SOIL AND LAND CAPABILITY ASSESSMENT FOR THE PROPOSED HYDRA – KRONOS 2ND 400 KV LINE IN THE NORTHERN CAPE PROVINCE

Prepared By

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Prepared for

Diges Group

Date: July 2023

DECLARATION OF INDEPENDENCE

I, L.D Mutshaine, declare that I:

- I consider myself bound to the rules and ethics of the South African Council for Natural Scientific Professions (SACNASP).
- At the time of conducting the study and compiling this report, I did not have any interest, hidden or otherwise, in the proposed development that this study has reference to, except for financial compensation for work done in a professional capacity.
- Work performed for this study was done objectively. Even if this study results in views and findings that are not favourable to the client/applicant, I will not be affected in any manner by the outcome of any environmental process of which this report may form a part, other than being a member of the general public.
- I declare that there are no circumstances that may compromise my objectivity in performing this specialist investigation. I do not necessarily object to or endorse the proposed development, but aim to present facts, findings, and recommendations based on relevant professional experience and scientific data.
- I do not have any influence over decisions made by the governing authorities.
- I undertake to disclose 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 a competent authority to such a relevant authority and the applicant.
- I have expertise and experience in conducting specialist reports 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 realize that a false declaration is an offence in terms of Regulation 71 of NEMA and is punishable in terms of section 24F of the Act.

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APPROVED

Date of Report	11/07/ 2023
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EXECUTIVE SUMMARY

Introduction

Nyamoki Consulting Pty Ltd was appointed to conduct a soil and land capability assessment for the proposed Hydra – Kronos 2nd 400 kV line in the Northern Cape province. The powerline is starting from the De Aar to Copperton Town from the Eastern to the western side of the Northern Cape and is approximately 180 km long. The proposed powerline routes traverse an area characterized by a mixture of natural and disturbed vegetation with the disturbance resulting primarily from farming and settlement.

Findings

The proposed Eskom powerline runs from De Aar to Copperton Town along different farming land and other towns in the middle. The area is very dry, characterized by dry rivers. The study area is drained largely by means of surface run-off, and a limited number of streams and rivers, most of which are non-perennial in nature. The drainage systems do not differ along the proposed route line. The presence of water bodies across the routes indicates the possibility of the development of irrigation systems for agriculture. The route line is associated with wetland types such as depression.

The proposed powerline traverses an area characterized by a mixture of natural and disturbed vegetation with the disturbance resulting primarily from farming and settlement. The corridor traverses along the Upper Karoo Bioregion, Upper Karoo Hardeveld, Bushmanland Arid Grassland, and the Bushmanland Basin Shrubland.

The assessment along the powerline compared to the desktop study shows similar details with land being categorized as very low to low-moderate. The land has low potential yield to produce crops due to its capability, climate associated with it. The soil has limited capacity to allow crops to grow due to limited soil depth. According to the general soil distribution pattern, the desktop shows that the soil along the proposed powerline route has limited pedological development, within the rocky areas and strongly saline soils.

Based on the desktop review, it has been noted that the study area is characterized by the following soil types:

- Soils with limited pedological development. Soils with minimal development, usually shallow, on hard or weathering rock, with or without intermittent diverse soils. Lime is generally present in part or most of the landscape.
- Soils with strong texture contrast. Soils with a marked clay accumulation, strongly structured and a non-reddish colour. This may occur or be associated with one or more of vertic, melanic and plinthic soils.
- Red-yellow soil with well drained characteristics, massive or weakly structured soils. Red soils with high base status.
- Sandy soils with little or no profile development. Red and yellow, well drained sandy soils with high base status.
- Strongly saline soils. Strongly saline soils generally occurring in relatively deep deposits in low lying arid areas.

Soils were investigated and samples were taken from survey positions using a spade to a maximum depth of 0.5 m or the depth of refusal. These positions were recorded as waypoints using a handheld Global Positioning System. Ten soil samples were collected along the powerline and two samples were collected at Holput 69 Farm. One soil sample was taken at each point, and it represented top, and subsoil combined. The soil samples were sealed in sampling plastic bags and sent to Soil Laboratory, Pretoria for analysis. Baseline soil fertility was analysed for electrical conductivity (EC), pH (KCl and H2O), phosphorus (Bray1), exchangeable cations (calcium, magnesium, potassium, and sodium), organic carbon (Walkley- Black) and texture classes (relative fractions of sand, silt and clay).

The levels of the basic cations Ca, Mg, K and Na are determined in soil samples for agronomic purposes through extraction with an ammonium acetate solution. In general, the amounts of exchangeable cations normally follow the same trend as outlined for soil pH and texture. For most soils, cations follow the typical trend of Ca>Mg>K>Na. Calcium, magnesium and potassium levels in the soils were generally not adequate for crop production, not below the required levels and these nutrients have not been limited to any production or are considered toxic. There will be no need to add Ca, K and Mg sources as the proposed is not going to be used for agricultural purposes.

The Bray 1 extraction and analysis procedure for phosphorus is preferred for soils with pH levels between 6 and 8 which is moderate pH and thus acceptable for plant growth. The calcium (Ca) and magnesium (Mg) levels encountered in the soil samples along the powerline were acceptable to high concentration elevation according to guidelines indicating soil which is not suitable for crop farming. Calcium and magnesium concentration in the soil shows acceptable variables which is good for agricultural purposes thus they are the limiting factor in terms of ecosystem function if the soil was going to be used for agricultural purposes. Magnesium and calcium fertilization must be required to establish good crop stand and growth, for the agricultural activities are taking place over the area.

According to the land, capability map the corridor is mainly dominated by low in the northwest towards Copperton Town and low moderate land capability in the far southeast, in the De Aar Town and Table 2 above indicating that the area is heavily for grazing purpose and wildlife.

Based on the project area, the soil capability within the study area falls within the low - very low land capability and low moderate area. According to the land capability classes' distribution within the country per province (Schoeman *et al.,* 2002), the project falls within class VIII of which the climate capability L5 is a Vlei class. The results show the L5 is characterized by restricted potential: Regular and/or severe to moderate limitations due to soil, slope, temperatures or rainfall.

Recommendations

Erosion as well as spills and leaks of vehicles and heavy machinery is expected to impact upon the groundwater source given the permeability of the underlying bedrock. These impacts can however be mitigated to a certain extent.

It is recommended that the project be approved as it poses less risk regarding soil should the mitigation measures in this report be implemented. It is also noted that the area for substation extension is within the substation yard as such this area has already been earmarked for use as a substation.

Cumulative impacts have been described as the impact of an activity that in itself may not be significant but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area. The site is already characterised by the existing Hyra – Kronos powerline, therefore, the impacts of the proposed 2nd Hydra – Kronos powerline may be exacerbated due to the existing Hyra – Kronos power line and adjacent/ nearby projects of a similar nature. In terms of significance, the cumulative impacts anticipated on soil and land capability will be Low to Moderate. The impacts will be reversible, however, mitigation measures provided above should be implemented. Increased wind and soil erosion will also be minimal however loss of topsoil may result in a drop in natural facility and grazing potential.

The following mitigation measures are recommended.

- Rehabilitation of soil needs to be done concurrently to the construction to avoid soil erosion and water damming for long periods during the rainy season.
- Soil nutrient cycles can be maintained by revegetation of topsoil stockpiles and through proper ecological land rehabilitation.
- The project footprint should be kept as small as possible. Traffic should be restricted to existing roads only. Topsoil stripping and stockpiling should not be conducted during wet periods, soil moisture should be below a pre-determined level.
- Proper soil contamination prevention measures will mitigate the risk of soil chemical pollution, e.g., checking vehicles before they drive onto the site.
- Control soil erosion using geotextiles and revegetation of exposed soil surfaces where possible.
- Rehabilitate land to restore the grazing capacity to a large extend.
- Avoid wetland areas as far as possible and do not include areas of surface disturbance.

GLOSSARY OF TERMS

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, and magnesium) will occupy two sites.
Buffer capacity:	The ability of soil to resist an induced change in pH.
Calcareous:	Contains 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 clay skin, 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 the 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 prevent run-off, with the result that the upper horizons remain wet. Gleyed soils are typically green, blue, or grey.
Land capability:	The ability of the 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, map-able at 1:250000 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 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 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.
Slicken sides:	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 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 is also known as heaving soils.
Texture soil:	The relative proportions of the various size separate 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 iv strongly developed, ped faces are shiny, and consistency is highly plastic when moist and sticky when wet.

ACRONYMS

ARC-ISCW	Agricultural Research Council Institute for Soil Climate and Water
ET	Evapotranspiration
GIS	Geographic Information Systems
GPS	Global positioning system
IRP	Integrated Resource Plan
m	Meter
NEMA	National Environmental Management Act
SACNASP	South African Council For Natural Scientific Professions
TDP	Transmission Development Plan

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1. INTRODUCTION

The conservation of South Africa's limited soil resources is essential for human survival. In the past, misuse of land due to not classifying the soils and their capability/potential correctly has led to the loss of these resources through erosion and destabilization of the natural systems.

In order to accurately determine the characteristics of soils, it is necessary to conduct a soil survey using established methods. The aim is to create precise documentation of the soil resources of an area. Based on these findings, assessments are made regarding the land's capability and potential. The objective of this assessment is to identify the most sustainable utilization of the soil resource while ensuring the system remains undegraded.

Therefore, soil mapping is essential to determine soil types that are present, their depths, their land capability/land potential, and their stripping ratios. These results will then be used to give practical recommendations on preserving and managing the construction of the powerline.

1.1. Project Background

Eskom is required to respond to the aggressive plans for the country to achieve a diversified energy mix. This entails strengthening of the Transmission infrastructure network in order to evacuate the existing and expected renewable power out of the Northern Cape province to other load centers in the country.

Aries – Kronos – Hydra 400 kV is one of the three major backbone corridors that move power to and from the Northern Cape. Furthermore, with the current generation allocation, the existing Kronos – Hydra 400 kV line will experience thermal overload by 2023 thus requiring the need for a second (2nd) Kronos – Hydra 400 kV line.

The scope of work for the proposed Hydra – Kronos 2nd 400 kV line is indicated below:

<u>Construction of the Proposed Hydra – Kronos 2nd 400 kV Line</u>

Hydra – Kronos 2nd 400 kV line

- Construct a second ±187 km 400 kV line from Hydra to Kronos Substation which will serve as an evacuation corridor for the large concentration of RE in the Northern Cape
- Bypass series compensation on the 1st Hydra – Kronos 400 kV line

Kronos Substation

- Extend 400 kV busbar at Kronos Substation
- Establish and equip a new 400 kV feeder bay at Kronos Substation

Hydra Substation

- Equip existing 400 kV feeder bay at Hydra Substation

1.2. Study Justification

The Department of Mineral Resources and Energy released the 2019 Integrated Resource Plan (IRP 2019) in October 2019. The IRP 2019 will see around 6 GW of new solar PV capacity and 14.4 GW of new wind power capacity commissioned by 2030. The 2020 TDP Generation Assumptions allocated generation capacity across the country in line with the IRP 2019. Due to the favorable sun and wind in the Northern Cape, the province has around 3.3 GW of committed renewable generation with over 10 GW expected by 2030.

1.3. Terms of Reference

The terms of reference require the assessment of the impact of the project development on the agricultural productivity of the area. This is to be assessed in terms of national criteria, specifically the impact on soil resources, water resources, vegetation and the overall agricultural activities at the project site. The report should be compiled according to the Gazetted Requirement Assessment Protocol for Agricultural Resources (Government Gazette No 43110, 20 March 2020). In addition, the assessment of cumulative impacts is mandatory.

1.4 Assumptions

All information relating to the proposed powerline route project as referred to in this report is assumed to be the latest available information. Additionally, best practice guidelines were taken into consideration and utilising the maximum expected heights of the infrastructures of the proposed powerline. Findings, recommendations, and conclusions provided in this report are based on the authors' best scientific and professional knowledge as well as information available at the time of compilation.

1.5 Limitations

The major limitation during the study was the acquisition of some relevant data, notably long-term climatic records for the project site.

2. ENVIRONMENTAL LEGISLATION APPLICABLE TO STUDY

The most recent South African Environmental Legislation that needs to be considered for any new or expanding development concerning the 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 the 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 using 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 before the commencement of that activity.

In addition to South African Environmental Legislation, the study also aligns to fulfil 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 route construction 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.

3. METHOD OF ASSESSMENT

A desktop study was compiled from various data sources including but not limited to the Agricultural Geo-Referenced Information System (AGIS) and other sources as listed under references. Desktop Screening

A background study including a literature review was conducted prior to the commencement of the field assessment. This is done in order to gather the pre-determined soil and land capability data within the study area. Different data sources that are listed under references were used for the assessment, including but not limited to the Agricultural Geo-Referenced Information System (AGIS).

Soil Classification and Sampling

- A soil survey was conducted in January 2019 by a qualified soil specialist at which time the identified soils within the study area were classified into soil forms;
- Subsurface soil observations were made using a manual hand auger in order to assess individual soil profiles, which entailed evaluating physical soil properties and prevailing limitations to various land uses;
- Dominant soil forms were classified according to the South African Soil Classification System (Soil Classification Working Group, 2018). A Global Positioning System (GPS) was used to record assessed survey and sampling points;
- It was also the objective of the assessment to provide recommended mitigation measures and management practices to implement in order to comply with applicable articles of legislation.

Table 1: Typical Arrangement of Master Horizons in Soil Profile.

<table>
<tr><td rowspan="4">Soil</td><td rowspan="4">Zone in which soil processes are maximally expressed</td><td colspan="5">Arrangement of master horizons</td></tr>
<tr><td rowspan="3">O- Organic</td><td rowspan="3">C- Regic sand (c), Stratified alluvium, (c), Man -Made Soil Deposits</td><td rowspan="2">A</td><td colspan="2">Humic, Vertic, Melanic, Orthic</td></tr>
<tr><td colspan="2">E</td></tr>
<tr><td>B</td><td>Red Apedal, yellow Brown Apedal, Soft Plinthic, Hard Plinthic, Prismacutanic, Pedocutanic, Lithocutanic,</td><td>G - Horizon</td></tr>
</table>

					Neocutanic, Neocarbonate, Podzol, Podzol with placic pan	
			C	Dorbank, Soft Carbonate horizon, Hard Carbonate horizon, Saprolite, Unconsolidated without signs of wetness, Unconsolidated with signs of wetness, Unspecified material with signs of wetness		
			R-Hard Rock			

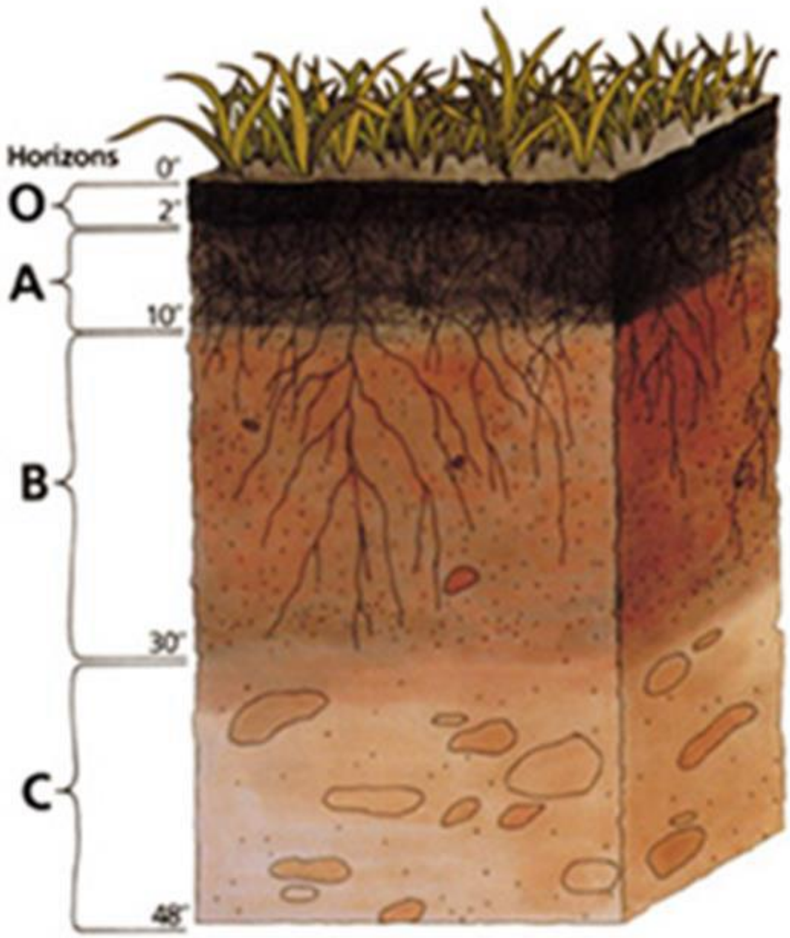

Figure 1: Schematic diagram depicting a conceptual presentation of a typical soil profile.

3.1. Land Capability and agricultural potential

Table 2 shows how the land classes and groups are arranged in order of decreasing capability and ranges of use. The risk of use increases from class I to class VIII (Smith, 2006) as shown in Table 2. Agricultural potential is directly correlated to Land Capability, as measured on a scale of I to VIII, as presented in Table

2 below; with Classes I to III classified as prime agricultural land that is well suitable for annual cultivated crops.

Table 2: Land Capability Classification (Scotney et al., *1987)*

Land Capability Group	**Land Capability Class**			**Increased intensity of use**							**Limitations**
	I	W	F	LG	MG	IG	LC	MC	IC	VIC	No or few limitations. Very high arable potential. Very low erosion hazard
Arable	II	W	F	LG	MG	IG	LC	MC	IC	-	Slight limitations. High arable potential. Low erosion hazard
	III	W	F	LG	MG	IG	LC	MC	-	-	Moderate limitations. Some erosion hazards
	IV	W	F	LG	MG	IG	LC	-	-	-	Severe limitations. Low arable potential. High erosion hazard.
	V	W	-	LG	MG	-	-	-	-	-	Water course and land with wetness limitations
Grazing	VI	W	F	LG	MG	-	-	-	-	-	Limitations preclude cultivation. Suitable for perennial vegetation
	VII	W	F	LG	-	-	-	-	-	-	Very severe limitations. Suitable only for natural vegetation
Wildlife	VIII	W	-	-	-	-	-	-	-	-	Extremely severe limitations. Not suitable for grazing or afforestation.

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

3.2. Climate Capability Classification

Class IV soils may be cultivated under certain circumstances and management practices, while Land Classes V to VIII are not suitable for cultivation. Additionally, the climate capability is also measured on a scale of 1 to 8, as illustrated in Table 3 below. The land capability rating is therefore adjusted accordingly, depending on the prevailing climatic conditions as indicated by the respective climate capability rating. The expected impacts of the proposed land use on soil and land capability were assessed in order to inform the necessary mitigation measures (Table 3).

Table 3: Climate Capability Classification (Scotney *et al.,* 1987).

Climate Capability Class	Limitation Rating	Description
C1	None to slight	The local climate is favourable for good yield for a wide range of adapted crops throughout the year.
C2	Slight	Local climate is favourable for good yield for a wide range of adapted crops and a year-round growing season. Moisture stress and lower temperatures increase risk and decrease yields relative to C1.
C3	Slight to moderate	Slightly restricted growing season due to the occurrence of low temperatures and frost. Good yield potential for a moderate range of adapted crops.
C4	Moderate	Moderately restricted growing season due to low temperatures and severe frost. Good yield potential for a moderate range of adapted crops but planting date options more limited than C3.
C5	Moderate to severe	Moderately restricted growing season due to low temperatures, frost and/or moisture stress. Suitable crops may be grown at risk of some yield loss.
C6	Severe	Moderately restricted growing season due to low temperatures, frost and/or moisture stress. Limited suitable crops for which frequently experience yield loss.
C7	Severe to very severe	Severely restricted choice of crops due to heat, cold and/or moisture stress.
C8	Very severe	Very severely restricted choice of crops due to heat and moisture stress. Suitable crops at high risk of yield loss.

3.3. Land Potential Classification

The land potential in South Africa is divided into 8 land potential which rates the land potential that is good for agricultural purposes Table 4.

Table 4: The Land Potential Classes

Land Potential	Description of land potential class
L1	Very high potential: No limitations. Appropriate contour protection must be implemented and inspected.
L2	High potential: Very infrequent and/or minor limitations due to soil, slope, temperatures or rainfall. Appropriate contour protection must be implemented and inspected.
L3	Good potential: Infrequent and/or moderate limitations due to soil, slope, temperatures or rainfall. Appropriate contour protection must be implemented and inspected.
L4	Moderate Potential: Moderately regular and/or severe to moderate limitations due to soil, slope, temperatures or rainfall. Appropriate permission is required before ploughing virgin land.
L5	Restricted potential: Regular and/or severe to moderate limitations due to soil, slope, temperatures or rainfall.
L6	Very restricted potential: Regular and/or severe limitations due to soil, slope, temperatures or rainfall. Non-arable
L7	Low potential: Severe limitations due to soil, slope, temperatures or rainfall. Non-arable
L8	Very low potential: Very severe limitations due to soil, slope, temperatures or rainfall. Non-arable

3.4. Soil Classification

The findings for the respective Soil Classes are as follows:

Class II: These soils are classified to have intensive cultivation land capability with an L3 (Good potential) land potential rating based on the C4 climatic classification. L3: Infrequent or moderate limitations due to soil, slope, temperature, or rainfall. Arable.

Class III: These soils are classified to have moderate cultivation land capability with an L3 (Good potential) land potential rating based on the C4 climatic classification. L3: Infrequent or moderate limitations due to soil, slope, temperature, or rainfall. Arable.

Class IV: These soils have a moderate cultivation / intensive grazing land capability with an L4 (Moderate potential) land potential rating based on the C4 climatic classification. L4: Moderate regular limitations due to soil, slope, temperature, or rainfall. Arable.

Class V: These soils have a wetland land capability as well as a wetland land potential rating. These classifications will remain wetland areas.

Class VI: These soils have a light cultivation / moderate grazing land capability with an L5 (Restricted potential) land potential rating based on the C4 climatic classification. L5: Moderate to severe limitations due to the soil, slope, temperature, or rainfall. Non-Arable as shown in Table 10 above.

3.5. Laboratory Analyses

All sampled soils were sent to the Aquatico Laboratory, a South African National Accreditation System (SANAS) accredited laboratory, for selected soil and water chemical analyses. The samples were prioritised for selected analyses of specific contaminants of potential concern (CPCs) according to the conceptual source-pathway-receptor linkages. The chemical analyses included the following selected constituents and contaminants of potential concern (CPCs):

- pH;
- Electrical conductivity (EC);
- Alkalinity;
- Anions; and
- Inorganic heavy metals and metalloids.

3.6. Soil Data Analysis and Interpretation

Analytical data was interpreted quantitatively, as a mass of contaminant per mass of dry weight (DW) of soil (mg/kg), pH values and/or milli-Siemens per meter (mS/m) for electrical conductivity (EC). Table 5 below was used as a reference guide to interpreting pH results in terms of acidity.

Table 5: pH classification with reference to common foods and other substances

pH range	Description	pH range of common foods and other substances	
<4,5	Extremely acid	Battery acid	<2.0
4,5 – 5,0	Very strongly acid	Lemon juice	2.0-2.6
5,1 – 5,5	Strongly acid	Vinegar	2.4-3.4
5,6 – 6,0	Medium acid	Wine	4-5
6,1 – 6,5	Slightly acid	Normal rain	5-6
6,6 – 7,3	Neutral	Distilled water	7
7,4 – 7,8	Mildly alkaline	Baking soda	8-9
7,9 – 8,4	Moderately alkaline	Soap	9-10
8,5 – 9,0	Strongly alkaline	Ammonia	10-12
>9,0	Very strongly alkaline	Lye	12-14

Note: pH Values of Common Foods and Ingredients obtained from (Anon, 1962), and (Bridges and Mattice 1939).

Table 6: Soil Fertility Guideline

Guideline per mg/kg					
Micronutrients			**Low**		**High**
Phosphate (P)			<5		>35
Potassium (K)			<40		>250
Sodium (Na)			<50		>200
Calcium (Cl)			<200		>3000
Magnesium (Mg)			<50		>300
pH (KLC)					
Very Acidic	**Acidic**	**Slightly Acidic**	**Neutral**	**Slightly Alkaline**	**Alkaline**
<4	4.1-5.9	6.-6.7	6.8-7.2	7.3-8	>8

4. DESKTOP ASSESSMENT RESULTS

4.1. Location

The Eskom proposed project is starting from the De Aar to Copperton Town from the Eastern to the western side of the Northern Cape. The powerline is approximately 180 km long (Figure 1).

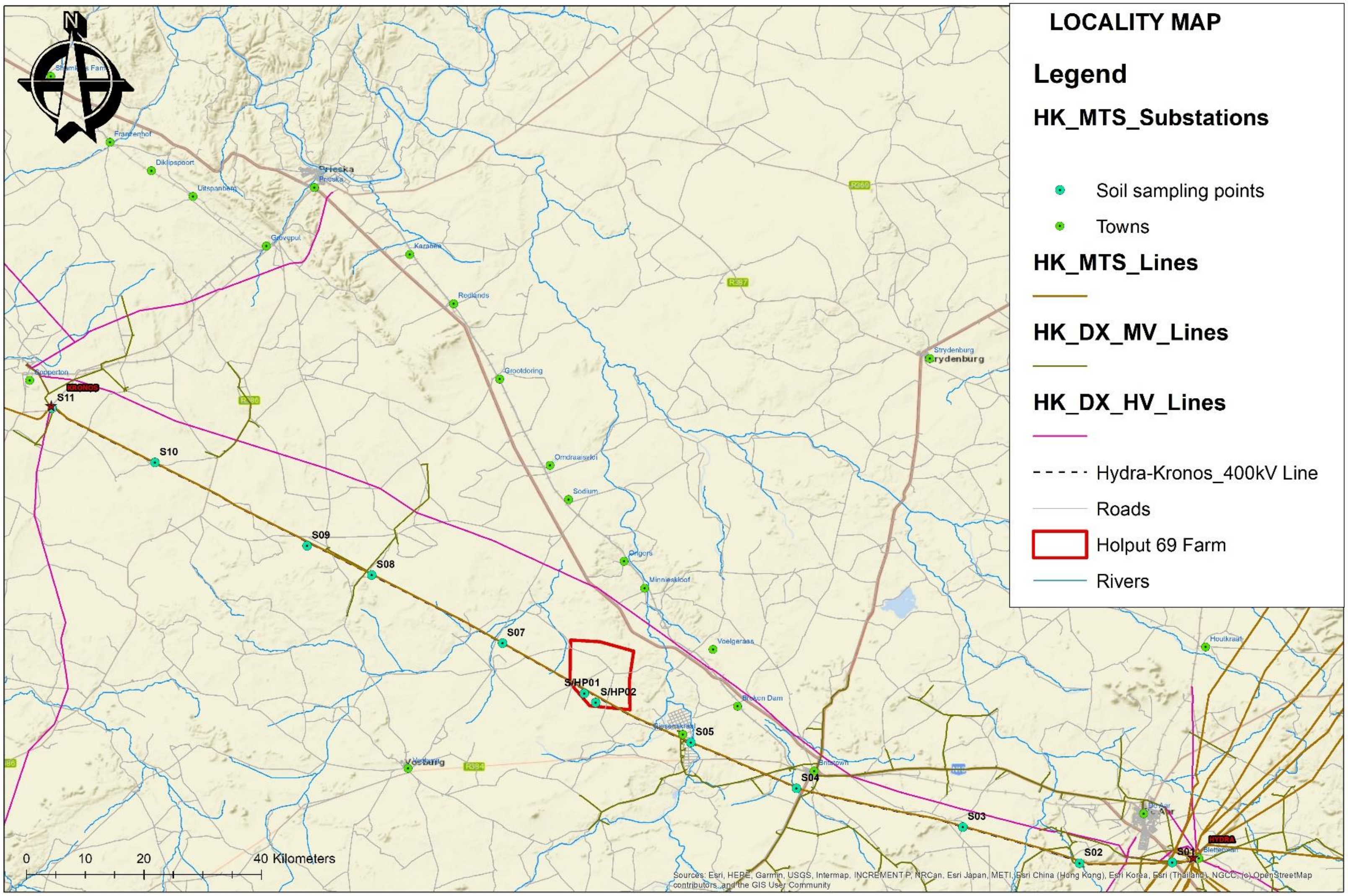

Figure 2: Locality map of the proposed Eskom powerline.

4.2. Landuse

The area where the proposed powerline is mainly dominated by farming such as cattle, sheep, goat and game farming with few crop farming.

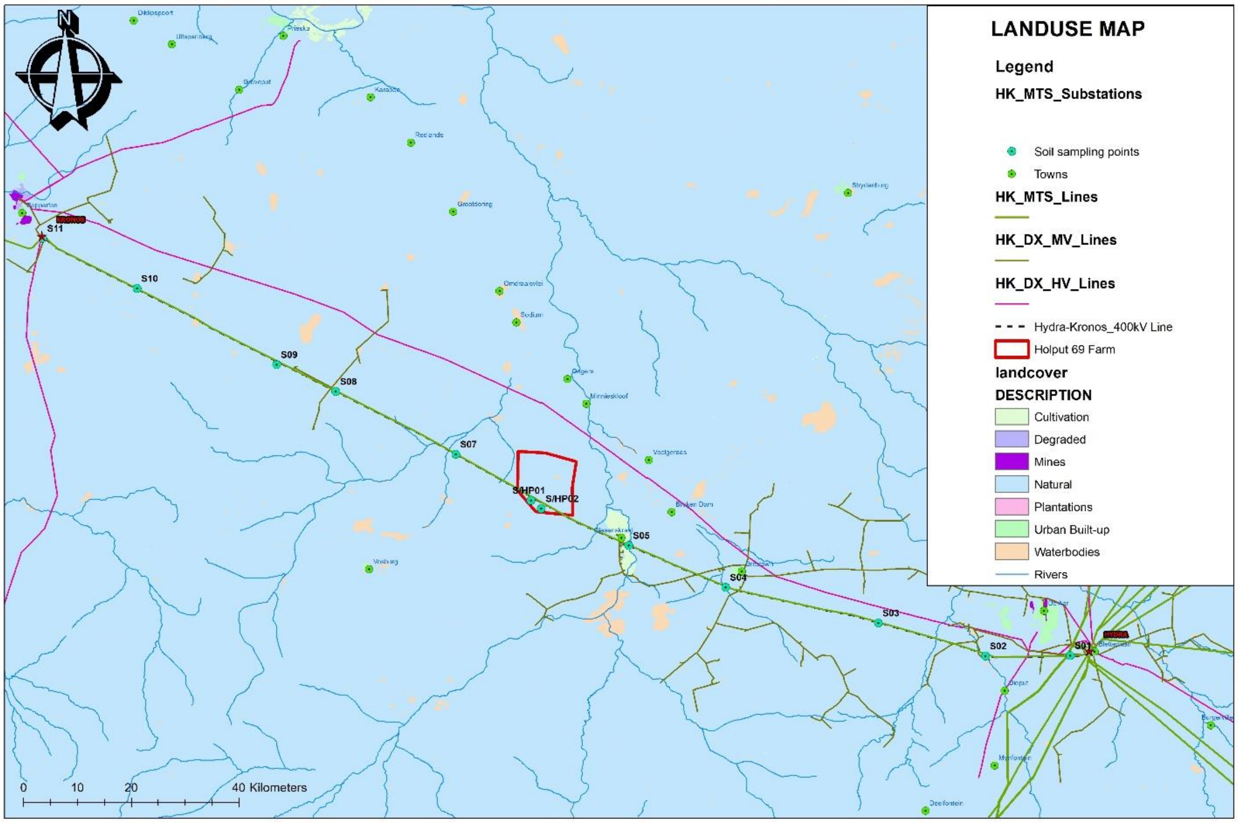

Figure 3: Landuse Map.

4.3. Climate change

The climate of the study area (ARC-ISCW, unpublished) can be regarded as warm to hot with wet summers and dry winters. The long-term average annual rainfall in this region of the Northern Cape is only 289 mm, of which 201 mm, or 70%, falls from November to April. Rainfall is erratic, both locally and seasonally and therefore cannot be relied on for agricultural practices. The average evaporation is over 2 000 mm per year, peaking at over 8.0 mm per day in December. Temperatures vary from an average monthly maximum and minimum of 32.6˚C and 15.4˚C for January to 16.8˚C and 0.3ºC for July respectively. The extreme high temperature that has been recorded is 41.6ºC and the extreme low –11.1˚C. Frost occurs most years on around 30 days on average between late May and early September.

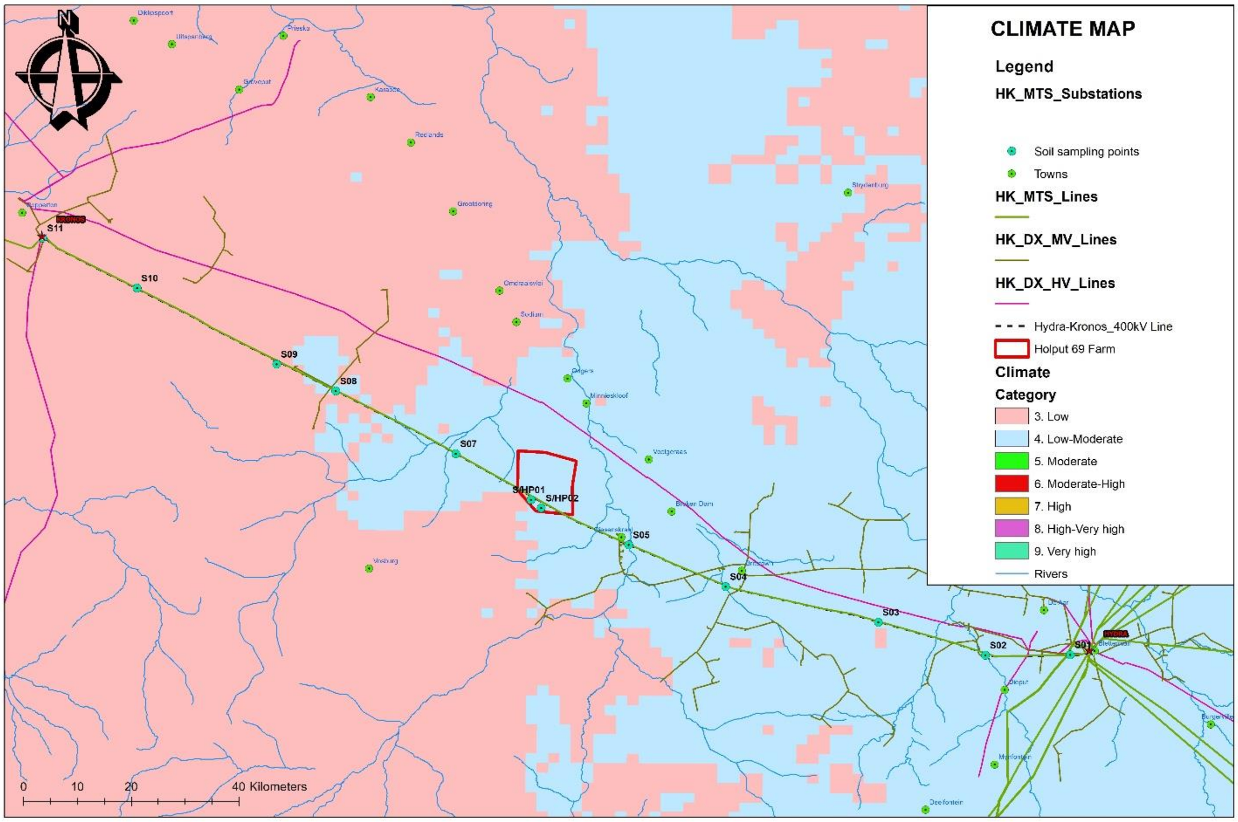

Figure 4: climate change map

4.3. Water Resources

The study area is drained largely by means of surface run-off, and a limited number of streams and rivers, most of which are non-perennial in nature. The drainage systems do not differ along the proposed route line. The presence of water bodies across the routes indicates the possibility of the development of irrigation system for agriculture. The route line is associated with wetland types such as depression.

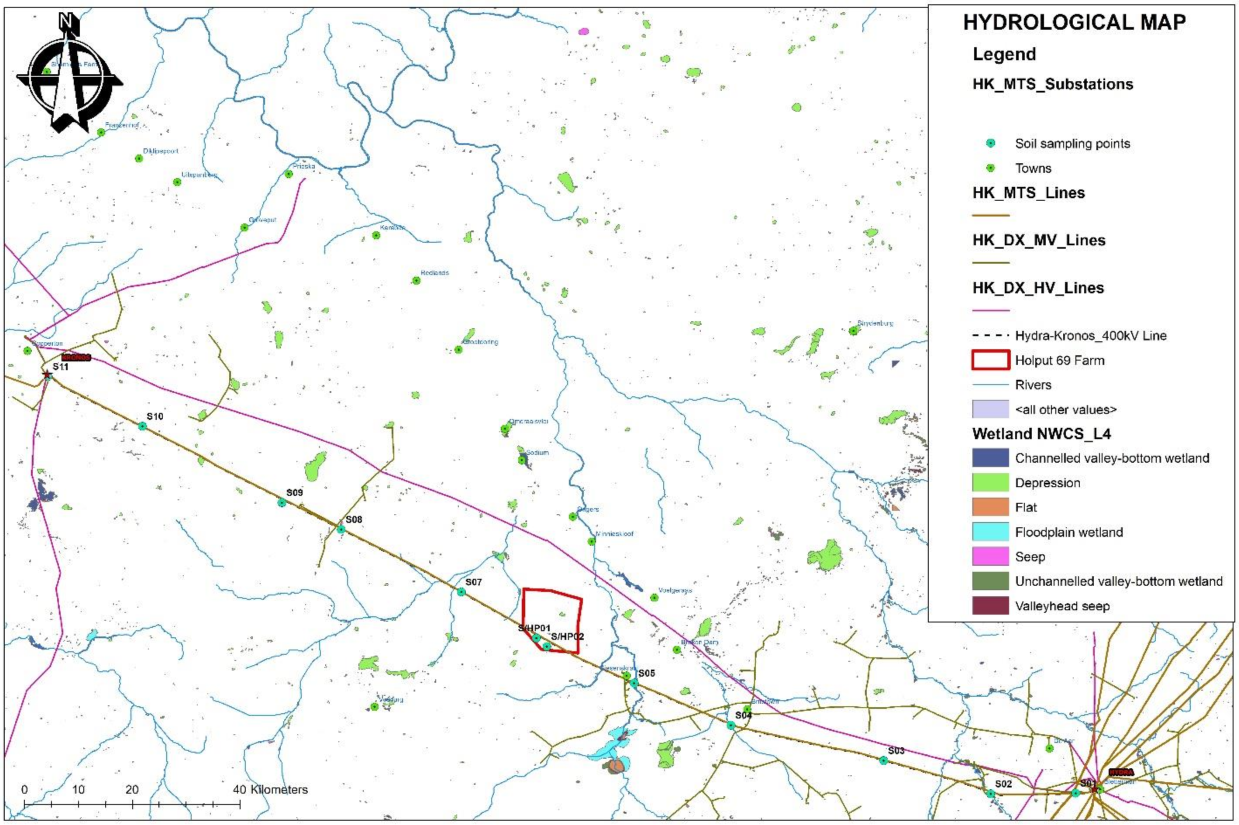

Figure 5: Water resources within the route line.

4.4. Moisture availability classification

The route line assessment compared to the desktop study shows similar output, therefore the area is very dry with the non-perennial stream. The moisture availability along the route line is very severe shows that there is no moisture available in the soil.

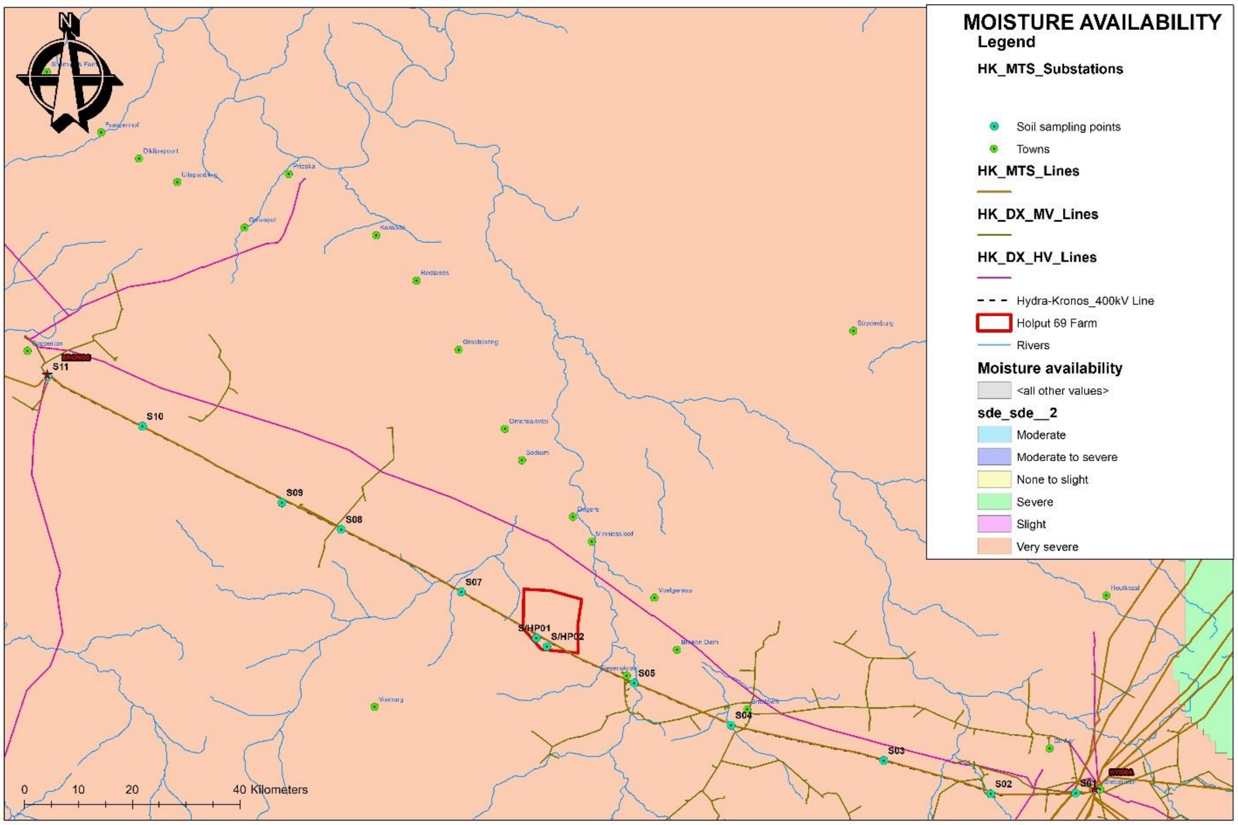

Figure 6: Moisture availability map.

4.5. Topography

The site lies at a height of approximately 1 300 to 1 340 metres above sea level, and is gently undulating, although a steeper hill occurs in some parts of the route line. No permanently wet drainage ways are present in the area.

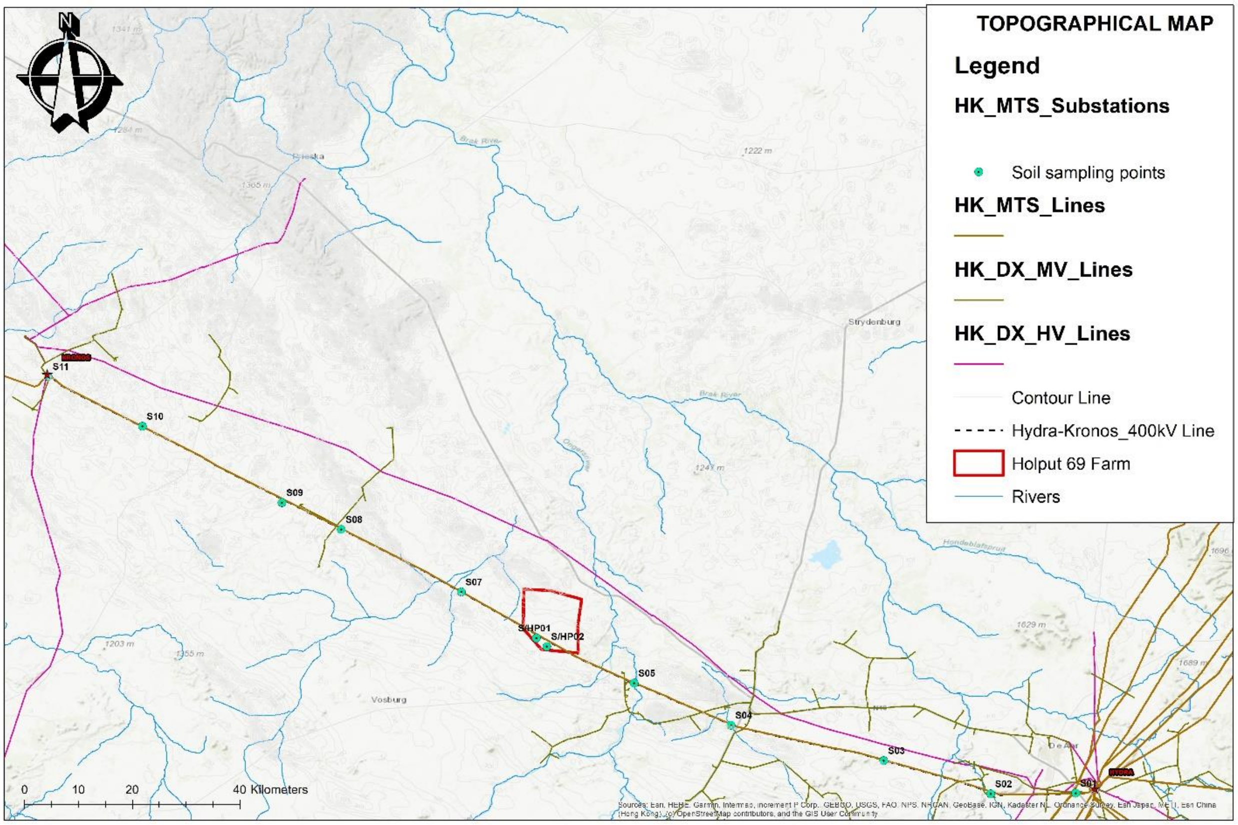

Figure 7: Topography associated with the proposed powerline.

4.6. Geology

The geology along the powerline route is almost similar. The geology of the area comprises mudstone and sandstone, shales and tillites rocks as indicated figure below of the Adelaide Formation, Karoo Sequence, with dolerite intrusions, especially in the east (Geological Survey, 1997).

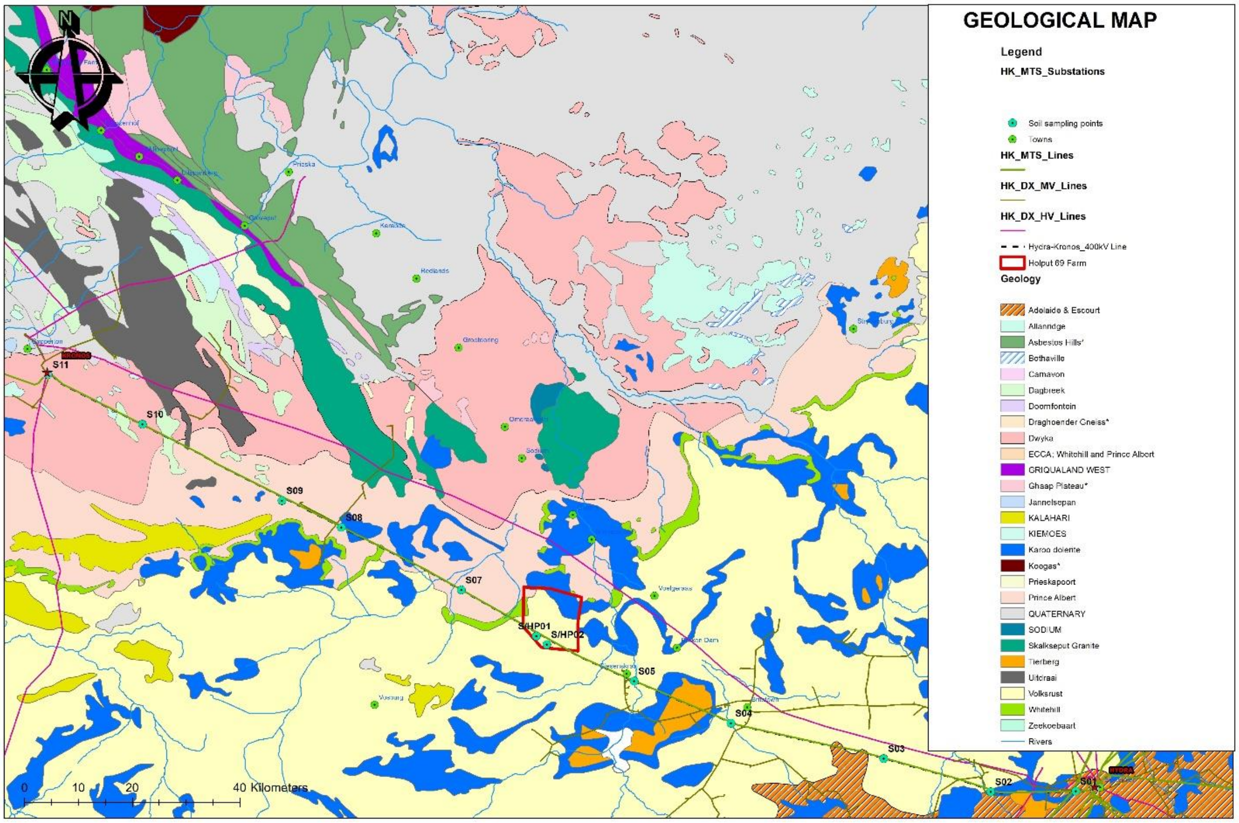

Figure 8: Geology of the study area.

4.7. Land Capability

Land capability refers to the capability of producing commonly cultivated crops and pasture plants without deteriorating over a long period of time. The land capability under the different powerline route is presented in appendix B. The assessment along the powerline compared to the desktop study shows similar details, the land is categorized as very low to low moderate. That is the land has low potential yield to produce crops due to its capability, climate associated with it, soil capability meaning that soil has limited capacity to allow crops to grow due to limited soil depth. According to the general soil distribution pattern, the desktop studies shows that the soil along the proposed powerline route has limited pedological development, within the rocky areas and strongly saline soils as indicated in Figure 9.

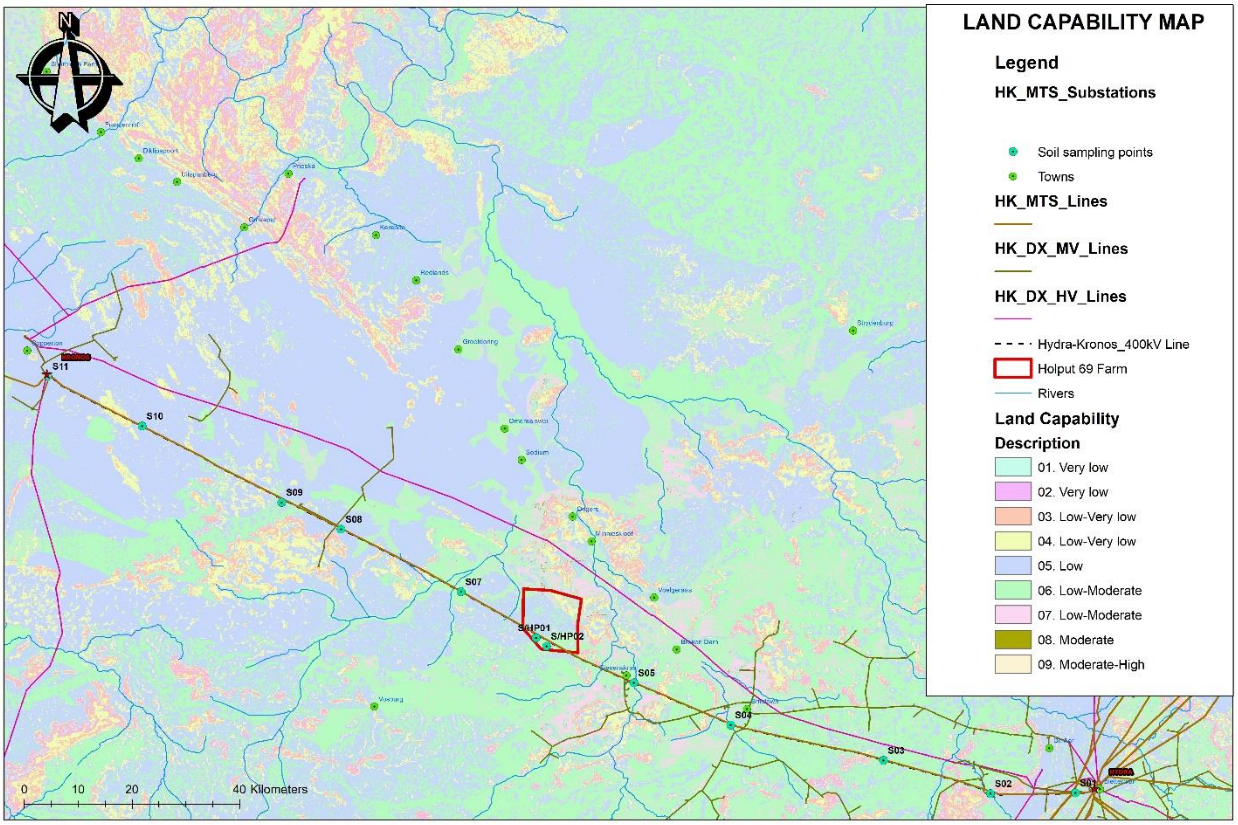

Figure 9: Land capability map.

4.8. Dominant soil

The following table depicts the dominant soil along the powerline and their characteristics.

Table 7: Soil dominant characteristics

Soil ID	Soil Class	Limitation	Properties
S2	Freely drained, structureless soils	May have restricted soil depth, excessive drainage, high erodibility, low natural fertility	Favourable physical properties
S7	Soils with a pedocutanic horizon	Restricted effective depth; may have slow water infiltration	Somewhat high natural fertility
S13	Lithosols (shallow soils on hard or weathering rock)	Restricted soil depth; associated with rockiness	May receive water runoff from associated rock
S16	Non soil land classes	Restricted land use options	May be water-intake areas
S17	Association of Classes 1 to 4: Undifferentiated structureless soils	One or more of: low base status, restricted soil depth, excessive or imperfect drainage, high erodibility	Favourable physical properties
S19	Association of Classes 7 and14: Undifferentiated texture contrast soils	One or more of: restricted effective depth; slow water infiltration; seasonal wetness; high erodibility	Somewhat high natural fertility or relative wetness favourable in dry areas
S21	Association of Classes 13 and 16: Undifferentiated shallow soils and land classes	Restricted land use options	Soil may receive water runoff from associated rock; water-intake areas
S23	Association of Classes 17 and 19: Structureless and textural contrast soils	Restricted depth, imperfect drainage, high erodibility; slow water infiltration; seasonal wetness	May have favourable physical properties, somewhat high natural fertility; relative wetness favourable in dry areas

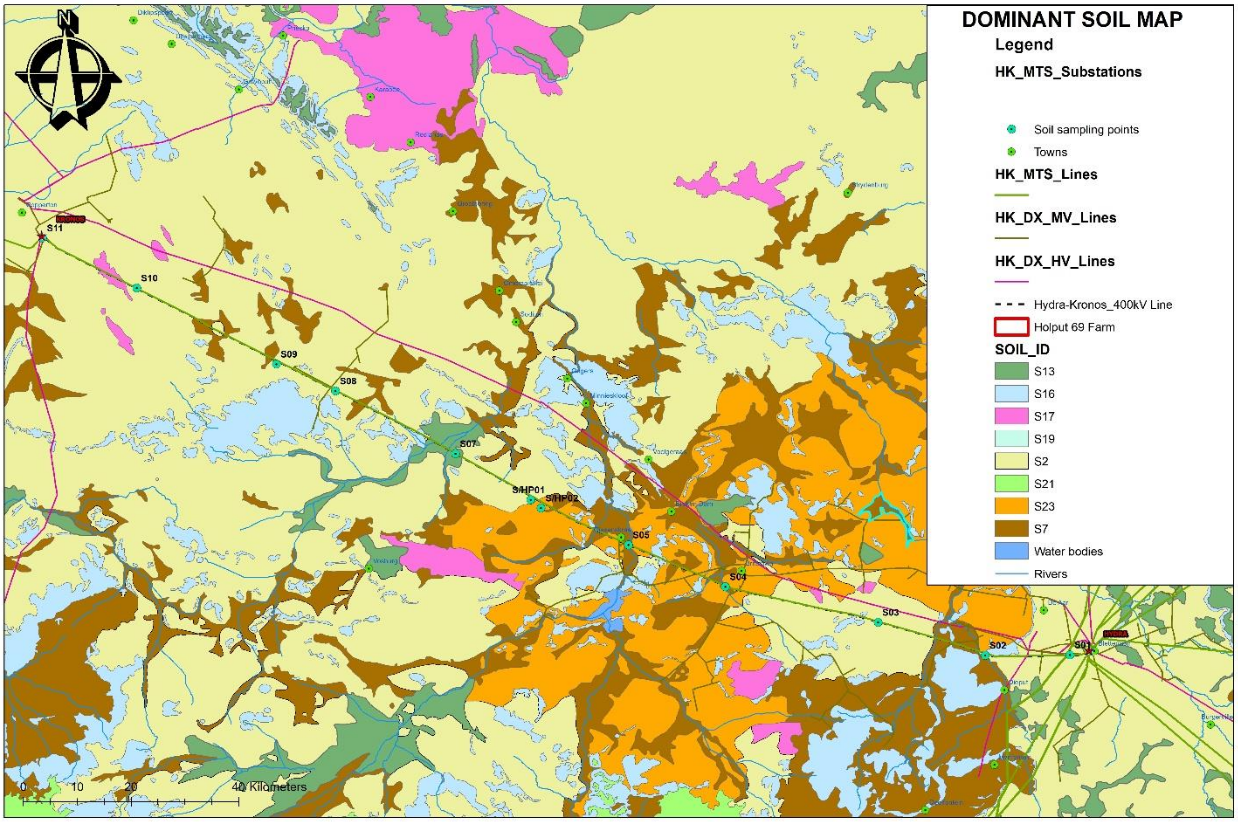

Figure 10: Dominant soil map.

4.10. Soil Sorter association

The Sorter database indicates that the study area collectively is comprised Soils with minimal development, usually shallow on hard or weathering rock, with or without intermittent diverse soils associated with (CMx) Rhodic Cambisols, (LPq) Lithic Leptosols, (SCk) Calcic Solonchaks, (LPe) Eutric Leptosols,(CMc) Calcaric Cambisols, (LVx) Chromic Luvisols and (CMx)Rhodic Cambisols (Figure 11).

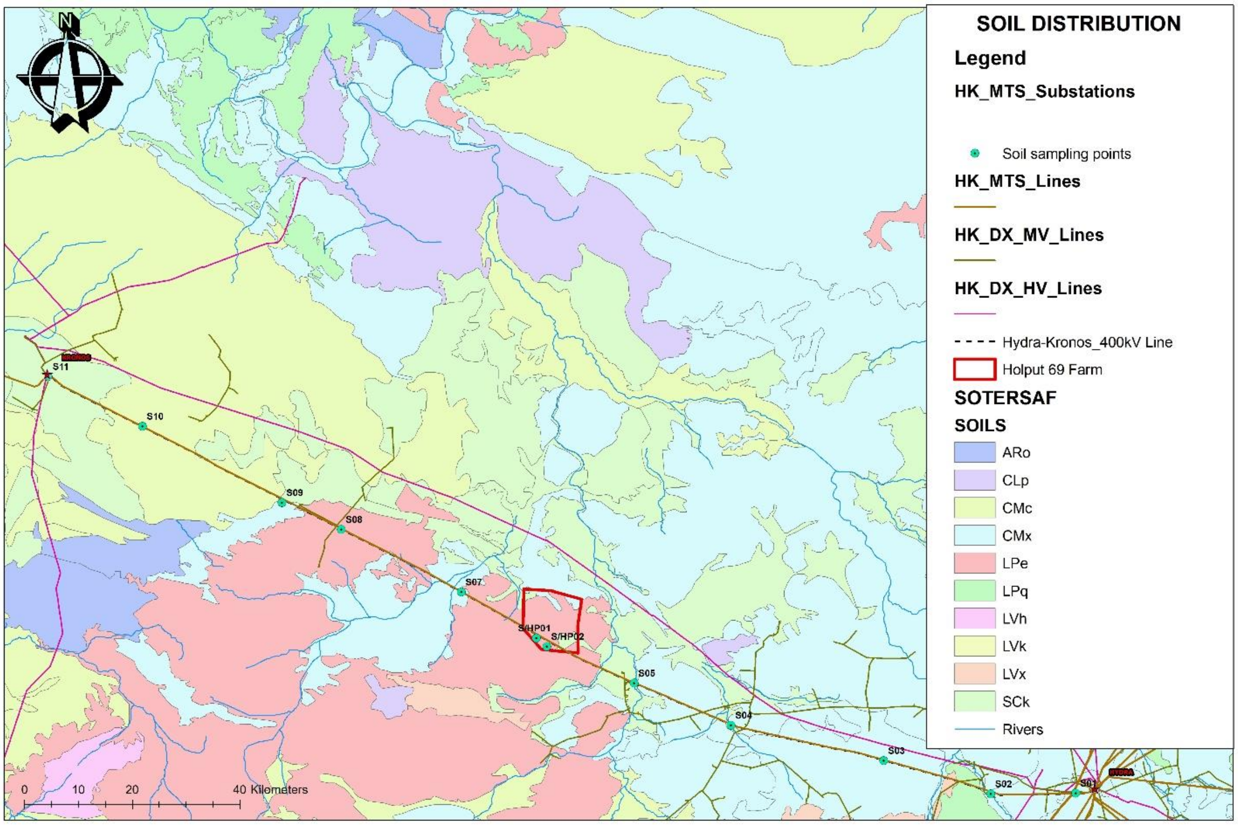

Figure 11: Soil sorter classification.

4.11. Land Capability

The desktop assessment indicates that the study area is generally considered to have a Low potential arable land capability (Class VII) these soils have a light cultivation / moderate grazing land capability with an L5 (Restricted potential). Moderate to severe limitations due to the soil, slope, temperature, or rainfall.

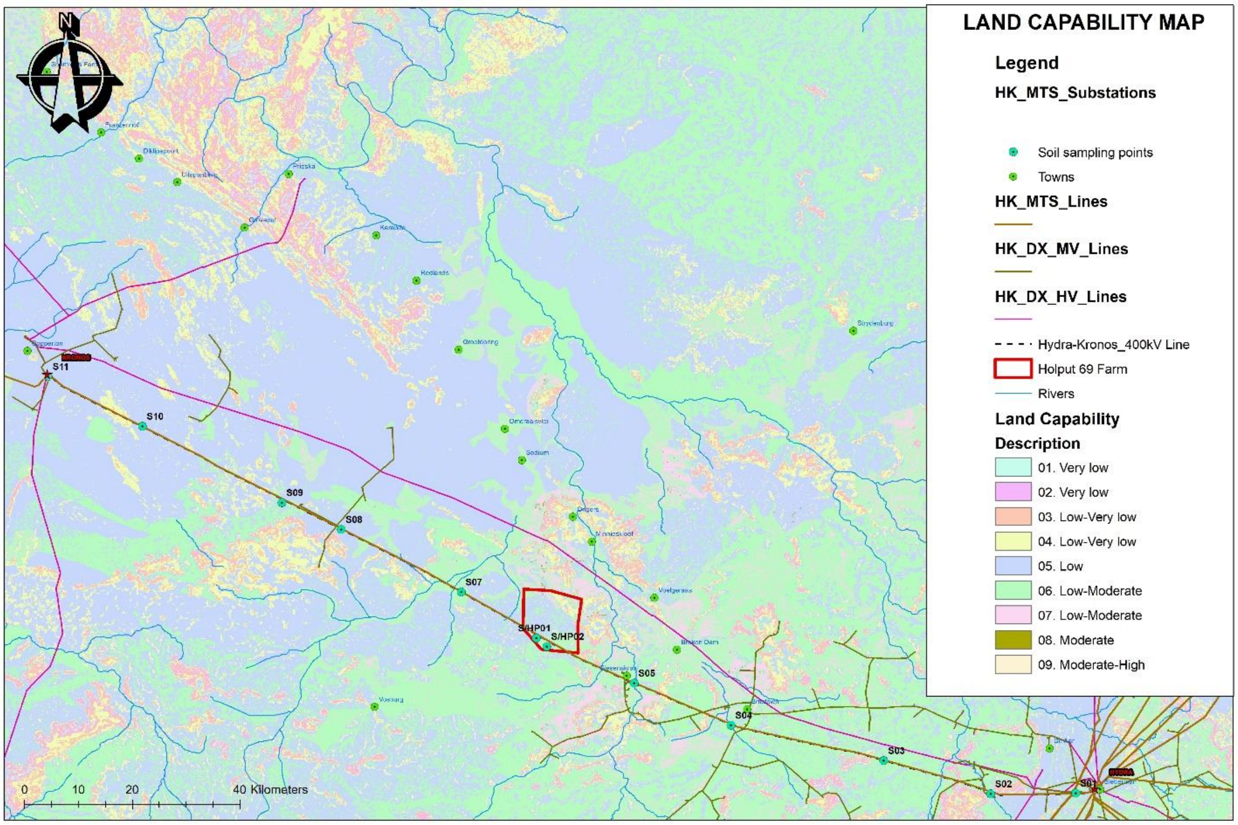

Figure 12: Land capability.

4.12. General soil pH

The natural soil pH is estimated to range between 7.5 and 8.4, indicating that the soils are anticipated to be neutral to alkaline, as interpolated from topsoil pH values obtained from the AGIS database (Figure 13).

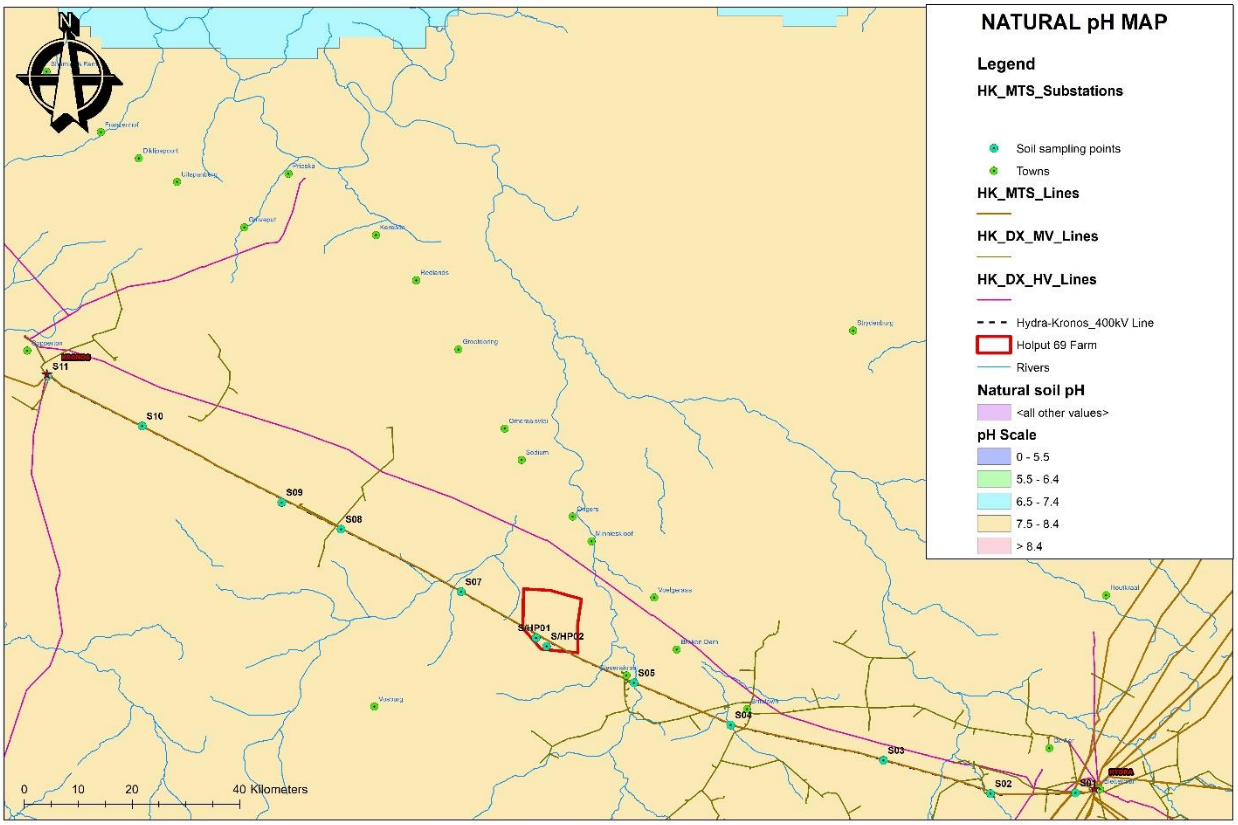

Figure 13: Natural soil pH.

4.13. Soil Characteristics

According to the Soils 2001 database layer the study area is characterized by a Lithosols (shallow soils on hard or weathering rock): restricted land use options; association of Classes 1 to 4: undifferentiated structureless soils; association of Classes 7 and14: Undifferentiated texture contrast soils; Freely drained, structureless soils; association of Classes 13 and 16: undifferentiated shallow soils and land classes; Association of Classes 13 and 16: Undifferentiated shallow soils and land classes; Association of Classes 17 and 19: Structureless and textural contrast soils and soils with a pedocutanic horizon.

5. FIELD ASSESSMENT RESULTS

5.1. Current Land use

The proposed Eskom powerline runs from De Aar to Copperton Town along different farming land and other towns in the middle. The current dominating land use is the natural land, which is used for cattle farming, followed by human settlement and limited number of crop farming. The area is very dry with dry rivers along the powerline. Figure 14 illustrates the dominant land use activities in the area that were observed during site assessments.

Figure 14: Photographs illustrating the dominant land use within the study area.

5.2. Dominant Soil Forms

In soil classification, the shallow soils (characteristic for many mountain soils) in Soil Taxonomy are only recognized at (lithic) sub-group level, grouping together all soils that are less than 50 cm thick to hard rock. Rhodic Cambisols (characterized by the absence of a layer of accumulated clay, humus, soluble salts, or iron and aluminum oxides), Lithic Leptosols (soils with a very shallow profile depth (indicating little influence of soil-forming processes), and they often contain large amounts of gravel. They typically remain under natural vegetation, being especially susceptible to erosion, desiccation, or waterlogging, depending on climate and topography), Calcic Solonchaks (his indicates that when chloride sodium waters enter the soil, saline soils with sodium chloride chemistry (solonchaks) are formed in a temperate climate), Calcaric Cambisols (soils at an early (incipient) stage of soil formation. There is generally a brownish discoloration below the surface horizon, to mark the beginning of pedogenesis. The subsoil has a soil rather than a geological structure), and Chromic Luvisols (soils in which high activity clay has migrated from the upper part of the profile, generally grayish in color, to be deposited in an argic B horizon, commonly of a browner hue).

5.3. Land Classification

In South Africa, agricultural land capability is usually restricted by climatic conditions, with specific mention to water availability (Rainfall). Even within similar climatic zones, different soil types typically have different land use capabilities attributed to their inherent characteristics. High potential agricultural land is defined as having the soil and terrain quality, growing season and adequate available moisture supply needed to produce sustained economically high crop yields when treated and managed according to the best possible farming practices (Scotney *et al*., 1987). For this assessment, the land capability was inferred in consideration of observed limitations to land use due to physical soil properties and prevailing climatic conditions. Climate Capability (measured on a scale of 1 to 8) was therefore considered in the agricultural potential classification. The study area falls within Class 7 These soils have a light cultivation / moderate grazing land capability with an L5 (Restricted potential) land potential rating based on the C4 climatic classification. L5: Moderate to severe limitations due to the soil, slope, temperature, or rainfall.

5.4. Chemical Characteristics of soil

An assessment of the soils present along the Eskom powerline from De Aar to Copperton Town in the Northern Cape Province area was conducted during a field visit in May 2023. The site was traversed on foot and spade was used to determine the soil type and depth. Soils were investigated using a spade to a maximum depth of 0.5 m or the depth of refusal. The soil forms (types of soil) found were identified using the South African Soil Classification System (Soil Classification Working Group, 1991).

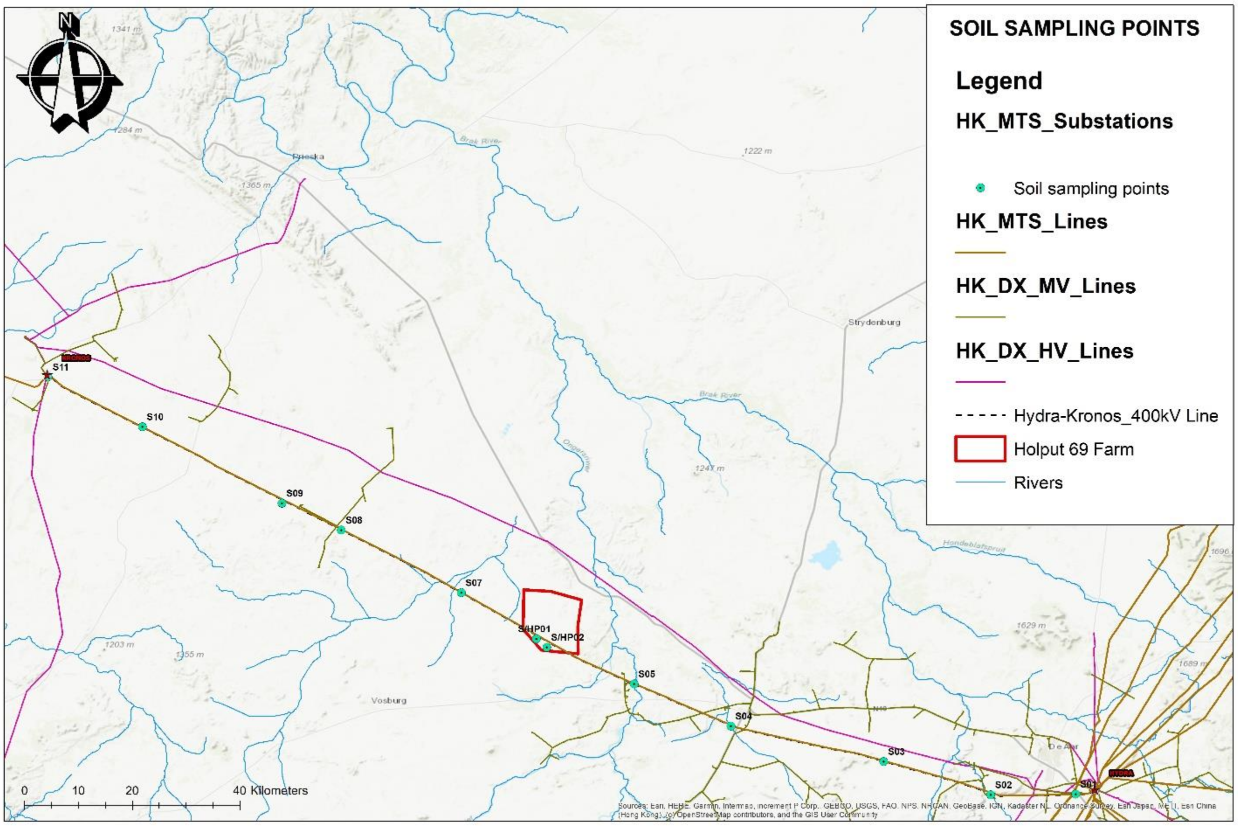

Figure 15: Soil sampling locations along the proposed powerline.

Table 8: Soil samples profiles.

Sample ID	Site Picture	Description of soil profile
SO1		Red-yellow soil with well drained characteristics, massive or weakly structured soils. Red soils with high base status.
SO2		Soils with a strong texture contrast. Soils with a marked clay accumulation, strongly structured and a non-reddish colour. This soil may occur associated with one or more of vertic, melanic and plinthic soils.

S03		Red-yellow well drained, massive or weakly structured soils. Red soils with high base status.
S04		Soils with strong texture contrast. Soils with a marked clay accumulation, strongly structured and a non-reddish colour. This may occur or be associated with one or more of vertic, melanic and plinthic soils.
S05		Soils with a strong texture contrast. Soils with a marked clay accumulation, strongly structured and a non-reddish colour. They may occur associated with one or more of vertic, melanic and plinthic soils.

S07		Soils with limited pedological development. Soils with minimal development, usually shallow, on hard or weathering rock, with or without intermittent diverse soils. Lime generally present in part or most of the landscape.
S/HP01		Soils with limited pedological development. Soils with minimal development, usually shallow, on hard or weathering rock, with or without intermittent diverse soils. Lime generally present in part or most of the landscape.

S/HP02		Soils with limited pedological development. Soils with minimal development, usually shallow, on hard or weathering rock, with or without intermittent diverse soils. Lime is generally present in part or most of the landscape.
S08		Soils with limited pedological development. Soils with minimal development, usually shallow, on hard or weathering rock, with or without intermittent diverse soils. Lime generally present in part or most of the landscape.

S09		Sandy soils with little or no profile development. Red and yellow, well drained sandy soils with high base status.
S10		Soils with limited pedological development. Soils with minimal development, usually shallow, on hard or weathering rock, with or without intermittent diverse soils. Lime generally present in part or most of the landscape.
S11		Strongly saline soils. Strongly saline soils generally occurring in relatively deep deposits in low lying arid areas.

5.4.1. Soil Sampling and Analysis

Ten soil samples were collected along the powerline and two samples were collected at Holput 69 Farm (for solar panels) and the following were recorded: one soil sample representing top and subsoil combined at each sampling point. All sampling and survey points are indicated in Figure 16. Soil samples were sealed in soil sampling plastic bags and sent to Soil Laboratory, Pretoria for analyses. Samples taken to determine baseline soil fertility were analysed for electrical conductivity (EC), pH (KCl and H2O), phosphorus (Bray1), exchangeable cations (calcium, magnesium, potassium, and sodium), organic carbon (Walkley- Black) and texture classes (relative fractions of sand, silt and clay).

Table 9: Soil analysis results of the study area.

Sample ID	Ph KCL	P Bray1	K AmAc	Na AmAc	Ca AmAc	Mg AmAc	S	Ca	Mg	K	Na	ACID SAT
		mg/kg						**%**				
S01	6.85	17.00	215.00	7.00	2179.00	279.00	44.14	79.18	16.61	3.99	0.21	0.00
S02	7.64	15.00	242.00	342.00	1961.00	237.00	37.95	70.77	14.03	4.46	10.74	0.00
S03	6.46	19.00	142.00	74.00	1397.00	487.00	57.14	59.88	34.24	3.12	2.76	0.00
S04	7.37	7.00	172.00	7.00	3433.00	190.00	33.01	89.41	8.13	2.29	0.17	0.00
S05	7.30	8.00	172.00	47.00	3176.00	269.00	39.88	84.81	11.76	2.34	1.08	0.00
S07	7.90	1.00	249.00	152.00	3256.00	239.00	36.90	83.32	10.02	3.26	3.39	0.00
S08	7.64	9.00	157.00	5.00	2071.00	76.00	13.83	90.84	5.45	3.53	0.18	0.00
S09	7.34	2.00	89.00	11.00	2960.00	173.00	2987.00	89.72	8.61	1.38	0.29	0.00
S10	7.37	11.00	138.00	11.00	3482.00	226.00	37.19	88.54	9.42	1.80	0.25	0.00
S11	7.64	8.00	277.00	11.00	2134.00	150.00	24.11	84.30	9.71	5.59	0.39	0.00
S/HP1	7.12	7.00	140.00	24.00	3370.00	317.00	42.00	84.65	13.04	1.80	0.52	0.00
S/HP2	7.02	5.00	90.00	19.00	2083.00	445.00	54.97	72.48	25.36	1.61	0.56	0.00

Table 10: Soil analysis results of the study area

Sample ID	Ca:Mg	(Ca+Mg)K	Mg:K	S-VALUE	Na:K	T-VALUE	EXCH ACID KCL	Dens
					cmol(+)kg			***g/ml***
S01	4.77	24.00	4.16	13.76	0.05	13.76	0.00	1.14
S02	5.05	19.01	3.15	13.85	2.41	13.85	0.00	1.26
S03	1.75	30.16	10.97	11.66	0.89	11.66	0.00	1.28
S04	10.99	42.59	3.55	19.20	0.07	19.20	0.00	1.21
S05	7.21	41.20	5.02	18.72	0.46	18.72	0.00	1.32
S07	8.31	28.65	3.08	19.54	1.04	19.54	0.00	1.23
S08	16.68	27.25	1.54	11.40	0.05	11.40	0.00	1.43
S09	10.42	71.45	6.26	16.49	0.21	16.49	0.00	1.33
S10	9.40	54.55	5.25	19.66	0.14	19.66	0.00	1.27
S11	8.68	16.81	1.74	12.66	0.07	12.66	0.00	1.26
S/HP1	6.49	54.28	7.24	19.91	0.29	19.91	0.00	1.25
S/HP2	2.86	60.93	15.79	14.37	0.35	14.37	0.00	1.26

5.4.2. Soil pH

The soil pH is determined in the supernatant liquid of an aqueous suspension of soil after having allowed the sand fraction to settle out of the suspension. Soil pH influences plant growth in the following manner:

- Through the direct effect of the hydrogen ion concentration on nutrient uptake;
- The mobilisation of toxic ions such as aluminium which restrict plant growth; and
- Indirect impacts that include the effect on trace nutrient availability.

5.4.3. Cations

The levels of the basic cations Ca, Mg, K and Na are determined in soil samples for agronomic purposes through extraction with an ammonium acetate solution. In general, the amounts of exchangeable cations normally follow the same trend as outlined for soil pH and texture. For most soils, cations follow the typical Ca>Mg>K>Na trend. Calcium, magnesium and potassium levels in the soils were generally not adequate for crop production (Tables 9 and 10), not below the required levels (Table 11) and these nutrients have not been limited to any production or are considered toxic. There will be no need to add Ca, K and Mg sources as the proposed is not going to be used for agricultural purposes.

Table 11: Cations soil samples analyses

Parameters	Unit	Samples												Guideline per mg/kg		
		S01	S02	S03	S04	S05	S07	S08	S09	S10	S11	S/HP1	S/HP2	Low	Accepted	High
pH KCl	-	6.85	7.64	6.46	7.37	7.30	7.90	7.64	7.34	7.37	7.64	7.12	7.02	Acidic	Moderate	Acidic
P Bray1	mg/kg	17.00	15.00	19.00	7.00	8.00	1.00	9.00	2.00	11.00	8.00	7.00	5.00	<5	Moderate	>35
K AmAc	mg/kg	215.00	242.00	142.00	172.00	172.00	249.00	157.00	89.00	138.00	277.00	140.00	90.00	<40	Moderate	>250
Na AmAc	mg/kg	7.00	342.00	74.00	7.00	47.00	152.00	5.00	11.00	11.00	11.00	24.00	19.00	<50	Moderate	>200
Ca AmAc	mg/kg	2179.00	1961.00	1397.00	3433.00	3176.00	3256.00	2071.00	2960.00	3482.00	2134.00	3370.00	2083.00	<200	Moderate	>3000
Mg AmAc	mg/kg	279.00	237.00	487.00	190.00	269.00	239.00	76.00	173.00	226.00	150.00	317.00	445.00	<50	Moderate	>300

5.4.4. Phosphorus

The Bray 1 extraction and analysis procedure for phosphorus is preferred for soils with pH levels between 6 and 8 which is moderate pH and consequently acceptable for plant growth. The calcium (Ca) and magnesium (Mg) levels encountered in the soil samples along the powerline were acceptable to high concentration elevation according to guidelines in Table 5 indicating soil which is not suitable for crop farming. Calcium and magnesium concentration in the soil shows acceptable variables which is good for agricultural purposes, as a result, they are the limiting factor in terms of ecosystem function if the soil was going to be used for agricultural purposes. Magnesium and calcium fertilization must be required to establish good crop stand and growth, for the agricultural activities are taking place over the area.

Table 12: Soil Fertility Guideline

Guideline per mg/kg					
Micronutrients			**Low**		**High**
Phosphate (P)			<5		>35
Potassium (K)			<40		>250
Sodium (Na)			<50		>200
Calcium (Cl)			<200		>3000
Magnesium (Mg)			<50		>300
pH (KLC)					
Very Acidic	**Acidic**	**Slightly Acidic**	**Neutral**	**Slightly Alkaline**	**Alkaline**
<4	4.1-5.9	6.-6.7	6.8-7.2	7.3-8	>8

6. IMPACTS ASSESSMENT

The impact assessment report includes the following:

- Assessment of impacts of ongoing and proposed activities on the agricultural potential of the Project Area;
- Assessment of whether the proposed activities are likely to have significant impacts on the agricultural potential for the area;
- Identification of practically implementable mitigation measures to reduce the significance of proposed activities on agricultural potential; and
- Assessment of residual and cumulative impacts after the implementation of mitigation measures.

7. ENVIRONMENTAL IMPACT ASSESSMENT AND MITIGATION MEASURES

7.1. Theoretical Background

In terms of soils, human impacts are described as different forms of soil degradation. Soil degradation can be divided into the following classes and subclasses:

Table 13: Soil degradation classification

Physical degradation	• Compaction • Surface crusting • Erosion • Structural degradation/hard setting
Chemical degradation	• Eutrophication - Nitrogen - Phosphorus • Soil organic carbon losses or alteration • Trace element and heavy metal pollution • Acidification • Salinisation and sodification
Biological degradation	• Soil microbial activity decreases/increases • Soil borne human, animal and plant pathogens
Soil quality deterioration (compound effects)	
Soil health deterioration	
Soil destruction	

7.2. Physical Degradation

The physical degradation of soils has many forms and causes. Compaction of soil usually occurs when vehicles, or other heavy loads, traverse soils or are placed on soil. The compatibility of soil is a function of a range of parameters that include: the grading of the sand fraction, soil water content, weight of load, shape, and deformation of the tire, frequency and number of passages, etc.

Compaction is the decrease in porosity of soil with a subsequent increase in bulk density that leads to impeded water infiltration and root penetration. In most soils, compaction can only be alleviated through the physical breaking up or ripping up of compacted layers. Refer to H. kansson and Voorhees (1998) for a general description of soil compaction.

Erosion of soil is caused by a range of factors that include other forms of physical degradation as well as chemical and biological degradation. The essence is that soil material is removed through the action of water or wind and transported further downslope or into water bodies. When most of the other factors of degradation are addressed soil erosion can usually be prevented or contained. Refer to Laflen and Roose (1998) for a general description of soil erosion.

7.3. Chemical Degradation

Chemical degradation of soils has varied and often complex causes and can, in turn, exacerbate physical and biological degradation. One of the most common human induced forms of degradation is the elevation of P and N levels in soils. Their effects in the soil can be mitigated through a range of activities but these elements tend to be more problematic where terrestrial and aquatic ecosystems meet or overlap. The main effect of this form of degradation is the alteration of natural biological conditions in a landscape. Refer to Pierzynski*et al*. (1994) for further information on N and P in the environment.

One of the largest negative impacts of human farming and poweline construction activities is the reduction of soil organic carbon levels. Soil organic carbon is readily oxidised or mineralised when soil is tilled and fertilizers added. The effect of soil organic carbon loss can be observed in increased soil physical problems (compaction, crust formation, etc.) as well as a decreased soil nutrient buffer capacity and altered biological activity and organism population composition. This currently forms one of the main focus areas regarding global climate change and carbon sequestration. Refer to Lal*et al.* (1998) for further information on organic carbon in soils.

Trace elements and heavy metal pollution are mostly associated with industrial activities and effluents. There is a wide range of pollutants with an even wider range of effects on humans and the environment largely determined by the pollutant’s chemical reactivity in soil and water.

Remediation is case specific and requires a proper assessment as well as an understanding of the chemical equilibrium of these elements in a range of environments. Refer to Davies (1980), Alloway (1995), Kabata-Pendias (1995) and Bourg (1995) for further information on trace elements and heavy metals in soils.

Soil acidification is often the product of agronomic practices, powerline infrastructure and industrial effluents and acid rain. The degree to which a soil can be acidified depends on the source and concentration of the acid as well as the buffer capacity of the soil.

Soil acidification is in most cases ameliorated through the addition/application of lime of which there are several sources, some of which can also contribute to metal and trace element pollution. Refer to Pierzynski*et al.* (1994) for further information on acid rain and the environment as well as Sumner (1998) for information on soil acidification.

Salinisation is the build-up of salts in soils due to the use of high salt content irrigation water, salt-containing waste spillages and/or poor drainage conditions in soils. In most cases, the most detrimental effects are on plants and crops but concrete and iron structures can also be detrimentally affected by corrosion.

Sodification is the increase of Na in soil due to irrigation or pollution processes. Increased Na leads to the dispersion of clays in the soil with subsequent degradation in structure as well as increasing the likelihood of surface crusts. Refer to Szabolcs (1998) for further information on the salinisation of soils and to Rengasamy (1998) for further information on the acidification of soils.

7.4. Biological Degradation

The biological degradation of soil is difficult to determine when natural systems are considered. Microbial diversity is high in most soils and very little is understood or known about the microbial diversity and functioning or complex interactions that take place in the soil. An increase in microbial activity in soils (above the natural background) can be just as detrimental to the soil as a decrease in microbial activity. Where humans, animals, and plants are concerned specific soil borne pathogens have been identified that could be detrimental.

Pathogens have been the subject of more intense study than many other ubiquitous but "harmless" soil organisms and the epidemiology of many is well understood. Although not as spectacular as the physical degradation of soils the biological degradation in the form an increased human, animal and plant pathogens can have far reaching implications on human, animal and plant communities.

7.5. Soil Quality Deterioration

Soil quality is a term that is qualitative and it encompasses the interpretation of a range of quantitative parameters to make a pronouncement on a broader concept. Examples are "the suitability of the soil for maize production" or the degree to which soils in a landscape can contribute to the mitigation of water pollution – taking into account chemical, physical and biological parameters. Soil quality parameters are not easily measured but it becomes very evident when soils lose certain natural abilities to mitigate detrimental environmental effects on crops, water quality and the quality of human life.

7.6. Soil Health Deterioration

The concept of "Soil Health" is a relatively new one and its interpretation is often as varied as the human population itself. Suffice to say that it links up with the concept of Soil Quality and there is an increasing effort underway to identify and quantify soil health parameters.

7.7. Soil Destruction

A drastic form of soil degradation is the destruction of natural soil bodies and all the parameters that led to the formation of the soil in the first place. The best known example is the road that drastically disturbs the soil profile itself, destroys the topographical, profile sequence of soils, alters the geohydrology of the landscape that in most cases determines the types and the position of soil horizon, and the soil forms that remove all original vegetation cover, and animals from the specific soils.

The effect is a combination of drastic physical, chemical and biological degradation of the soils on the powerline construction site with the resultant drastic alteration in soil quality. The most desired approach in such cases is to rehabilitate the soils to the best possible state taking into account the current technology and knowledge available as well as the financial means to conduct such rehabilitation.

7.8. Soil Impacts vs. Land Capability / Agriculture Impacts

The impacts of powerline construction activities on soils are often drastic but this does not imply that the impacts on agriculture or land capability are the same (and vice versa). It is important to note that these impacts can and should be assessed separately as is done in the following sections.

8. QUANTIFICATION OF IMPACTS

Table 14: Impact assessment rating for the proposed powerline area.

AFFECTED ENVIRONMENT			ACTIVITY			IMPACT DESCRIPTION			BEFORE MITIGATION			AFTER MITIGATION		
MAGNITUDE	DURATION	SPATIAL SCALE	CONSEQUENCE	PROBABILITY		SIGNIFICANCE		MAGNITUDE		DURATION	SPATIAL SCALE	CONSEQUENCE	PROBABILITY	SIGNIFICANCE
CONSTRUCTION														
Soil	Stripping and stockpiling of topsoil	Disturbance of *in situ* horizon organization	*Major -*	*Long Term > 2 years*	*Site or Local*	High	*Definite*	High	*Major -*	*Long Term > 2 years*	*Site or Local*	High	*Definite*	High
Soil	Stripping and stockpiling of topsoil	Loss of soil fertility through impacts on nutrient cycles	*Major -*	*Long Term > 2 years*	*Site or Local*	High	*Definite*	High	*Moderate -*	*Medium Term > 18 months < 2 years*	*Site or Local*	Medium	*Definite*	Medium
Soil	Vehicle traffic and construction of infrastructure	Soil compaction	*Major -*	*Long Term > 2 years*	*Site or Local*	High	*Definite*	High	*Moderate -*	*Long Term > 2 years*	*Site or Local*	Medium	*Definite*	Medium
Soil	Trucks and equipment on site and waste generation by construction activities	Soil chemical pollution	*Major -*	*Medium Term > 12 months < 2 years*	*Site or Local*	Medium	*Possible*	Medium	*Minor -*	*Short Term < 12 months*	*Site or Local*	Low	*Possible*	Low
Soil	Vegetation clearance exposes the soil surface to the energy of wind and water movement	Soil erosion	*Moderate -*	*Long Term > 2 years*	*Site or Local*	Medium	*Definite*	Medium	*Moderate -*	*Short Term < 12 months*	*Site or Local*	Low	*Possible*	Low
Land capability	Soil stripping and construction of infrastructure	Loss of arable land capability	*Major -*	*Long Term > 2 years*	*Site or Local*	High	*Definite*	High	*Major -*	*Long Term > 2 years*	*Site or Local*	High	*Definite*	High
Land capability	Soil stripping and construction of infrastructure	Loss of grazing land capability	*Moderate -*	*Long Term > 2 years*	*Site or Local*	Medium	*Definite*	Medium	*Moderate -*	*Medium Term > 12*	*Site or Local*	Medium	*Possible*	Medium
months < 2 years														
Land capability	Soil stripping and construction of infrastructure	Loss of wetland land capability	*Major -*	*Long Term > 2 years*	*Site or Local*	High	*Definite*	High	*Moderate -*	*Long Term > 2 years*	*Site or Local*	Medium	*Unlikely*	Low
Land use	Establishment of Powerline infrastructure	Change in land use from agriculture to powerline	*Major -*	*Long Term > 2 years*	*Site or Local*	High	*Definite*	High	*Major -*	*Long Term > 2 years*	*Site or Local*	High	*Definite*	High

Table 15: Mitigation measures

AFFECTED ENVIRONMENT	ACTIVITY	IMPACT DESCRIPTION	SIGNIFICANCE BEFORE MITIGATION	SIGNIFICANCE POST-MITIGATION	MITIGATION MEASURES PROPOSED
		CONSTRUCTION PHASE			
Soil	Stripping and Stockpiling of topsoil	Disturbance of *in situ* horizon organisation	High	High	The only mitigation for this impact is to keep the surface disturbance footprint as small as possible. However, horizon inversion/disturbance is a permanent impact.
Soil	Stripping and Stockpiling of topsoil	Loss of soil fertility through impacts on nutrient cycles	High	Medium	Soil nutrient cycles can somehow be maintained by revegetation of topsoil stockpiles and through proper ecological land rehabilitation.
Soil	Vehicle traffic and construction of infrastructure	Soil compaction	High	Medium	The project footprint should be kept as small as possible. Traffic should be restricted to existing roads only. Topsoil stripping and stockpiling should not be conducted during wet periods, soil moisture should be below a pre-determined level.
Soil	Trucks and equipment on site and waste generation by construction activities	Soil chemical pollution	Medium	Low	Proper soil contamination prevention measures will mitigate the risk for example checking vehicles before they drive onto the site.
Soil	Vegetation clearance exposes the soil surface to the energy of wind and water movement	Soil erosion	Medium	Low	Control soil erosion through the use of geotextiles and revegetation of exposed soil surfaces where possible.
Land capability	Soil stripping and construction of infrastructure	Loss of arable land capability	High	Medium	Current soil rehabilitation techniques are not able to restore the arable land capability and the loss is therefore permanent
Land capability	Soil stripping and construction of infrastructure	Loss of grazing land capability	Medium	Medium	Rehabilitation of land can restore the grazing capacity to a large extend
Land capability	Soil stripping and construction of infrastructure	Loss of wetland land capability	Medium	Low	Avoid wetland areas as far as possible and do not include areas of surface disturbance
Land use	Establishment of powerline infrastructure	Change in land use from agriculture to powerline infrastructure	Medium		Keep the project surface footprint as small as possible

8.1. Cumulative impacts

Cumulative impacts have been described as the impact of an activity that in itself may not be significant but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area. The site is already characterized by the existing Hyra – Kronos powerline, therefore, the impacts of the proposed 2nd Hydra – Kronos powerline may be exacerbated due to the existing Hyra – Kronos power line and adjacent/ nearby projects of a similar nature. In terms of significance, the cumulative impacts anticipated on soil and land capability will be Low to Moderate. The impacts will be reversible, however, mitigation measures provided above should be implemented. Increased wind and soil erosion will also be minimal however loss of topsoil may result in a drop in natural facility and grazing potential.

9. DISCUSSIONS AND CONCLUSIONS

The proposed Eskom powerline runs from De Aar to Copperton Town along different farming land and other towns in the middle. The area is very dry, characterized by dry rivers. The study area is drained largely by means of surface run-off, and a limited number of streams and rivers, most of which are non-perennial in nature. The drainage systems do not differ along the proposed route line. The presence of water bodies across the routes indicates the possibility of the development of irrigation systems for agriculture. The route line is associated with wetland types such as depression.

The proposed powerline traverses an area characterized by a mixture of natural and disturbed vegetation with the disturbance resulting primarily from farming and settlement. The corridor traverses along the Upper Karoo Bioregion, Upper Karoo Hardeveld, Bushmanland Arid Grassland, and the Bushmanland Basin Shrubland.

The assessment along the powerline compared to the desktop study shows similar details with land being categorized as very low to low-moderate. The land has low potential yield to produce crops due to its capability, climate associated with it. The soil has limited capacity to allow crops to grow due to limited soil depth. According to the general soil distribution pattern, the desktop shows that the soil along the proposed powerline route has limited pedological development, within the rocky areas and strongly saline soils.

Based on the desktop review, it has been noted that the study area is characterized by the following soil types:

- Soils with limited pedological development. Soils with minimal development, usually shallow, on hard or weathering rock, with or without intermittent diverse soils. Lime is generally present in part or most of the landscape.
- Soils with strong texture contrast. Soils with a marked clay accumulation, strongly structured and a non-reddish colour. This may occur or be associated with one or more of vertic, melanic and plinthic soils.
- Red-yellow soil with well drained characteristics, massive or weakly structured soils. Red soils with high base status.
- Sandy soils with little or no profile development. Red and yellow, well drained sandy soils with high base status.
- Strongly saline soils. Strongly saline soils generally occurring in relatively deep deposits in low lying arid areas.

Soils were investigated and samples were taken from survey positions using a spade to a maximum depth of 0.5 m or the depth of refusal. These positions were recorded as waypoints using a handheld Global Positioning System. Ten soil samples were collected along the powerline and two samples were collected at Holput 69 Farm. One soil sample was taken at each point, and it represented top, and subsoil combined. The soil samples were sealed in sampling plastic bags and sent to Soil Laboratory, Pretoria for analysis. Baseline soil fertility was analysed for electrical conductivity (EC), pH (KCl and H2O), phosphorus (Bray1), exchangeable cations (calcium, magnesium, potassium, and sodium), organic carbon (Walkley- Black) and texture classes (relative fractions of sand, silt and clay).

The levels of the basic cations Ca, Mg, K and Na are determined in soil samples for agronomic purposes through extraction with an ammonium acetate solution. In general, the amounts of exchangeable cations normally follow the same trend as outlined for soil pH and texture. For most soils, cations follow the typical trend of Ca>Mg>K>Na. Calcium, magnesium and potassium levels in the soils were generally not adequate for crop production, not below the required levels and these nutrients have not been limited to any production or are considered toxic. There will be no need to add Ca, K and Mg sources as the proposed is not going to be used for agricultural purposes.

The Bray 1 extraction and analysis procedure for phosphorus is preferred for soils with pH levels between 6 and 8 which is moderate pH and thus acceptable for plant growth. The calcium (Ca) and magnesium (Mg) levels encountered in the soil samples along the powerline were acceptable to high concentration elevation according to guidelines indicating soil which is not suitable for crop farming. Calcium and magnesium concentration in the soil shows acceptable variables which is good for agricultural purposes thus they are the limiting factor in terms of ecosystem function if the soil was going to be used for agricultural purposes. Magnesium and calcium fertilization must be required to establish good crop stand and growth, for the agricultural activities are taking place over the area.

According to the land, capability map the corridor is mainly dominated by low in the northwest towards Copperton Town and low moderate land capability in the far southeast, in the De Aar Town and Table 2 above indicating that the area is heavily for grazing purpose and wildlife.

Based on the project area, the soil capability within the study area falls within the low - very low land capability and low moderate area. According to the land capability classes' distribution within the country per province (Schoeman *et al.,* 2002), the project falls within class VIII of which the climate capability L5 is a Vlei class. The results show the L5 is characterized by restricted potential: Regular and/or severe to moderate limitations due to soil, slope, temperatures or rainfall.

10. RECOMMENDATIONS

Erosion as well as spills and leaks of vehicles and heavy machinery is expected to impact upon the groundwater source given the permeability of the underlying bedrock. These impacts can however be mitigated to a certain extent.

It is recommended that the project be approved as it poses less risk regarding soil should the mitigation measures in this report be implemented. It is also noted that the area for substation extension is within the substation yard as such this area has already been earmarked for use as a substation.

Cumulative impacts have been described as the impact of an activity that in itself may not be significant but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area. The cumulative impact in terms of the loss of agricultural land due to existing powerline infrastructure is minimal as agricultural activities can be undertaken underneath the power line. Increased wind and soil erosion will also be minimal however loss of topsoil may result in a drop in natural facility and grazing potential.

The following mitigation measures are recommended.

- Rehabilitation of soil needs to be done concurrently to the construction to avoid soil erosion and water damming for long periods during the rainy season.
- Soil nutrient cycles can be maintained by revegetation of topsoil stockpiles and through proper ecological land rehabilitation.
- The project footprint should be kept as small as possible. Traffic should be restricted to existing roads only. Topsoil stripping and stockpiling should not be conducted during wet periods, soil moisture should be below a pre-determined level.
- Proper soil contamination prevention measures will mitigate the risk of soil chemical pollution, e.g., checking vehicles before they drive onto the site.
- Control soil erosion using geotextiles and revegetation of exposed soil surfaces where possible.
- Rehabilitate land to restore the grazing capacity to a large extend.
- Avoid wetland areas as far as possible and do not include areas of surface disturbance.

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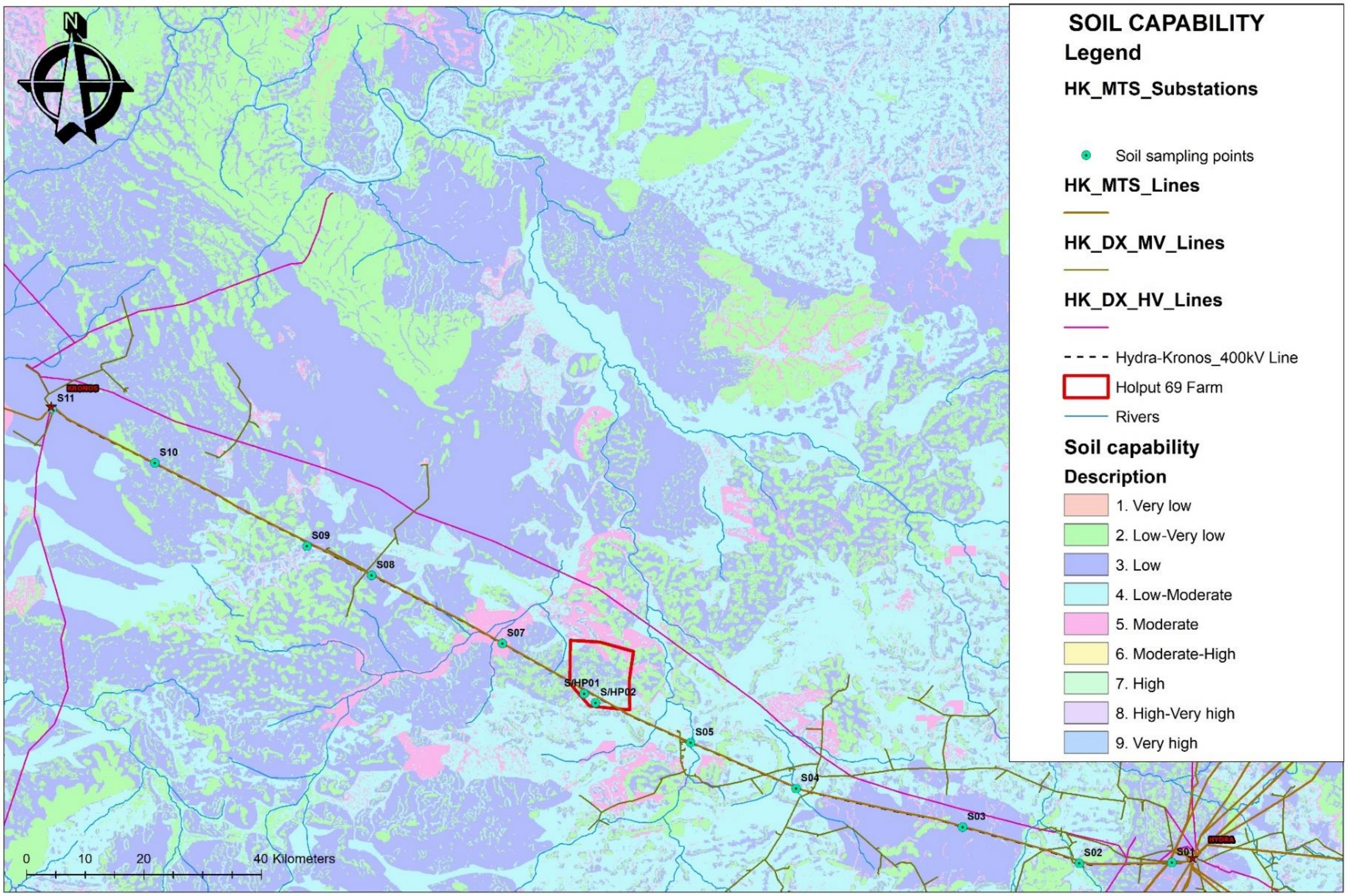
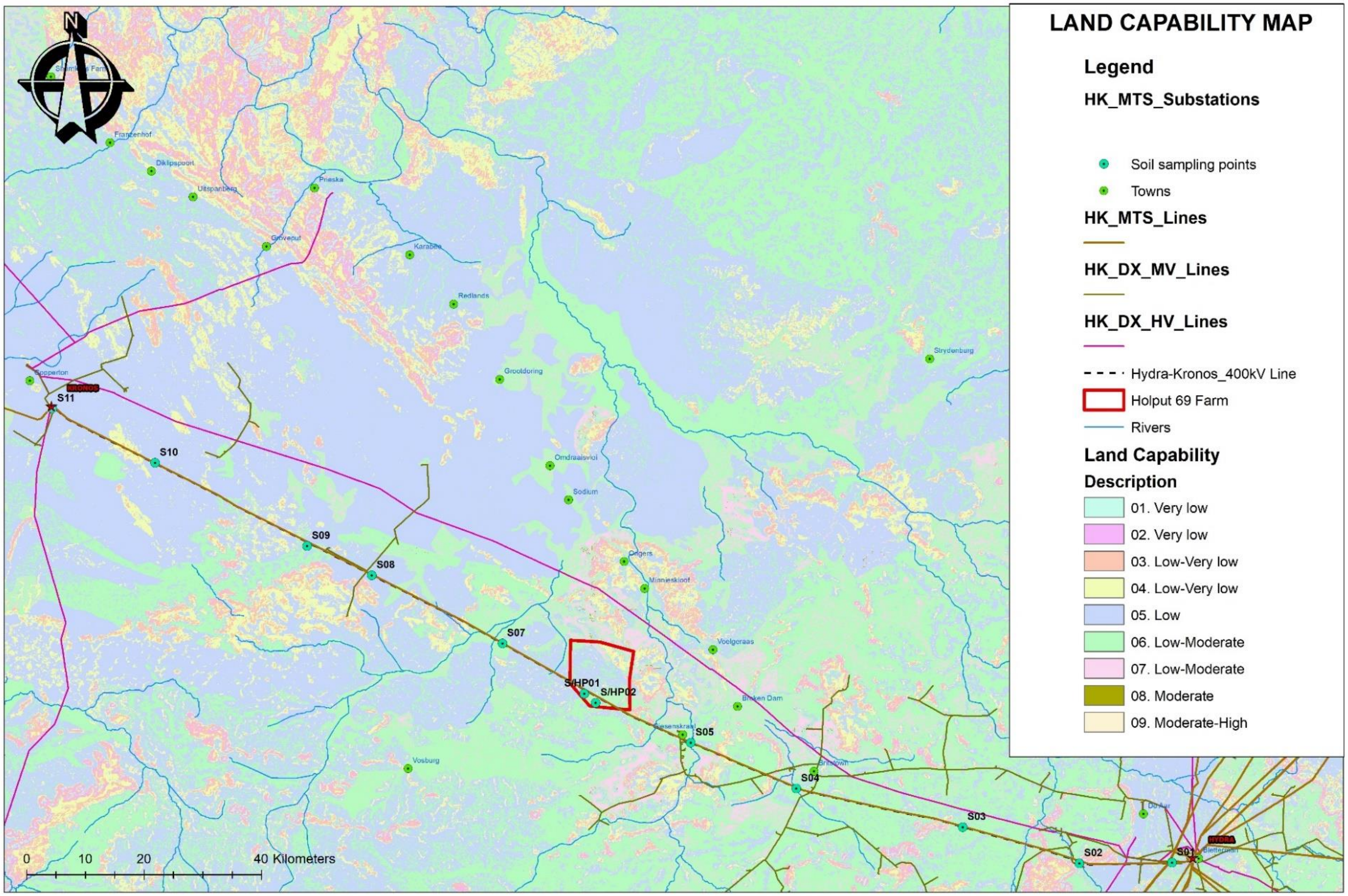
11. APPENDICES

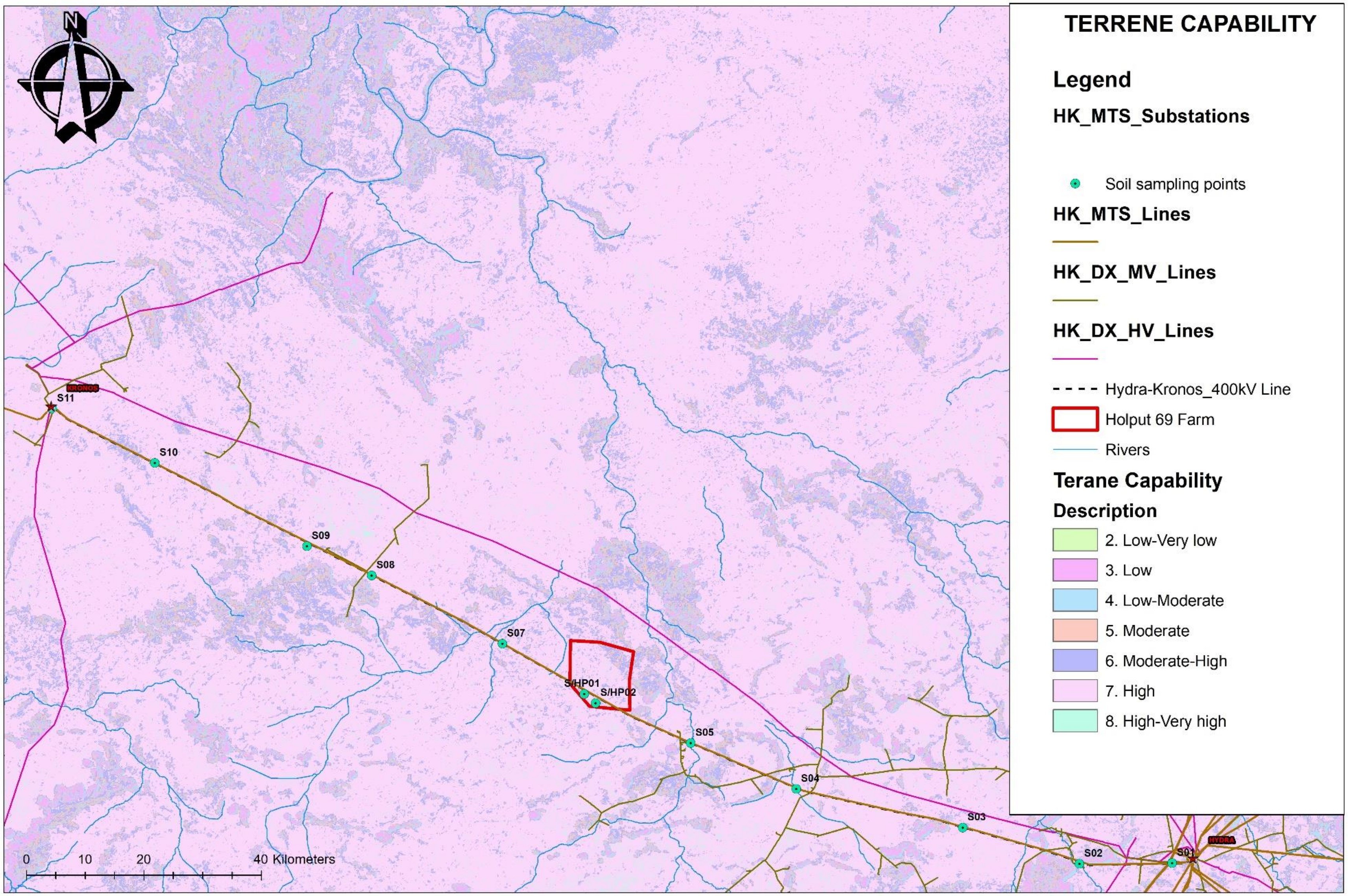
APPENDIX A: SOIL CAPABILITY MAP



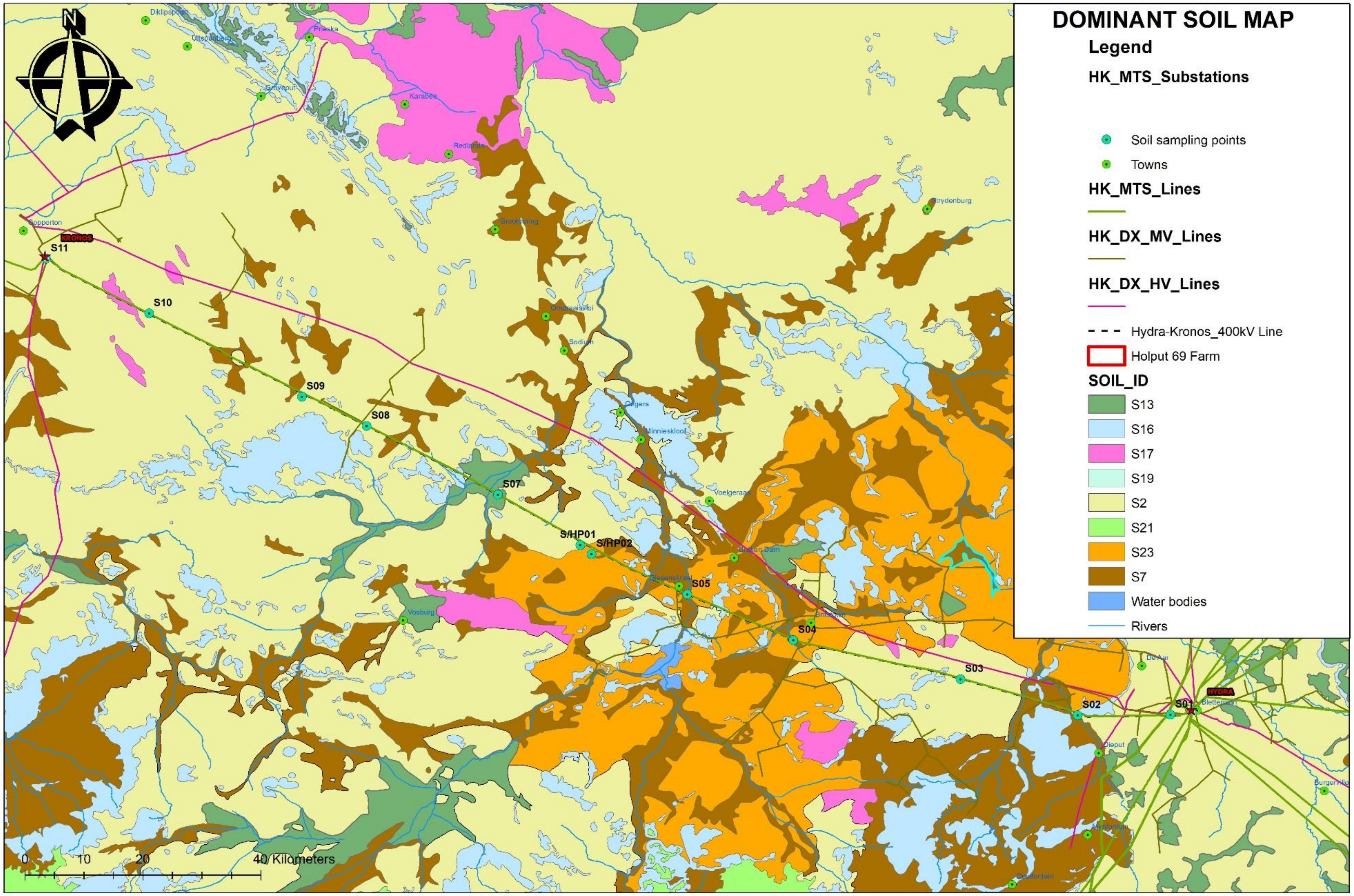
APPENDIX B: LAND CAPABILITY MAP



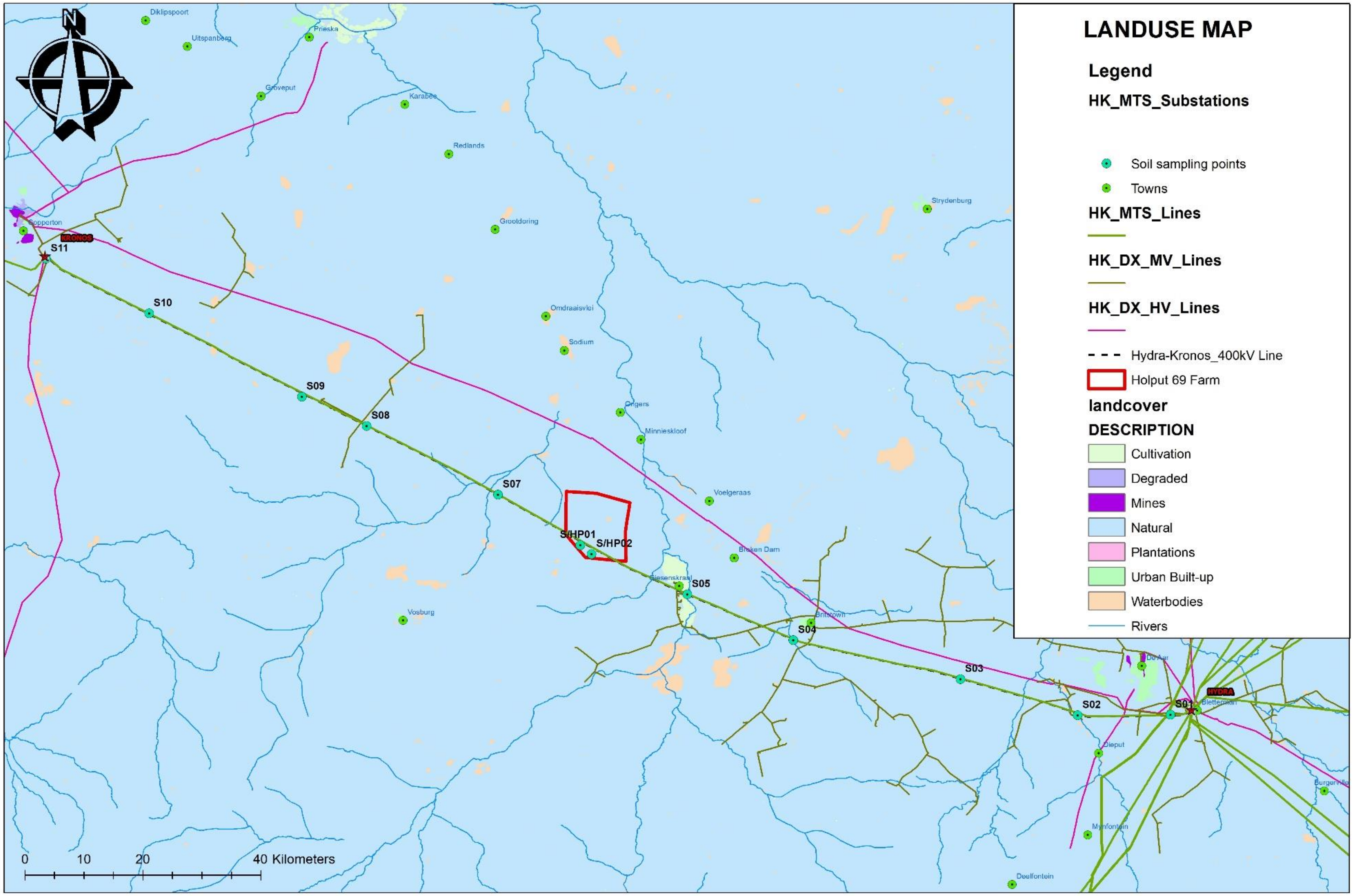
APPENDIX C: TERENE CAPABILITY MAP



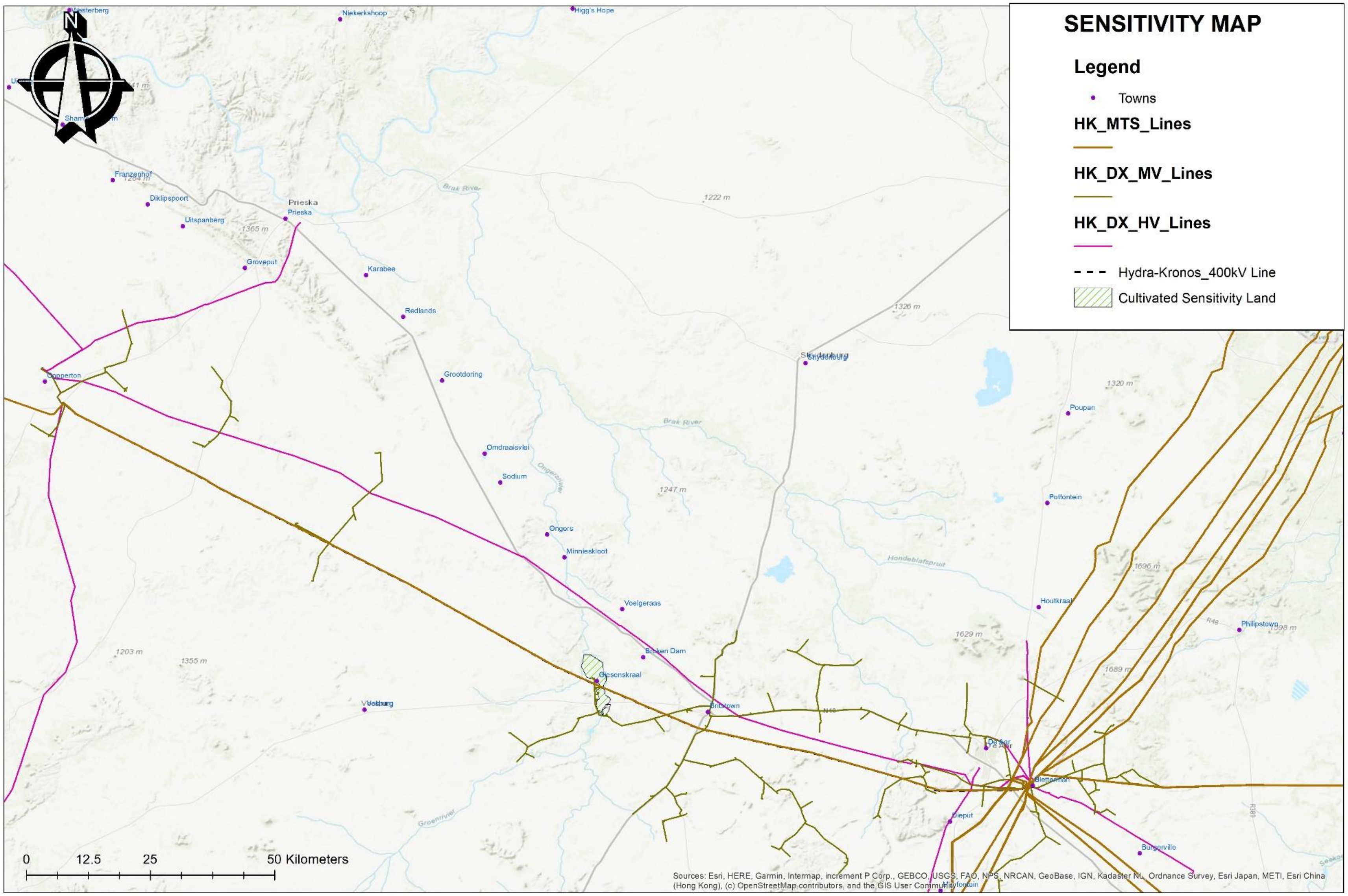
APPENDIX D: DOMINANT SOIL



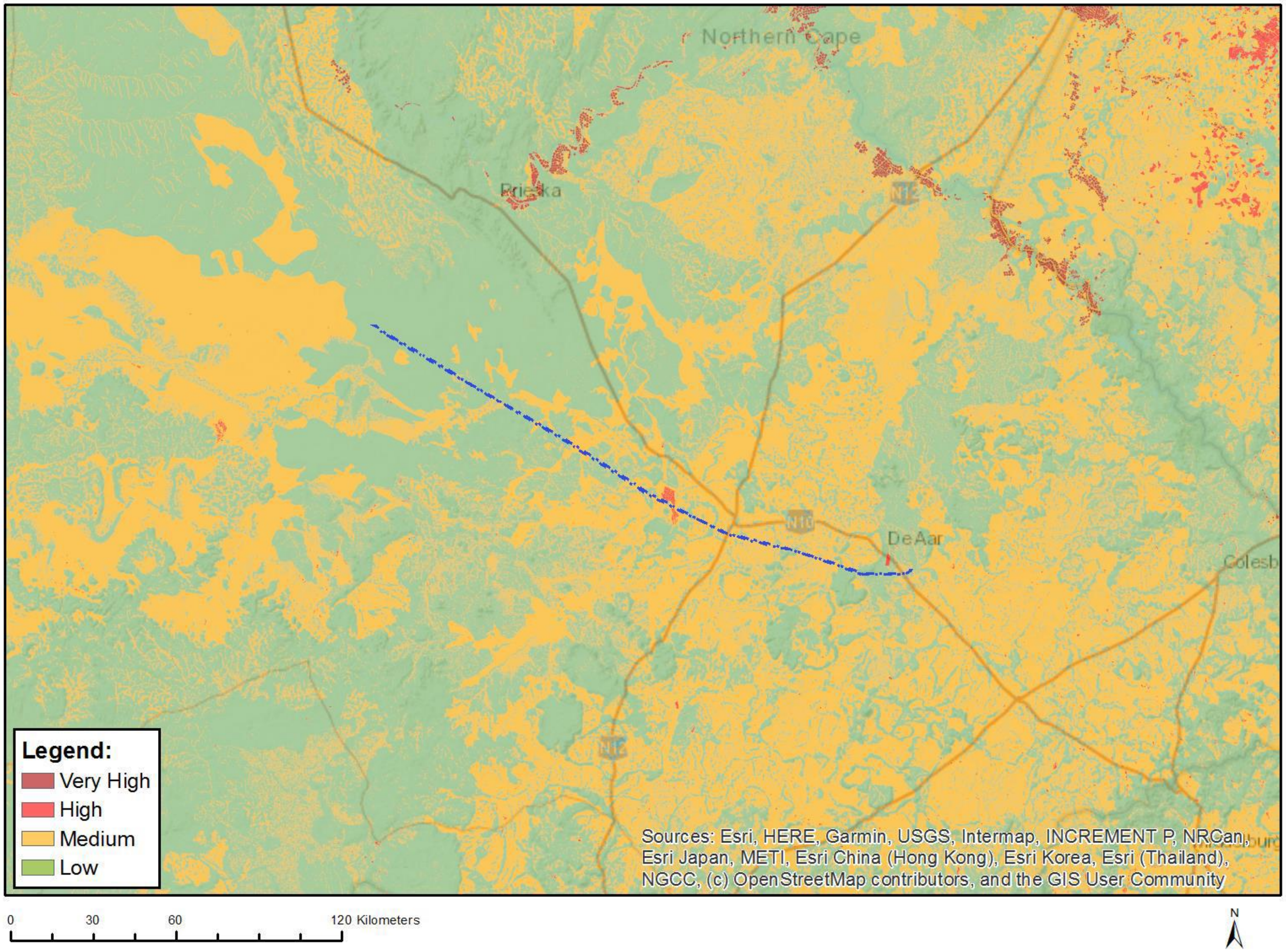
APPENDIX E: LANDUSE ASSESSMENT COMBINED WITH ESKOM EXISTING AND PROPOSED LINE



APPENDIX F: CULTIVATED SENSITIVITY MAP



APPENDIX G: SCREENING TOOL OUTCOMES



APPENDIX H: SCREENING TOOL VERIFICATION TABLE

Agriculture	**Screening tool before site**	**Screening to after site**
Land Capability	Low to Medium	Low to moderate (No status changes)
Land use	Low to Medium	Low to Moderate (No status changes)
Soil capability	Low to moderate	Low to Moderate (No status changes)
Agricultural potential	Moderate	Moderate (No status changes) (Figure 14)
Terrene Capability	Low	Low (No status changes)

APPENDIX I: CURRICULUM VITAE

CURRICULUM VITAE

LUTENDO DESMOND MUTSHAINE

Profession:	Hons Geology
Date of Birth:	07 March 1986
Position:	Managing Director
Years of Experience:	12 Years
Nationality:	South African
Qualification:	**Msc** in Environmental Management (Geochemistry), University of South Africa (UNISA).
	BSc Mining and Environmental Geology, University of Venda (Univen), 2009.
Languages:	Tshivenda (Home Language), English, Sotho, Spedi, Zulu.

Employment History

Nyamoki Consulting:	2014 - Current
WWFSA: Mining and Biodiversity Officer	2015 - 2016
Geocoal Services: Geologist	2010 - 2015

Professional

- Registered Member of the South African Council for Natural Professionals (SACNASP)
- Registered Member of the Geological Society of South Africa (GSSA)

Relevant Experience and Project Management

Extensive experience in borehole citing; core logging; field mapping; coal sampling; preparation of samples for labs; compilation reports; analysis and interpretation of lab results; geophysical interpretation. Ensuring quality of work and had to report to the chief project geologist. Technical consulting work; project management; health and safety management, technical reviews, geotechnical engineering, chip sampling and logging and compiling SAMREC compliance reports and SHE.

Supervision onsite TLB, to refusal or maximum depth of the machine, mapping the pit for profiling and sampling, determining soil samples that will be tested at our laboratory to determine their major engineering properties, Preparation for a report after laboratory data analysis, identifying the soil profile to a depth of approximately 3.0m or refusal of a TLB, determine the engineering parameters of the near-surface soils, recommend general foundations for the structures, supply a Site Classification designation to the site, and comment on any geotechnical problems that may impact upon the construction.

Mr Mutshaine Lutendo Desmond has knowledge of Mine Water and Mine Environmental Management (acid mine drainage, heavy metal assessments and tailings management) in various commodities including coal, gold, magnesite and base metals (Cu, Pb, Zn). He has extensive knowledge of defunct mining waste and wastewater impact assessments in communities residing in the vicinity of those mines. This knowledge was gained through Hons and Msc. Mutshaine Lutendo Desmond has sound knowledge of risk assessment, both in terms of human health and the environment. He is experienced in the appraisal of potential constraints, as well as devising means of mitigation through remedial strategy development, feasibility and validation.

He is experienced in wetland studies with background knowledge of Wetland delineation, floodline hydrology, environmental impact assessment and status of the wetland, modelling of the floodline picks, and hydrocensus. Experienced in research, Arc GIS, Map production, EIA and EMP review, Report writing, AMD Strategic plan, Assessing AMD mines, providing specialist and technical Support.

- Geologist for the exploration of Springbok Flats Coalfield for Houlgoun Mining at Mpumalanga province.
- Coal Geologist of (Waterberg Coalfield) for Resource Generation at Lephalale area.
- Geologist for the CBM gas at Amersfoot area for Kinetiko (Badimogas) exploration.
- Geologist of Carolina coal fields for the (Western Crown) at Mpumalanga area.
- Coal Geologist of Mbuyelo Group for the development of Geluk mine operation in Mpumalanga area.
- Geologist of Umbono Capital Ltd Pty for the development of Eendracht Farm (Waterberg Coalfield)

Specialist reports

Project : Coal project (CPR) Mpumalanga (Driefontein, Roodepoort and Geluk)

Client : Geocoal services (Mbuyelo Group)

Project Manager: Nyamoki Consulting Pty Ltd

Year : 2013-2014

Project: Geology, Mining, Environment, Survey, Metallurgy

Client: University of South Africa

Project Managers: Nyamoki Consulting Pty Ltd

Year : 2013-2018

Project: A study of metals dispersion from the Magnesite dumps towards the immediate community of Folovhodwe Village, Limpopo Province.

Nature: Academic research

Project Managers: Nyamoki Consulting Pty Ltd

Year : 2015- Current

Project**:. Environmental Impact Assessment on Gas Tank Gauteng province for Bp Masana.**

Nature: Inspection and report writing.

Project Managers: Sivhungwana Environmental Solution and Nyamoki consulting on the ground.

Year : 2015- 2016

Client : Tshifcor Investment and Resources

Nature : Geotechnical assessment for Graspan Coal Project for design of Box Cut and Hydrological Studies for storm water and water balance.

Project Managers: Nyamoki consulting Pty Ltd

Year : 01/04/2017 – 31/05/2017

Client : Sebadi Environmental and Social Services cc

Nature : Hydrogeological studies for Bethanie Fuel Station at Rustenburg area, Floodline studies for Luka Community Cemetery development at Rustenburg area. Hydrogeological Studies for Ha-Luka Rustenburg area.

Project Managers: Nyamoki consulting Pty Ltd

Year : 01/09/2017 – 31/12/2017

Client : Sebadi Environmental and Social Services cc

Nature : Traffic Assessment Report and Noise Impact Study for Karussel (Ten Flag Recreational services).

Project Managers: Nyamoki consulting Pty Ltd

Year : 01/09/2019 – 31/09/2018

Client : NDI Geological Services

Nature : Specialist Studies Steinkopf Town (Northern Cape); Hydrogeological, Wetlands, Biodiversity, Floodline, and Traffic Impact Assessment.

Project Managers: Nyamoki consulting Pty Ltd

Year : 01/04/2018 – 31/04/2018

Client : NDI Geological Services

Nature : Specialist Studies for Pella (Pofadder Town in Northern Cape); Hydrogeological, Wetlands, Biodiversity, Floodline, and Traffic Impact Assessment.

Project Managers: Nyamoki consulting Pty Ltd

Year : 01/05/2018 – 31/05/2018

Client : NDI Geological Services

Nature : Specialist Studies for Avoca (Douglas in Northern Cape); Hydrogeological, Wetlands, Biodiversity, Floodline, and Traffic Impact Assessment.

Project Managers: Nyamoki consulting Pty Ltd

Year : 01/04/2018 – 31/04/2018

Client : NDI Geological Services

Nature : Specialist Studies for Maxwell 146 CC (Northern Cape); Hydrogeological, Wetlands, Biodiversity, Floodline, and Traffic Impact Assessment.

Project Managers: Nyamoki consulting Pty Ltd

Year : 01/05/2018 – 31/07/2019

Client : NDI Geological Services

Nature : Specialist Studies for Kareevlei Mining Pty Ltd (Northern Cape); Hydrogeological, Wetlands, Biodiversity, Floodline, and Traffic Impact Assessment.

Project Managers: Nyamoki consulting Pty Ltd

Year : 01/05/2019 – 31/05/2019

Client : Mr Muapi

Nature : Geotechnical Investigation for filling station

Project Managers: Nyamoki consulting Pty Ltd

Year : 01/05/2019 – 31/05/2019

Client : Namerc Fuel

Nature : Geotechnical Investigation Mebaskraal Filling Station

Project Managers: Nyamoki consulting Pty Ltd

Year : 01/06/2019 – 31/06/2019

Client : Namerc Fuel

Nature : Geotechnical Investigation Lekoko Filling Station

Project Managers: Nyamoki consulting Pty Ltd

Year : 01/05/2019 – 31/06/2019

Client : Namerc Fuel

Nature : Geotechnical Investigation Lekoko Filling Station

Project Managers: Nyamoki consulting Pty Ltd

Year : 01/05/2019 – 31/06/2019

Client : Rhulani Nkuna Pty Ltd

Nature : EIA for Housing development at Cosmos city, Gauteng Province

Project Manager : Nyamoki Consulting Pty Ltd

Year: 01/01/2020 - 30/07/2021

Client : Mamiane Enterprise Pty Ltd

Nature : EIA for Prospecting Right application in Limpopo Province for Andalusite Mining and resource estimations.

Project Managers: Nyamoki Consulting Pty Ltd

Year : 15/04/2021 – 30/08/2021

Client : Senkosi Environmental Pty Ltd

Nature : Specialist Studies for Tsantsabane Municipality new landfill construction and old landfill closure (Postmasburg Town in Northern Cape); Hydrogeological, Wetlands, Biodiversity, Floodline, and Traffic Impact Assessment, visual impact assessment, soil and land capability study

Project Managers: Nyamoki Consulting Pty Ltd

Year : 01/09/2021 – 15/10/2021

Client : Thuso Architects

Nature : Geotechnical Investigation for school building (Nelsonkop primary school) in Lephalale Limpopo

Project Managers: Nyamoki consulting Pty Ltd

Year : 20/08/2021 – 30/08/2021

Client : Namerc Fuel

Nature : Geotechnical Investigation for school building (Mebaskraal Community building)

Project Managers: Nyamoki consulting Pty Ltd

Year : 15/10/2021 – current

Client : Hoxan Consulting Engineering Pty Ltd

Nature : Geotechnical Investigation Four community Streets Lights in Rustenburg for school building

Project Managers: Nyamoki consulting Pty Ltd

Year : 10th January 2022 – 25th February 2022

Client : Above Average Mines Pty Ltd

Nature : Competent Person Report for the Gold Reclamation Project in Barberton Town

Project Managers: Nyamoki consulting Pty Ltd

Year : March to September 2021

Additional Projects

1. Marula Platinum: Fy2021 Aquatic Biomonitoring Report (Dry Season): Low Flow Survey – September 2021

2. Biodiversity Study Of The Proposed Development Of A Fun Park In The Moses Kotane Local Municipality, North West Province, August 2021

3. Wetland Delineation Of The Proposed Prospecting Right Application For Diamond (Alluvial), Diamond (General), Diamond (In Kimberlite), Iron Ore And Manganese Ore On The Remaining Extent And Remaining Extent Of Portions 1 And 2 Of The Farm Mooifontein 640 Hn And Remaining Extent And Portion 1 Of The Farm Driehoek 641 Hn, Situated In The Greater Taung Local Municipality, North West Province, June 2021

4. Biodiversity Study Of The Proposed Prospecting Right Application For Diamond (Alluvial), Diamond (General), Diamond (In Kimberlite), Iron Ore And Manganese Ore On The Remaining Extent And Remaining Extent Of Portions 1 And 2 Of The Farm Mooifontein 640 Hn And Remaining Extent And Portion 1 Of The Farm Driehoek 641 Hn, Situated In The Greater Taung Local Municipality, North West Province, May 2021

5. Wetland Delineation: Application for A Prospecting Right And Associated Environmental Authorisation (Ea) And Waste Management Licence (Wml) For Diamond (Alluvial And General) On Farm Lot 271 And Remainder And Portion Of Portion 3 Of The Farm Slypsteen 41, Situated In The Thembelihle Local Municipality, Northern Cape Province, June 2021

6. Biodiversity Impact Assessment: Application For A Prospecting Right And Associated Environmental Authorisation (Ea) And Waste Management Licence (Wml) For Diamond (Alluvial And General) On Farm Lot 271 And Remainder And Portion Of Portion 3 Of The Farm Slypsteen 41, Situated In The Thembelihle Local Municipality, Northern Cape Province, August 2021

7. Biodiversity Impact Assessment: Application for a Mining Right and Associated Environmental Authorisation and Waste Management Licence (WML) for the proposed mining of granite on a Portion of Zwart Modder Mountain No. 446 (445) in the Kai! Garib Local Municipality, Northern Cape Province.May 2021

8. Biodiversity Impact Assessment: Prospecting Right And Environmental Authorisation Application For Chrome Ore, Copper Ore, Andalusite, Iron Ore And Sillimanite Resources On The Farm Hooggenoeg 293 Ks Within The Lepelle-Nkumpi Magisterial District, Limpopo Province.March 2021

9. Wetland Delineation: Prospecting Right And Environmental Authorisation Application For Andalusite Minerals On The Farm Hooggenoeg 293 Ks Within The Lepelle-Nkumpi Magisterial District, Limpopo Province, April 2021

10. Wetland Delineation: Proposed Alluvial Diamond Mine And Associated Infrastructure: Samara Pty Ltd Prospecting Project, Northern Cape Province, November 2020

11. Terrestrial Biodiversity Assessment And Wetland Delineation Report For The Proposed Permit Application To Use Borrow Pit Material As Part Of The Ongoing Rehabilitation. December 2021

12. Wetland Delineation For The Construction Of Pilanesberg South Bulk Water Supply – Phase 2 To Boshoek, Phokeng, Tlhabane And Rustenburg North West Province, May 2021

13. Final Wetland Delineation Study For The Tsantsabane Local Municipality Postmasburg Landfill Sites Project, In The Northern Cape. May 2022

14. Biodiversity Study for The Tsantsabane Local Municipality Postmasburg Landfill Sites Project, September 2021

15. Wetland Delineation Study For The Rehabilitation And Decommissioning Closure Of Boichoko Landfill In Postmasburg In The Northern Cape. September 2021

16. Biodiversity Study For The Rehabilitation And Decommissioning Closure Of Boichoko Landfill In Postmasburg In The Northern Cape. September 2021

17. WETLAND DELINEATION REPORT:Application For Construction Of A Three Storeys Residential Building At Farm Zandspruit 191 Iq, Remaining Extent Of Portion 12. October 2020

18. Terrestrial Biodiversity Impact Assessment: The proposed development of Filling Station on a portion of the Remaining Extent of the Farm Gemsbok 505 JU, situated within Nkomazi Local Municipality, Mpumalanga Province. February 2022

19. Wetland Delineation and Assessment: The proposed development of Filling Station on a portion of the Remaining Extent of the Farm Gemsbok 505 JU, situated within Nkomazi Local Municipality, Mpumalanga Province. February 2022

20. Rehabilitation And Closure Plan In Support Of The Mining Right Application For Grasdrif Diamond Mine In Grasdrif, Richtersveld Local Municipality, In The Namaqua District Of The Northern Cape Province.June 2022

21. Draft Wetland Delineation And Impact Assessment Study In Support Of The Mining Right Application For Grasdrif Diamond Mine In Grasdrif, Richtersveld Local Municipality, In The Namaqua District Of The Northern Cape Province.June 2022

22. Nungu Colliery Quarter 1 Aquatic Biomonitoring Report (Wet Season): January 2022

23. Wetland Delineation and Assessment: The proposed development of the Kapstewel Mine, situated within Tsantsabane Local Municipality, Northern Cape Province.March 2022

24. Terrestrial Biodiversity Impact Assessment: The proposed development of the Kapstewel Mine, situated within Tsantsabane Local Municipality, Northern Cape Province. March 2022

25. Marula Platinum: Fy2021 Aquatic Biomonitoring Report (Wet Season): High Flow Survey – March 2022

26. Terrestrial Biodiversity Impact Assessment: Proposed Coal Mining Right Application In Portion Of The Farms: Grootspruit 23 Ht (Excluding The Mining Permit Area), Kaffir Locatie 24 Ht (Excluding Mining Permit Area), Voorslag 25 Ht And Sobbeken 390 It, Wakkerstroom.May 2022.

27. Wetland Delineation And Assessment: Proposed Coal Mining Right Application In Portion Of The Farms: Grootspruit 23 Ht (Excluding The Mining Permit Area), Kaffir Locatie 24 Ht (Excluding Mining Permit Area), Voorslag 25 Ht And Sobbeken 390 It, Wakkerstroom.June 2022

28. Wetland Delineation And Assessment: The Proposed Coal Processing Plant (Cpp) Is Located On The Remaining Extent Of The Farms Klipspruit 138 Ht, Portion 7 Of The Farm Annysspruit 141 Ht And Portion 1 Of The Farm Annysspruit 139 Ht Under Wakkerstroom And Piet Retief Magisterial Districts, Mpumalanga Province. August 2022