITY AND LAND USE STUDY

SOIL, LAND USE AND LAND CAPABILITY REPORT FOR THE PROPOSED COMMISSIEKRAAL COAL MINE PROJECT

For and on behalf of TerraAfrica Consult

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Position: Principal consultant

Date: 12 October 2015

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DEFINITIONS AND ACRONYMS

Base status: A qualitative expression of base saturation. See base saturation percentage. Base Saturation Base saturation refers to the proportion of the cation exchange sites in the soil that are occupied by the various cations (hydrogen, calcium, magnesium, potassium). The surfaces of soil minerals and organic matter have negative charges that attract and hold the positively charged cations. Cations with one positive charge (hydrogen, potassium, sodium) will occupy one negatively charged site. Cations with two positive charges (calcium, magnesium) will occupy two sites.

Buffer capacity: The ability of soil to resist an induced change in pH.

Calcareous: Containing calcium carbonate or magnesium carbonate.

Catena: A sequence of soils of similar age, derived from similar parent material, and occurring under similar macroclimatic conditions, but having different characteristics due to variation in relief and drainage.

Cutan: Cutans occur on the surfaces of peds or individual particles (sand grains, stones). They consist of material which is usually finer than, and that has an organisation different to the material that makes up the surface on which they occur. They originate through deposition, diffusion or stress. Synonymous with clayskin, clay film, argillan.

Erosion: The group of processes whereby soil or rock material is loosened or dissolved and removed from any part of the earth's surface.

Fertilizer: An organic or inorganic material, natural or synthetic, which can supply one or more of the nutrient elements essential for the growth and reproduction of plants.

Fine sand: (1) A soil separate consisting of particles 0,25-0,1mm in diameter. (2) A soil texture class (see texture) with fine sand plus very fine sand (i.e. 0,25-0,05mm in diameter) more than 60% of the sand fraction.

Gleying: The process whereby the iron in soils and sediments is bacterially reduced under anaerobic conditions and concentrated in a restricted horizon within the soil profile. Gleying usually occurs where there is a high water table or where an iron pan forms low down in the soil profile and prevents run-off, with the result that the upper horizons remain wet. Gleyed soils are typically green, blue, or grey in colour.

Land capability: The ability of land to meet the needs of one or more uses under defined conditions of management.

Land type: (1) A class of land with specified characteristics. (2) In South Africa it has been used as a map unit denoting land, mapable at 1:250,000 scale, over which there is a marked uniformity of climate, terrain form and soil pattern.

Land use: The use to which land is put.

Orthic A horizon: A surface horizon that does not qualify as organic, humic, vertic or melanic topsoil although it may have been darkened by organic matter.

Overburden: Material that overlies another material difference in a specified respect, but mainly referred to in this document as materials overlying weathered rock.

Ped: Individual natural soil aggregate (e.g. block, prism) as contrasted with a clod produced by artificial disturbance.

Pedocutanic, diagnostic B-horizon: The concept embraces B-horizons that have become enriched in clay, presumably by illuviation (an important pedogenic process which involves downward movement of fine materials by, and deposition from, water to give rise to cutanic character) and that have developed moderate or strong blocky structure. In the case of a red pedocutanic B-horizon, the transition to the overlying A-horizon is clear or abrupt.

Pedology: The branch of soil science that treats soils as natural phenomena, including their morphological, physical, chemical, mineralogical and biological properties, their genesis, their classification and their geographical distribution.

Saline, soil: Soils that have an electrical conductivity of the saturation soil extract of more than 400 mS/m at 25°C.

Slickensides: In soils, these are polished or grooved surfaces within the soil resulting from part of the soil mass sliding against adjacent material along a plane which defines the extent of the slickensides. They occur in clayey materials with a high smectite content.

Swelling clay: Clay minerals such as the smectites that exhibit interlayer swelling when wetted, or clayey soils which, on account of the presence of swelling clay minerals, swell when wetted and shrink with cracking when dried. The latter are also known as heaving soils.

Texture, soil: The relative proportions of the various size separates in the soil as described by the classes of soil texture shown in the soil texture chart (see diagram on next page). The pure sand, sand, loamy sand, sandy loam and sandy clay loam classes are further subdivided (see diagram) according to the relative percentages of the coarse, medium and fine sand sub-separates.

Vertic, diagnostic A-horizon: A-horizons that have both, high clay content and a predominance of smectitic clay minerals possess the capacity to shrink and swell markedly in response to moisture changes. Such expansive materials have a characteristic appearance: structure is strongly developed, ped faces are shiny, and consistence is highly plastic when moist and sticky when wet.

Declaration of EAP

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Declaration of Independence

I, Mariné Pienaar, hereby declare that TerraAfrica Consult, an independent consulting firm, has no interest or personal gains in this project whatsoever, except receiving fair payment for rendering an independent professional service.

I further declare that I was responsible for collecting data and compiling this report. All assumptions, assessments and recommendations are made in good faith and are considered to be correct to the best of my knowledge and the information available at this stage.

TerraAfrica Consult cc represented by M Pienaar
October 2015

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1. Introduction

SLR Consulting Africa (Pty) Ltd (SLR) appointed Terra Africa Consult to conduct the soil, land use and land capability study as part of the Environmental Impact Assessment (EIA) process for the Environmental Authorisation of the proposed Commissiekraal Coal Mine (CCM). Tholie Logistics (Pty) Ltd proposes to develop an underground coal mine with related surface infrastructure to support the mining operation.

The proposed project is located on the farm Commissiekraal 90 HT located about 28 km north of Utrecht and 27 km east of Wakkerstroom (hereafter referred to as the “subject property”) (**Figure 1**). The Project is located in the eMadlangeni Local Municipality within the Amajuba District Municipality in the KwaZulu-Natal Province of South Africa.

2. Objective of the study

The objective of the Soil, Land Use and Land Capability study is to fulfill the requirements of the most recent South African Environmental Legislation with reference to the assessment and management of these natural resource aspects (stipulated in Section 3 below). The key components of assessment including determining the current baseline soil properties and the associated agricultural potential as well as current land uses. From this baseline data, the anticipated future impacts of the proposed mining developments at the proposed Commissiekraal Coal Mine can be predicted and mitigation and management measures can be recommended to minimise negative impacts and maximise land rehabilitation success towards successful mine closure at the end of the project life.

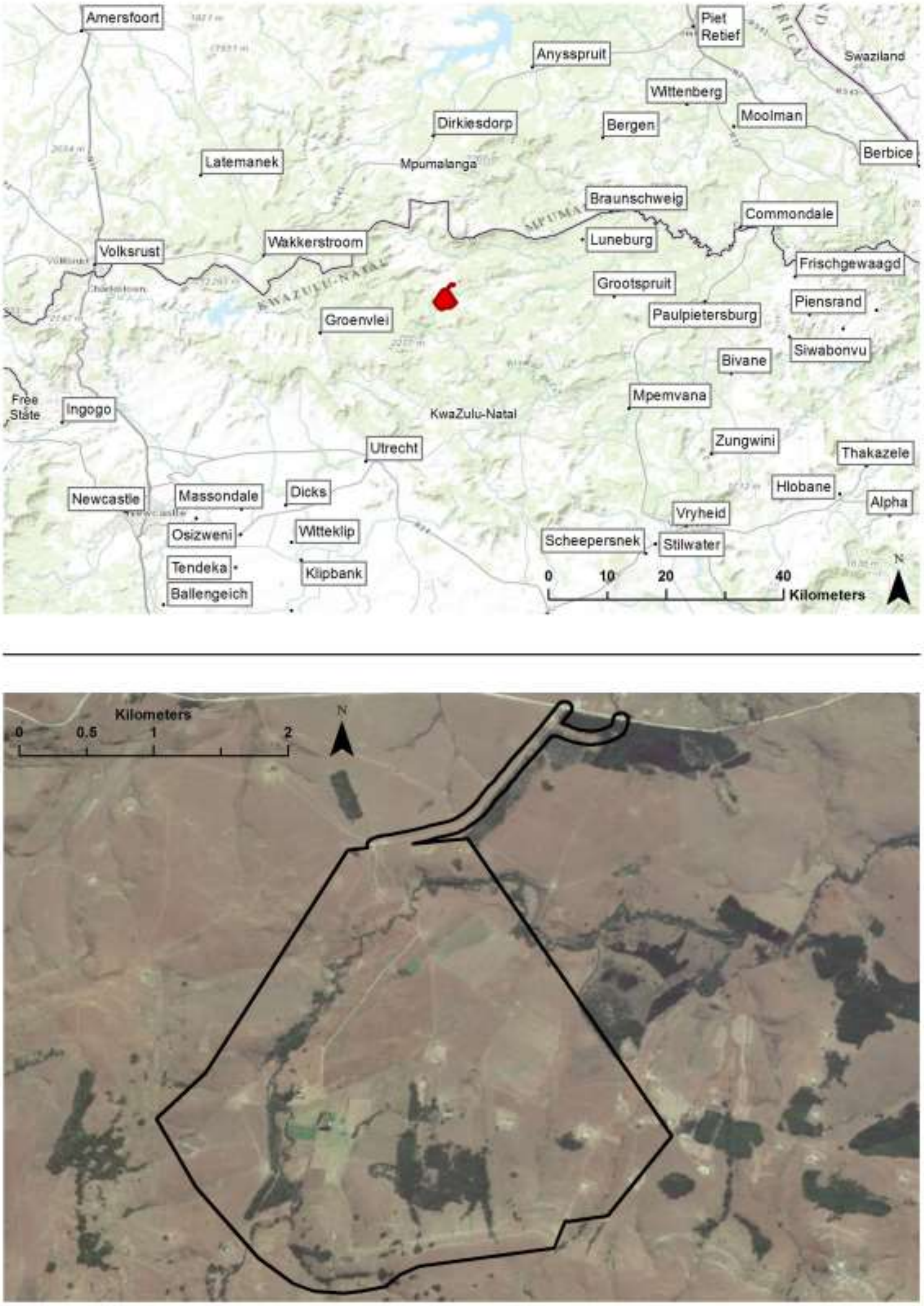

Figure 1: Locality of the proposed Commissiekraal Coal Mine Project

3. Environmental legislation applicable to study

The most recent South African Environmental Legislation that needs to be considered for any new or expanding development with reference to management of soil and land use includes:

- Soils and land capability are protected under the National Environmental Management Act 107 of 1998, the Minerals Act 28 of 2002 and the Conservation of Agricultural Resources Act 43 of 1983.
- The National Environmental Management Act 107 of 1998 requires that pollution and degradation of the environment be avoided, or, where it cannot be avoided be minimised and remedied.
- The Conservation of Agricultural Resources (Act 43 of 1983) states that the degradation of the agricultural potential of soil is illegal.
- The Conservation of Agriculture Resources Act 43 of 1983 requires the protection of land against soil erosion and the prevention of water logging and salinization of soils by means of suitable soil conservation works to be constructed and maintained. The utilisation of marshes, water sponges and watercourses are also addressed.
- Government Notice R983 of 4 December 2014, Activity 21. The purpose of this Notice is to identify activities that would require environmental authorisation prior to commencement of that activity.

In addition to South African Environmental Legislation, the study also aligns to fulfill the IFC Performance Standards on Environmental and Social Sustainability that became effective on 1 January, 2012. With regards to the Soil, Land Use and Land Capability assessment, the following standards and guidelines are of most relevance:

- IFC Performance Standard 3: Resource Efficiency and Pollution Prevention provides guidelines on project-level approach to resource efficiency and pollution prevention, in this case specifically for land management.
- IFC Guidelines for Mining which recommend practices for sustainable land use and topsoil management.
- IFC General Environmental, Health and Safety Guidelines: Contaminated Land for the detection, remediation and monitoring of contaminated land, should it be present.

4. Terms of reference

The following Terms of Reference as stipulated by SLR Consulting Africa (Pty) Ltd applies to the baseline soil and land capability study:

- Undertake a desktop study to establish broad baseline soil conditions, land capability and areas of environmental sensitivity in the proposed subject property;
- Undertake a soil survey of the proposed subject property area focusing on all landscape features including potentially wet areas;
- Describe soils in terms of soil texture, depth, structure, moisture content, organic matter content, slope and land capability of the area;
- Describe and categorise soils using the South African Soil Classification Taxonomic System;
- Identify and assess potential soil, agricultural potential and land capability impacts resulting from the proposed Commissiekraal Coal Mine Project with associated infrastructure (including impacts associated with the construction, operation, decommissioning and post closure phases of the project), using the prescribed impact rating methodology;
- Identify and describe potential cumulative soil, agricultural potential and land capability impacts resulting from the proposed development in relation to proposed and existing land uses in the surrounding area;
- Recommend mitigation measures to minimise impacts and/or optimise benefits associated with the proposed project.

5. Assumptions

The following assumptions were made during the assessment and reporting phases:

- The project will only consist of the development of an adit to access the underground coal mine, adits for ventilation shafts and support infrastructure which may include access roads, site offices, workshops and a parking area for vehicles and machinery, washing bays, septic tanks for sewerage, storm water dams and pollution control dams at the various mining operations. It will also include the development of overburden stockpiles and topsoil stockpiles.

6. Uncertainties, limitations and gaps

The following uncertainties, limitations and gaps exists with regards to the study methodology followed and conclusions derived from it:

- Soil profiles were observed using a 1.5m hand-held soil auger or open profiles where it was possible in erosion gullies. A description of the soil characteristics deeper than 1.5m cannot be given.
- The study did not include a land contamination assessment to determine pre-mining contamination.

7. Methodology

7.1 *D*esktop study and literature review

The following data was obtained and studied for the desktop study and literature review:

- Land type data for the site was obtained from the Institute for Soil Climate and Water (ISCW) of the Agricultural Research Council (ARC);
- Broad geological, soil depth and soil description classes were obtained from the Department of Environmental Affairs and studied. This data forms part of the Environmental Potential Atlas (ENPAT) of South Africa;
- The Bioresource units of KwaZulu-Natal obtained from the KwaZulu-Natal Department of Agriculture;
- The most recent aerial photography of the area available from Google Earth was obtained.

7.2 Site survey

A systematic soil survey was undertaken with sampling points between 100 and 250m apart in the study area, depending on accessibility (Figure 2). The soil profiles were examined to a maximum depth of 1.5m using an auger. Observations were made regarding soil texture, structure, colour and soil depth at each survey point. A cold 10% hydrochloric acid solution was used on site to test for the presence of carbonates in the soil. The soils are described using the S.A. Soil Classification Taxonomic System (Soil Classification Working Group, 1991) published as memoirs on the Agricultural Natural Resources of South Africa No.15. For soil mapping, the soils were grouped into classes with relatively similar soil characteristics.

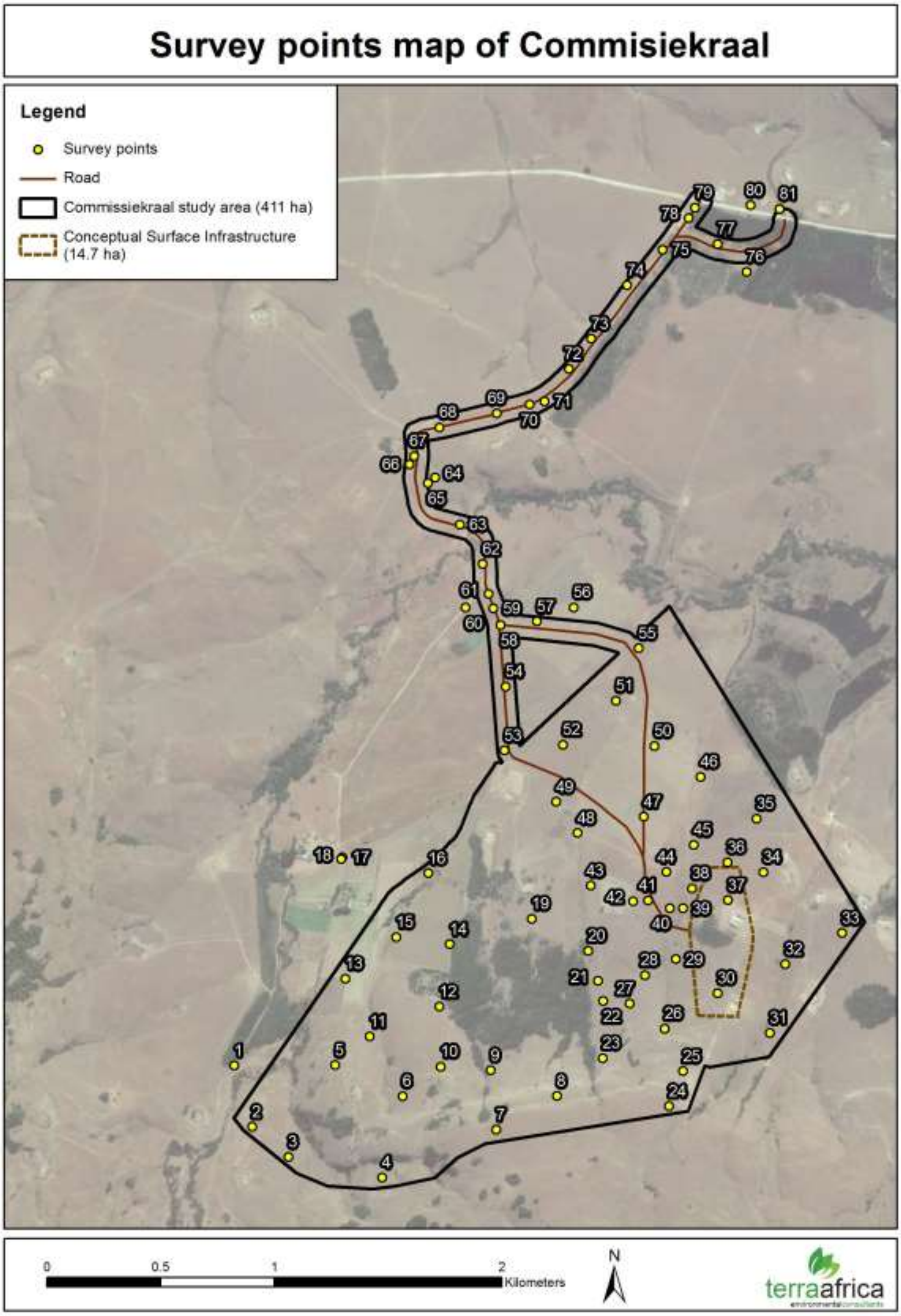

Figure 2: Soil survey points map for the Commissiekraal Coal Mine Project

7.3 Analysis of samples at soil laboratory

Ten soil samples (six topsoil and four subsoil) were collected at the subject property. Soil samples were sealed in soil sampling plastic bags and sent to Nvirotek Labs, Brits for analyses. The samples were analysed for pH (KCl and H2O), phosphorus (Bray1), exchangeable cations (calcium, magnesium, potassium, sodium), organic carbon (Walkley-Black) and texture classes (relative fractions of sand, silt and clay).

7.4 Land capability classification

Land capability classes were determined using the guidelines outlined in Section 7 of The Chamber of Mines Handbook of Guidelines for Environmental Protection (Volume 3, 1981). The Chamber of Mines pre-mining land capability system was utilised, given that this is the dominant capability classification system used for the mining industry. **Table 1** indicates the set of criteria as stipulated by the Chamber of Mines to group soil forms into different land capability classes.

Table 1: Pre-Mining Land Capability Requirements

Criteria for Wetland	➢ Land with organic soils or ➢ A horizon that is gleyed throughout more than 50 % of its volume and is significantly thick, occurring within 750mm of the surface.
Criteria for Arable Land	➢ Land, which does not qualify as a wetland, ➢ The soil is readily permeable to the roots of common cultivated plants to a depth of 750mm, ➢ The soil has a pH value of between 4,0 and 8.4, ➢ The soil has a low salinity and SAR, ➢ The soil has a permeability of at least 1,5-mm per hour in the upper 500-mm of soil ➢ The soil has less than 10 % (by volume) rocks or pedocrete fragments larger than 100-mm in diameter in the upper 750-mm, ➢ Has a slope (in %) and erodibility factor (K) such that their product is <2.0, ➢ Occurs under a climatic regime, which facilitates crop yields that are at least equal to the current national average for these crops, or

	is currently being irrigated successfully.
Criteria for Grazing Land	➢ Land, which does not qualify as wetland or arable land, ➢ Has soil, or soil-like material, permeable to roots of native plants, that is more than 250-mm thick and contains less than 50 % by volume of rocks or pedocrete fragments larger than 100-mm, ➢ Supports, or is capable of supporting, a stand of native or introduced grass species, or other forage plants, utilizable by domesticated livestock or game animals on a commercial basis.
Criteria for Wilderness Land	➢ Land, which does not qualify as wetland, arable land or grazing land.

8. Baseline conditions

8.1 Soil forms present in the study area

Sixteen different soil forms were identified within the study area (**Figure3**). Below follows a description of each of these soil forms:

Champagne soil form (Ch) (4.36 ha or 1.06 % of the total study area)

The Champagne soil form is the only representative of organic soils in South Africa and is subdivided into four families. Rietfontein in which humified organic material is dominant and underlain by unconsolidated material is the family found on Commissiekraal. The Champagne soil form can be defined as a soil with a diagnostic O horizon in which the majority of plant forms are not macroscopically identifiable. Soils of the Champagne form are only found in bottomland sites in the cool mountain regions. Unlike all other soil forms, these soils occupy disparate areas and never constitute a major soil spatially within the landscape. Organic soils are commonly associated with wetlands and their importance does not lie in the total area covered but in the particular ecological niche that they occupy being the region between that occupied by permanent free-standing water and the mineral soils upslope. They moderate stream flows, act as natural filters for sediment and pollutants and form a unique natural habitat for a range of fauna and flora.

The optimum land use for these soils is to be conserved as natural wetlands under natural vegetation. In their undisturbed state they have low erosion risk but this increases dramatically once drained and severe erosion usually follows.

Lusiki form (Lu) (7.1 ha or 1.73 % of the total study area)

The Lusiki soil forms consist of a humic A horizon on a pedocutanic B horizon. The humic A horizon has low base status, consists of freely drained topsoil horizons which have accumulated relatively large amounts of humified organic material in moist climates that are cool or cold. The pedocutanic B horizon has a moderately to strongly developed sub-angular or angular blocky structure in the moist state. The cutanic character develops by a downward movement of fine materials by, and deposition from water in the soil forming process.

These soils can be used for the production of sugarcane, maize, forestry and vegetable crops although nutrient deficiencies and soil acidity are to be expected. These soils are also resistant to erosion. Under natural grassland the erosion risk is low because of both structural stability and plant cover.

Sweetwater form (Sr) (1.2 ha or 0.29 % of the total study area)

Soil of the Sweetwater form is present on the boundary of the wetland areas identified there. This form consists of a humic A-horizon overlying a neocutanic B-horizon. The humic A-horizon on the project area is 20 cm deep, has accumulated large volumes of organic matter and has very dark colours. The thinner humic horizons (they are typically 50 cm or more) occur at cooler, higher elevations further inland as in the case of the Commissiekraal site. The A-horizon is very well-drained. The neocutanic B-horizon is multi-coloured and although clay accumulation has resulted in structure development, the structure of this horizon is not strong enough to classify it as a pedocutanic B-horizon.

The soils of the Sweetwater soil form are also part of the humic soils and can also be used for the production of sugarcane, maize, forestry and vegetable crops. Nutrient deficiencies and soil acidity are to be expected as in the case of the Lusiki soil form. These soils are also resistant to erosion, especially when under natural grassland.

<u>Katspruit form (Ka)</u> (6.05 ha or 1.47 % of the total study area)

The Katspruit soil form consists of an orthic A horizon and in this area on a non-calcareous G horizon and thus belonging to the Lammermoor family. The A horizon has a very dark greyish-brown colour with medium faint grey and/or olive mottles. The texture is a medium sandy loam. The G horizon is saturated with water for long periods and is dominated by grey, low chroma matrix colours often with blue or green tints. This soil form is associated with wetland land capability and usually indicates the presence of seasonal or permanent wetlands.

<u>Longlands form (Lo)</u> (10.3 ha or 2.51 % of the total study area)

The Longlands soil form consists of an orthic A horizon (30 cm) overlying an E horizon that is underlain by a soft plinthic B horizon. A fluctuating water table has resulted in the accumulation of ferric oxides sufficient to form a soft plinthic B horizon in the lower part of what would otherwise have been a thick E horizon. This soil form is therefore associated with wetland land capability.

The Longlands soil form has a moderately high degree of weathering, depletion of bases and moderate acidity and a sandy loam texture. The soil needs lime and broad-spectrum fertilising for crop production but low buffer capacity will lead to rapid acidification if nitrogen is applied to generously. Groundwater vulnerability would be high in the case of pollution. Lateral discharge through the E and B horizons would result in the toe slope reception area being affected by a plume of polluted water.

The soil on the study site belonging to the Longlands soil form has a depth of 120 cm and will thus not present problems with rooting depth and periodic waterlogging for crops like maize. Plinthic soil is not regarded as being a good choice for forest plantations because of poor internal drainage.

<u>Constantia form (Ct)</u> (81.76 ha or 19.89 % of the total study area)

The Constantia soil form consists of an orthic A horizon, overlaying an E horizon which is underlain by a yellow-brown apedal B horizon. The E horizon is a greyish horizon which is

usually paler in colour as the overlying topsoil or the horizon which underlies it. The yellow-brown apedal B horizon has structure that is weaker than moderate blocky or prismatic in the moist state. A podzolic character is absent beneath the yellow-brown apedal B horizon which place the Constantia soil form found on the study site in the Potberg family.
Soils of the Constantia soil form are deep and generally highly suited to cultivation.

<u>Avalon form (Av)</u> (14.17 ha or 3.45 % of the total study area)

The Avalon soil form consists of an orthic A horizon (35 cm deep on study site) on a yellow-brown apedal B horizon overlying a red-mottled, soft plinthic B at a depth of about 1 metre. The yellow-brown apedal B horizon has structure that is weaker than moderate blocky or prismatic in the moist state.
Avalon soil has usually a loamy texture with moderate organic matter status and is well drained. It is usually acidic and extremely low in bases. Phosphate status is low and P sorption capacity is moderate to high. Dolomitic lime would be needed to achieve good crop yields and fertilizer containing Zn would also be advisable. The soil is highly suited to dryland crop production, subject to appropriate chemical amelioration.

<u>Glencoe form (Gc)</u> (52.5 ha or 12.77 % of the total study area)

The Glencoe soil form consists of an orthic A horizon, overlying a yellow brown apedal B horizon on a hard plinthic B. The Glencoe soil form differs from Avalon form only on the basis that the soft plinthic horizon of the Avalon form is replaced by a hard plinthic horizon. Glencoe soil has a moderately high degree of weathering, depletion of bases and no significant acidity, sandy loam structure and a morphology which indicates a fluctuating water table. Available phosphorous (P) is very low. The soil is suited to dryland crop production if the plinthic layer is deeper than 60 cm and appropriate fertilization is done.

<u>Pinedene form (Pn)</u> (34.47 ha or 8.39 % of the total study area)

The Pinedene soil form consists of an orthic A horizon overlying a yellow-brown apedal B horizon that is underlain by unspecified material with signs of wetness. The Pinedene soil form has a moderately high degree of weathering, depletion of bases and moderate acidity and a sandy loam texture. Dolomitic lime would be needed to achieve good crop yields. The soil is suited to dryland crop production, subject to appropriate chemical amelioration.

<u>Griffin form (Gf</u>) (2.95 ha or 0.72 % of the total study area)

The Griffin soil form consists of an orthic A horizon, overlying a yellow brown apedal B horizon on a red apedal B. The Griffen soil form is one of the apedal oxidic soils of which the tillage is much easier and erosion less prevalent than with many other soil groups. The oxides provide a micro-aggregating effect which reduces the dispersibility of fine particles. In high rainfall areas the more leached apedal forms may be deficient in a number of nutrients (base cations and even trace elements such as zinc and boron). Subsoil acidity is also a problem in summer rainfall areas. With the application of lime or gypsum to rectify the pH and appropriate chemical amelioration good crop yields can be achieved.

<u>Magwa form (Ma</u>) (1.14 ha or 0.28 % of the total study area)

The Magwa form consists of a humic A horizon on a yellow-brown apedal B horizon. The yellow-brown , luvic B horizon, contains kaolinite, aluminous chlorite and mica. Acidity, exchangeable aluminium and buffer capacity are substantial, especially in the topsoil. The buffer capacity and high water holding capacity are associated with the high organic matter content. Despite the high water retentivity the well aggregated structure of the soil cause it to drain freely and be well aerated.
Plant nutritional problems are likely to occur mainly because of the extremely low reserve of exchangeable bases while some trace element deficiencies may also be expected. Because of the low clay content it would be important to use this soil in such a way as to ensure the conservation of organic matter.

<u>Sepane form (Se</u>) (6.26 ha or 1.53 % of the total study area)

The Sepane form has an orthic A horizon which consist of a coarse sandy clay loam, overlying a pedocutanic B horizon, underlain by unconsolidated material with signs of wetness. Soils of the Sepane soil form can be productively used under irrigation, but has the following limitations. Extractable P and Zinc levels are markedly deficient. Being a duplex soil it is also very susceptible to hard setting (soils that set to a hard structureless mass during drying and are thereafter impossible to cultivate) and erosion. On the positive side neither salinity, nor sodicity are predominant.

Valsrivier form (Va) (0.75 ha or 0.18 % of the total study area)

The Valsrivier soil form is also a duplex soil and very similar to Sepane. It consists of an orthic A horizon , overlying a pedocutanic B horizon which is underlain by unconsolidated material without signs of wetness. This profile consists of a deep clay loam, formed in gneissic colluvium, containing nodules of secondary lime in the B horizon and showing no evidence of wetness at depth. The B-horizon have become enriched in clay by illuviation (a pedogenic process which involves downward movement of fine materials by, and deposition from, water to give rise to cutanic character) and that have developed moderate or strong blocky character. Neither salinity nor sodicity are prevalent. Zinc levels are markedly deficient and extractable P is also very low. Such soils can be productively used under irrigation but the duplex nature means that artificial drainage would have to be taken into consideration. Hard setting and erodibility are two physical conditions to be taken into consideration when stockpiling topsoil during mining activities. The texture of this soil is likely to intensify physical problems such as hard setting and erodibility and makes duplex soils less amendable to use.

Tukulu form (Tu) (174.56 ha or 42.47 % of the total study area)

The Tukulu soil form consists of an orthic A horizon, overlying a neocutanic B horizon on unspecified material with signs of wetness. Soils of the Tukulu soil form are deep and generally highly suited to cultivation. It has signs of wetness beneath the neocutanic horizon which may require careful management in irrigated soils but which generally favours dryland farming with deeper rooted crops.

Nomanci form (No) (7.11 ha or 1.73 % of the total study area)

The Nomanci soil form identified consists of a humic A horizon, overlying a lithocutanic B horizon. More than 70% by volume of the lithocutanic B horizon is freshly or partly weathered parent bedrock with at least a hard consistence in the dry, moist and wet states. Nomanci soils are environmentally robust in that they can be subjected to a good deal of physical and chemical abuse without markedly eroding or deteriorating. Physical attributes of humic soils and the climatic circumstances on this site make it near ideal for forestry.

Mispah form (Ms) (3.47 ha or 0.84 % of the total study area)

These shallow, rocky soils are dominated by rock or saprolite (weathered rock). These soils have a very shallow (as shallow as 0.10 m) layer of soil on hard rock. The orthic A-horizon of this lithic soil group is unsuitable for annual cropping or forage plants (poor rooting medium since the low total available moisture causes the soil to be drought prone). These topsoils are not ideal for rehabilitation purposes for they are too shallow and/or too rocky to strip. Topsoil stripping and stockpiling of the 'shallow' soils should only be attempted where the surface is not too rocky.

Clovelly form (Cv) (2.81 ha or 0.68 % of the total study area)

The Clovelly soil forms consist of a sandy -loam orthic A horizon on a well-drained yellow-brown apedal B horizon overlying unspecified material where limited pedogenesis has taken place. Soil depths of the Clovelly profiles surveyed on site was deeper than 1500 mm. Manganese concretions were observed in less than 5 % of the profile from 1500 mm. Clovelly soils with no restrictions shallower than 500mm are generally good for crop production. The high quality orthic A and yellow-brown apedal B-horizons make it a suitable soil form for annual crop production

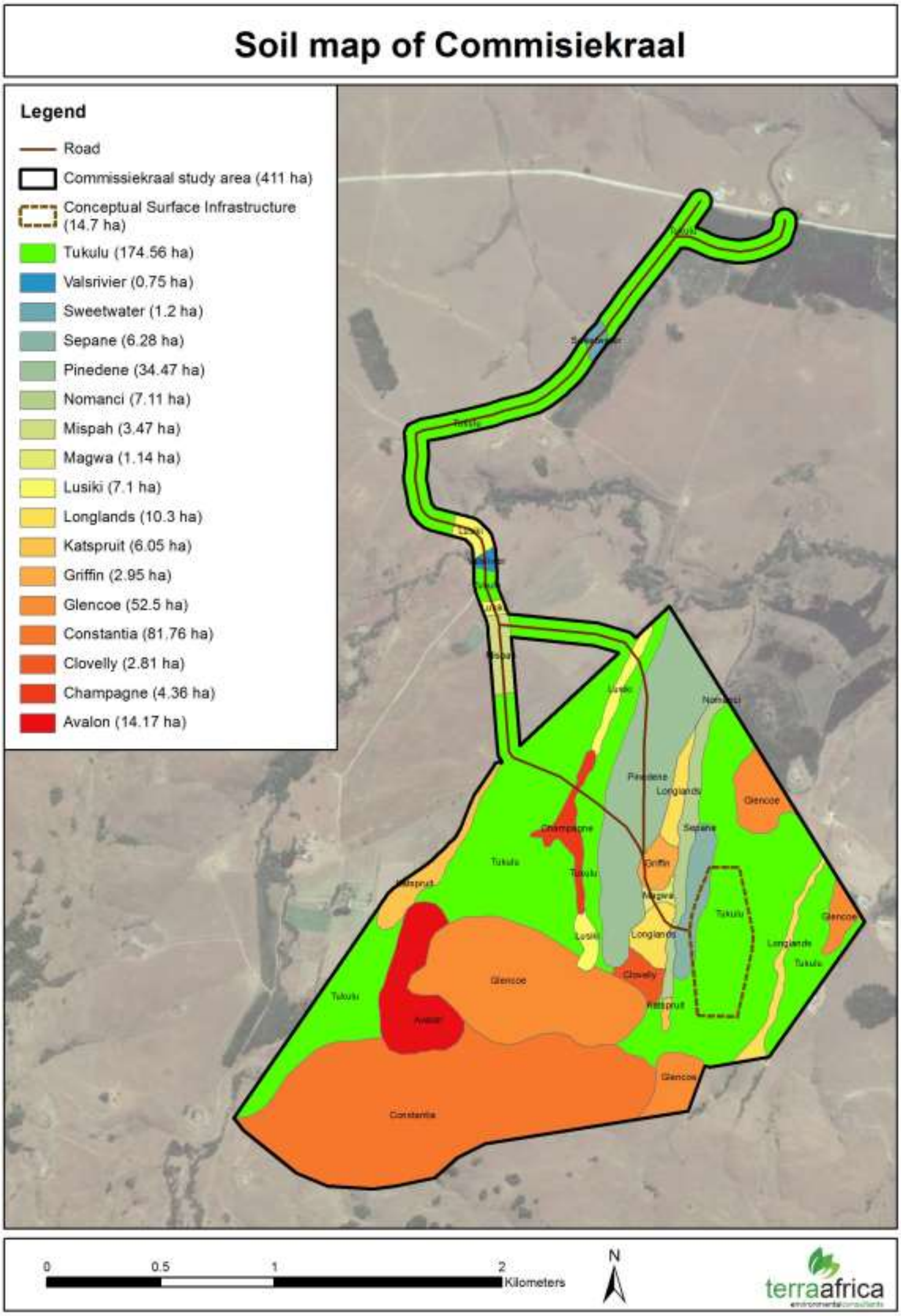

Figure 3: Locality of soil forms present in the Commissiekraal Coal Mine Project area

8.2 Soil chemical conditions of the study area

8.2.1 Soil fertility

The pH of the analyzed soil samples in the study area ranges from 4.07 (extremely acid) to 4.58 (very strongly acid). For successful crop production, a pH of between 5.8 and 7.5 is optimum and crops produced in soils with lower pH may suffer aluminium (Al) toxicities if toxic levels of Al are present. The danger of Al toxicity in maize only exists when the pH (KCl) is lower than 4.5. Even under these low pH levels, Al toxicity may not prevail. The pH of the soil can be improved by the addition of dolomitic lime or gypsum. However, this process is costly and adds to production costs of crops.

Phosphorus levels were as low as expected for natural veld conditions and in soils which are strongly acid (ranging between 1 mg/kg and 2 mg/kg P). For crop production optimum extractable P levels in the soil according to Bray 1 are 33.5 mg/kg for sandy soils such as the Oakleaf and Longlands soil forms and < 30 mg/kg for soils with a clay percentage of > 15 % such as of the Shortlands soil form. The calcium and magnesium levels are marginally deficient at some sampling points but the potassium levels are higher than what is adequate efor crop plants but is not considered as toxic and the balance between these three cations could be corrected with chemical fertilizer.

The soil chemistry of the samples analysed indicate that soil at the project site has the chemical suitability for crop production since the addition of dolomitic lime or gypsum to improve low pH is standard practice in most crop production areas. Intensive annual crop production would however require proper fertilization as soil nutrients should be balanced and will get depleted. No serious soil chemical issues such as soil salinity or sodicity occur on site.

Table 2: Soil chemistry results

Lab No	Reference no	pH (KCl)	PBray1	K	Na	Ca	Mg	Extractable Acid	%Ca	%Mg	%K	%Na
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	cmol(+)/kg	%	%	%	%
72133	CK01	4.07	1	218	16	118	40	1.73	18.04	9.90	17.07	2.07
72134	CK02	4.28	1	41	12	82	19	1.40	19.25	7.31	4.99	2.49
72135	CK03	4.11	1	32	79	366	78	0.60	52.27	18.37	2.31	9.84
72136	CK04	4.41	1	63	39	142	69	0.40	35.42	28.13	8.02	8.43
72137	CK05	4.58	1	64	48	76	22	0.00	40.66	19.65	17.41	22.28
72138	CK06	4.20	1	74	15	167	54	1.44	28.13	14.80	6.33	2.25
72139	CK07	4.13	1	41	11	76	24	1.91	14.41	7.57	3.97	1.80
72140	CK08	4.28	2	72	55	117	40	1.27	22.51	12.49	7.09	9.15
72141	CK09	4.15	1	80	8	73	25	0.88	21.79	11.98	12.16	2.11
72142	CK10	4.44	1	21	13	64	19	0.34	34.73	17.17	5.85	5.89

Lab No	Reference no	Acid Saturation	Ca:Mg	(Ca+Mg)/K	Mg:K	S-Waarde	Na:K	T	Digtheid	S AmAc	SAmAc	C	EC
		%	1.5-4.5	10.0-20.0	3.0-4.0	cmol(+)/kg		cmol(+)/kg	g/cm3	mg/kg	mg/kg	%	µS/cm
72133	CK01	52.93	1.82	1.64	0.58	1.54	0.12	3.27	0.99	80.02	9.47	3.37	100.2
72134	CK02	65.96	2.63	5.32	1.47	0.72	0.50	2.12	1.00	42.51	8.72		31.2
72135	CK03	17.20	2.85	30.55	7.95	2.90	4.26	3.50	0.76	26.39	17.85	6.54	77.6
72136	CK04	20.00	1.26	7.93	3.51	1.60	1.05	2.00	1.13	33.37	17.63	1.86	44.9
72137	CK05	0.00	2.07	3.46	1.13	0.94	1.28	0.94	1.02	30.54	2.88		30.8
72138	CK06	48.49	1.90	6.78	2.34	1.53	0.36	2.97	0.87	41.81	4.98	5.68	63.2
72139	CK07	72.25	1.90	5.53	1.91	0.73	0.45	2.64	1.08	46.41	11.37		35.2
72140	CK08	48.75	1.80	4.93	1.76	1.33	1.29	2.60	0.61	44.32	16.07	20.22	102.9
72141	CK09	51.96	1.82	2.78	0.98	0.81	0.17	1.68	1.08	47.21	47.21	2.14	62.6
72142	CK10	36.36	2.02	8.87	2.94	0.59	1.01	0.92	0.98	22.02	22.02		30.3

8.3 Agricultural potential

The province of KwaZulu-Natal is classified into Bioresource Units (BRUs). The BRUs provide an appraisal of the natural resources for both environmental impact assessments and the agricultural potential.

Within a Bioresource Unit the environmental factors such as land type, climate, terrain form and vegetation are homogeneous to such a degree that uniform land use and production techniques can be applied within the BRU. There is however one remaining factor which can cause a considerable range in site specific agricultural potential, namely the production potential of the soil. The production potential of the soil in combination with the other factors mentioned, forms a class of land which is referred to as an ecotope.

An ecotope is thus a class of land which is defined in terms of soil (form, texture and depth) and soil surface characteristics (rockiness and slope). The production potential for a specific farming enterprise will be uniform within an ecotope and will be uniform and there will be a significant difference between one ecotope and another.

The study site falls within bioresource unit Yd3. That means that the annual rainfall is between 901 mm and 1100 mm and the altitude 1401 – 1800 m above sea level with a mean annual temperature of 14.1 – 14.3 ˚C.

The realized soil sampling locations during the field survey are shown in Figure 2. Soils are grouped into veld ecotopes and these ecotopes encountered during the survey are listed in **Error! Reference source not found.**3.

More than 50% of the soil ecotopes encountered were well-drained profiles (code A) with an effective rooting depth greater than 200 mm. There were also poorly drained soil forms and soil forms typically associated with wetlands.

There was no evidence of crop production on the subject property during the site visit. Although soils of the well-drained soil forms (Symbol A) would be highly suitable for crop production and the average annual rainfall of 1000 mm is sufficient for the successful production of different crops, the slope of the land are in many parts greater than 12% which is not suitable for crop production because of the danger of soil erosion. Small pieces of crop lands do occur near rural settlements.

The subject property is currently used for mainly cattle farming. A small flock of sheep was also seen during the site visit.

The grazing capacity of a specified area for domestic herbivores is given either in large animal unit per hectare or in hectares per large animal unit. One large animal unit is regarded as a steer of 450kg whose weight increases by 500g per day on veld with a mean energy digestibility of 55%.

The grazing capacity of the veld for the study area is 2.5 hectares per large animal unit or large stock unit. The proposed project area can thus provide grazing for around 164 head of cattle or large stock units. These large stock units can further be converted to include small grazers and browsers such as Boer goats or sheep.

Cattle farming is a viable long-term land use of the site as long as the field quality is maintained by never exceeding the grazing capacity. Post-mining land use should aim to re-establish the cattle farming potential of the land.

Table 3: Summary of veld ecotopes encountered on Commissiekraal Coal Mine study site

Soil Type	Symbol	Soil forms
Well-drained soil forms (Depth > 200 mm)	A	Constantia, Pinedene, Avalon, Griffin,Nomanci, Magwa, Tukulu, Glencoe.
Well-drained soil forms (Depth < 200 mm)	S	Mispah
Duplex and Plinthic soil forms	D	Valsrivier, Longlands, Sepane
Poorly drained soil forms	P	Katspruit, Sweetwater, Lusiki
Vlei and wet soil forms	V	Champagne

8.4 Land use and surrounding land use

Refer to the Addendum for details on the land use.

8.5 Land capability

Following the classification system above in Section 6.4, the soil and land types identified in the study area could all be classified into four different land capability classes.

Deeper (Symbol A) soils (**Table 3**) have arable land capability and could also have been suitable for irrigated crop production should irrigation water be available.

On slopes greater than 12 % the land capability is grazing because of the danger of erosion. Because of the restricted soil depth of the Mispah soil form (Symbol S) the land capability is wilderness and should only be grazed at very low livestock density.

Duplex and plinthic soils (Symbol D) are usually used as grazing because the duplex soils (Sepane and Valsrivier forms) on this site are easily erodible and many orthic A horizons of duplex soils are hard setting and this can greatly impede tillage when the soil is too dry. The soft or hard plinthic B horizon of plinthic soils causes poor drainage which renders these soils only marginal for the production of most crops besides vegetables and grazing, except where the overlying apedal B horizon occurs with sufficient depth. The plinthic soil on the study site namely the Longlands soil form has a depth of 120 cm and will thus not present problems with rooting depth and periodic waterlogging for crops like maize. Plinthic soil is not regarded as being a good choice for forest plantations because of poor internal drainage. The land capability of the symbol D soils on the study area is thus partly grazing and partly arable.

Areas In the valley bottoms where Symbol P and V soils are encountered have wetland land capability.

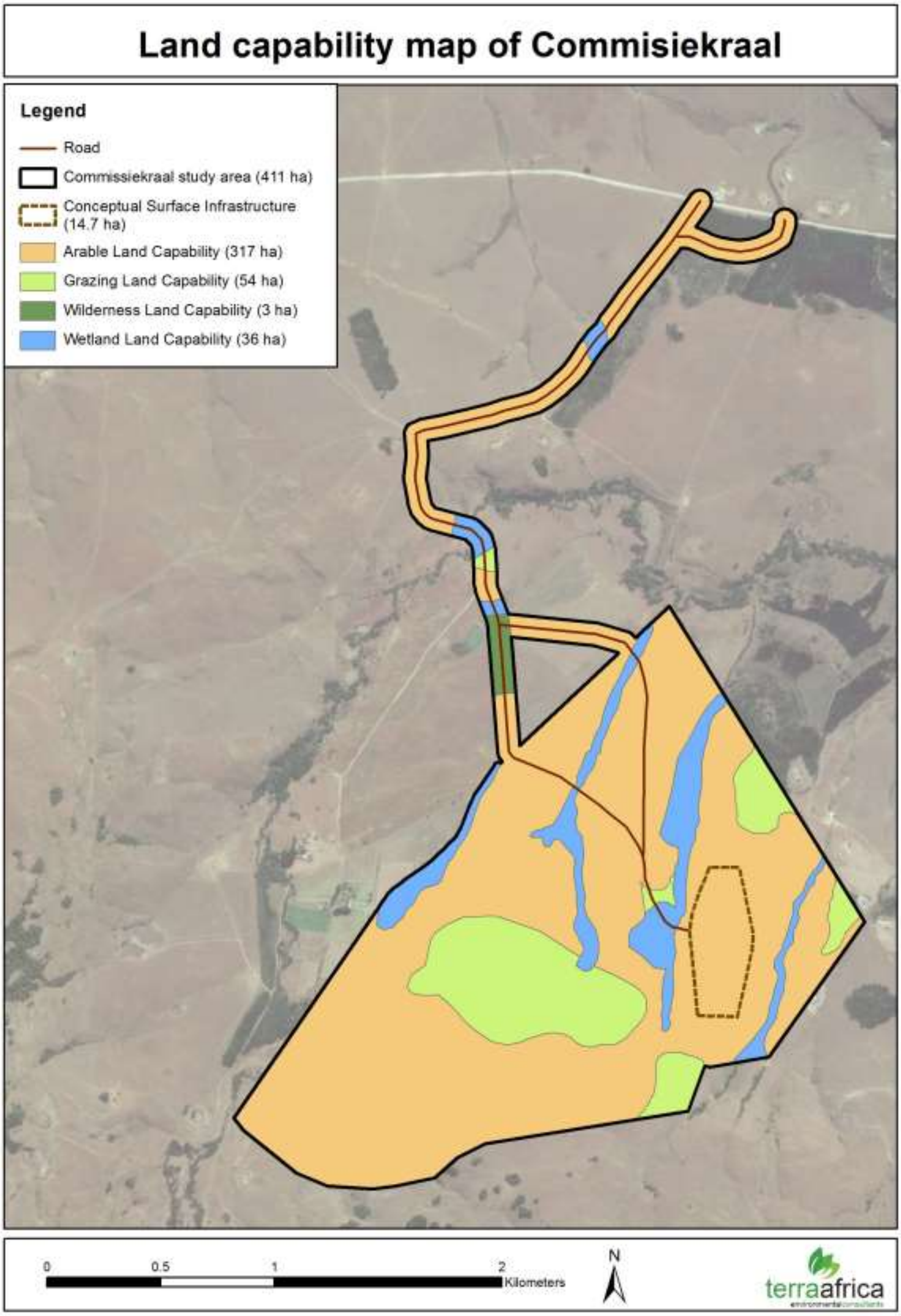

Figure 4: Land capability classification for the Commissiekraal Coal Mine Project area

9 Impact assessment

9.1 *Assessment methodology*

The impact assessment methodology is based on the Hacking method of determination of the significance of impacts (Hacking, 1998). This method also complies with the method provided in the EIA guideline document. Part A provides the definition for determining impact consequence (combining severity, spatial scale and duration) and impact significance (the overall rating of the impact). Impact consequence and significance are determined from Part B and C. The interpretation of the impact significance is given in Part D.

PART A: DEFINITION AND CRITERIA*		
Definition of SIGNIFICANCE		**Significance = consequence x probability**
Definition of CONSEQUENCE		**Consequence is a function of severity, spatial extent and duration**
Criteria for ranking of the SEVERITY of environmental impacts	**H**	Substantial deterioration (death, illness or injury). Recommended level will often be violated. Vigorous community action.
	M	Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints.
	L	Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	L+	Minor improvement. Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	M+	Moderate improvement. Will be within or better than the recommended level. No observed reaction.
	H+	Substantial improvement. Will be within or better than the recommended level. Favourable publicity.
Criteria for ranking the DURATION of impacts	**L**	Quickly reversible. Less than the project life. Short term
	M	Reversible over time. Life of the project. Medium term
	H	Permanent. Beyond closure. Long term.
Criteria for ranking the SPATIAL SCALE of impacts	**L**	Localised - Within the site boundary.
	M	Fairly widespread – Beyond the site boundary. Local
	H	Widespread – Far beyond site boundary. Regional/ national

PART B: DETERMINING CONSEQUENCE					
		SEVERITY = L			
DURATION	Long term	**H**	**Medium**	**Medium**	**Medium**
	Medium term	**M**	**Low**	**Low**	**Medium**
	Short term	**L**	**Low**	**Low**	**Medium**
		SEVERITY = M			
DURATION	Long term	**H**	**Medium**	**High**	**High**
	Medium term	**M**	**Medium**	**Medium**	**High**
	Short term	**L**	**Low**	**Medium**	**Medium**
		SEVERITY = H			
DURATION	Long term	**H**	**High**	**High**	**High**
	Medium term	**M**	**Medium**	**Medium**	**High**
	Short term	**L**	**Medium**	**Medium**	**High**
			L	**M**	**H**
			Localised Within site boundary Site	Fairly widespread Beyond site boundary Local	Widespread Far beyond site boundary Regional/ national
			SPATIAL SCALE		

PART C: DETERMINING SIGNIFICANCE					
PROBABILITY (of exposure to impacts)	Definite/ Continuous	**H**	**Medium**	**Medium**	**High**
	Possible/ frequent	**M**	**Medium**	**Medium**	**High**
	Unlikely/ seldom	**L**	**Low**	**Low**	**Medium**
			L	**M**	**H**
			CONSEQUENCE		

PART D: INTERPRETATION OF SIGNIFICANCE	
Significance	**Decision guideline**
High	It would influence the decision regardless of any possible mitigation.
Medium	It should have an influence on the decision unless it is mitigated.
Low	It will not have an influence on the decision.

***H = high, M= medium and L= low and + denotes a positive impact**

9.2 Project layout and description

The proposed mine layout indicated areas of surface disturbance for adit and ventilation shaft as well as areas where surface infrastructure will be constructed. The site infrastructure includes the upgrading of the existing farm road , site access roads and weighbridge, storm water drainage and recycle water systems and storage, potable water system and storage, parking areas, administration block, workshop and stores, re-fuelling depot, security and fencing, supporting civil works to the plant area and load-out flask, specifications for mine haul roads, civil works for a water processing plant and sewerage treatment plant, civil works for the electrical installation components that require foundations and general building work that may be required to support prefabricated office accommodation and off-the-shelf steel structures including civil work for the plant structures. The layout includes the adit area and areas for product and topsoil stockpiles.

9.3 Impact assessment per project phase

9.3.1 Construction phase

During the construction phase, all infrastructure and activities required for the operational phase will be established. The main envisaged activities include the following:

- Transport of materials and labour with trucks and buses as well as other light vehicles using the existing farm roads. This will compact the soil of the existing roads and fuel and oil spills from vehicles may result in soil chemical pollution.
- Earthworks will include clearing of vegetation from the surface, stripping topsoil (soil excavation) and stockpiling as well as drilling and blasting for the initial box cut as well as the construction of new haul roads. These activities are the most disruptive to natural soil horizon distribution and will impact on the current soil hydrological properties and functionality of soil. It will also change the current land use as well as land capability in areas where activities occur and infrastructure is constructed.
- Other activities in this phase that will impact on soil are the handling and storage of building materials and different kinds of waste. This will have the potential to result in soil pollution when not managed properly.

The disturbance of original soil profiles and horizon sequences of these profiles during earthworks is considered to be a measurable deterioration. This impact is considered to be permanent but will be localised within the site boundary. This impact is possible and will have medium significance. Even though topsoil management is described in the Soil Management Plan (SMP), the impact will still have medium significance as it is impossible to re-create original soil profile distribution.

Soil chemical pollution as a result of potential oil and fuel spillages from vehicles, is considered to be a moderate deterioration of the soil resource. This impact will be localised within the site boundary and have medium significance on the soil resource when not managed. However, with proper waste management and immediate clean-up, the significance of this impact can be reduced to low (Soil Management Plan).

Soil compaction will be a measurable deterioration that will occur as a result of the heavy vehicles commuting on the existing roads as well as any new haul roads constructed for this project. This is a permanent impact that will be localised within the site boundary with medium consequence and significance.

Soil erosion is also anticipated due to steep slopes and vegetation clearance. The impacts of soil erosion are both direct and indirect. The direct impacts are the reduction in soil quality which results from the loss of the nutrient-rich upper layers of the soil and the reduced water-holding capacity of severely eroded soils. The off-site indirect impacts of soil erosion include the disruption of riparian ecosystems and sedimentation. Soil erosion is a permanent impact for once the resource has been lost from the landscape it cannot be recovered. Although there are off-site indirect impacts associated with this, the impact is mainly considered to be local. The consequence and significance of the impact is considered as high. With proper mitigation measures and the embedded controls as recommended in the Soil Management Plan, it is anticipated that the significance of this impact can be reduced to medium.

In areas of permanent changes such as road upgrades, the sinking of adits and the erection of infrastructure and stockpiles, the current land capability and land use will be lost permanently.

Table 4: Rating of unmitigated impacts for the construction phase

Impact	Severity	Duration	Spatial scale	Consequence	Significance

Disturbance of original soil profiles and horizon sequences	M	H	L	M	M
Soil chemical pollution by petroleum hydrocarbons and other waste	M	H	L	M	M
Soil compaction	M	H	L	H	H
Soil erosion	M	H	L	H	H
Loss of current land capability	H	H	L	H	H
Loss of current land use	M	H	L	M	M

Table 5: Rating of mitigated impacts for the construction phase

Impact	Severity	Duration	Spatial scale	Consequence	Significance
Disturbance of original soil profiles and horizon sequences	M	M	L	M	M
Soil chemical pollution by petroleum hydrocarbons and other waste	L	L	L	L	L
Soil compaction	M	H	L	M	M
Soil erosion	M	H	L	M	M
Loss of current land capability	M	H	L	M	M
Loss of current land use	M	H	L	M	M

9.3.2 Operational phase

The operational phase includes all the processes associated with the mining of the coal as well as the daily management of the mine and related activities. The main envisaged operational activities that will impact on soil, land use and land capability include the following:

- Adits and surface infrastructure will both lead to surface impacts on soil resources. Surface infrastructure like buildings, conveyor system and product stockpiles are by far the most disruptive to current land uses, land capability as well as agricultural potential of the soil. Soil underneath buildings and stockpiles are subject to compaction and sterilization of the topsoil;

- Daily traffic on roads for inspection and maintenance of adit and conveyor;
- Daily mining activities in different areas of the proposed Commissiekraal Coal Mining project and
- Loading of coal at the product stockpile and transporting it to distribution points.

The disturbance of original soil profiles and horizon sequences of these profiles is considered to be a measurable deterioration. This impact is considered to be permanent but will be localised within the site boundary. This impact is possible and will have medium significance when unmanaged.

Soil chemical pollution as a result of pollutants leaching into subsurface soil horizons under the product stockpile, is considered to be a moderate deterioration of the soil resource. This impact will be localised within the site boundary and have medium significance on the soil resource when unmanaged.

Soil compaction will be a measurable deterioration that will occur as a result of the weight of the topsoil stockpiles stored on the soil surface as well as the movement of vehicles on the soil surfaces (including access and inspection roads). This is a permanent impact that will be localised within the site boundary with medium consequence and significance in the mitigated scenario.

During the operational phase, topsoil stockpiles as well as roads following steep slopes down valleys will still be susceptible to erosion. Soil surfaces with infrastructure such as concrete slabs will not be exposed to erosion any longer. This is a permanent impact that will be localized within the site boundary with medium consequence and significance. With proper mitigation measures and the embedded controls as recommended in the Soil Management Plan, it is anticipated that the significance of this impact will remain medium. Taking the relatively high rainfall in the area and the slope of the terrain in consideration it is unlikely that soil erosion will have low significance.
The current land capability and land use of areas with active mining will be lost temporarily. However, the land capability and land use of areas where infrastructure will be decommissioned can be restored through mined land rehabilitation techniques.

Table 6: Rating of unmitigated impacts for the operational phase

Impact	Severity	Duration	Spatial scale	Consequence	Significance
Disturbance of original soil profiles and horizon sequences	M	H	L	M	M
Soil chemical pollution into subsurface soil profiles	M	H	L	M	M
Soil compaction	M	H	L	H	H
Soil erosion	M	H	L	M	M
Loss of current land capability	H	H	L	H	H
Loss of current land use	M	H	L	M	M

Table 7: Rating of mitigated impacts for the operational phase

Impact	Severity	Duration	Spatial scale	Consequence	Significance
Disturbance of original soil profiles and horizon sequences	M	L	L	L	M
Soil chemical pollution by petroleum hydrocarbons and other waste	L	L	L	L	L
Soil compaction	M	H	L	M	M
Soil erosion	M	H	L	M	M
Loss of current land capability	M	M	L	M	M
Loss of current land use	M	M	L	M	M

9.3.3 Decommissioning phase

Decommissioning can be considered a reverse of the construction phase with the demolition and removal of the majority of infrastructure and activities very similar to those described with respect to the construction phase.

- Transport of materials away from site. This will compact the soil of the existing roads and fuel and oil spills from vehicles may result in soil chemical pollution.
- Earthworks will include redistribution of inert waste materials to fill the adits as well as topsoil to add to the soil surface. These activities will not result in further impacts on land use and land capability but may increase soil compaction.
- With the decommissioning phase, soil surfaces are in the process of being replanted with indigenous vegetation and until vegetation cover has established successfully, all surfaces are still susceptible to potential soil erosion.
- Other activities in this phase that will impact on soil are the handling and storage of materials and different kinds of waste generated as well as accidental spills and leaks with decommissioning activities. This will have the potential to result in soil pollution when not managed properly.

Table 8: Rating of unmitigated impacts for the decommissioning phase

Impact	Severity	Duration	Spatial scale	Consequence	Significance
Soil chemical pollution by petroleum hydrocarbons and other waste	M	H	L	M	M
Soil compaction	M	H	L	M	M
Soil erosion	M	H	L	M	M

Table 9 Rating of mitigated impacts for the decommissioning phase

Impact	Severity	Duration	Spatial scale	Consequence	Significance
Soil chemical pollution by	L	L	L	L	L

petroleum hydrocarbons and other waste					
Soil compaction	M	L	L	L	M
Soil erosion	L	M	L	L	L

Soil chemical pollution as a result of potential oil and fuel spillages from vehicle, is considered to be a moderate deterioration of the soil resource. This impact will be localised within the site boundary and have medium significance on the soil resource when not managed. However, proper waste management and immediate clean-up, the significance of this impact can be reduced to low (**Soil Management Plan**).

Soil compaction will be a measurable deterioration that will occur as a result of the heavy vehicles. This is a long-term impact because soil ripping will only alleviate compaction in surface soil layers and have little to no effect on deeper soil compaction. Soil compaction will be localised within the site boundary with medium consequence and significance in the unmitigated scenario.

Successful re-vegetation of all denuded areas with indigenous vegetation can reduce the significance of erosion to low.

9.3.4 Closure phase

The closure phase occurs after the cessation of all decommissioning activities. Relevant closure activities are those related to the after care and maintenance of remaining structures. It is assumed that all mining activities and processing operations will have ceased by the closure phase of the mining project. The potential for impacts during this phase will depend on the extent of demolition and rehabilitation efforts during decommissioning and on the features that will remain, such as upgraded roads.

There will be no further impacts on soil during the closure phase.

Soil Management Plan

The purpose of the Soil Management Plan (SMP) is to ensure the protection of soils and maintenance of the terrain of the Commissiekraal Coal Mine Project footprint during the construction, operational, decommissioning and closure phases. The plan contains methods that will be used to prevent adverse effects as well as a monitoring plan to assess potential effects during construction, operation, decommissioning and closure.

The objectives of the SMP are to:

- Address the prevention, minimisation and management of erosion, compaction and chemical soil pollution during construction, operations, decommissioning and closure;
- Describe soil stripping and stockpiling methods that will reduce the loss of topsoil;
- Define requirements and procedures to guide the Project Management Team and other project contractors;
- Define monitoring procedures.

9.4 Soil management during the construction phase

From the perspective of conserving the soil properties that will aid mine rehabilitation during the closure phase, the key factors to consider during the preparation for the construction phase of the mining project are to minimise the area affected by the development, minimise potential future contact of toxic or polluting materials with the soil environment and to maximise the recovery and effective storage of soil material that will be most useful during the rehabilitation process after mining is complete. Some of these measures will minimise a combination of impacts simultaneously while other measures are specific to one impact.

9.4.1 Minimise mining infrastructure footprint

The existing pre-construction mine layout and design is aiming to minimise the area to be occupied by mine infrastructure (workshops, administration, product stockpile, etc.) to as small as practically possible. All footprint areas should also be clearly defined and demarcated and edge effects beyond these areas clearly defined. This measure will significantly reduce areas to be compacted by heavy construction vehicles and regular activities during the operational phase.

9.4.2 Management and supervision of construction teams

The activities of construction contractors or employees will be restricted to the planned areas. Instructions must be included in contracts that will restrict construction work and construction workers to the clearly defined limits of the construction site. In addition, compliance to these instructions must be monitored.

9.4.3 Location of stockpiles

Locate all topsoil stockpiles in areas where they will not have to be relocated prior to replacement for final rehabilitation. Refrain from locating stockpiles as close as possible to the extraction point for cost saving only to have it relocated later during the life of mine. The ideal is to place all overburden materials removed at mine opening in their final closure location, or as close as practicable to it.

9.4.4 Topsoil stripping

Wherever possible, stripping and replacing of soils should be done in a single action. This is both to reduce compaction and also to increase the viability of the seed bank contained in the stripped surface soil horizons.

9.4.5 Stockpiling of topsoil

To minimise compaction associated with stockpile creation, it is recommended that the height of stockpiles be restricted between of 4 – 5 metres maximum. For extra stability and erosion protection, the stockpiles may be benched although the clay content is sufficient for stockpiles to remain relatively stable without benching.

9.4.6 Demarcation of topsoil stockpiles

Ensure all topsoil stockpiles are clearly and permanently demarcated and located in defined no-go areas. As the mining will last over several years it is important to have well defined maps of stockpile locations that correlate with these demarcated areas as re-vegetated stockpiles may easily be mistaken for something else. These areas should be maintained for rehabilitation purposes and topsoil should never be used as a filling material for roads, etc.

9.4.7 Prevention of stockpile contamination

Topsoil stockpiles can be contaminated by dumping waste materials next to or on the stockpiles, contamination by coal dust from product stockpile and the pumping out of contaminated water from the underground mine are all hazards faced by stockpiles. This should be avoided at all cost and if it occurs, should be cleaned up immediately.

9.4.8 Terrain stability to minimise erosion potential

Management of the terrain for stability by using the following measures will reduce the risk of erosion significantly:

- Stripping of topsoil should not be conducted earlier than required (maintain vegetation cover for as long as possible) in order to prevent the erosion (wind and water) of organic matter, clay and silt.
- Reducing slope gradients as far as possible along road cuts and disturbed areas to gradients at or below the angle of repose of those disturbed surfaces; and
- Using drainage control measures and culverts to manage the natural flow of surface runoff.
- Soil stockpiles must be sampled, ameliorated (if necessary) and re-vegetated as soon after construction as possible. This is in order to limit raindrop and wind energy, as well as to slow and trap runoff, thereby reducing soil erosion.

9.4.9 Management of access and haulage roads

Existing established roads should be used wherever possible. Where possible, roads that will carry heavy-duty traffic should be designed in areas previously disturbed rather than clearing new areas, where possible. The moisture content of access road surface layers must be maintained through routine spraying or the use of an appropriate dust suppressant.

Access roads should be designed with a camber to avoid ponding and to encourage drainage to side drains; where necessary, culverts should be installed to permit free drainage of existing water courses. The side drains of the roads can be protected with sediment traps and/or gabions to reduce the erosive velocity of water during storm events and where necessary geo-membrane lining can be used.

9.4.10 Prevention of soil contamination

During the construction phase, chemical soil pollution should be minimised as follows:

- Losses of fuel and lubricants from the oil racks of vehicles and equipment should be contained using a drip tray with plastic sheeting filled with sand;
- Using biodegradable drilling fluids, using lined sumps for collection of drilling fluids, recovering drilling muds and treating them off-site, and securely storing dried waste mud by burying it in a purpose-built containment area;
- Avoiding waste disposal at the site wherever possible, by segregating, trucking out, and recycling waste;
- Containing potentially contaminating fluids and other wastes; and
- Cleaning up areas of spillage of potentially contaminating liquids and solids.

9.5 Soil management during the operational phase

Soil management should be an on-going strategy through the operational phase as soil disturbing activities will continue in areas where mining continues and new areas are developed through mining activities.

It is recommended that concurrent rehabilitation techniques be followed to prevent topsoil from being stockpiled too long and losing its inherent fertility but opportunities may be limited by the geometry of the ore body. Historical borrow pits and other disturbed sites must be rehabilitated as soon as they have reached the end of their life.

As new stockpiles are created, they should be re-vegetated immediately to prevent erosion and resulting soil losses from these stockpiles. It is recommended that vegetation removed during land clearance be composted during the operational phase and that this compost be used as a soil ameliorant for soil rehabilitation purposes.

All above soil management measures explained under the Construction Phase should be maintained for similar activities during the Operational Phase. In addition to this, the following Soil Management Measures are recommended:

- The vegetative (grass) cover on the soil stockpiles (berms) must be continually monitored in order to maintain a high basal cover. Such maintenance will limit soil erosion by both the mediums of water (runoff) and wind (dust).

- Drains and intercept drains must be maintained so that it continues to redirect clean water away from the operating plants, and to convey any potentially polluted water to a potential pollution control dams.
- Routine monitoring will be required in and around the sites.

9.5.1 Managing potential soil contamination during the operational phase

The following management measures will either prevent or significantly reduce the impact of soil chemical pollution on site during the operation phase:

- Stockpiles are managed so they do not become contaminated and then need additional handling or disposal;
- A low process or storage inventory must be held to reduce the potential volume of material that could be accidentally released or spilled;
- Processing areas should be contained and systems designed to effectively manage and dispose of contained stormwater, effluent and solids;
- Storage tanks of fuels, oils or other chemicals stored are above ground, preferably with inspectable bottoms, or with bases designed to minimise corrosion. Above-ground (rather than in-ground) piping systems should be provided. Containment bunds should be sealed to prevent spills contaminating the soil and groundwater;
- Equipment, and vehicle maintenance and washdown areas, are contained and appropriate means provided for treating and disposing of liquids and solids;
- Air pollution control systems avoid release of fines to the ground (such as dust from dust collectors or slurry from scrubbing systems);
- Solids and slurries are disposed of in a manner consistent with the nature of the material by recognising and avoiding contamination; and
- Effluent and processing drainage systems avoid leakage to ground.

9.6 Soil management during the decommissioning phase

At decommissioning the adits will be backfilled and covered with a layer of topsoil. Some re-grading and re-contouring will be carried out. Soil management in the decommissioning phase will include the following:

9.6.1 Management and supervision of decommissioning teams

The activities of decommissioning contractors or employees will be restricted to the planned areas. Instructions must be included in contracts that will restrict decommissioning workers to the areas demarcated for decommissioning. In addition, compliance to these instructions must be monitored.

9.6.2 Infrastructure removal

All buildings, structures and foundations not part of the post-closure land use plan must be demolished and removed from site.

9.6.3 Site preparation

Once the site has been cleared of infrastructure and potential contamination, the slope must be re-graded (slope) in order to approximate the pre-mining aspect and contours. The previous infrastructure footprint area must be ripped a number of times in order to reduce soil compaction. The area must then be covered with topsoil material from the stockpiles.

9.6.4 Seeding and re-vegetation

Once the land has been prepared, seeding and re-vegetation will contribute to establishing a vegetative cover on disturbed soil as a means to control erosion and to restore disturbed areas to beneficial uses as quickly as possible. The vegetative cover reduces erosion potential, slows down runoff velocities, physically binds soil with roots and reduces water infiltration through evapotranspiration. Indigenous species will be used for the re-vegetation, the exact species will be chosen based on research available and then experience as the further areas are re-vegetated.

9.6.5 Prevention of soil contamination

During the decommissioning phase, chemical soil pollution should be minimised as follows:

- Losses of fuel and lubricants from the oil racks of vehicles and equipment should be contained using a drip tray with plastic sheeting filled with sand;
- Using biodegradable drilling fluids, using lined sumps for collection of drilling fluids, recovering drilling muds and treating them off-site, and securely storing dried waste mud by burying it in a purpose-built containment area;

- Avoiding waste disposal at the site wherever possible, by segregating, trucking out, and recycling waste;
- Containing potentially contaminating fluids and other wastes; and
- Cleaning up areas of spillage of potentially contaminating liquids and solids.

9.7 Soil management during the closure phase

During the closure phase activities include the maintenance and aftercare of final rehabilitated land. In this regard, frequent visual observations should be undertaken to confirm if vegetation has re-established and if any erosion gulley's have developed. In the event that vegetation has not re-established and erosion gulley's have developed, remedial action should be taken.

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The land of the proposed project site supports natural vegetation suitable for cattle and and small stock farming. In areas where the slope is less than 12 % crop production is also possible. The proposed new Commissiekraal Coal Mine consisting of an adit through which access is obtained to underground mining, a product stockpile, an overland conveyor, a ventilation shaft, upgraded farm roads and associated plant and infrastructure, will impact upon soil and land capability properties in the areas where the footprint will cause surface disturbance. Cumulative impacts are also related to increase in the surface footprint. These impacts can be reduced by keeping the footprint minimised where possible and strictly following soil management measures pertaining to topsoil stripping, stockpiling, conservation of the soil quality of topsoil stockpiles and erosion control measures.

11 A reasoned opinion as to whether the activity should or should not be authorised

The proposed Commissiekraal Coal mining developments falls within a larger area with mainly cattle farming and guest houses attracting tourists to the pristine natural environment. There are a few informal settlements with low population density on the subject property. Although the land capability and soil quality of land affected by the surface footprint of mining activities will be compromised, the proposed mining area will not impact on any current crop production and will therefore not affect primary grain production. Livestock farming activities will be influenced due to mining activities, however if soil management measures are followed as outlined in this report and the land be rehabilitated to the highest standard possible, it is of my opinion that the activity should be authorised. It follows that the recommendations and monitoring requirements as set out in this report should form part of the conditions of the environmental authorisation for the proposed project.

12 Reference list

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Addendum: Land use

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1. Introduction

SLR Consulting Africa (Pty) Ltd (SLR) appointed Terra Africa Consult land use impact assessment as part of the Environmental Impact Assessment (EIA) process for the Environmental Authorisation of the proposed Commissiekraal Coal Mine (CCM). Tholie Logistics (Pty) Ltd proposes to develop an underground coal mine with related surface infrastructure to support the mining operation.

The proposed project is located on the farm Commissiekraal 90 HT located about 28 km north of Utrecht and 27 km east of Wakkerstroom (hereafter referred to as the "subject property") (**Figure 1**). The Project is located in the eMadlangeni Local Municipality within the Amajuba District Municipality in the KwaZulu-Natal Province of South Africa.

2. Objective of the study

The objective of the Land Use Impact Assessment is to understand the current land uses of people living on the subject property as well as surrounding land users. The study aims to do this through analysis of a complex set of interactions between people inhabiting the land and their dependence on the natural resources and all other aspects of the landscape for their livelihoods. The study further sets out to determine potential future scenarios with regards to the proposed CCM and to assess the impacts of each of these scenarios on the current land users as well as potential future land users. An important objective is the fulfillment of the requirements of the most recent South African Environmental Legislation with reference to the assessment and management of the current land uses (stipulated in Section 3 below).

3. Environmental legislation applicable to study

The most recent South African Environmental Legislation that needs to be considered for the land use impact assessment includes the following:

- The Spatial Planning and Land Use Management Act of 2013 (that came into effect on1 July 2015) provides for sustainable and efficient use of land as well as development principles and norms and standards.
- The National Environmental Management Act 107 of 1998 requires that pollution and degradation of the environment be avoided, or, where it cannot be avoided be minimised and remedied.
- Government Notice R983 of 4 December 2014, Activity 21. The purpose of this Notice is to identify activities that would require environmental authorisation prior to commencement of that activity.

4. Terms of reference

The following Terms of Reference as stipulated by SLR Consulting Africa (Pty) Ltd applies to the baseline soil and land capability study:

- Undertake a desktop study to gain a high level understanding of the current land uses on the subject property as well as the surrounding land uses;
- Undertake a site visit of the proposed subject property area as well as the surrounding area to determine the characteristics of current land uses;
- Develop a set of future scenarios with regards to the proposed project;
- Study all other specialist impact reports to determine what the anticipated noise, air quality, biodiversity as well as surface and groundwater impacts are and determine how it will impact on the current land uses in the area.
- Identify and assess potential land use impacts resulting from the proposed Commissiekraal Coal Mine Project with associated infrastructure (including impacts associated with the construction, operation, decommissioning and post closure phases of the project), using the prescribed impact rating methodology;
- Identify and describe potential cumulative land use impacts resulting from the proposed development;
- Recommend mitigation measures to minimise impacts and/or optimise benefits associated with the proposed project.

5. Assumptions

The following assumptions were made during the assessment and reporting phases:

- The project will only consist of the development of an adit to access the underground coal mine, adits for ventilation shafts and support infrastructure which may include access roads, site offices, workshops and a parking area for vehicles and machinery, washing bays, septic tanks for sewerage, storm water dams and pollution control dams at the various mining operations. It will also include the development of overburden stockpiles and topsoil stockpiles.
- The impacts assessed for other environmental aspects such as air quality, noise levels and biodiversity is the best possible reflection of how the proposed project will impact on these.
- Current land users respect and value principles of sustainability and use resources wisely in absence of signs of current land degradation. Where current land degrading practices were observed, it is described under baseline conditions.

6. Uncertainties, limitations and gaps

The following uncertainties, limitations and gaps exists with regards to the study methodology followed and conclusions derived from it:

- There is limited potential to predict future land uses under changing climate that may result in wetter or drier as well as hotter conditions that is currently experienced on site;
- The effect that the aspirations of local land users for better or higher paid employment will have on land use change is extremely difficult to predict since it hinges on personal decisions and cannot be scientifically derived.
- The predicted impacts of the different components of the total environmental impact assessments were each determined specifying its own sets of limitations. These study

limitations pose the same limitations on the certainty of predictions made towards the anticipated impacts on land users.

7. Methodology

*7.1 D*esktop study and literature review

The following data was obtained and studied for the desktop study and literature review:

- Air quality specialist impact assessment report for the proposed Commissiekraal Coal Mine by Airshed Planning Professionals;
- Groundwater Impact Assessment for the Commissiekraal Coal Mine Project by Delta H Water Systems Modelling;
- Noise Assessment for the Development of the Commissiekraal Coal Mine produced by SLR;
- Traffic Impact Assessment for the Commissiekraal Coal Mine Project by SLR;
- Social Impact Assessment Report for the Commissiekraal Coal Mine by SLR;
- Hydrology Assessment for the proposed Commissiekraal Project prepared by Highlands Hydrology;
- The most recent aerial photography of the area available from Google Earth was obtained.

7.2 Site survey

The proposed project site was visited and traversed to determine current land uses as well as identify signs of historic land uses that may not be practiced anymore. The surrounding areas were scouted to observe the natural resources present as well as the current land uses within the larger area. These observations were categorised and documented to form part of the description of baseline conditions.

8. Baseline conditions

8.1 Land uses present in the proposed project area

For the purpose of the baseline description, the proposed project area is regarded as the Commissiekraal farm as well as the section of gravel road protruding from this area towards the main gravel road.

8.1.1 Small-scale and subsistence farming

The dominant land use of the proposed project area (as derived from the number of land user units that engage in this land use) is small-scale and subsistence farming around rural settlements. A typical land user unit of this nature consist of a house that is either built of earth materials sourced on site or a mixture of conventional bricks and earth materials. There are small outbuildings or huts in close proximity to the main house. Small crop fields are bordering the household and all of this is fenced in by barbed wire. Outside of the fenced-off living unit, cattle, horses and donkeys were found grazing the fields and drinking water form surface water resources on site.

Cultivation of crop patches are mainly done by manual labour but one tractor was present that indicate that some land users may have access to more mechanised agriculture. Wattle plantations are present in close proximity to these households and signs of deforestation by land users to gather wood as a source of energy, were present. Signs of water-harvesting from the first 120cm of the soil were present in several isolated spots. This technique was observed during the site visit and consists of holes being dug in the soil so that it can fill up with water that can be transferred to smallish water tanks and transported to the households. In small patches around these water collection pits, signs of soil erosion were evident and it is expected that this can aggravate should more holes be made for water collection.

8.1.2 Commercial farming

The other main activity on the Commissiekraal farm in close proximity to the proposed project site, is commercial cattle farming with fenced-off paddocks and cattle handling facilities. The livestock and property belongs to the Lenz family and is currently being managed by Clement Lenz. In addition to cattle grazing the field, there are a few fields with cultivated pastures that are harvested and feed bales were visible during the site visit. Historically, some of these fields as well as areas now under natural vegetation, have been used for crop production. However, during an interview with Mr Lenz, it was established that the transport cost of harvested grains to the nearest grain silo, significantly reduces the profitability of crop production on the farm. The land is generally well managed and no signs of serious historical and present land degradation was observed.

8.2 Land uses present in the surrounding area

8.2.1 Commercial farming

The study site falls within bioresource unit Yd3. That means that the annual rainfall is between 901 mm and 1100 mm and the altitude 1401 – 1800 m above sea level with a mean annual temperature of 14.1 – 14.3 °C. This environment lends itself to a variety of commercial options that are practiced in the area including crop production of maize and soy beans, forestry, cattle and game farming.

8.2.2 Tourism and eco-tourism

The proposed project area is surrounded by a number of protected areas that aim to preserve the high natural biodiversity present. These areas are ideal for the development of tourism facilities such as accommodation for families that would like to stay for a few days and experience this.

8.2.3 Miscellaneous other land uses

- A school is situated next to the transport route and learners use the access road to the proposed mining site to travel to and from the school.
- The proposed Elandsberg Protected Environment is situated adjacent to the subject property, on its southwestern, northwestern and northeastern boundaries.

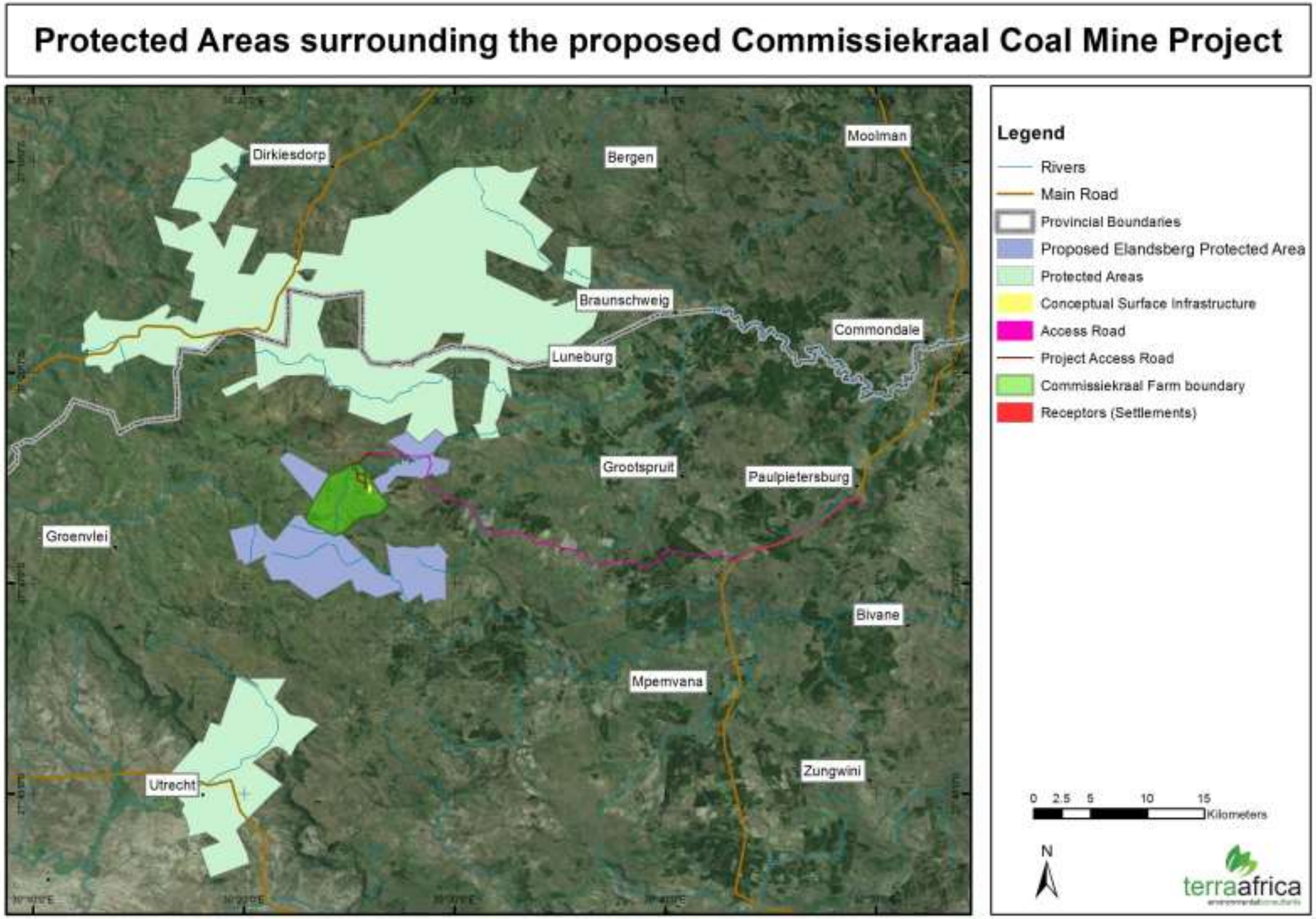

Figure 1: Protected Areas surrounding the proposed Commissiekraal Coal Mine Project

9 Anticipated impacts on land users

9.1 Traffic

Project-related traffic has the potential to degrade roads due to the increase of heavy goods vehicles (HGV) which may result in serious injury and/or death to land users all along the route used during all relevant phases. The following key aspects are of importance:

- There will be a significant increase in traffic volumes on the more rural roads (D699 and P40) and to a lesser extent on the more established roads (R33 and P221) especially during the operational phase.
- Four schools have been identified along the haulage route exposing vulnerable road users such as children to project-related traffic.

In the unmitigated scenario, the project presents the potential for a decrease in road conditions and a possible increase in the number of road accidents. The potential severity of reduced road conditions during the construction phase is medium and increases to high during the operation phase due to the addition of coal trucks. The potential severity of any injury or death of land users along the route, including pedestrians as a result of project related traffic is high, regardless of the project phase. With implementation of mitigation measures, the severity of potential impacts on road users due to road conditions will be minimised.

Mitigation measures envisaged are among others possible bus transport for learners of schools and discussions with the relative road authority to maintain the relevant sections of the road on which heavy vehicle movement is anticipated. In the context of road safety impacts, if an accident occurs resulting in permanent injury or death the severity will remain high in the mitigated scenario for all phases.

9.2 Air quality

The proposed Commissiekraal Coal Mine project is located within a region where influences on existing ambient air concentrations are limited. The project has the potential to alter this if not managed correctly.

The main emissions associated with the project include particulate matter and limited gaseous emissions. Gaseous pollutants derived from vehicle exhausts are predicted to be low in comparison to particulate emissions. Particulate matter includes inhalable particulate matter less than 10 and less than 2.5 microns in size (PM_{10} and $PM_{2.5}$, respectively) and larger total suspended particulates (TSP). The inhalable components of particulates can cause human health impacts at high concentrations over extended periods. Reduced air quality has the potential to increase the risk of acute and chronic respiratory conditions. The larger particulate component can cause dust nuisance impacts and affect animal and plant health at high fallout quantities over extended periods. In the case of animals, grazing on soiled vegetation over extended periods reduces teeth life which can reduce animal life expectancy. In the case of plants, soiling of vegetation can reduce growth and productivity and can lead to vegetation die-off.

Land users that will be affected include private farmsteads, rural homesteads, the Luthilunye School and the natural environment. The assessment assumes that the two homesteads within the surface infrastructure footprint will be relocated prior to construction.
In the unmitigated scenario, exceedances of the $PM_{2.5}$ and PM_{10} annual and daily limits and European vegetation limits are predicted to occur on-site and in some instances off-site to the east and north east of the surface infrastructure area and beyond the transport route. After mitigation of on-site activities, the spatial extent reduces but exceedances of the daily PM_{10} limit just east of the farm boundary are still predicted. In the context of transport operations, the implementation of mitigation measures that focuses on water suppression reduces the footprint of impacts significantly.

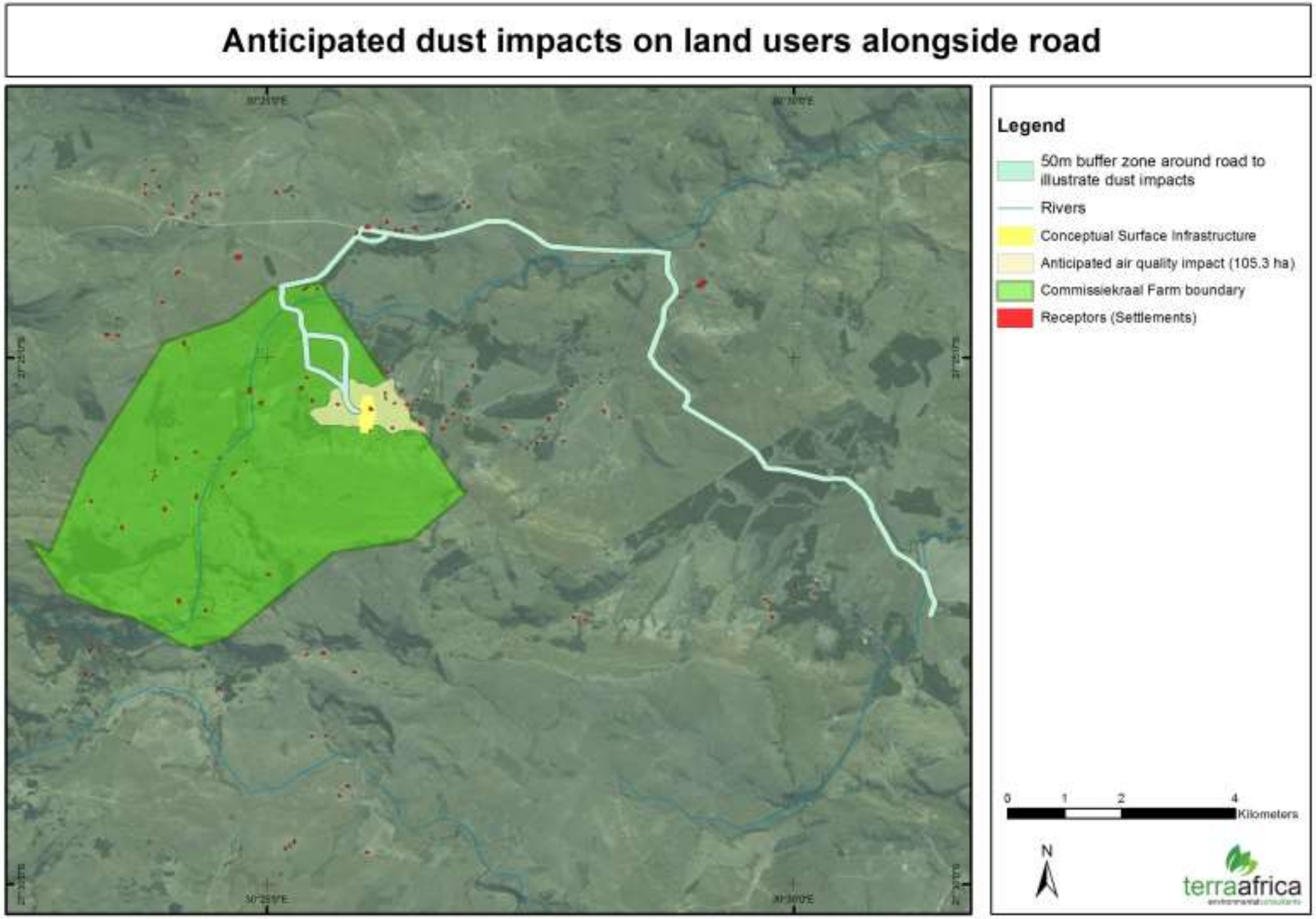

Figure 2: Anticipated dust impacts on land users alongside road

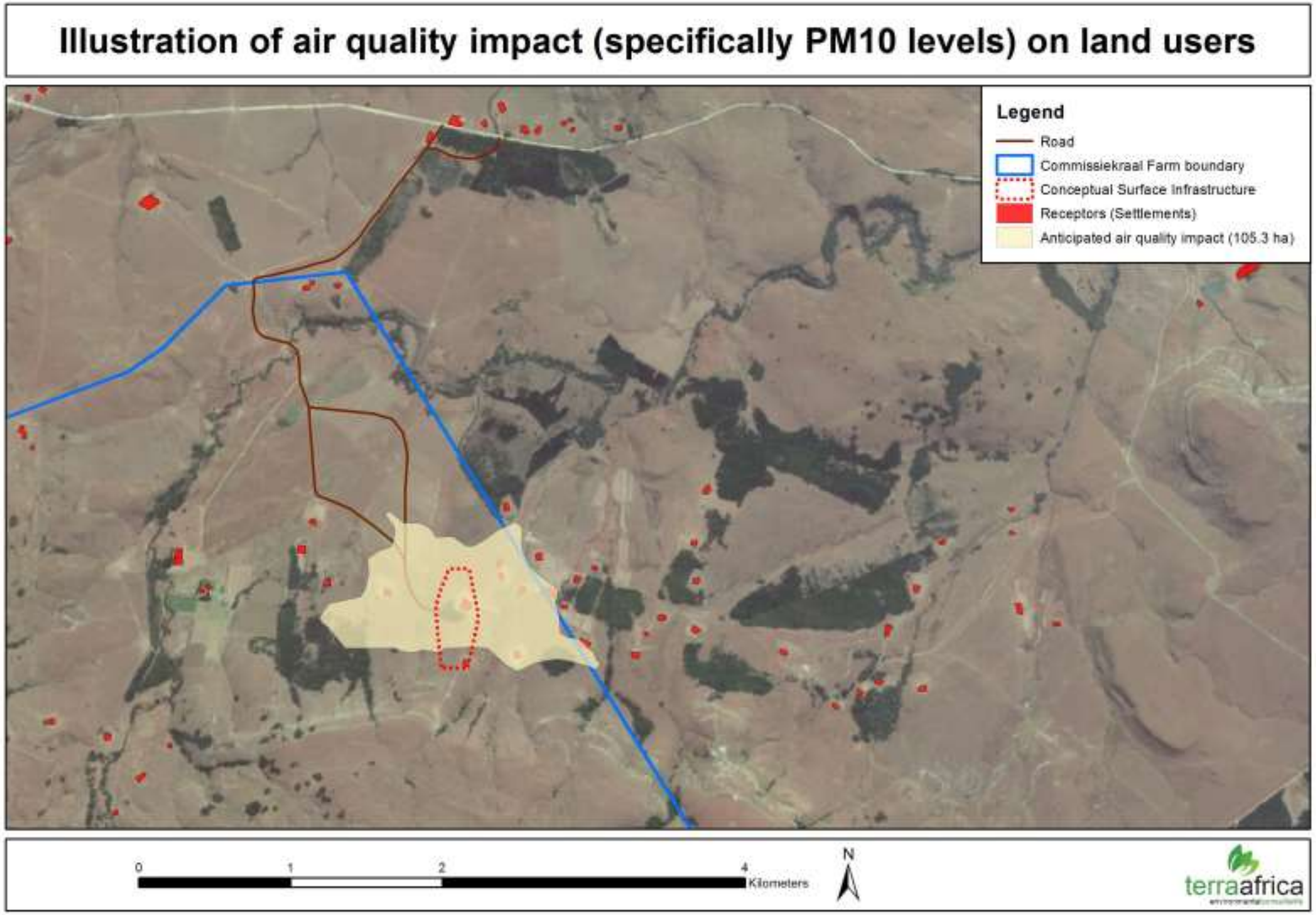

Figure 3: Illustration of air quality impact (specifically PM10 levels) on land users

9.3 Ground water

Land users, mainly subsistence farmers use surface water from rivers and water from springs and hand dug wells for domestic purposes and livestock watering on and surrounding the project site. Reliance on groundwater through borehole abstraction is limited to the hand pumps installed at schools. There is no alternative water supply to the project area. The project area and surrounds are seen as a key water production area for downstream surface water users.

The only activity that has the potential to negatively reduce the local groundwater level is dewatering of the underground mine (to ensure safe mining conditions).
Groundwater dependent water sources and yields of springs located within the zone of dewatering of the shallow aquifer, limited to the site boundaries, could be negatively impacted and some may dry up during the life of mine. This could also reduce the base flow contribution to surface water resources.

The containment of rainfall falling within designated dirty areas in terms of the storm water management plan can contribute to a loss of mean annual runoff (MAR) for the catchment by changing drainage patterns.

The impact of the loss in water supply to spring users within the cone of depression and downstream surface water users due to a loss of base flow contribution is high. With mitigation that focuses on providing an alternative supply to on-site water users and compensation for loss through controlled discharge should mine-related loss occur, the impact will be reduced significantly.

9.4 Soil

Soil covered by the mine footprint will be lost to land users who used the area for crop production, grazing of livestock or housing. There are two households within the mine's infrastructure footprint that will require relocation. Other households located near the mining activities may also require relocation because of the effect of the cumulative impacts of the mine's surface activities on their land use.

The relocation of people will result in the permanent loss of immovable assets such as their agricultural fields.

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The impact on the land users currently residing in the area of the surface infrastructure footprint will be directly and permanently affected since they will be relocated to another portion of land without surface infrastructure. Land users within the area of mitigated air quality (PM10) impacts may still be affected by reduced air quality and it should be considered that they be relocated as well to avoid this. Other land users alongside the road (within 50m of each side) may suffer from impacts caused by dust generated on the roads by haul trucks and the strongest mitigation measures possible to reduce this, should be considered and implemented. Apart from that, the most significant long term impact on land users that is very difficult to quantify, is the possibility of water quality reduction and pollution over a period of time as mining activities continue. This will have the most significant impact on land users now dependent on surface water for themselves and their animals. An impact on water quantity and quality will also affect the biodiversity that rely on current water conditions for their survival.