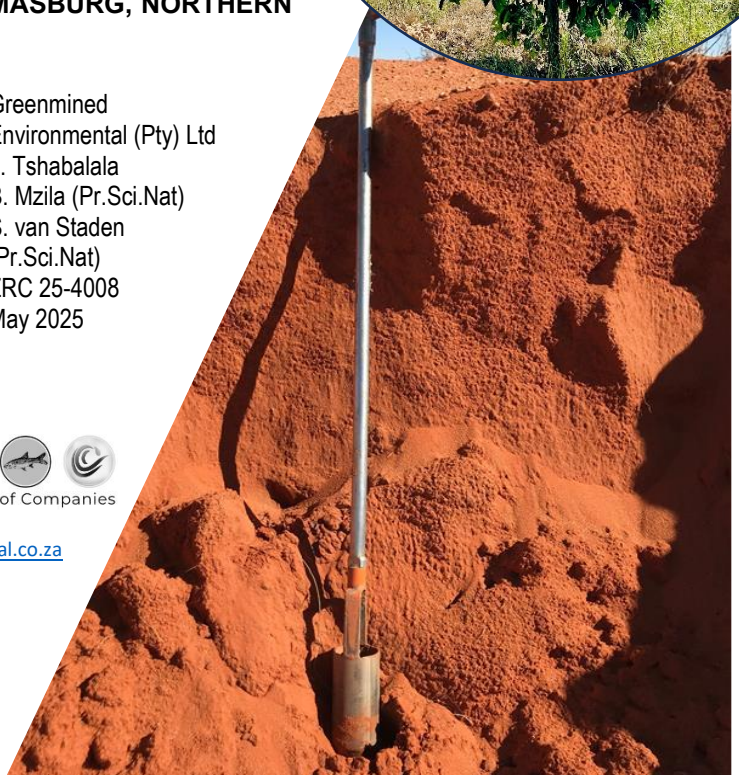
ZIMPANDE
RESEARCH COLLABORATIVE

Soil, Land use and Land Capability Assessment Report

FOR THE PROPOSED MAKGANYANE IRON ORE MINE NEAR POSTMASBURG, NORTHERN CAPE PROVINCE.

Prepared for:	Greenmined Environmental (Pty) Ltd
Report author:	L. Tshabalala B. Mzila (Pr.Sci.Nat)
Report Reviewers:	S. van Staden (Pr.Sci.Nat)
Report Reference:	ZRC 25-4008
Date:	May 2025



Part of the SAS Environmental Group of Companies

Website: http://www.sasenvironmental.co.za

EXECUTIVE SUMMARY

The Zimpande Research Collaborative (ZRC) was appointed to conduct a soil, land use, land capability, and land potential and provide an environmental impact assessment (EIA) specialist study as part of the Environmental Authorisation (EA) process for the proposed Makganyane Iron Ore Mine near Postmasburg, Northern Cape Province. The mining right area (MRA) for the proposed development will henceforth be referred to as the "study area".

The overall mining right area (MRA) comprises approximately 1549,61 hectares (ha) and is made up of Portion 2 (A Portion of Portion 1), Remainder Portion, Remainder Portion of Portion 1 and Portion 3 of the Farm Makganyane No. 667. However, this assessment focused on certain pre-selected areas, within the above-mentioned farm boundaries, associated with (i) an historical mining operational area, and (ii) the proposed mining operation. These areas along with a 200 meters (m) buffer area will hereafter be collectively referred to as the 'focus area'.

The objective of this study was to determine the impact of the proposed development on the soil, land use and land capability through the evaluation of the following:

- Climatic conditions within the context of agricultural productivity and constraints;
- Landscape setting and presently occurring land uses;
- Dominant soil forms, their respective land capability and potential for agricultural productivity;
- Soil physical properties and current limitations of soils to various land use purposes in their present state;
- Determine the impact of the proposed development on the soil, land capability and agricultural potential; and
- Present mitigation measures to minimise the impact significance by applying the hierarchy of mitigation in line with the sustainable development principles.

The entire MRA is characterised by approximately 300 mm of mean annual rainfall (MAR) per annum. This rainfall is deemed inadequate for a variety of cultivated crops and as such, adjusting planting and/or an irrigation scheme may be necessary for successful cultivation of crops. Additionally, the entire MRA are characterised by mean annual evaporation of more than (>2400 mm) per annum. Moisture deficit and crop wilting may be a problem for non-irrigated crops.

According to observations made during the site assessment, the focus area for the proposed Makganyane Mine is dominated by bushveld with shrubby and thorny vegetation, wilderness/wildlife, open grassland that is currently utilised for livestock grazing (cattle). No small scale and/or commercial agricultural cultivation activities were observed within the immediate surroundings (5 km radius) of the focus area.

According to the Department of Agriculture, Land Reform and Rural Development DALRRD, 2022) database on the Natural Agricultural Resources Atlas of South Africa (NAR Atlas Manual), the proposed Makganyane Iron Ore Mining Right Area (MRA) is not located within any of the protected agricultural areas (PAAs) which are classified into two categories, namely the irrigated (IR) and the rainfed (RF) production systems. Therefore, the proposed mining project is not likely to have an impact on the protected agricultural areas and consequent food security.

The identified soil forms occurring within the focus area include Mispah/Glenrosa, Mispah (outcrops), Glenrosa, Clovelly, Witbank (Infrastructure), and Cullinan (Excavation with Water). Of these identified soils, the Mispah/Glenrosa and Mispah soil forms were the most dominant within the focus area, occupying 69.62% and 18.24% of the total enclosed area respectively.

The Mispah/Glenrosa and Mispah soil formations are typically shallow in nature and in some instances no bedrock outcrops on surface. These soils are characterised by spatial heterogeneity associated with weathering of the rock material, illuviation, and biotic disturbance (plants and animals) especially along the joints or bedding planes which results in the mixing of soil and rock material in some instances. These types of soils are usually avoided for intensive agricultural use and thus left for grazing and wildlife land uses in this arid region since they do not present adequate soil depth for most cultivated crops.

The Witbank (Transported Technosols) soil forms are soils which have been subjected to physical disturbance due to infrastructural developments. In this context, Witbank soils include areas with transported soil material which has been significantly transformed and heavily modified such that the diagnostic horizons could not be identified. As a result, these soils are not ideal for agricultural cultivation.

The soils of Hutton formations are characterised by development in well-drained oxidising environmental conditions (warm and moist) which allow for iron oxide coating on soil particles thus resulting in the dominating red colours of the soils. These soils have a good depth (approximately 120 cm), which is considered sufficient to allow plants' roots to extract moisture and nutrients to sustain growth and development. In the absence of climatic constraints, the soils are suitable for arable cultivation.

Table A below indicates the dominant soils occurring within the focus areas, together with the associated land capability and the area extent covered in hectares (ha).

Table A: Dominant soil forms and their respective land capability and land potential classes.

Soil Forms	Soil Depth (cm)	DALRRD (2018) Classification	Field Verified Agricultural Sensitivity	Land Potential	Area Extent (ha)	Percentage (%)
Hutton	120	14. Very High	Medium	Good – L3	5.50	1.51
Glenrosa	<30	6. Low - Moderate		Restricted – L5	37.04	10.17
Mispah/ Glenrosa	<15	4. Low – Very Low	Low	Very Restricted – L6	253.46	69.62
Mispah	0	2. Very Low		Very Low – L8	66.39	18.24
Cullinan	n/a				1.24	0.34
Witbank	n/a				0.41	0.11
Total Enclosed Area					**364.04**	**100**

The cumulative loss from a soil and land capability point of view is anticipated to be low for the proposed Makganyane Iorn Ore Mine. This can be attributed to the dominance of Glenrosa and Mispah soil forms within the focus area which account for approximately 85% of the focus area. The lack of soil medium (Mispah) and limited effective rooting depth (<15 cm) for Glenrosa render these soils more suitable for wilderness and/or small stock grazing under extensive farming practices. The dominant soils have a little bearing on agricultural productivity and their contribution towards local, regional, and national food security is highly minimal. Additionally, the existence of other currently operating mines and the proposed Makganyane Mine may have incremental effects on the environment over time; however, the cumulative impacts within the context of local and regional setting are not anticipated to be significant given the low land capability associated with the identified soils as well as the low grazing capacity potential regionally.

Although arable soils of good agricultural potential (Hutton) also occur within the focus area, the prevailing climatic constraints of the area such as the low mean annual rainfall (201 – 300 mm) and high mean annual evaporation rate (>2400 mm) combined with the lack of irrigation options limits the viability of the soils for small scale and/or commercialised cultivated agricultural production.

According to the Natural Agricultural Resources Manual (NAR Atlas Manual, 2018), the livestock grazing capacity potential is estimated to be approximately 14 hectares per livestock unit (ha/LSU) for the entire focus area. This grazing capacity potential associated with the focus area is considered insufficient to support both small scale and/or commercialised livestock farming.

The field assessment and verification indicate that while the Department of Fisheries, Forestry, and the Environment (DFFE) national web-based screening tool initially flagged the focus area as having medium sensitivity to impact, the field verified agricultural sensitivity revealed a low agricultural sensitivity due to factors such as poor soil quality (lack of soil medium and effective rooting depth) and climatic constraints that limit restricts the potential for commercial agricultural production. Therefore, the screening tool is disputed and thus, the proposed mine development can be supported. In addition, the historical imagery on google earth revealed that no prior commercial cultivation was observed within the focus area for the past 5 years. Given the restrictive soil physical properties and unfavourable climatic conditions associated with the footprint area, the proposed development is not regarded as a significant threat towards regional, provincial, and national food production and security.

The following key mitigation measures have been developed to minimise the potential impacts on the soil regime, should the proposed mine be approved, and these include but are not limited to:

- Direct surface disturbance of the identified arable soils must be avoided where possible to minimise loss of arable soils;
- The proposed development and the associated surface infrastructure should be limited to within the demarcated footprint area;
- Stockpiles that will remain in location for more than one growing season and that have not revegetated naturally, should be revegetated to avoid erosion losses;
- Ensure all stockpiles (especially topsoil) are clearly and permanently demarcated and located in defined “no-go areas”;
- Restrict the amount of mechanical handling, as each handling event increases the compaction level and the changes to the soil structure. Wherever possible, the ‘cut and cover’ technique (where the stripped soils is immediately placed in an area already prepared for rehabilitation, thus avoiding stockpiling) should be used;
- The footprint areas should be lightly ripped to alleviate compaction;
- The footprint of the proposed development and construction activities should be clearly demarcated to restrict vegetation clearing activities within the infrastructure footprint as far as practically possible;
- Bare soils within the access roads must be regularly dampened with water to suppress dust during the construction and operational phase, especially when strong wind conditions are predicted according to the local weather forecast;
- Temporary erosion control measures should be used to protect the disturbed soils during the construction phase until adequate vegetation has established;
- Contamination prevention measures should be addressed in the Environmental Management Programme (EMP) for the proposed development, and this should be always implemented and made available and accessible to the contractors and construction crew conducting the works on site for reference;
- A spill prevention and emergency spill response plan considering the nature of the proposed development, as well as dust suppression, and fire prevention plans should also be compiled to guide the construction works;
- An emergency response contingency plan should be put in place to address clean-up measures should a spill and/or a leak occur, as well as preventative measures to prevent contamination; and
- Burying of any waste including domestic waste, empty containers on the site should be strictly prohibited.

It is the opinion of the soil specialist that the proposed Makganyane Iron Ore Mine will not result in an unacceptable risk or loss of agricultural resources, and the proposed development is therefore deemed acceptable from a soil, land use, and land capability point of view, provided adequate and appropriate mitigation measures are put in place to minimise disturbances on the soil regime of the focus area.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

DOCUMENT GUIDE

The table below provides the criteria for the specialist assessment and minimum report content requirements for impacts on agricultural resources for activities requiring environmental authorisation as it relates to Government Notice No. 320 Protocol as published in Government Gazette 43110 dated 20 March 2020.

Theme-Specific Requirements as per Government Notice No. 320 Agricultural Resources Theme – Very High and High Sensitivity Rating as per Screening Tool Output		
No.	**SPECIALIST ASSESSMENT AND MINIMUM REPORT CONTENT REQUIREMENTS**	**Section in report/Notes**
2	**Agricultural Agro-Ecosystem Specialist Assessment**	
2.1	The assessment must be undertaken by a soil scientist or agricultural specialist registered with the South African Council for Natural Scientific Professionals (SACNASP).	Appendix B
2.2	The assessment must be undertaken on the preferred site and within the proposed development footprint.	Section 1.1
2.3	**The assessment must be undertaken based on a site inspection as well as an investigation of the current production figures, where the land is under cultivation or has been within the past 5 years, and must identify:**	
2.3.1	the extent of the impact of the proposed development on agricultural resources; and	Section 6
2.3.2	Whether or not the proposed development will have an unacceptable impact on the agricultural production capability of the site, and in the event where it does, whether such a negative impact is outweighed by the positive impact of the proposed development on agricultural resources.	Section 6.1.5
2.4	**The status quo of the site must be described, including the following aspects which must be considered as a minimum in the baseline description of the agro-ecosystem:**	
2.4.1	the soil form/s, soil depth (effective and total soil depth), top and sub-soil clay percentage, terrain unit and slope;	Section 3 and 4.2
2.4.2	where applicable, the vegetation composition, available water sources as well as agro-climatic information;	
2.4.3	the current productivity of the land based on production figures for all agricultural activities undertaken on the land for the past 5 years, expressed as an annual figure and broken down into production units;	Section 1.4
2.4.4	the current employment figures (both permanent and casual) for the land for the past 3 years, expressed as an annual figure; and	Section 1.4
2.4.5	existing impacts on the site, located on a map (e.g. erosion, alien vegetation, non-agricultural infrastructure, waste, etc.).	Section 4.1
2.5	**Assessment of impacts, including the following aspects which must be considered as a minimum in the predicted impact of the proposed development on the agro-ecosystem:**	
2.5.1	change in productivity for all agricultural activities based on the figures of the past 5 years, expressed as an annual figure and broken down into production units;	Section 1.4
2.5.2	change in employment figures (both permanent and casual) for the past 5 years expressed as an annual figure; and	Section 1.4
2.5.3	any alternative development footprints within the preferred site which would be of “medium” or “low” sensitivity for agricultural resources as identified by the screening tool and verified through the site sensitivity verification.	Section 6.1.5
2.6	**The findings of the Agricultural Agro-Ecosystem Specialist Assessment must be written up in an Agricultural Agro-Ecosystem Specialist Report.**	
2.7	**This report must contain the findings of the agro-ecosystem specialist assessment and the following information, as a minimum:**	
2.7.1	details and relevant experience as well as the SACNASP registration number of the soil scientist or agricultural specialist preparing the assessment including a curriculum vitae;	Appendix B
2.7.2	A signed statement of independence by the specialist;	Appendix B
2.7.3	the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;	Section 2.2

2.7.4	a description of the methodology used to undertake the on-site assessment inclusive of the equipment and models used, as relevant;	Section 2.2
2.7.5	a map showing the proposed development footprint (including supporting infrastructure) with a 50 m buffered development envelope, overlaid on the agricultural sensitivity map generated by the screening tool;	Section 5.1
2.7.6	an indication of the potential losses in production and employment from the change of the agricultural use of the land as a result of the proposed development;	Section 6.1.5
2.7.7	an indication of possible long-term benefits that will be generated by the project in relation to the benefits of the agricultural activities on the affected land;	Section 6.1.5
2.7.8	additional environmental impacts expected from the proposed development based on the current status quo of the land including erosion, alien vegetation, waste, etc.;	Section 6
2.7.9	information on the current agricultural activities being undertaken on adjacent land parcels;	Section 4.1
2.7.10	an identification of any areas to be avoided, including any buffers;	Section 5.2
2.7.11	a motivation must be provided if there were development footprints identified as per paragraph 2.5.3 above that were identified as having a “medium” or “low” agriculture sensitivity and that were not considered appropriate;	Section 6.1.5
2.7.12	confirmation from the soil scientist or agricultural specialist that all reasonable measures have been considered in the micro-siting of the proposed development to minimise fragmentation and disturbance of agricultural activities;	Section 2.4
2.7.13	a substantiated statement from the soil scientist or agricultural specialist with regards to agricultural resources on the acceptability or not of the proposed development and a recommendation on the approval or not of the proposed development;	Section 6.1.5
2.7.14	any conditions to which this statement is subjected;	Section 1.4
2.7.15	where identified, proposed impact management outcomes or any monitoring requirements for inclusion in the Environmental Management Programme (EMPr); and	Section 6.2
2.7.16	a description of the assumptions made and any uncertainties or gaps in knowledge or data.	Section 1.4
2.8	**The findings of the Agricultural Agro-Ecosystem Specialist Assessment must be incorporated into the Basic Assessment Report or Environmental Impact Assessment Report, including the mitigation and monitoring measures as identified, which are to be contained in the EMPr.**	
2.9	**A signed copy of the assessment must be appended to the Basic Assessment Report or Environmental Impact Assessment Report.**	

GLOSSARY OF TERMS

AGIS	Agricultural Geo-Referenced Information Systems
Alluvial soil:	A deposit of sand, mud, etc. formed by flowing water, or the sedimentary matter deposited thus within recent times, especially in the valleys of large rivers.
Chromic:	Having within ≤150 cm of the soil surface, a subsurface layer ≥30 cm thick, that has a Munsell colour hue redder than 7.5YR, moist.
Catena	A sequence of soils of similar age, derived from similar parent material, and occurring under similar macroclimatic condition, but having different characteristics due to variation in relief and drainage.
Catchment	The area where water is collected by the natural landscape, where all rain and run-off water ultimately flow into a river, wetland, lake, and ocean or contributes to the groundwater system.
Chroma	The relative purity of the spectral colour which decreases with increasing greyness.
Evapotranspiration	The process by which water is transferred from the land to the atmosphere by evaporation from the soil and other surfaces and by transpiration from plants
IEM	Integrated Environmental Management
IUSS	International Union of Soil Sciences
Lithic	Having continuous rock or technic hard material starting ≤10 cm from the soil surface.
SACNASP	South African Council for Natural Scientific Professions
Salinity	High Sodium Adsorption Ratio (SAR) above 15% are indicative of saline soils. The dominance of Sodium (Na) cations in relation to other cations tends to cause soil dispersion (deflocculation), which increases susceptibility to erosion under intense rainfall events.
Sodicity	High exchangeable sodium Percentage (ESP) values above 15% are indicative of sodic soils. Similarly, the soil dispersion.
SOTER	Soil and Terrain

ACRONYMS

°C	Degrees Celsius.
EAP	Environmental Assessment Practitioner
EMP	Environmental Management Programme
ET	Evapotranspiration
FAO	Food and Agriculture Organization
EIA	Environmental Impact Assessment
DALRRD	Department of Agriculture, Land Reform & Rural Development
GIS	Geographic Information System
GPS	Global Positioning System
SOTER	Soil & Terrain
NWA	National Water Act
m	Meter
EA	Environmental Authorisations
MAP	Mean Annual Precipitation
NEMA	National Environmental Management Act
DEFF	Department of the Environment, Forestry and Fisheries
SACNASP	South African Council for Natural Scientific Professions
DMRE	Department of Mineral Resources & Energy
CARA	Conservation of Agricultural Resources Act
ZRC	Zimpande Research Collaborative

1. INTRODUCTION

The Zimpande Research Collaborative (ZRC) was appointed to conduct a soil, land use, land capability, and land potential and provide an environmental impact assessment (EIA) specialist study as part of the Environmental Authorisation (EA) process for the proposed Makganyane Iron Ore Mine near Postmasburg, Northern Cape Province.

1.1 Background and Locality

The overall mining right area (MRA) comprises approximately 1549,61 hectares (ha) and is made up of Portion 2 (A Portion of Portion 1), Remainder Portion, Remainder Portion of Portion 1 and Portion 3 of the Farm Makganyane No. 667. However, this assessment focused on certain pre-selected areas, within the above-mentioned farm boundaries, associated with (i) an historical mining operational area, and (ii) the proposed mining operation. These areas along with a 200 meters (m) buffer area will hereafter be collectively referred to as the 'focus area'. The focus area is located approximately 24 km north-west of Postmasburg on opposite sides of the R385 provincial road in the administrative district of Kuruman, Northern Cape Province of South Africa.

This report aims to provide the soil, land use, and land capability aspects for the footprint areas associated with the proposed Makganyane Iron Ore Mine, provide a detailed agricultural and environmental impact assessment based on the provided layout for the proposed development.

The locality of the focus area is depicted in Figures 1 and 2 below.

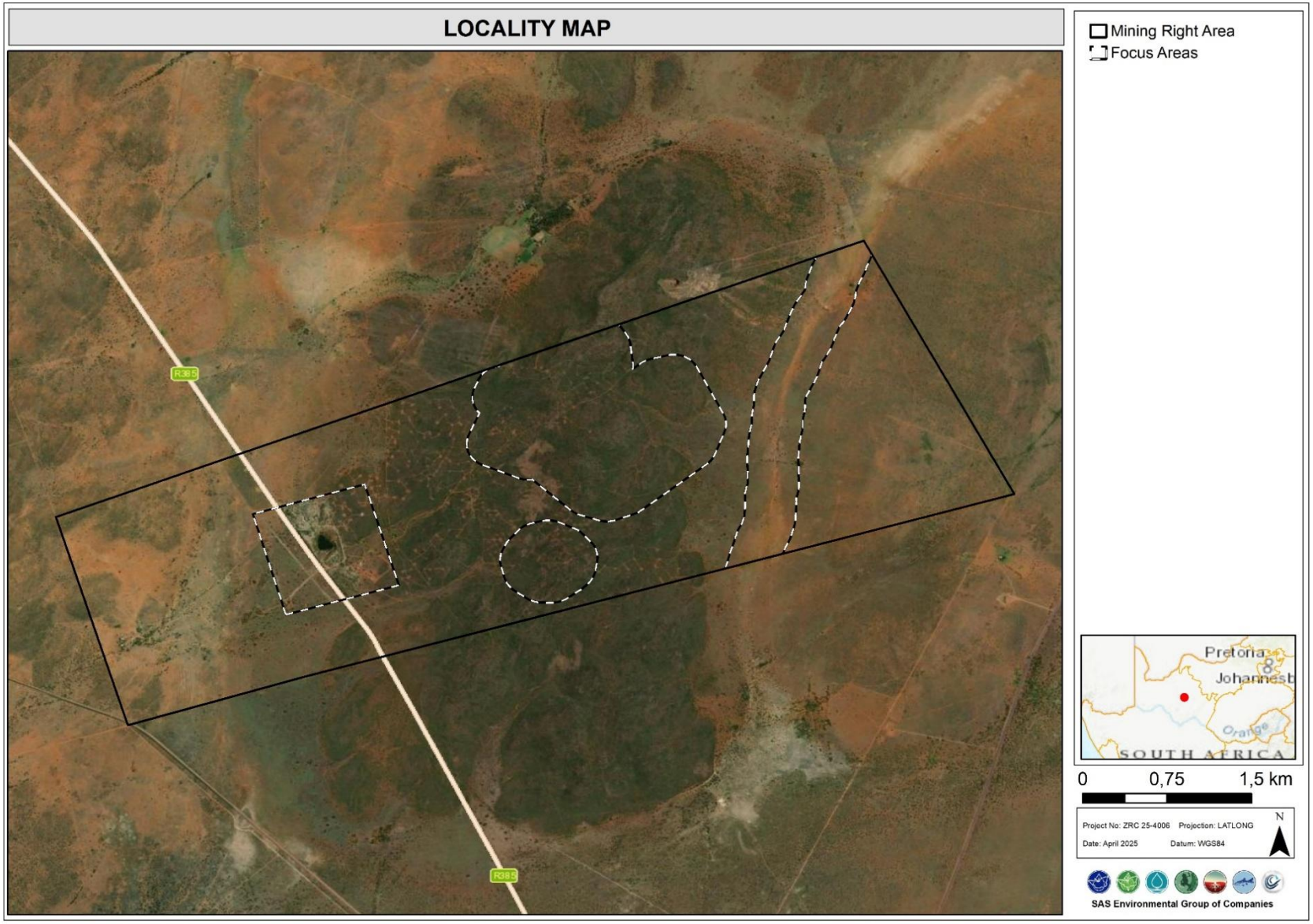


Figure 1: Digital satellite imagery depicting the locality of the focus areas in relation to the surrounding areas.

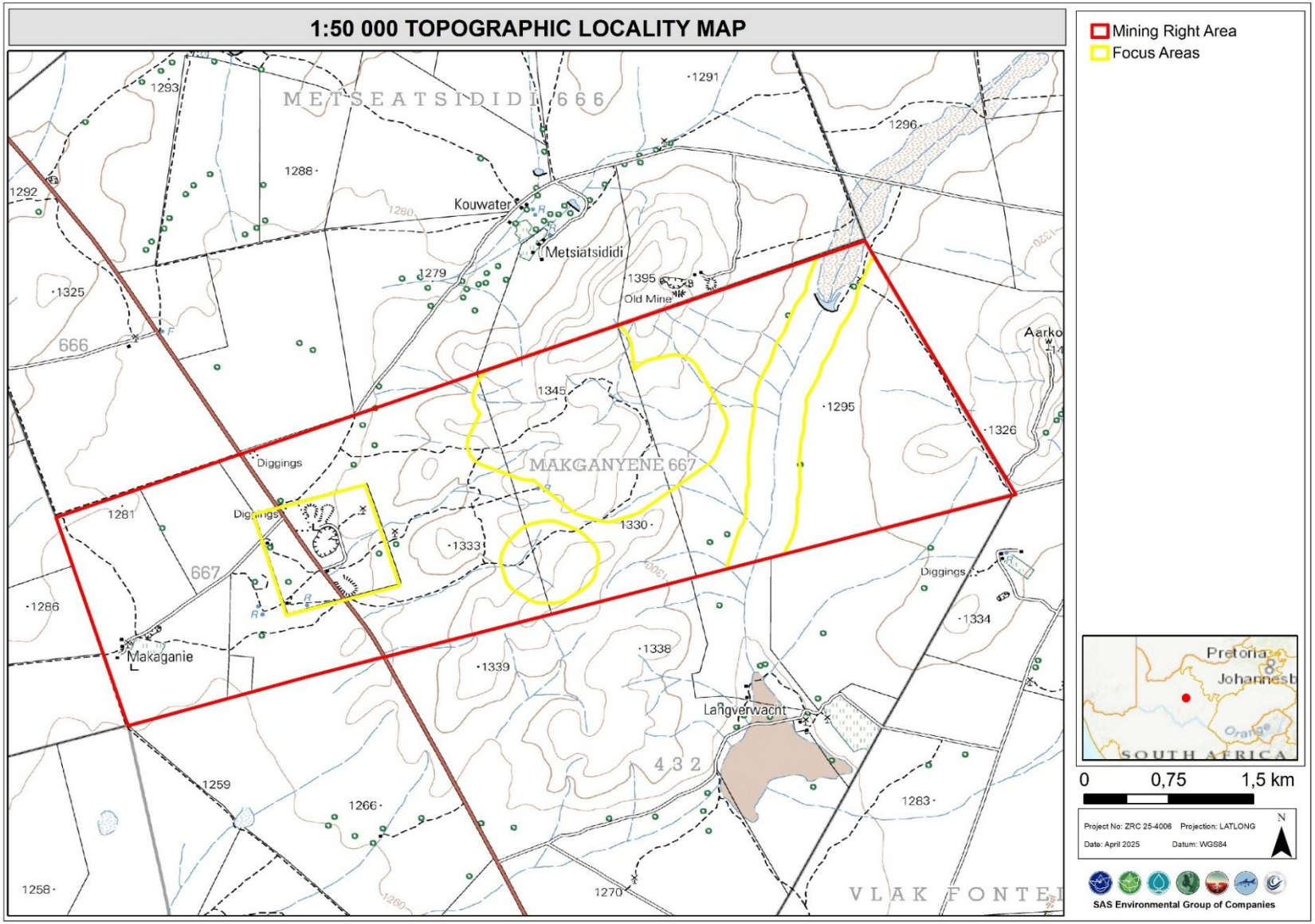


Figure 2: Location of the focus areas depicted on a 1:50 000 topographical map in relation to surrounding area.

1.2 Project Description

The proposed Makganyane Mine operation is proposing the extraction of iron ore material from two open cast pits whereafter the crushed raw material will be transported by means of trucks along the R385 to the operational Beeshoek plant for processing. Once processed at the Beeshoek plant the concentrate is transported from the Postmasburg area to Arcelormittal's Vanderbijlpark and Newcastle Works through a combination of rail and road transport.

The following information was extracted from the mining work programme submitted for a mining right application for Makganyane Iron Ore Mine (Assmang (Pty) Ltd):

- The proposed mining operations will include two open cast pits, a stockpile area and a waste dump area.
- Contractors will make use of diesel generated power supply and hence minimal electricity infrastructure will be required.
- A general water authorisation is available for 30m³ per day. Should additional water be required, it would need to be purchased from a third party.
- Offices, parking and other supporting infrastructure will be constructed as required.

No information relating to clean and dirty water separation systems (trenches, channels or a Pollution Control Dam [PCD]) or stormwater management systems was provided at the time of undertaking this assessment. Furthermore, it was assumed that the existing road network developed as part of the prospecting operation will be used for the mining operation as well.

The layout map for the proposed Makganyane Iron Ore Mine is depicted in Figure 3 below.

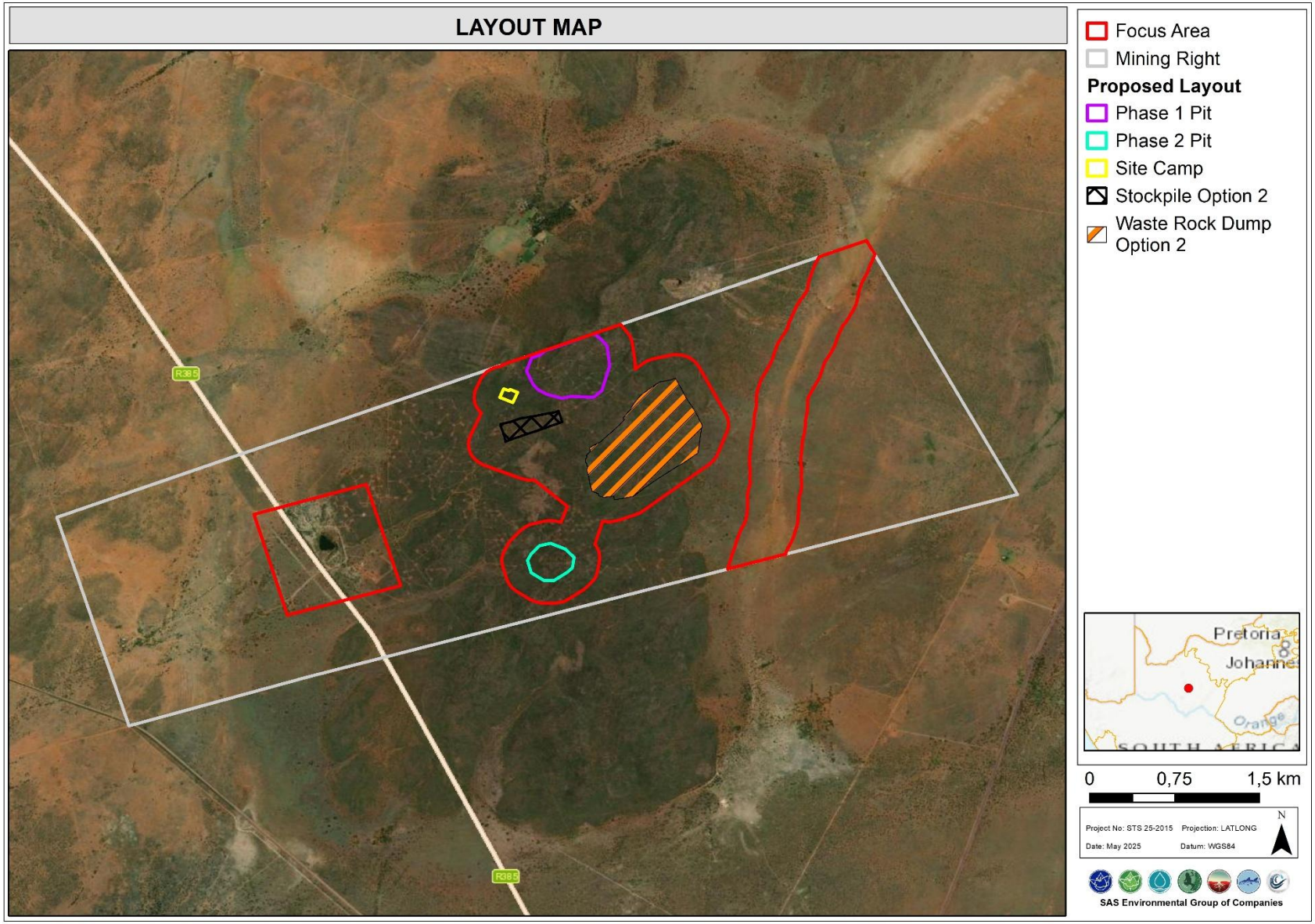


Figure 3: Layout map for the proposed Makganyane Iron Ore Mine.

1.3 Terms of Reference and Scope of Work

The Environmental Authorisation process of the soil, land use and land capability assessment entailed the following aspects:

- As part of the desktop study, various datasets were consulted which includes but not limited to: Natural Agricultural Resources Atlas of South Africa (NAR Atlas Manual, 2018) database, Soil and Terrain dataset (SOTER, 2013), and land capability maps to establish broad baseline conditions and sensitivity of the focus area both on environmental and agricultural perspective;
- Compile various maps depicting the on-site conditions based on review of existing data and databases;
- Classification of the climatic conditions occurring within the focus area;
- Conduct a soil classification survey within the focus area;
- Assess the spatial distribution of various soil types within the focus area and classify the dominant soil types according to the South African Soil Classification System: A Natural and Anthropogenic System for South Africa (Soil Classification Working Group, 2018);
- Identify restrictive soil properties on land capability under prevailing conditions;
- Identify and assess the potential impacts in relation to the proposed development;
- Compile soil, land use and land capability report under current on-site conditions based on the field finding data; and
- Compile an agricultural impact assessment and provide mitigation measures.

1.4 Assumptions and Limitations

For the purpose of this assessment, the following assumptions and limitations are applicable:

- The information gathered during the desktop assessment must be considered with caution, as inaccuracies and data capturing errors are often present within these databases;
- The soil survey conducted as part of the land capability assessment was confined to within the focus area boundaries associated with the footprint areas. However, consideration of the immediately adjacent areas was given;
- A detailed investigation of economic aspects pertaining to the current agricultural activities was not undertaken as part of the specialist study because no history of previous agricultural cultivation of crops exists within the focus area;
- The soil survey was a detailed ‘’free survey’’ which involved ground truthing and confirmation of pre-determined points of interests (using satellite imagery) as well as

pre-established physiographic factors such as slope, land types and geology type within an area. This type of assessment was deemed sufficient to give the agricultural sensitivity of the focus areas and guide the decision-making process by the competent authorities;

- Sampling by definition means that not all areas are assessed, and therefore some aspects of soil characteristics may have been overlooked on this assessment; and
- Chemical analysis was not conducted as part of this soil study because the chemistry of the soils is not seen as a limitation, since the soil fertility status can be corrected based on the crop type being cultivated.

1.5 Legislative Requirements

The proposed Makganyane Iron Ore Mine and its associated activities will trigger environmental authorisation requirements. These legislative requirements guide this assessment and are outlined in bullet points below, they include but not limited to:

- The Constitution of the Republic of South Africa;
- The National Water Act (Act 36 of 1998) as amended (NWA);
- National Environmental Management Act, (Act 107 of 1998) as amended (NEMA);
- National Environmental Management: Waste Act (Act 59 of 2008); and
- Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983) (CARA).

2. METHOD OF ASSESSMENT

2.1 Literature and Database Review

A background study, including a literature review was conducted prior to the commencement of the field investigation to collect the pre-determined soil, land use and land capability data in the vicinity of the investigated focus areas. Various data sources including but not limited to the Agricultural Geo-referenced Information System (AGIS) and Soil and Terrain (SOTER) as well as the Natural Agricultural Resources Atlas of South Africa (NAR Atlas Manual, 2018) database provided by the Department of Agriculture, Land Reform and Rural Development (DALRRD) and other sources as listed under references were utilised to fulfil the objectives for the assessment.

2.2 Soil Classification and Sampling

A soil survey was conducted in April 2025 at which time the identified soils within the focus areas were classified into different soil forms according to the Soil Classification System: A Natural and Anthropogenic System for South Africa Soil Classification System (2018). The soil survey was restricted to the focus areas and not necessarily the mining right area (MRA). Subsurface soil observations were made using a manual hand auger to assess individual soil profiles, which entailed evaluation of physical soil properties and prevailing limitations to various land uses.

2.3 Land Capability Classification

Agricultural potential is directly related to Land Capability, as measured on land capability classes of between I to VIII (Smith, 2006) and classification rating score ranging from 1 to 15 (DALRRD, 2018). Table 1 below presents Classes I to IV classified as arable agricultural land that is well suited for annual cultivated crops, whereas Class V - VII soils are grouped as soils suitable for livestock or wildlife (game farm) grazing. Land Capability Class VIII comprises of soils that are classified as unsuitable for agricultural cultivation and/or livestock grazing and are best suited for wildlife or wilderness.

Furthermore, the climate capability is also measured on a scale of C1 to C8 depending on the limitation rating (rainfall/moisture and temperature), as illustrated in Table 2 below. The land capability rating is therefore adjusted accordingly, depending on the prevailing climatic conditions as indicated by the respective climate capability rating. The anticipated impacts of the proposed land use on soil and land capability were then assessed to inform the necessary mitigation measures.

Table 1: South Africa's agricultural land capability (DALRRD, 2018).

DFFE (2017) Classification	(Smith 2006) Land Capability Class	Land Capability Groups	Limitations
15 - Very High	I	Arable land	No or few limitations
14 – Very High			
13 High – Very high	II		Slight limitations
12 High – Very high			
11 High			
10 Moderate - High	III		Moderate limitations
9 Moderate - High			
8 Moderate	IV		Severe limitations
7 Low - Moderate	V	Grazing land	Water course and land with wetness limitations.
6 Low - Moderate			
5 Low	VI		Limitations preclude cultivation. Suitable for perennial vegetation.
4 Low – Very Low	VII		Very severe limitations. Suitable only for natural vegetation.
3 Low – Very Low			
2. Very Low	VIII	Wildlife	Extremely severe limitations. Not suitable for grazing or afforestation.
1 Very Low			

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

Climate Capability Class	Limitation Rating	Description
C1	None to slight	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.

The land potential assessment entails the combination of climatic, slope and soil condition characteristics to determine the agricultural land potential of the investigated focus area. The classification of agricultural land potential and knowledge of the geographical distribution of agricultural viable land within an area of interest. This is of importance for making an informed decision about land use. Table 3 below presents the land potential classes, whilst Table 4 presents a description thereof, according to Guy and Smith (1998).

Table 3: Table of Land Potential Classes (Adapted from Guy and Smith, 1998).

Land Capability Class	Climate Capability Class							
	C1	C2	C3	C4	C5	C6	C7	C8
I	L1..	L1	L2	L2	L3	L3	L4	L4
II	L1	L2	L2	L3	L3	L4	L4	L5
III	L2	L2	L3	L3	L4	L4	L5	L6
IV	L2	L3	L3	L4	L4	L5	L5	L6
V	(L3) Wetland	(L3) Wetland	(L4) Wetland	(L4) Wetland	(L5) Wetland	(L5) Wetland	(L6) Wetland	(L6) Wetland
VI	L4	L4	L5	L5	L5	L6	L6	L7
VII	L5	L5	L6	L6	L7	L7	L7	L8
VIII	L6	L6	L7	L7	L8	L8	L8	L8

Table 4: The Land Capability Classes Description (Guy and Smith, 1998).

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, temperature, or rainfall. Appropriate permission is required before ploughing virgin land.
L5	**Restricted potential:** Regular and/or moderate to severe limitations due to soil, slope, temperature, or rainfall.
L6	**Very restricted potential:** Regular and/or severe limitations due to soil, slope, temperature, or rainfall. Non-arable.
L7	**Low potential:** Severe limitations due to soil, slope, temperature, or rainfall. Non-arable.
L8	**Very low potential:** Very severe limitations due to soil, slope, temperature, or rainfall. Non-arable.

2.4 Consideration of the DFFE Web-Based Environmental Screening Tool

The Agricultural Agro-Ecosystem Assessment protocol provides the criteria for the assessment and reporting of impacts on agricultural resources for activities requiring environmental authorization. The assessment requirements of this protocol are associated with a level of environmental sensitivity determined by the national web-based environmental screening tool for which agricultural resources are based on the most recent land capability evaluation values as provided by the Department of Fisheries, Forestry, and the Environment (DFFE). The national web-based environmental screening tool can be accessed at: https://screening.environment.gov.za/screeningtool

To meet this objective, site sensitivity verification must be conducted of which the results must meet the following objectives:

- It must confirm or dispute the current land use and the environmental sensitivity as indicated by the National Environmental Screening Tool;
- It must contain proof (e.g., photographs) of the current land use and environmental sensitivity pertaining to the focus area;

- All data and conclusions are submitted together with the main report for the proposed developments to guide the Environmental Management Programme (EMPr) by the competent authority;
- It must indicate whether the proposed mining operation will have an unacceptable impact on the agricultural production capability of the site, and in the event where it does, whether such a negative impact is outweighed by the positive impact on agricultural resources.

This report is thus compiled in a manner that meets the minimum report content requirements for impacts on agricultural resources by the proposed mine and related activities.

3. DESKTOP ASSESSMENT RESULTS

Prior to site assessment, background information and literature review relating to the MRA and focus area were sourced from various databases such as the Agricultural Geo-referenced Information System (AGIS) and Soil and Terrain (SOTER) as well as the Natural Agricultural Resources Atlas of South Africa (NAR Atlas Manual, 2018) database provided by the Department of Agriculture, Forestry & Fisheries. It should be noted that the desktop results are *not field verified results* and, thus, inaccuracies may exist in the data presented. The data however gives useful information of the soils within the focus area investigated.

Table 5 below presents the summary of the desktop exercise.

Table 5: Desktop based soil background information sourced from various databases.

Parameters	Description
Mean Annual precipitation (MAP) (DALRRD, 2018)	Most of the MRA is dominated by approximately 300 mm of rainfall per annum while a small north-eastern portion is characterised by 300 – 400 mm of rainfall. This rainfall is deemed inadequate for a variety of cultivated crops and adjusting planting and/or an irrigation scheme may be necessary for successful cultivation of crops. Refer to Figure 7.
Mean Annual Evaporation (MAE) (DALRRD, 2018)	The entire MRA is characterised by >2400 mm evaporative demand per annum. Moisture deficit and crop wilting may be a problem for non-irrigated crops.
Geology (DALRRD, 2018)	The entire MRA is dominated by the Transvaal, Rooiberg & and the Griqualand-west formations which gives rise to sandy and structureless soils (Figure 8).
Terrain type (DALRRD, 2018)	Level plains with some relief and open hills or ridges dominate most of the MRA while some portions are characterised by rolling or regular plains with some relief terrain type. This means the terrain is somewhat unsuitable for agricultural cultivation. Refer to Figure 9.
Soil and Terrain (SOTER, 2013) soil classification	The Soil and Terrain (SOTER) database indicates that most of the footprint area is dominated by Ferralic Arenosols (ARo) while small southwestern portions are characterised by Chromic Cambisols (CMx) and Calcic Solonchaks (SCk). Ferralic Arenosols consists of sandy soils developed in residual sands, in situ after weathering of old, usually quartzite-rich soil material or rocks and these soils are common in arid, extremely cold to extremely hot regions. Chromic Cambisols comprises soils of medium and fine-textured usually derived from a wide range of rocks. Refer to Figure 10.
Land Type Data (DALRRD, 2018)	The dominant land type for most of the MRA is the Ae12 and Ib238 while other small portions comprise of Ag110 and Ae7 land types. The Ae12 land types are characterised red and yellow, freely drained soils that occupy approximately 40% of the landscape while shallow and rocky soils occupy significant proportions of the landscape. The Ag110 land type is dominated by shallow soils (less than 300 mm thick), freely-drained apedal soils of the Hutton soil form while Ib238 land type groupings are areas where 60 – 80% of the surface is occupied by exposed rock and stones/boulders and the slopes are usually steep (Figure 11).
Desktop land capability (DALRRD, 2018)	According to DALRRD (2018), land with a capability to be used for sustained long-term agricultural production is a very limited resource in South Africa. In this case, the proposed development is dominated by land capability ranging from low to moderate with a capability rating score of 5 (low) and 6 (low – moderate). This means the perceived potential impacts on the soil and land capability will not be severe and likely to be within acceptable limits, especially with mitigating measures sufficiently and adequately implemented. Refer to Figures 12 and 13.
Desktop Grazing Capacity (DALRRD, 2018)	According to the Natural Agricultural Resources Manual (NAR Atlas Manual, 2018), the livestock grazing capacity potential is estimated to be approximately 14 hectares per livestock unit (ha/LSU) for the entire MRA. This grazing capacity

	potential associated with the MRA is deemed marginal to support small scale and/or commercialised livestock farming. Refer to Figure 14.
Probability of soil loss (DALRRD, 2018)	The MRA is dominated by very low probability of soil loss. These could potentially be attributed to the absence of sodium which disperse soil particles resulting in increased susceptibility of soils to erosion risk.

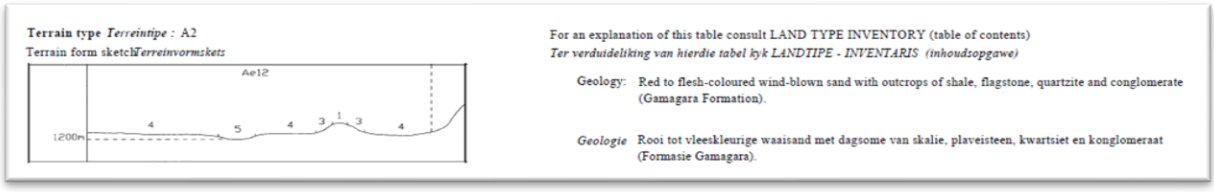


Figure 4: Terrain unit associated with the Ae12 land type class identified within the focus area.

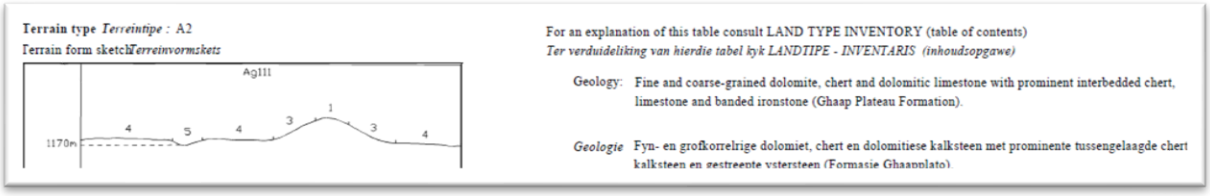


Figure 5: Terrain unit associated with the Ag110 land type class identified within the focus area.

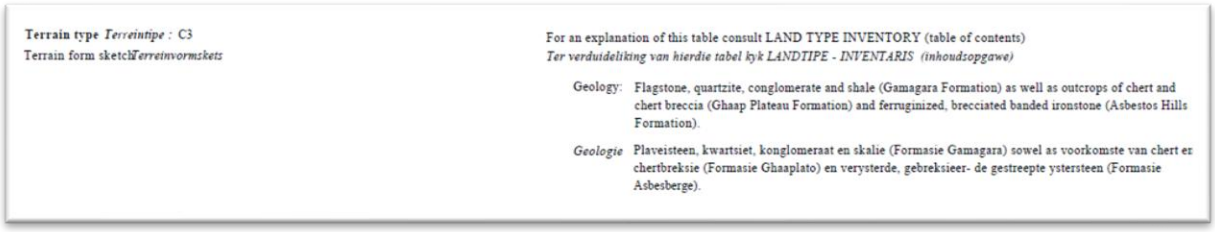


Figure 6: Terrain unit associated with the Ib238 land type class identified within the focus area.

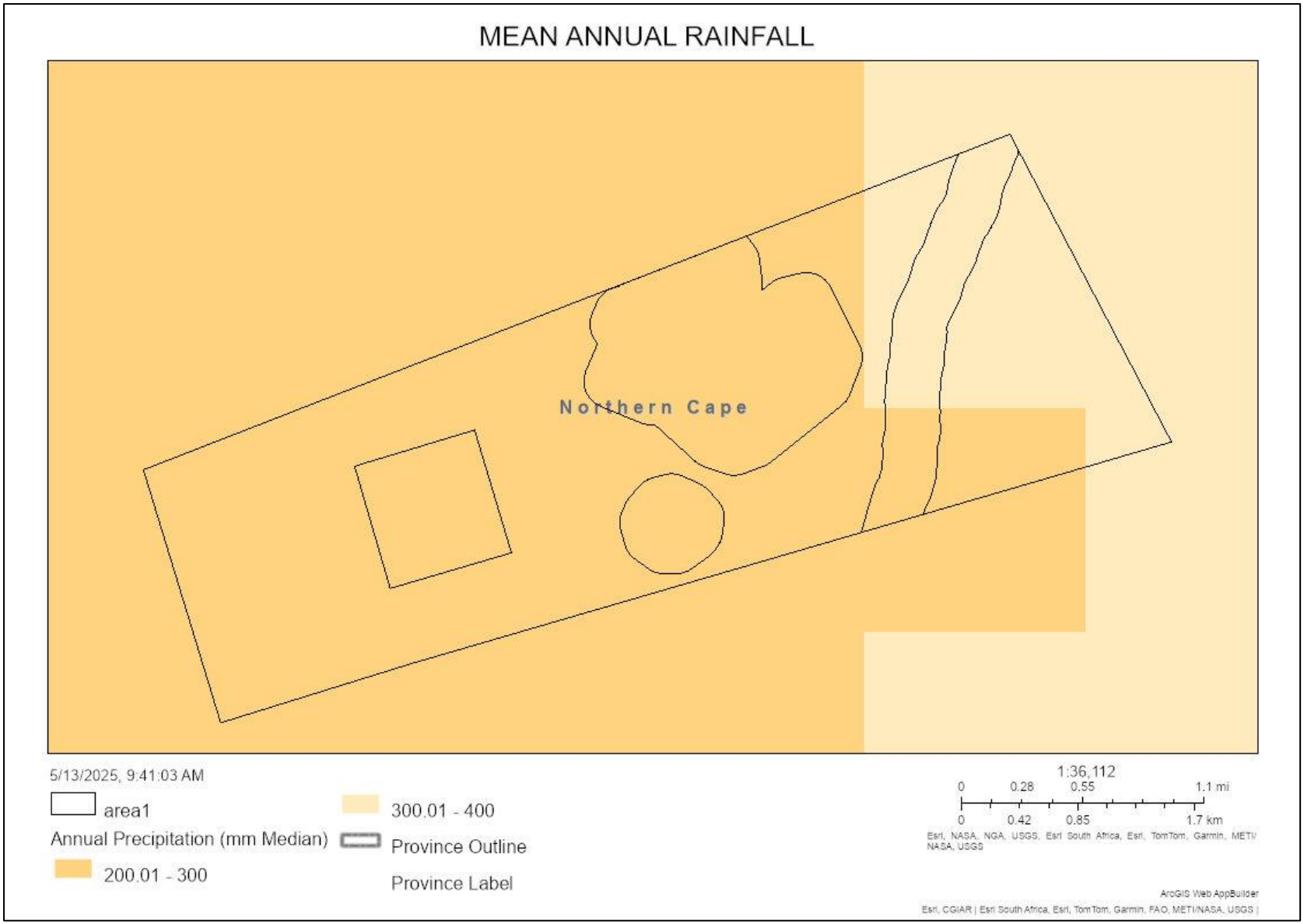


Figure 7: Annual rainfall (mm) associated with the focus area and immediate surroundings.

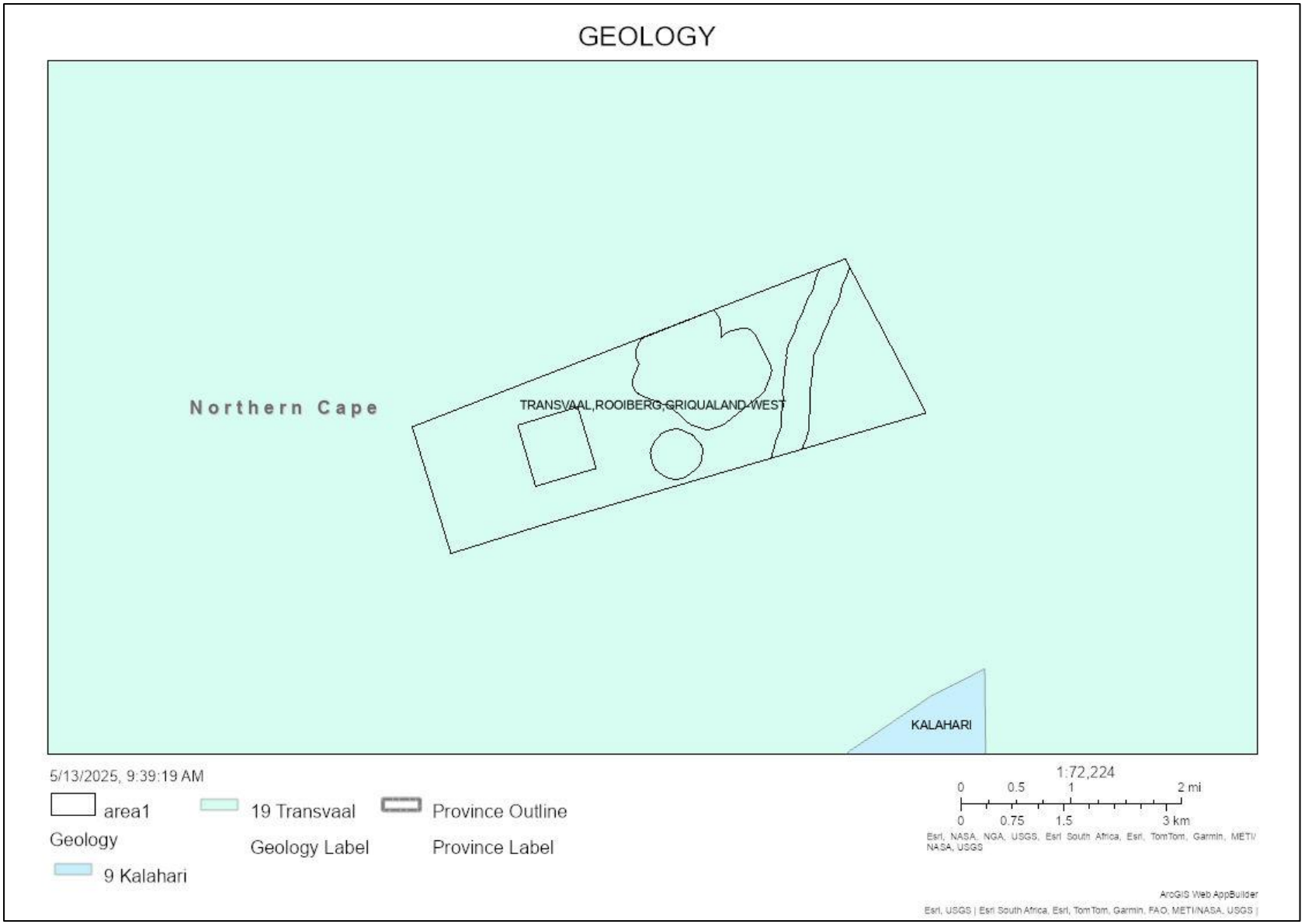


Figure 8: Geological formations associated with the focus area and immediate surroundings.

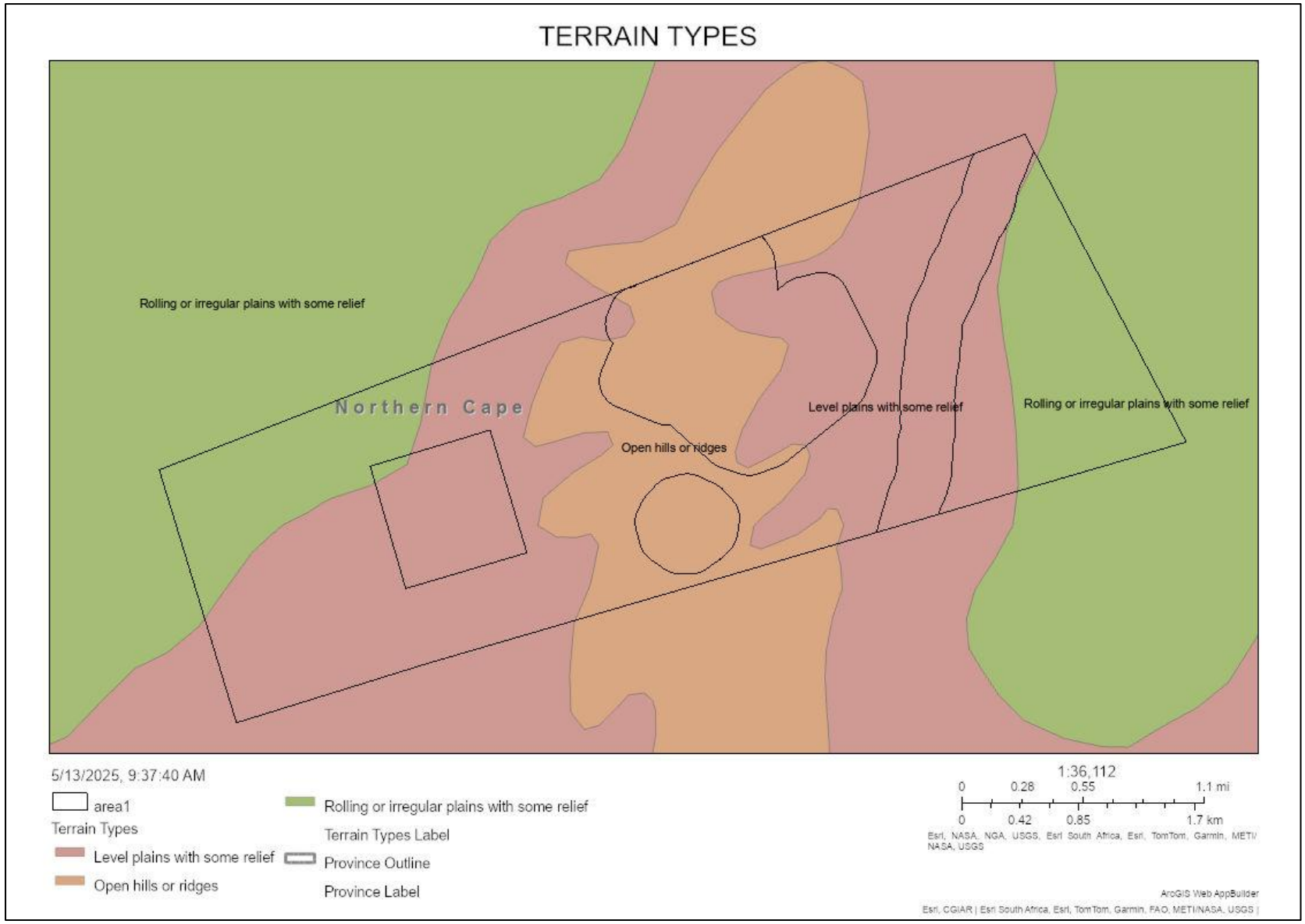


Figure 9: Terrain types associated with the focus area and immediate surroundings.

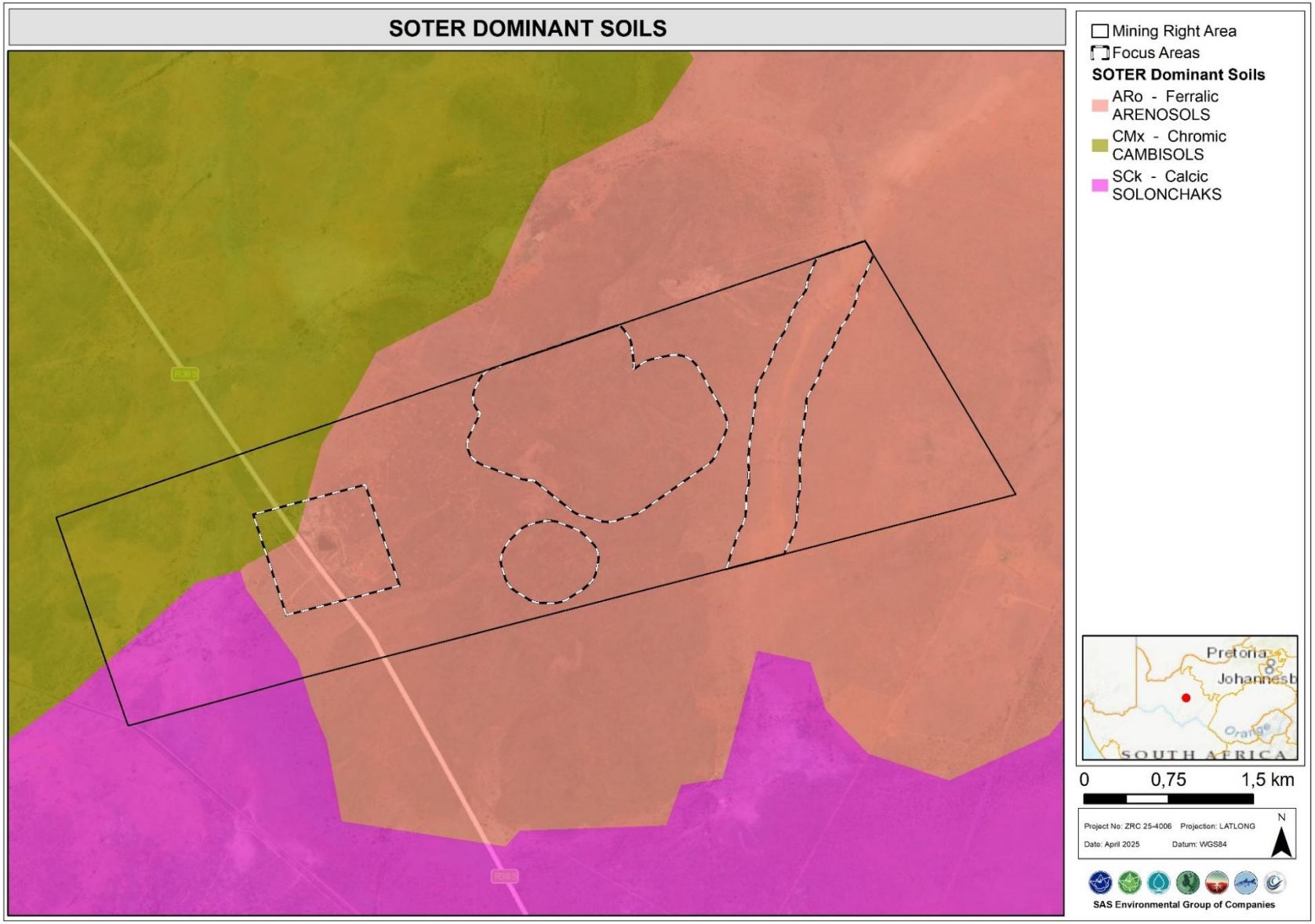


Figure 10: Soil and Terrain (SOTER, 2013) associated with the focus area and immediate surroundings.

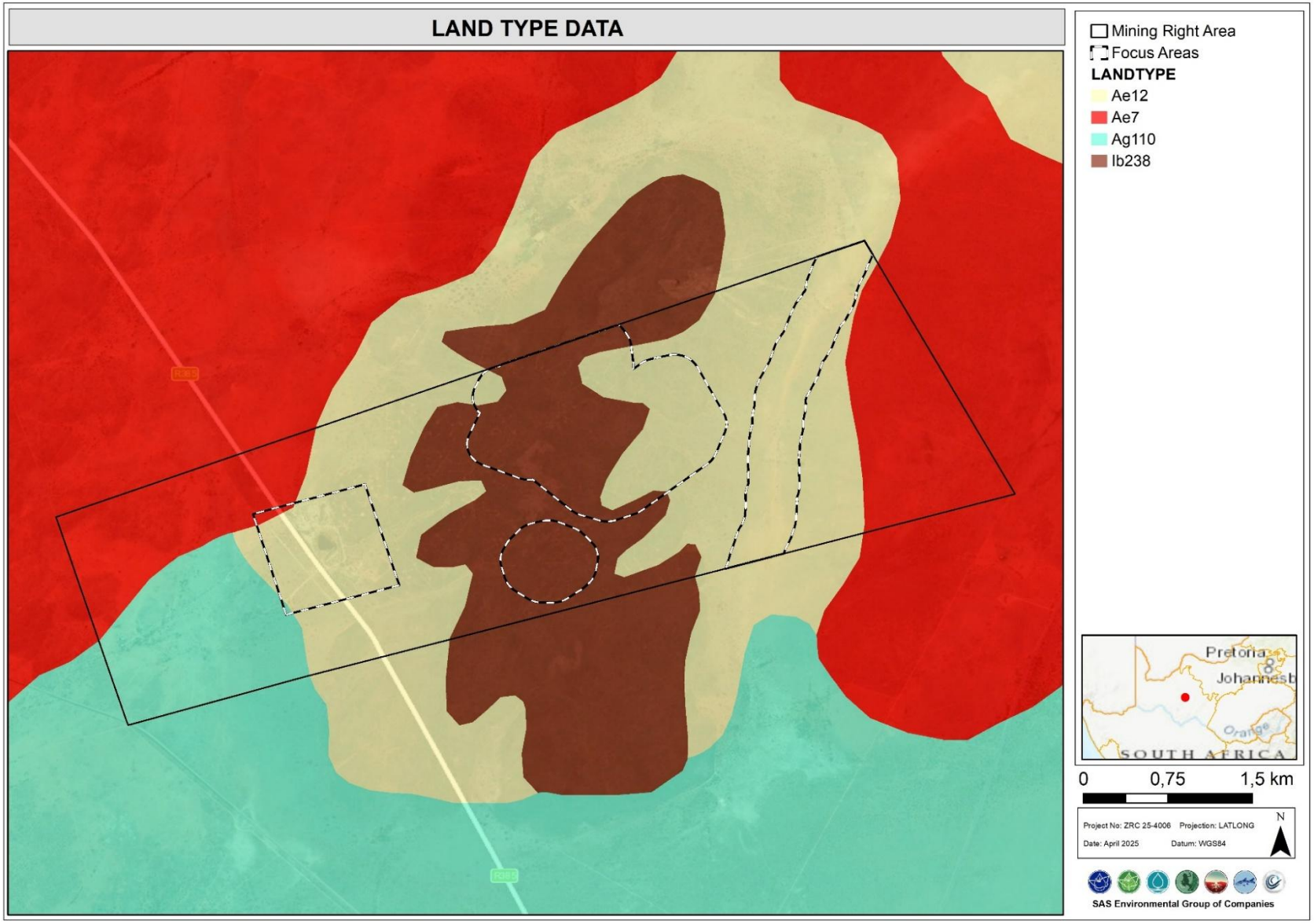


Figure 11: Land types associated with the focus area and immediate surroundings.

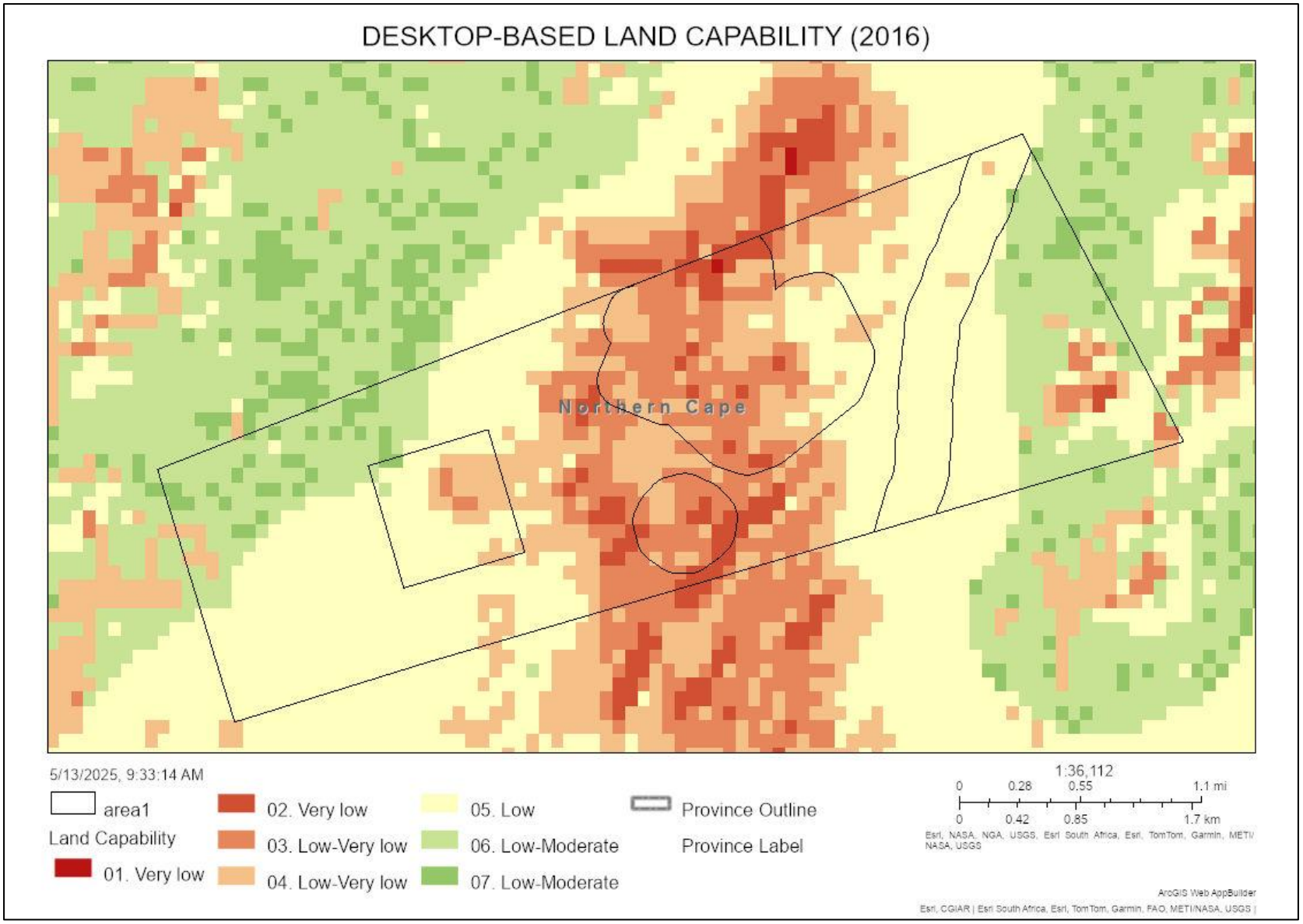


Figure 12: Desk-based land capability associated with the focus area and immediate surroundings.

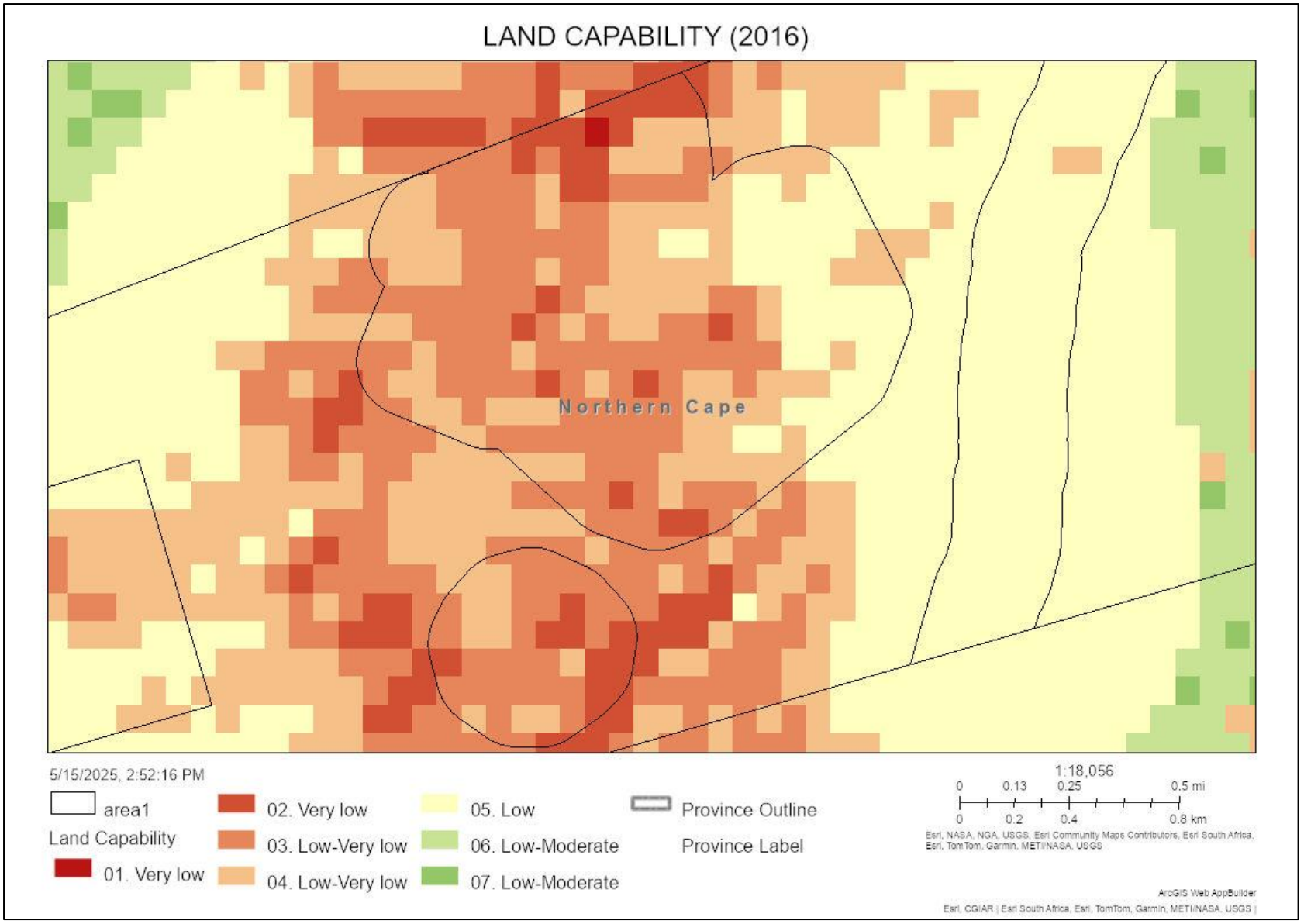


Figure 13: Zoomed-in map depicting lower land capability class (very low) associated with the open pit 1, stockpile, & waste dump.

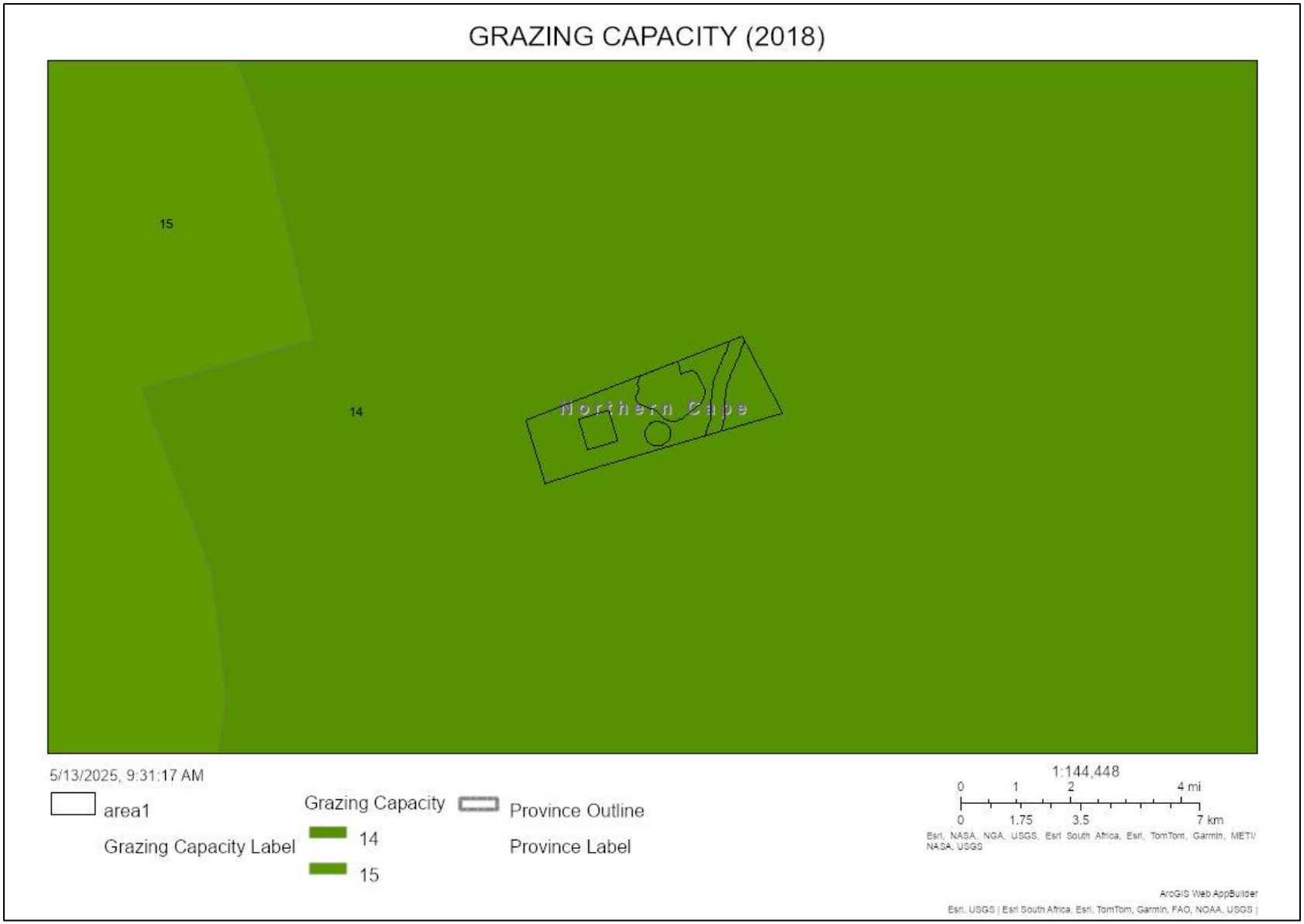


Figure 14: Grazing capacity (ha/LSU) associated with the focus area and immediate surroundings.

4. FIELD ASSESSMENT RESULTS

The results presented in this section are field-verified and specifically pertain to the focus areas where the proposed development is planned. They do not include results for the entire MRA. The MRA-wide data was only assessed at a desk-based level to provide a general overview of expected conditions.

4.1 Current Land Use

According to observations made during the site assessment, the footprint area is dominated by bushveld with shrubby and thorny vegetation, wilderness/wildlife, open grassland that is currently utilised for livestock grazing (cattle). No active small scale and/or commercial agricultural cultivation activities were observed within the immediate surroundings (5 km radius) of the focus area.

Figure 15 below depicts the dominant land uses as identified within the focus area and immediate surroundings.

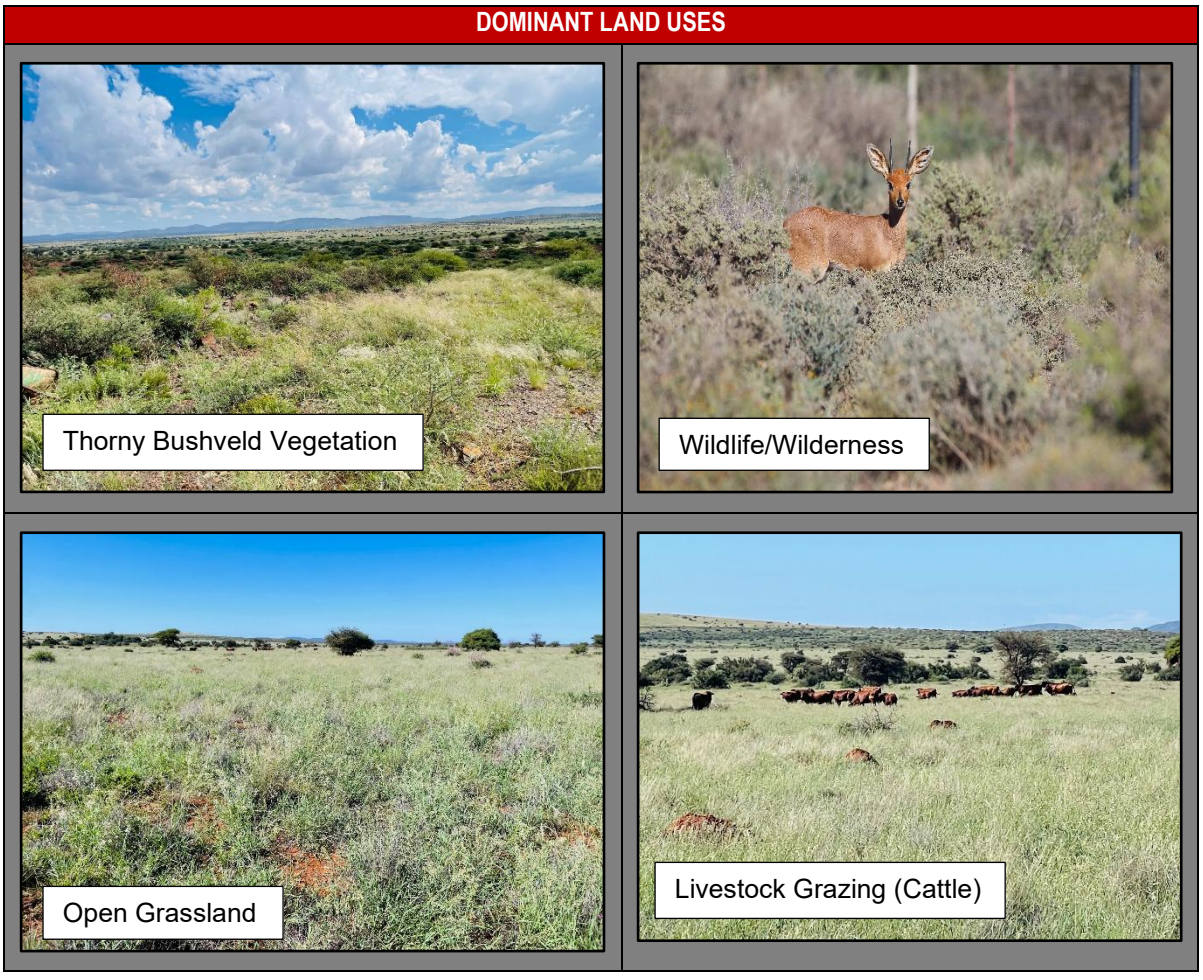


Figure 15: Current land uses within the focus area and immediate surroundings.

4.2 Dominant Soil Forms

The identified soil forms occurring within the focus area include Mispah/Glenrosa, Mispah (outcrops), Glenrosa, Clovelly, Witbank (Infrastructure), and Cullinan (Excavation with Water). Of these identified soils, the Mispah/Glenrosa and Mispah soil forms were the most dominant within the focus area, occupying 69.62% and 18.24% of the total enclosed area respectively.

The Mispah/Glenrosa and Mispah soil formations are typically shallow in nature and in some instances no bedrock outcrops on surface. These soils are characterised by spatial heterogeneity associated with weathering of the rock material, illuviation, and biotic disturbance (plants and animals) especially along the joints or bedding planes which results in the mixing of soil and rock material in some instances. These types of soils are usually avoided for any agricultural cultivation activities and thus left for grazing and wildlife land uses in this arid region since they do not present adequate soil depth for most cultivated crops.

The Witbank (Transported Technosols) soil forms are soils which have been subjected to physical disturbance due to infrastructural developments. In this context, Witbank soils include areas with transported soil material which has been significantly transformed and heavily modified such that the diagnostic horizons could not be identified. As a result, these soils are not ideal for agricultural cultivation.

The soils of Hutton formations are characterised by development in well-drained oxidising environmental conditions (warm and moist) which allow for iron oxide coating on soil particles thus resulting in the dominating red colours of the soils. In some instances, the red colour can be because of the iron-rich parent material (hematite). These soils have a good depth (approximately 120 cm), which is considered sufficient to allow plants' roots to extract moisture and nutrients to sustain growth and development. In the absence of climatic constraints, the soils are suitable for arable cultivation.

Table 6 below presents the identified soil forms within the focus area, their respective diagnostic horizon and soil depth (cm).

Table 6: Identified soil forms associated with the focus area.

Soil Forms	Soil Depth (cm)	Diagnostic Horizons	Area Extent (ha
Hutton	120	Orthic A/ Yellow Brown Apedal/ Lithic	5.50
Cullinan	n/a	(Excavation with Water)	1.24
Glenrosa	<30	Orthic A/ Lithic	37.04
Mispah/Glenrosa	<15	Orthic A/ Lithic and/or Hard Rock	253.46
Mispah	0	Orthic A/ Hard Rock	66.39
Witbank	n/a	Transported Technosols	0.41
Total Enclosed Area			**364.04**

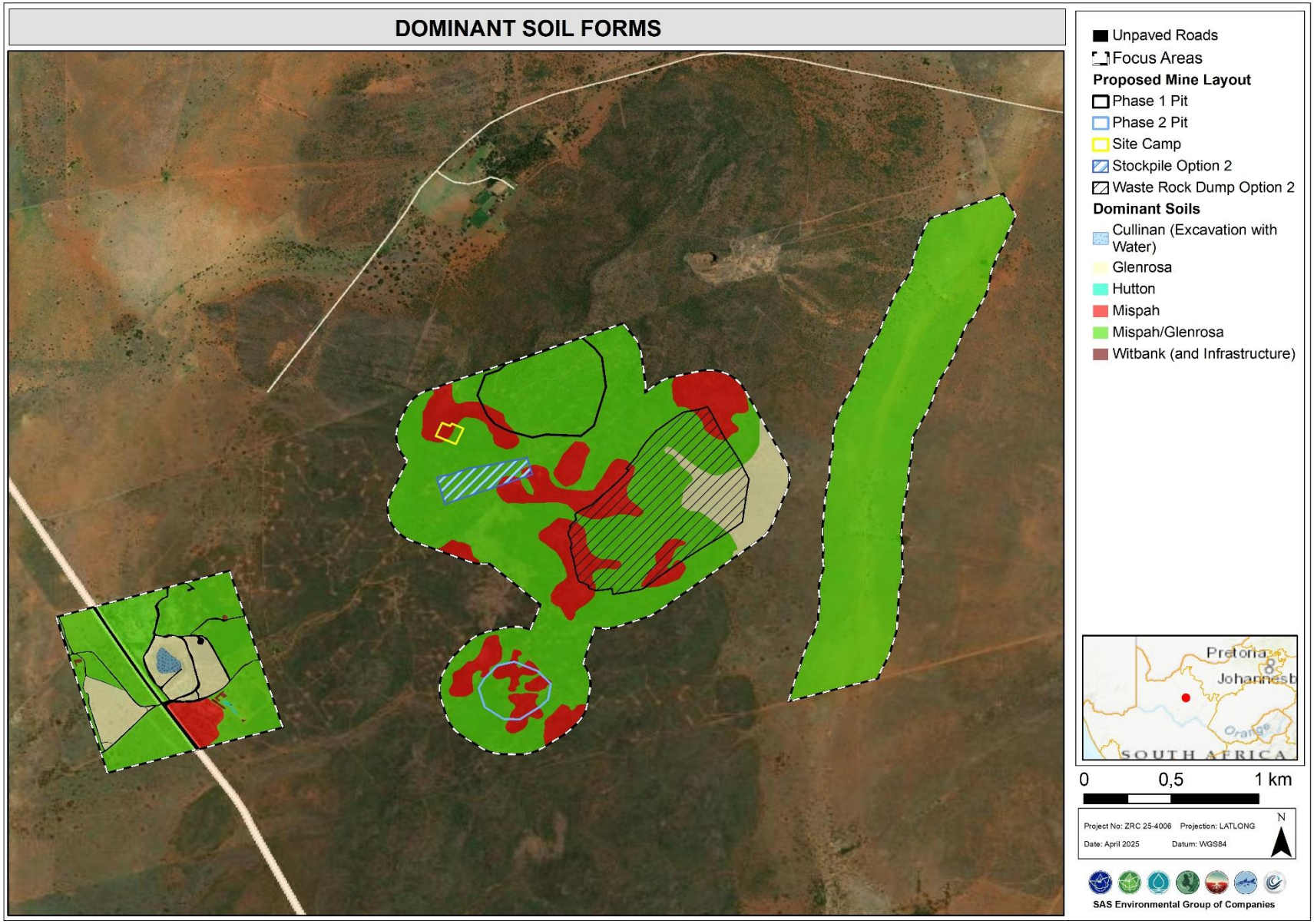


Figure 16: Dominant soil forms associated with the focus area.

4.3 Land Capability Classification

The focus area falls under Climate Capability Class 5 which is characterised by moderate to severe limitation rating. This is due to moderately restricted growing season due to low temperatures, frost and/or moisture stress. Suitable crops may be grown at risk of some yield loss under this climatic capability class (C5).

The identified land capability limitations for the identified soils are discussed in comprehensive "dashboard style" summary tables presented from Tables **8, 9, 10, and 11** below. The dashboard report's aim is to present all the pertinent information in a concise and visually appealing fashion.

Table 7: Land capability and land potential associated with the soils occurring within the focus area.

Soil Forms	Soil Depth (cm)	DALRRD (2018) Classification	Field Verified Agricultural Sensitivity	Land Potential	Area Extent (ha)	Percentage (%)
Hutton	120	14. Very High	Medium	Good – L3	5.50	1.51
Glenrosa	<30	6. Low - Moderate		Restricted – L5	37.04	10.17
Mispah/ Glenrosa	<15	4. Low - Very Low	Low	Very Restricted – L6	253.46	69.62
Mispah	0	2. Very Low		Very Low – L8	66.39	18.24
Cullinan	n/a				1.24	0.34
Witbank	n/a				0.41	0.11
Total Enclosed Area					**364.04**	**100**

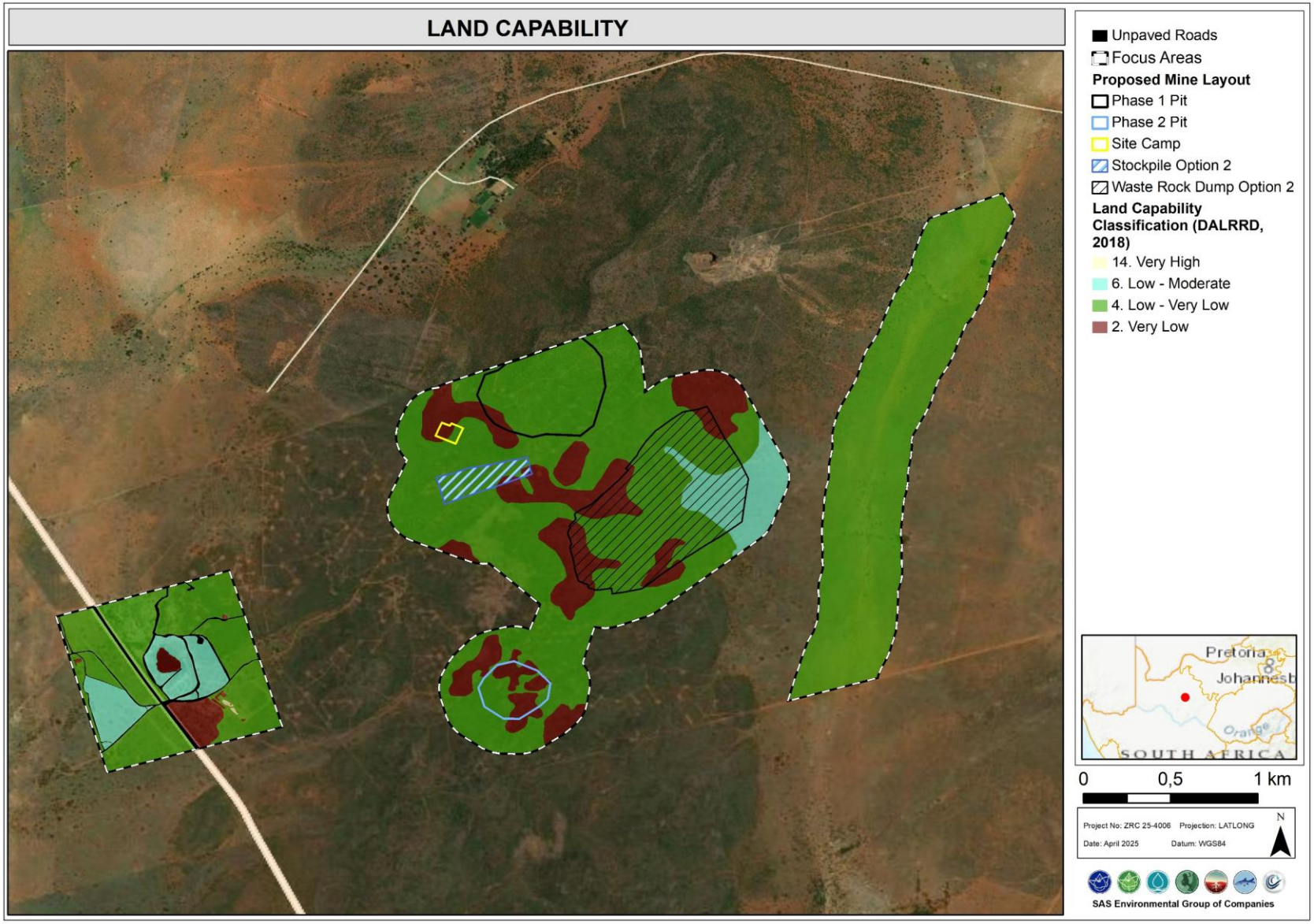


Figure 17: Land capability of the soil forms associated with the focus area.

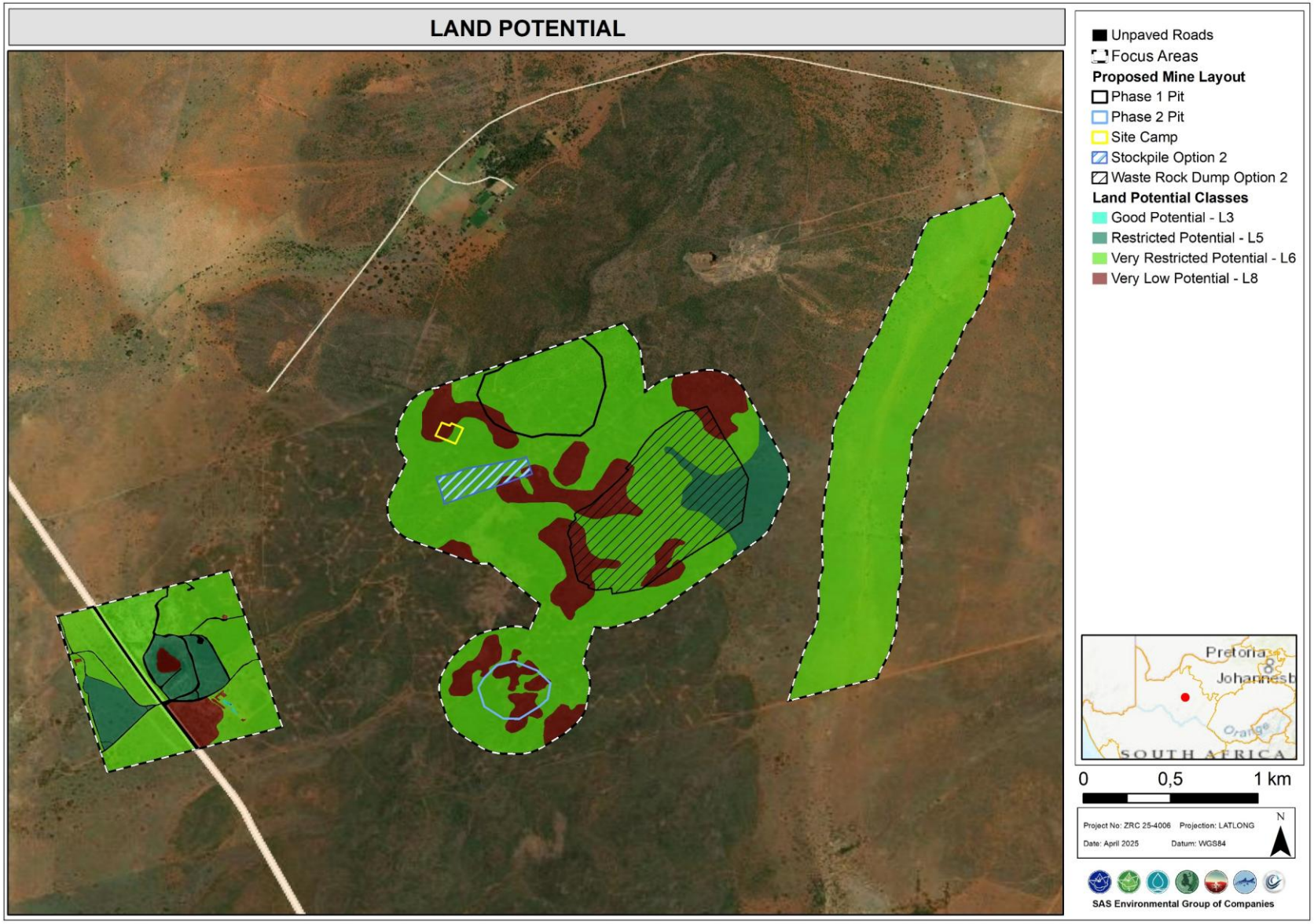


Figure 18: Land potential of the soil forms associated with the focus area.

Table 8: Summary discussion of the [14. Very High: (Arable - Class II)] land capability class associated with the Hutton soil form.

<table>
<tr><th colspan="4">Land Capability: 14. Very High: (Arable - Class II)</th></tr>
<tr><td colspan="4">View of the identified Hutton soil form within the focus area.
  </td></tr>
<tr><td>Terrain Morphological Unit (TMU)</td><td colspan="2">Flat terrain with less than 0.5% slope</td><td>Photograph notes
View of the identified red apedal horizons associated with the Hutton soil forms.</td></tr>
<tr><td>Soil Form(s)</td><td colspan="2">Hutton</td><td>Area Extent (ha)
5.50 (1.51%)</td></tr>
<tr><td>Diagnostic Horizon Sequence</td><td colspan="2">Orthic A/ Red Apedal B</td><td rowspan="3">Land Capability
Land capability (Class II) is suitable for arable agricultural land use with restrictions. The identified soil forms are of good potential (L3) particularly when they occur under Climate Capability Class (C5) which is characterised by a moderate to severely restricted growing season due to low temperatures, frost and/or moisture stress. Therefore, these soils are considered to make a considerable contribution to agricultural productivity on a regional and national scale.</td></tr>
<tr><td>Land Potential</td><td colspan="2">Good Potential – L3: Infrequent and/or moderate limitations due to soil, slope, temperatures, or rainfall. Appropriate contour protection must be implemented and inspected.</td></tr>
<tr><td>Physical Limitations</td><td colspan="2">None. These soils have a good depth (approximately >120 cm) which is considered sufficient to allow plants' roots to extract moisture to sustain growth and development.</td></tr>
<tr><td>Overall impact significance prior to mitigation</td><td>M</td><td rowspan="2">The overall impact on land capability is anticipated to be Medium (M) without mitigation. Although this soil have inherently good land capability, no placement of mining infrastructure will occur on this soil according to the layout provided by the proponent. Therefore, if better managed, anticipated impacts can be further reduced to a low level (L) with effective application of soil conservation mitigation measures.</td><td rowspan="2">Consideration of Integrated Environmental Management and Sustainable Development principles:
Although the areal extent of this soil is limited, the identified soils are considered good agricultural soils and suitable for arable crops. These soils can yield profit returns under prudent crop selection and conservation soil management practices. However, the prevailing local climatic conditions (low rainfall and high evaporation) severely restricts the choice of crop cultivation under rainfed agriculture. Therefore, lack of irrigation options disqualifies this area for commercial cultivated agriculture although ideal soils occur. Thus, the soils are restricted to grazing land use.</td></tr>
<tr><td>Overall impact significance post mitigation</td><td>L</td></tr>
</table>

Table 9: Summary discussion of the [6. Low – Moderate: (Grazing Land - Class VI)] land capability class associated with the Glenrosa soil form.

<table>
<tr><th colspan="5">Land Capability: [6. Low – Moderate: (Grazing Land - Class VI)]</th></tr>
<tr><td colspan="5">Occurrence of Glenrosa as identified within the focus area.
  </td></tr>
<tr><td>Terrain Morphological Unit (TMU)</td><td colspan="2">Gently sloping landscape, >1.5% slope</td><td>Photograph notes</td><td>View of the morphology of the identified Glenrosa soil form.</td></tr>
<tr><td>Soil Form(s)</td><td colspan="2">Glenrosa</td><td>Area Extent (ha)</td><td>37.04 ha (10.17%)</td></tr>
<tr><td>Diagnostic Horizon Sequence</td><td colspan="2">Orthic A /Lithic</td><td colspan="2" rowspan="3">Land Capability
The identified Glenrosa soil form is of poor (Class VI) land capability and is not suitable for arable agricultural use. Theses soils is, at best, suitable for natural pastures and for light grazing. Therefore, these soils are not considered to make a substantial contribution to extensive subsistence farming on a local scale.</td></tr>
<tr><td>Land Potential</td><td colspan="2">Restricted Potential – L5: Regular and/or moderate to severe limitations due to soil, slope, temperature, or rainfall.</td></tr>
<tr><td>Physical Limitations</td><td colspan="2">Primarily effective rooting depth due to the occurrence of lithic material at a relatively shallow depth (<30 cm).</td></tr>
<tr><td>Overall impact significance prior to mitigation</td><td>M</td><td rowspan="2">The overall impact on land capability is anticipated to be medium (M) without mitigation due to the inherently marginal land capability of the identified soil forms. If better managed, these anticipated impacts can be reduced to low level (L).</td><td colspan="2" rowspan="2">Consideration of Integrated Environmental Management and Sustainable Development principles:
These soils are generally not considered to be of significant agricultural productivity as a result of their shallow nature which effectively reduce the rooting depth. Therefore, these soils are at best suited for light grazing with intensive management practices. The proposed development is viable on these soils due to their low agricultural potential. However, mitigatory measures should still be put in place to minimise disruption of other adjacent soils which can potentially be used for grazing.</td></tr>
<tr><td>Overall impact significance post mitigation</td><td>L</td></tr>
</table>

Table 10: Summary discussion of the [5. Low: (Grazing Land - Class VII)] land capability class associated with the Mispah/Glenrosa soil form.

<table>
<tr><th colspan="5">Land Capability: 5. Low: (Grazing Land - Class VII)]</th></tr>
<tr><td colspan="5">Occurrence of Glenrosa and Mispah/Glenrosa as identified within the focus area.
  </td></tr>
<tr><td>Terrain Morphological Unit (TMU)</td><td colspan="2">Sharply steep landscape, >1.5% slope</td><td>Photograph notes</td><td>View of the morphology of the identified Mispah/Glenrosa soil forms.</td></tr>
<tr><td>Soil Form(s)</td><td colspan="2">Mispah/Glenrosa</td><td>Area Extent (ha)</td><td>253.46 ha (69.62%)</td></tr>
<tr><td>Diagnostic Horizon Sequence</td><td colspan="2">Orthic A /Lithic or Hard Rock</td><td colspan="2" rowspan="3">Land Capability
The identified Mispah/Glenrosa soil forms are of poor (Class VII) land capability and are not suitable for arable agricultural use. Theses soils are, at best, suitable for natural pastures and for light grazing. Therefore, these soils are not considered to make a substantial contribution to extensive subsistence farming on a local scale.</td></tr>
<tr><td>Land Potential</td><td colspan="2">Very Restricted Potential – L6: Regular and/or severe limitations due to soil, slope, temperature, or rainfall. Non-arable.</td></tr>
<tr><td>Physical Limitations</td><td colspan="2">Primarily effective rooting depth and/or the absence of growth medium (soil) due to the occurrence of lithic and hard rock material just below the topsoil horizon.</td></tr>
<tr><td>Overall impact significance prior and post mitigation</td><td>L</td><td>The overall impact on land capability is anticipated to be low (L) without mitigation due to the inherently poor land capability of the identified soil forms. If better managed, these anticipated impacts can further be reduced to very low level (VL).</td><td colspan="2">Consideration of Integrated Environmental Management and Sustainable Development principles:
These soils are generally not considered to be of significant agricultural productivity as a result of their poor effective rooting depth and in some instances, the total absence of growth medium (soil). Therefore, these soils are at best suited for light grazing with intensive management practices. The proposed mining project is viable on these soils due to their low agricultural potential.</td></tr>
</table>

Table 11: Summary discussion of the [2. Very Low: (Wilderness - Class VIII)] land capability class associated with the Mispah, Cullinan, and Witbank soil formations.

<table>
<tr><th colspan="5">Land Capability: 2. Very Low: (Wilderness - Class VIII)]</th></tr>
<tr><td colspan="5">   </td></tr>
<tr><td>Terrain Morphological Unit (TMU)</td><td colspan="2">Mispah - Sharply steep landscape, >1.5% slope
Witbank/Cullinan - Not applicable; highly disturbed areas</td><td>Photograph notes</td><td>View of the morphology of the anthropogenically excavated soils, exposed hard rock (outcrops) and the disturbed soils.</td></tr>
<tr><td>Soil Form(s)</td><td colspan="2">Mispah - Orthic A/Hard Rock
Witbank - (Transported Technosols)
Cullinan - (Excavation with Water)</td><td>Area Extent</td><td>68.04 ha (18.69%)</td></tr>
<tr><td>Physical Limitations</td><td colspan="2">Comprises of significantly disturbed areas due to anthropogenic activities (i.e. infrastructural developments, and historic mining and related activities) to an extent that no recognisable diagnostic soil horizon properties could be identified. These soils are characterised by various limitations, primarily the absence of soil horizon as a growth medium.</td><td colspan="2" rowspan="2">Land Capability

These identified soils have very poor (Class VIII) land capability due to the significant disturbance that has occurred because of infrastructural developments and historic mining and related activities. This has led to the long-term alteration of the soil physical properties such that these soils are no longer viable for agriculture while the Mispah is characterised by outcrops which cannot be cultivated for agricultural activities. This land capability class also includes areas where the original soil has been excavated and/or extensively modified by anthropogenic activities. These soils are not considered to make any contribution towards agricultural productivity even on a local scale.</td></tr>
<tr><td>Land Potential</td><td colspan="2">Very Low Potential (L8): Very severe limitations due to soil, slope, temperature, or rainfall. Non-arable.</td></tr>
<tr><td>Overall impact significance prior and post mitigation</td><td>L</td><td>The overall impact of the proposed development on the land capability of these soils is anticipated to be low (L) due to their already existing poor land capability because of historic mining and related activities as well as characterization of rocky outcrops.</td><td colspan="2">Consideration of Integrated Environmental Management and Sustainable Development Principles:

The current state of these soils requires significant rehabilitation already. The proposed development is not anticipated to cause any loss of agricultural resources since these soils have been disturbed and therefore are not ideal for cultivation.</td></tr>
</table>

5. AGRICULTURAL SENSITIVITY

5.1 Field Verified Agricultural Sensitivity

The field assessment and verification indicate that while the DFFE national web-based screening tool initially flagged the focus area as having medium sensitivity to impact, the field verified agricultural sensitivity revealed a low agricultural sensitivity due to factors such as poor soil quality (lack of soil medium and effective rooting depth) and climatic constraints that limit restricts the potential for commercial agricultural production. Therefore, the screening tool is disputed and thus, the proposed mine development can be supported.

Upon verification, the agricultural sensitivity classes with varying degrees of impact depending on the type of land use or soil classification were determined as follows:

- Arable soil [14. Very High (Class II)] – Rated as medium sensitivity due to climatic constraints although the soil inherently has a good potential for crop growth.
- Grazing land [6. Low - Moderate (Class VI)] – Rated as Medium Low sensitivity due to the soil's prevailing physical limitations.
- Grazing land [5. Low (Class VII)] – Rated as Low sensitivity due to the dominance of rocky outcrops (exposed hard rock).
- Disturbed footprint areas [2. Very Low (Class VIII)] – Rated as Very Low sensitivity due to significant alterations (infrastructure and mining related activities) to the land which makes it less suitable for agricultural activities.

Table 12 below summarizes the identified soils, and their respective fields verified agricultural sensitivity while Figure 20 depicts field verified agricultural sensitivity associated with the proposed development.

Table 12: Identified soils within the focus area and their respective field verified agricultural sensitivity.

Soil Forms	DALRRD (2018) Land Capability Classification	Field Verified Agricultural Sensitivity	Area Extent (ha)	Percentage (%)
Hutton	14. Very High	Medium	5.50	1.51
Glenrosa	6. Low - Moderate		37.04	10.17
Mispah/Glenrosa	4. Low – Very Low	Low	321.50	88.31
Mispah	2. Very Low			
Cullinan				
Witbank				
Total Enclosed Area			**364.04**	**100**

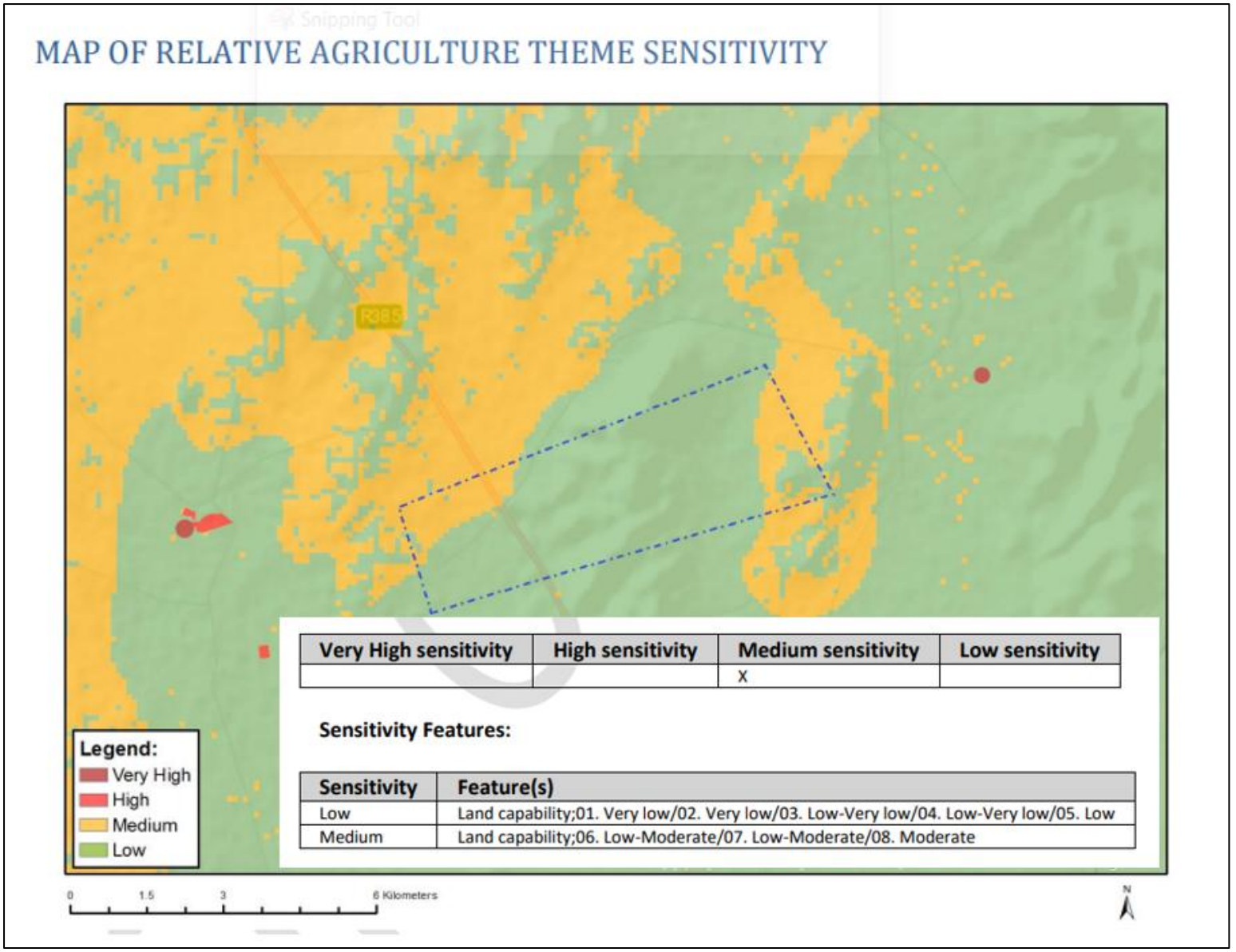


Figure 19: Screening tool results as associated with the focus area.

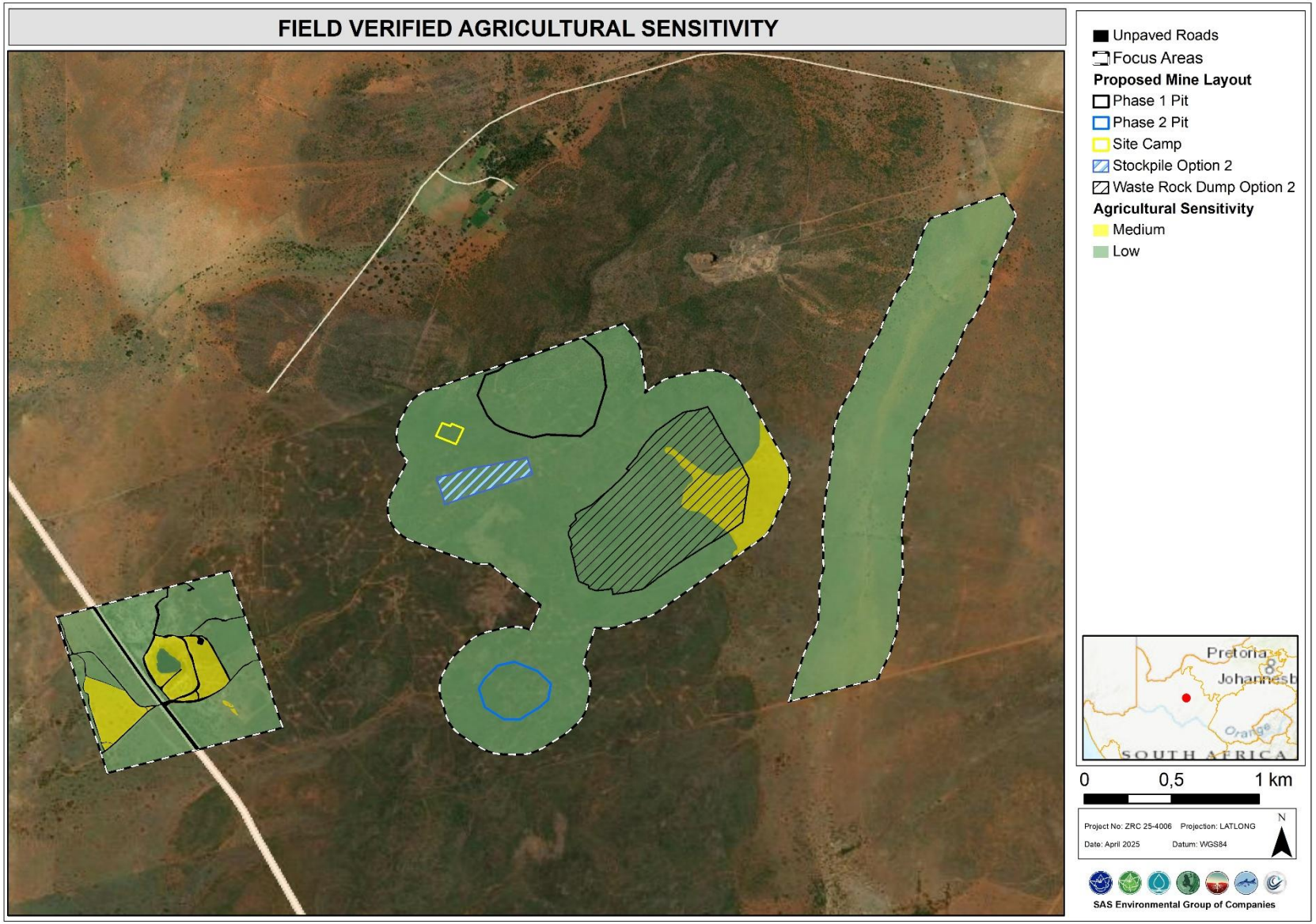


Figure 20: Field verified agricultural sensitivity associated with the focus area.

5.2 Northern Cape Protected Agricultural Areas (PAAs)

The Protected Agricultural Areas (PAA) have been mapped out according to their agricultural potential within the Northern Cape province (Department of Agriculture, Land Reform and Rural Development, 2022). These protected agricultural areas are classified into two categories, the irrigated (IR) areas and the rainfed (RF) production systems.

It is of importance to identify and demarcate agricultural land, based on its inherent capability and suitability (agricultural potential), for it to be preserved for exclusive agricultural use. Preservation and Development of Agricultural Land Bill (PDALB) defined the "*Protected Agricultural Areas*" as a:

"Cartographic delineated area of agricultural land –

- preserved for purposes of ensuring high value agricultural land is protected against non- agricultural land uses to promote long-term agricultural production and food security;
- includes all areas demarcated as such."

According to the Department of Agriculture, Land Reform and Rural Development DALRRD, 2022) database, the proposed Makganyane Iron Ore Mine is not located within any of the protected agricultural areas (PAAs). Therefore, the proposed development is not likely to have an impact on the protected agricultural areas as well as the regional, provincial, and national food production.

Figure 21 below presents these major classes to give an indication of the available PAAs on a high level for planning purposes. This is in line with the Conservation of Agricultural Resources Act (CARA) 1983 (Act No. 43 of 1983) which advocates for the protection of scarce agricultural resources of the Republic of South Africa.

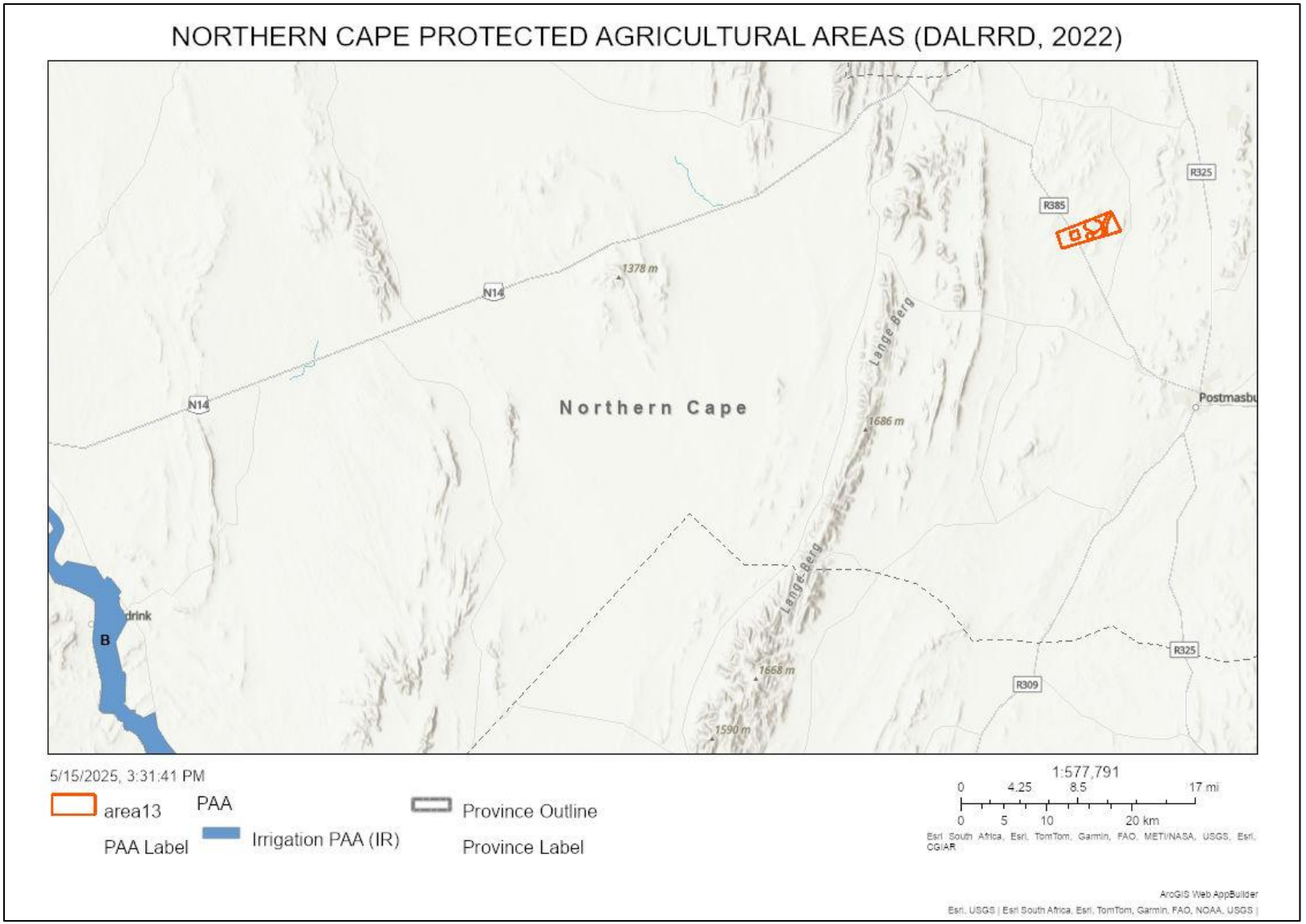


Figure 21: Protected Agricultural Areas (PAAs) associated with the proposed development.

6. IMPACT ASSESSMENT AND MITIGATION MEASURES

This section presents the significance of potential impacts on the identified soil resources associated with the proposed mine. In addition, it also provides the required mitigatory measures to minimise the perceived impacts and present an assessment of the significance of the impacts taking into consideration the available mitigatory measures and assuming that they are fully implemented. The description of the impact significance and ratings are presented from Table 13 to 15 below.

Table 13: Summary of the impact significance of potential impacts for the planning and pre-construction phase of the proposed development.

Planning and Pre-Construction																
Potential & Nature of Impacts	Pre-mitigation								Post-mitigation							
	Severity	Duration	Extent	Frequency	Probability	**Consequence**	**Overall likelihood**	**Significance**	Severity	Duration	Extent	Frequency	Probability	**Consequence**	**Overall likelihood**	**Significance**
Loss of Land Capability: • Potential inappropriate planning leading to placement of stripped and stockpiled soils outside the demarcated areas • Potential poor planning leading to excessive or unnecessary placement of supporting surface infrastructure and/or opencast pits on arable soils and/or soils suited for grazing	3	3	4	3	3	**3.3**	**3**	**10.00**	3	2	1	2	2	**2.00**	**2.00**	**4.00**
Soil Erosion: • Exposure of soils resulting from vegetation clearing as part of ground preparation for establishment of infrastructure and opencast pits • Loosening of soils due to removal of vegetation. Increased runoff, erosion, and consequent loss of land capability in cleared areas	3	3	4	4	3	**3.3**	**3.5**	**11.67**	2	2	3	2	2	**2.33**	**2.00**	**4.67**
Soil compaction: • Potential poor planning leading to excessive or unnecessary placement of infrastructure outside the project footprint or the demarcated infrastructure areas leading to increased soils compaction	3	3	3	2	3	**3.0**	**2.5**	**7.50**	2	2	2	2	2	**2.0**	**2.00**	**4.00**
Soil Contamination: • Potential poor planning on management of dust fallout and consequent dust suppression activities leading to increased soils contamination and sedimentation of watercourses (if any)	5	4	4	4	5	**4.3**	**4.5**	**19.50**	3	3	3	3	3	**3.0**	**3.00**	**9.00**

Table 14: Summary of the impact significance of potential impacts for the construction and operational phase of the proposed development.

Construction and Operational																	
Potential & Nature of Impacts	Pre-mitigation								Post-mitigation								
	Severity	Duration	Extent	Frequency	Probability	**Consequence**	**Overall likelihood**	**Significance**	Severity	Duration	Extent	Frequency	Probability	**Consequence**	**Overall likelihood**	**Significance**
Loss of Land Capability: • Loss of the utilisation of the soil resource will impact the land use, reducing the land capability from subsistence farming (cultivation) and low intensity grazing land to mining during the construction phase of the proposed development • Site clearing, soil excavation, removal of vegetation, and other associated disturbances to soils, leading to soil degradation	4	4	3	4	4	**3.7**	**4**	**14.67**	2	2	3	2	2	**2.33**	**2.00**	**4.67**
Soil Erosion: • Exposure of soils resulting from vegetation clearing as part of ground preparation for establishment of infrastructure and opencast pit • Site clearing, removal of vegetation, and associated disturbances to soils, leading to, increased runoff, erosion and consequent loss of land capability in cleared areas • Frequent movement of construction and earth moving equipment within lose and exposed soils, potentially leading to excessive erosion • Constant disturbances of soils, resulting in risk of erosion	4	4	4	4	3	**4.0**	**3.5**	**14.00**	3	2	2	2	3	**2.33**	**2.50**	**5.83**
Soil compaction: • Potential poor planning leading to excessive or unnecessary placement of infrastructure outside the project footprint or the demarcated infrastructure areas leading to increased soils compaction • Frequent movement of digging machinery and construction vehicles within lose and exposed soils, leading to excessive soil compaction	3	3	3	2	3	**3.0**	**2.5**	**7.50**	1	2	2	2	1	**1.7**	**1.50**	**2.50**
Soil Contamination: • Spillages and/or leaks of hydrocarbons from the construction vehicles and heavy machinery • Frequent movement of digging machinery and construction vehicles within lose and exposed soils, increasing the risk of soil contamination • Oil spills/leakages and dust suppression resulting in risk of contamination	4	4	4	4	5	**4.0**	**4.5**	**18.00**	3	3	2	2	2	**2.7**	**2.00**	**5.33**

Table 15: Summary of the impact significance of potential impacts for the closure and rehabilitation phase of the proposed development.

Closure and Rehabilitation																
Potential & Nature of Impacts	Pre-mitigation								Post-mitigation							
	Severity	Duration	Extent	Frequency	Probability	**Consequence**	**Overall likelihood**	**Significance**	Severity	Duration	Extent	Frequency	Probability	**Consequence**	**Overall likelihood**	**Significance**
Loss of Land Capability: • Potentially poor rehabilitation strategy that may result in lower infiltration rate, and consequently increased surface runoff and increased soil erosion leading to permanent loss of soil resources • Contamination of replaced soils by use of dirty water for plant watering and dust suppression on roadways	3	3	4	3	3	**3.3**	**3**	**10.00**	3	2	1	2	2	**2.00**	**2.00**	**4.00**
Soil Erosion: • Soil handling during backfilling and capping leading to erosion	4	4	4	4	3	**4.0**	**3.5**	**14.00**	3	2	2	2	3	**2.33**	**2.50**	**5.83**
Soil compaction: • Compaction and dust contamination due to vehicle movement while rehabilitating the shaft site and conveyer servitude • Erosion management/reduction due to slope stabilization and re-vegetation of disturbed	3	3	3	3	3	**3.0**	**3**	**9.00**	1	2	2	2	1	**1.7**	**1.50**	**2.50**
Soil Contamination: • Spillage of hydrocarbons resulting from leakages from demolition equipment/machinery and other chemical storage facilities, leading to soil contamination (soil chemical characteristics)	4	4	4	4	5	**4.0**	**4.5**	**18.00**	2	2	3	2	2	**2.3**	**2.00**	**4.67**

6.1.5 Cumulative Impacts & Screening Tool Verification

The cumulative loss from a soil and land capability point of view is anticipated to be low for the proposed Makganyane Iorn Ore Mine. This can be attributed to the dominance of Glenrosa and Mispah soil forms within the focus area which account for approximately 85% of the focus area. The lack of soil medium (Mispah) and limited effective rooting depth (<15 cm) for Glenrosa render these soils more suitable for wilderness and/or small stock grazing under extensive farming practices. The dominant soils have a little bearing on agricultural productivity and their contribution towards local, regional, and national food security is highly minimal. Additionally, the existence of other currently operating mines and the proposed Makganyane Mine may have incremental effects on the environment over time; however, the cumulative impacts within the context of local and regional setting are not anticipated to be significant given the low land capability associated with the identified soils as well as the low grazing capacity potential regionally.

According to the Natural Agricultural Resources Manual (NAR Atlas Manual, 2018), the livestock grazing capacity potential is estimated to be approximately 14 hectares per livestock unit (ha/LSU) for the entire focus area. This grazing capacity potential associated with the focus area is considered insufficient to support both small scale and/or commercialised livestock farming.

The regional climate also does not permit highly productive dry land agriculture unless supplementary irrigation options are considered. Although, the cumulative impact on the local and regional scale is considered low, it is imperative to note that protection of agricultural resources should be prioritised as far as practically possible while considering the need for sustainable development in compliance with the CARA, 1983 (Act No. 43 of 1983).

In addition, the historical imagery on google earth revealed that no prior commercial cultivation was observed within the focus area for the past 5 years. Given the restrictive soil physical properties and unfavourable climatic conditions associated with the footprint area, the proposed development is not regarded as a significant threat towards regional, provincial, and national food production and security.

6.2 Integrated Mitigation Measures

Based on the findings of the soil, land use and land capability assessment, the following mitigation measures have been developed to minimise the impact on the soil resources of the focus area, should the proposed project proceed:

6.2.1 Management of Loss of Land Capability

- Direct surface disturbance of the identified arable soils must be avoided where possible to minimise loss of arable soils;
- The proposed development and associated surface infrastructure should be limited to within the demarcated footprint area;
- Soils of different characteristics should be stockpiled separately and clearly demarcated;
- The dumping of waste materials next to or on the stockpiles should be prohibited;
- Construction of surface infrastructure should preferably be limited to areas of the footprint or on already significantly disturbed soils.

6.2.2 Stockpile and Stripping Management

- Excavation and long-term stockpiling of soil should be limited within the demarcated areas;
- Ensure all stockpiles (especially topsoil) are clearly and permanently demarcated and located in defined “no-go areas”;
- Restrict the amount of mechanical handling, as each handling event increases the compaction level and the changes to the soil structure. Wherever possible, the ‘cut and cover’ technique (where the stripped soils is immediately placed in an area already prepared for rehabilitation, thus avoiding stockpiling) should be used;
- Separate stockpiles of different soils to achieve the highest post-development land capability and thus reduce the residual loss of agricultural potential;
- Stockpile height should be restricted to that which can deposited without additional traversing by machinery. A Maximum height of 4-5 m is therefore proposed, and the stockpile should be treated with temporary soil stabilisation methods, such as the application of organic matter to promote soil aggregate formation, leading to increased infiltration rate, thereby reducing soil erosion. Also, the use of agricultural lime to stabilise soil pH levels;
- The topsoil stockpile should be vegetated and while vegetating, measures will be needed to contain erosion of the stockpile during rain events; and
- Temporary berms can be installed, around stockpile areas whilst vegetation cover has not established to avoid soil loss through erosion.

6.2.3 Soil Compaction Management

- Soil compaction is usually greatest when soils are moist, so soils should ideally be stripped when moisture content is as low as possible. If they have to be moved when

wet, truck and shovel should be used as bowl scrapers create excessive compaction when moving on wet soils;

- Minimise compaction during the stockpiling phase by keeping stockpile soil loose and limit stockpile height to 4-5 meters height, to limit internal soil compaction (Coaltech: chamber of mines, 2007);
- Compaction should be minimised by use of appropriate equipment and replacing soil to the greatest possible thickness in single lifts;
- Heavy equipment movement over replaced soils should be minimized; and
- Following placement, compacted soils should be ripped to full rooting depth (at least 60 cm or 30cm as the bare minimum seedbed) to allow penetration of plant roots.

6.2.4 Soil Contamination Management

- Contamination prevention measures should be addressed in the Environmental Management Programme (EMP) for the proposed development, and this should be always implemented and made available and accessible to the contractors and construction crew conducting the works on site for reference;
- A spill prevention and emergency spill response plan, as well as dust suppression, and fire prevention plans should also be compiled to guide the construction works;
- An emergency response contingency plan should be put in place to address clean-up measures should a spill and/or a leak occur, as well as preventative measures to prevent contamination; and
- Burying of any waste including rubble, domestic waste, empty containers on the site should be strictly prohibited and all construction rubble waste must be removed to an approved disposal site.

6.2.5 Soil Erosion and Dust Emission Management

- The footprint of the proposed development and construction activities should be clearly demarcated to restrict vegetation clearing activities within the infrastructure footprint as far as practically possible;
- Bare soils within the access roads can be regularly dampened with water to suppress dust during the construction phase, especially when strong wind conditions are predicted according to the local weather forecast;
- All disturbed areas adjacent to the proposed development areas should be re-vegetated with an indigenous grass mix, if necessary, to re-establish a protective cover, to minimise soil erosion and dust emission;
- Temporary erosion control measures should be used to protect the disturbed soils during the construction phase until adequate vegetation has established.

7. CONCLUSION

The Zimpande Research Collaborative (ZRC) was appointed to conduct a soil, land use, land capability, and land potential and provide an environmental impact assessment (EIA) specialist study as part of the Environmental Authorisation (EA) process for the proposed Makganyane Iron Ore Mine. The mining right area (MRA) for the proposed development will henceforth be referred to as the "study area" while the footprint areas (open cast pits, RoM Stockpile, etc) will be referred to as the "focus areas".

The Rights area is located approximately 24 km north-west of Postmasburg on opposite sides of the R385 provincial road in the administrative district of Kuruman, Northern Cape Province of South Africa.

The objective of this study was to determine the impact of the proposed development on the soil, land use and land capability through the evaluation of the following:

- Climatic conditions within the context of agricultural productivity and constraints;
- Landscape setting and presently occurring land uses;
- Dominant soil forms, their respective land capability and potential for agricultural productivity;
- Soil physical properties and current limitations of soils to various land use purposes in their present state;
- Determine the impact of the proposed developments on the soil, land capability and agricultural potential; and
- Present mitigation measures to minimise the impact significance by applying the hierarchy of mitigation in line with the sustainable development principles.

The entire focus area is characterised by approximately by 300 mm of mean annual rainfall (MAR) per annum. This rainfall is deemed inadequate for a variety of cultivated crops and adjusting planting and/or an irrigation scheme may be necessary for successful cultivation of crops. Additionally, the entire focus areas are characterised by mean annual evaporation of more than (>2400 mm) per annum. Moisture deficit and crop wilting may be a problem for non-irrigated crops.

According to observations made during the site assessment, the footprint areas for the proposed Makganyane Mine is dominated by bushveld with shrubby and thorny vegetation, wilderness/wildlife, open grassland that is currently utilised for livestock grazing (cattle). No small scale and/or commercial agricultural cultivation activities were observed within the immediate surroundings (5 km radius) of the focus area.

According to the Department of Agriculture, Land Reform and Rural Development DALRRD, 2022) database on the Natural Agricultural Resources Atlas of South Africa (NAR Atlas Manual), the proposed Makganyane Iron Ore Mining Right Area (MRA) is not located within any of the protected agricultural areas (PAAs) which are classified into two categories, namely the irrigated (IR) and the rainfed (RF) production systems. Therefore, the proposed mining project is not likely to have an impact on the protected agricultural areas and consequent food security.

The identified soil forms occurring within the focus area include Mispah/Glenrosa, Mispah (outcrops), Glenrosa, Clovelly, Witbank (Infrastructure), and Cullinan (Excavation with Water). Of these identified soils, the Mispah/Glenrosa and Mispah soil forms were the most dominant within the focus area, occupying 69.62% and 18.24% of the total enclosed area respectively.

The Mispah/Glenrosa and Mispah soil formations are typically shallow in nature and in some instances no bedrock outcrops on surface. These soils are characterised by spatial heterogeneity associated with weathering of the rock material, illuviation, and biotic disturbance (plants and animals) especially along the joints or bedding planes which results in the mixing of soil and rock material in some instances. These types of soils are usually avoided for intensive agricultural use and thus left for grazing and wildlife land uses in this arid region since they do not present adequate soil depth for most cultivated crops.

The Witbank (Transported Technosols) soil forms are soils which have been subjected to physical disturbance due to infrastructural developments. In this context, Witbank soils include areas with transported soil material which has been significantly transformed and heavily modified such that the diagnostic horizons could not be identified. As a result, these soils are not ideal for agricultural cultivation.

The soils of Hutton formations are characterised by development in well-drained oxidising environmental conditions (warm and moist) which allow for iron oxide coating on soil particles thus resulting in the dominating red colours of the soils. These soils have a good depth (approximately 120 cm), which is considered sufficient to allow plants' roots to extract moisture and nutrients to sustain growth and development. In the absence of climatic constraints, the soils are suitable for arable cultivation.

Table A below indicates the dominant soils occurring within the focus areas, together with the associated land capability and the area extent covered in hectares (ha).

Table A: Dominant soil forms and their respective land capability and land potential classes.

Soil Forms	Soil Depth (cm)	DALRRD (2018) Classification	Land Capability Class & Groups (Smith, 2006)	Land Potential	Area Extent (ha)	Percentage (%)
Hutton	120	14. Very High	Arable (Class II)	Good – L3	5.50	1.51
Glenrosa	<30	6. Low - Moderate	Grazing (Class VI)	Restricted – L5	37.04	10.17
Mispah/ Glenrosa	<15	5. Low	Grazing (Class VII)	Very Restricted – L6	253.46	69.62
Mispah	0	2. Very Low	Wildlife (Class VIII)	Very Low – L8	66.39	18.24
Cullinan	n/a				1.24	0.34
Witbank	n/a				0.41	0.11
Total Enclosed Area					**364.04**	**100**

The cumulative loss from a soil and land capability point of view is anticipated to be low for the proposed Makganyane Iorn Ore Mine. This can be attributed to the dominance of Glenrosa and Mispah soil forms within the focus area which account for approximately 85% of the focus area. The lack of soil medium (Mispah) and limited effective rooting depth (<15 cm) for Glenrosa render these soils more suitable for wilderness and/or small stock grazing under extensive farming practices. The dominant soils have a little bearing on agricultural productivity and their contribution towards local, regional, and national food security is highly minimal. Additionally, the existence of other currently operating mines and the proposed Makganyane Mine may have incremental effects on the environment over time; however, the cumulative impacts within the context of local and regional setting are not anticipated to be significant given the low land capability associated with the identified soils as well as the low grazing capacity potential regionally.

Although arable soils of good agricultural potential (Hutton) also occur within the focus area, the prevailing climatic constraints of the area such as the low mean annual rainfall (201 – 300 mm) and high mean annual evaporation rate (>2400 mm) combined with the lack of irrigation options limits the viability of the soils for small scale and/or commercialised cultivated agricultural production.

According to the Natural Agricultural Resources Manual (NAR Atlas Manual, 2018), the livestock grazing capacity potential is estimated to be approximately 14 hectares per livestock unit (ha/LSU) for the entire focus area. This grazing capacity potential associated with the focus area is considered insufficient to support both small scale and/or commercialised livestock farming.

The field assessment and verification indicate that while the Department of Fisheries, Forestry, and the Environment (DFFE) national web-based screening tool initially flagged the focus area as having medium sensitivity to impact, the field verified agricultural sensitivity revealed a low agricultural sensitivity due to factors such as poor soil quality (lack of soil medium and effective rooting depth) and climatic constraints that limit restricts the potential for commercial

agricultural production. Therefore, the screening tool is disputed and thus, the proposed mine development can be supported. In addition, the historical imagery on google earth revealed that no prior commercial cultivation was observed within the focus area for the past 5 years. Given the restrictive soil physical properties and unfavourable climatic conditions associated with the footprint area, the proposed development is not regarded as a significant threat towards regional, provincial, and national food production and security.

The following key mitigation measures have been developed to minimise the potential impacts on the soil regime, should the proposed mine be approved, and these include but are not limited to:

- Direct surface disturbance of the identified arable soils must be avoided where possible to minimise loss of arable soils;
- The proposed development, associated infrastructure and the access roads should be limited to within the demarcated footprint areas;
- Stockpiles that will remain in location for more than one growing season and that have not revegetated naturally, should be revegetated to avoid erosion losses;
- Ensure all stockpiles (especially topsoil) are clearly and permanently demarcated and located in defined “no-go areas”;
- Restrict the amount of mechanical handling, as each handling event increases the compaction level and the changes to the soil structure. Wherever possible, the ‘cut and cover’ technique (where the stripped soils is immediately placed in an area already prepared for rehabilitation, thus avoiding stockpiling) should be used;
- Separate stockpiles of different soils to achieve the highest post-development land capability and thus reduce the residual loss of agricultural potential;
- The footprint areas should be lightly ripped to alleviate compaction;
- The footprint of the proposed development and construction activities should be clearly demarcated to restrict vegetation clearing activities within the infrastructure footprint as far as practically possible;
- Bare soils within the access roads must be regularly dampened with water to suppress dust during the construction and operational phase, especially when strong wind conditions are predicted according to the local weather forecast;
- Temporary erosion control measures should be used to protect the disturbed soils during the construction phase until adequate vegetation has established;
- Contamination prevention measures should be addressed in the Environmental Management Programme (EMP) for the proposed development, and this should be always implemented and made available and accessible to the contractors and construction crew conducting the works on site for reference;

- A spill prevention and emergency spill response plan considering the nature of the proposed development, as well as dust suppression, and fire prevention plans should also be compiled to guide the construction works;
- An emergency response contingency plan should be put in place to address clean-up measures should a spill and/or a leak occur, as well as preventative measures to prevent contamination; and
- Burying of any waste including domestic waste, empty containers on the site should be strictly prohibited.

It is the opinion of the soil specialist that the proposed Makganyane Iron Ore Mine will not result in an unacceptable risk or loss of agricultural resources, and the proposed development is therefore deemed acceptable from a soil, land use, and land capability point of view, provided adequate and appropriate mitigation measures are put in place to minimise disturbances on the soil regime of the focus area.

8. REFERENCES

Agricultural Geo-referenced Information System (AGIS) database. www.agis.agric.za. Concept Study Report: Chapter 05 - Mining dated 17 October 2018

Cboil, F.C., 2003. Environmental Management Framework Report (Consolidated). Volume 1 Chapter 1 to 9. Illovo, South Africa.

Conservation of Agricultural Resources Act (CARA), 1983 (Act No. 43 of 1983).

Darmody, R.G. Daniels, W.L Marlin, J.C. and Cremeens, D.L. 2009. topsoil: what is it and who cares? 26th Annual Meetings of the American Society of Mining and Reclamation and 11th Billings Land Reclamation Symposium 2009.

Department of Agriculture, Forestry and Fisheries. Agricultural Geo-referenced Information system (AGIS). Grazing Capacity Maps (1993).

Department of Mines (1970). 1:250 000 Geological Map Series (sheet no. 2730) of the Republic of South Africa (RSA) and the Kingdoms of Lesotho and Swaziland. Department of Mines (1970).

Fey, M. V. (2010). *Soils of South Africa*. Cambridge, UK: Cambridge University Press.

Grimalt, J.O., Ferrer, M. and Macpherson, E., 1999. The mine tailing accident in Aznalcollar. Science of the Total Environment, 242(1-3), pp.3-11.

International Union of Soil Sciences (IUSS) Working Group (2014). World Reference Base (WRB) for Soil Resources 2014. International soil classification system for naming soils and creating legends for soil maps. World Soil Resources Reports No. 106. FAO, Rome.

Land Type Survey Staff, 1972–2002. 1:250 000 scale Land Type Survey of South Africa. ARC Institute for Soil, Climate and Water, Pretoria, South Africa.

Morgenthal, T.L., Newby, T., Smith, H.J.C., and Pretorius, D.J. (2004*). Developing and refinement of a grazing capacity map for South Africa using NOAA (AVHRR) satellite derived data*. Report GW/A/2004/66. ARC Institute for Soil, Climate and Water, Pretoria.

National Department of Agriculture, 2002. Development and Application of a Land Capability Classification System for South Africa.

Smith, B. 2006. The Farming Handbook. UKZN press. South Africa.

Smith, H.J., 1998. Definition and demarcation of high potential land for rainfed annual crop production. M.Inst.Agrar. dissertation, Univ. Pretoria.

Soil Classification Working Group, 2018. Soil classification. A Natural and Anthropogenic system for South Africa. Mem. agric. nat. Resource. S. Afr. No. 15. Dept. Agric. Dev., Pretoria.

Soil Classification Working Group, 2018. Soil classification. A Natural and Anthropogenic System for South Africa. ARC-Institute for Soil, Climate and Water, Pretoria.

World Reference Base (WRB) for soil resources, 2014. International Soil Classification System for Naming Soils and Creating Legends for Soil Maps. Rome: Food and Agriculture Organization of the United Nations. *World Soil Resources Reports 0488.*

APPENDIX A: IMPACT ASSESSMENT METHODOLOGY

Methodology for the assessment of the potential environmental, social and cultural impacts

DEFINITIONS AND CONCEPTS

Environmental Significance

The concept of significance is at the core of impact identification, evaluation and decision-making. The concept remains largely undefined and there is no international consensus on a single definition. The following common elements are recognized from the various interpretations:

- δ Environmental significance is a value judgment
- δ The degree of environmental significance depends on the nature of the impact
- δ The importance is rated in terms of both biophysical and socio-economic values
- δ Determining significance involves the amount of change to the environment perceived to be acceptable to affected communities.

Significance can be differentiated into impact magnitude and impact significance. Impact magnitude is the measurable change (i.e. intensity, duration and likelihood). Impact significance is the value placed on the change by different affected parties (i.e. level of acceptability) (DEAT (2002) Impact Significance, Integrated Environmental Management, Information Series 5).

The concept of risk has two dimensions, namely the consequence of an event or set of circumstances, and the likelihood of particular consequences being realised (Environment Australia (1999) Environmental Risk Management).

Impact

The positive or negative effects on human well-being and / or the environment.

Consequence

The intermediate or final outcome of an event or situation OR it is the result, on the environment, of an event.

Likelihood

A qualitative term covering both probability and frequency.

Frequency

The number of occurrences of a defined event in a given time or rate.

Probability

The likelihood of a specific outcome measured by the ratio of a specific outcome to the total number of possible outcomes.

Environment

Surroundings in which an organisation operates, including air, water, land, natural resources, flora, fauna, humans and their interrelation (ISO 14004, 1996).

Methodology that will be used

The environmental significance assessment methodology is based on the following determination:

Environmental Significance = Overall Consequence x Overall Likelihood

Determination of Overall Consequence

Consequence analysis is a mixture of quantitative and qualitative information, and the outcome can be positive or negative. Several factors can be used to determine consequence. For the purpose of determining the environmental significance in terms of consequence, the following factors were chosen: Severity/Intensity, Duration and Extent/Spatial Scale. Each factor is assigned a rating of 1 to 5, as described in the tables below.

Determination of Severity / Intensity

Severity relates to the nature of the event, aspect or impact to the environment and describes how severe the aspects impact on the biophysical and socio-economic environment.

Table 16: Table to be used to obtain an overall rating of severity, taking into consideration the various criteria.

TYPE OF CRITERIA	RATING				
	1	2	3	4	5
Quantitative	0-20%	21-40%	41-60%	61-80%	81-100%
Qualitative	Insignificant / Non-harmful	Small / Potentially harmful	Significant/ Harmful	Great/ Very harmful	Disastrous Extremely harmful
Social/ Community response	Acceptable / I&AP satisfied	Slightly tolerable / Possible objections	Intolerable/ Sporadic complaints	Unacceptable / Widespread complaints	Totally unacceptable / Possible legal action
Irreversibility	Very low cost to mitigate/	Low cost to mitigate	Substantial cost to mitigate/	High cost to mitigate	Prohibitive cost to mitigate/

TYPE OF CRITERIA	RATING				
	1	2	3	4	5
	High potential to mitigate impacts to level of insignificance/ Easily reversible		Potential to mitigate impacts/ Potential to reverse impact		Little or no mechanism to mitigate impact Irreversible
Biophysical (Air quality, water quantity and quality, waste production, fauna and flora)	Insignificant change / deterioration or disturbance	Moderate change / deterioration or disturbance	Significant change / deterioration or disturbance	Very significant change / deterioration or disturbance	Disastrous change / deterioration or disturbance

Determination of Duration

Duration refers to the amount of time that the environment will be affected by the event, risk or impact, if no intervention e.g. remedial action takes place.

Table 17: Criteria for the rating of duration.

RATING	DESCRIPTION
1	Up to ONE MONTH
2	ONE MONTH to THREE MONTHS (QUARTER)
3	THREE MONTHS to ONE YEAR
4	ONE to TEN YEARS
5	Beyond TEN YEARS

Determination of Extent/Spatial Scale

Extent or **spatial scale** is the area affected by the event, aspect or impact.

Table 18: Criteria for the rating of extent / spatial scale.

RATING	DESCRIPTION
1	Immediate, fully contained area
2	Surrounding area
3	Within Business Unit area of responsibility
4	Within the farm/neighbouring farm area
5	Regional, National, International

Determination of Overall Consequence

Overall consequence is determined by adding the factors determined above and summarized below, and then dividing the sum by 3.

Table 19: Example of calculating overall consequence.

CONSEQUENCE	RATING
Severity	Example 4
Duration	Example 2
Extent	Example 4
SUBTOTAL	**10**
TOTAL CONSEQUENCE: (Subtotal divided by 3)	**3.3**

Determination of Likelihood

The determination of likelihood is a combination of Frequency and Probability. Each factor is assigned a rating of 1 to 5, as described below.

Determination of Frequency

Frequency refers to how often the specific activity, related to the event, aspect or impact, is undertaken.

Table 20: Criteria for the rating of frequency.

RATING	DESCRIPTION
1	Once a year or once/more during operation
2	Once/more in 6 Months
3	Once/more a Month
4	Once/more a Week
5	Daily

Determination of Probability

Probability refers to how often the activity or aspect has an impact on the environment.

Table 21: Criteria for the rating of probability.

RATING	DESCRIPTION
1	Almost never / almost impossible
2	Very seldom / highly unlikely
3	Infrequent / unlikely / seldom
4	Often / regularly / likely / possible
5	Daily / highly likely / definitely

Overall Likelihood

Overall likelihood is calculated by adding the factors determined above and summarized below, and then dividing the sum by 2.

Table 22: Example of calculating overall likelihood.

CONSEQUENCE	RATING
Frequency	Example 4
Probability	Example 2
SUBTOTAL	**6**
TOTAL LIKELIHOOD (Subtotal divided by 2)	**3**

Determination of Overall Environmental Significance

The multiplication of overall consequence with overall likelihood will provide the environmental significance, which is a number that will then fall into a range of **LOW, LOW-MEDIUM, MEDIUM, MEDIUM-HIGH** or **HIGH**, as shown in the table below.

Table 23: Determination of overall environmental significance.

SIGNIFICANCE OR RISK	LOW	LOW-MEDIUM	MEDIUM	MEDIUM-HIGH	HIGH
Overall Consequence X Overall Likelihood	1 - 4.9	5 - 9.9	10 - 14.9	15 – 19.9	20 - 25

Qualitative description or magnitude of Environmental Significance

This description is qualitative and is an indication of the nature or magnitude of the Environmental Significance. It also guides the prioritizations and decision making process associated with this event, aspect or impact.

Table 24: Description of environmental significance and related action required.

SIGNIFICANCE	LOW	LOW-MEDIUM	MEDIUM	MEDIUM-HIGH	HIGH
Impact Magnitude	Impact is of very low order and therefore likely to have very little real effect. Acceptable.	Impact is of low order and therefore likely to have little real effect. Acceptable.	Impact is real, and potentially substantial in relation to other impacts. Can pose a risk to company	Impact is real and substantial in relation to other impacts. Pose a risk to the company. Unacceptable	Impact is of the highest order possible. Unacceptable. Fatal flaw.
Action Required	Maintain current management measures. Where possible improve.	Maintain current management measures. Implement monitoring and evaluate to determine potential increase in risk. Where possible improve	Implement monitoring. Investigate mitigation measures and improve management measures to reduce risk, where possible.	Improve management measures to reduce risk.	Implement significant mitigation measures or implement alternatives.

Based on the above, the significance rating scale has been determined as follows:

HIGH Of the highest order possible within the bounds of impacts which could occur. In the case of negative impacts, there would be no possible mitigation and / or remedial activity to offset the impact at the spatial or time scale for which it was predicted. In the case of positive impacts, there is no real alternative to achieving the benefit.

MEDIUM-HIGH Impacts of a substantial order. In the case of negative impacts, mitigation and / or remedial activity would be feasible but difficult, expensive, time-consuming or some combination of these. In the case of positive impacts, other means of achieving this benefit would be feasible, but these would be more difficult, expensive, time-consuming or some combination of these.

MEDIUM Impact would be real but not substantial within the bounds of those, which could occur. In the case of negative impacts, mitigation and / or remedial activity would be both feasible and fairly easily possible, In case of positive impacts; other means of achieving these benefits would be about equal in time, cost and effort.

LOW-MEDIUM Impact would be of a low order and with little real effect. In the case of negative impacts, mitigation and / or remedial activity would be either easily achieved of little would be required, or both. In case of positive impacts alternative means for achieving this benefit would likely be easier, cheaper, more effective, less time-consuming, or some combination of these.

LOW Impact would be negligible. In the case of negative impacts, almost no mitigation and or remedial activity would be needed, and any minor steps, which might be needed, would be easy, cheap, and simple. In the case of positive impacts, alternative means would almost all likely be better, in one or a number of ways, than this means of achieving the benefit.

INSIGNIFICANT There would be a no impact at all – not even a very low impact on the system or any of its parts.

APPENDIX B: DETAILS, EXPERTISE AND CURRICULUM VITAE OF SPECIALISTS

1. (a) (i) Details of the specialist who prepared the report

Stephen van Staden MSc (Environmental Management) (University of Johannesburg)

Lourens Tshabalala BSc. Agric (Hons) Soil Science & Agronomy (University of Free State)

Braveman Mzila BSc (Hons) Environmental Hydrology (University of KwaZulu-Natal)

1. (a). (ii) The expertise of that specialist to compile a specialist report including a curriculum vitae

Company of Specialist:	Zimpande Research Collaborative		
Name / Contact person:	Stephen van Staden		
Postal address:	29 Arterial Road West, Oriel, Bedfordview		
Postal code:	2007	Cell:	083 415 2356
Telephone:	011 616 7893	Fax:	011 615 6240/ 086 724 3132
E-mail:	stephen@sasenvgroup.co.za		
Qualifications	MSc (Environmental Management) (University of Johannesburg) BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg) BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)		
Registration / Associations	Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP) Accredited River Health practitioner by the South African River Health Program (RHP) Member of the South African Soil Surveyors Association (SASSO) Member of the Gauteng Wetland Forum		

1. (a) a declaration that the specialist is independent in a form as may be specified by the competent authority

I, Stephen van Staden, declare that -

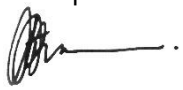
- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct

Signature of the Specialist

1. (b) a declaration that the specialist is independent in a form as may be specified by the competent authority

I, Lourens Tshabalala, declare that -

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct

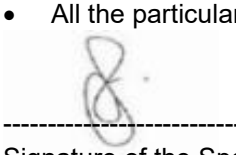


Signature of the Specialist

1.(c) A declaration that the specialist is independent in a form as may be specified by the competent authority

I, Braveman Mzila, declare that -

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct



Signature of the Specialist

SAS ENVIRONMENTAL GROUP OF COMPANIES –

SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF STEPHEN VAN STADEN

PERSONAL DETAILS

Position in Company	Group CEO, Water Resource discipline lead, Managing member, Ecologist, Aquatic Ecologist
Joined SAS Environmental Group of Companies	2003 (year of establishment)

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP)
Accredited River Health practitioner by the South African River Health Program (RHP)
Member of the South African Soil Surveyors Association (SASSO) Member of the Gauteng Wetland Forum
Member of the Gauteng Wetland Forum;
Member of International Association of Impact Assessors (IAIA) South Africa;
Member of the Land Rehabilitation Society of South Africa (LaRSSA)

EDUCATION

Qualifications

MSc Environmental Management (University of Johannesburg)	2003
BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg)	2001
BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)	2000
Tools for wetland assessment short course Rhodes University	2016
Legal liability training course (Legricon Pty Ltd)	2018
Hazard identification and risk assessment training course (Legricon Pty Ltd)	2013

Short Courses

Certificate – Department of Environmental Science in Legal context of Environmental Management, Compliance and Enforcement (UNISA)	2009
Introduction to Project Management - Online course by the University of Adelaide	2016
Integrated Water Resource Management, the National Water Act, and Water Use Authorisations, focusing on WULAs and IWWMPs	2017

AREAS OF WORK EXPERIENCE

South Africa – All Provinces
Southern Africa – Lesotho, Botswana, Mozambique, Zimbabwe Zambia
Eastern Africa – Tanzania Mauritius
West Africa – Ghana, Liberia, Angola, Guinea Bissau, Nigeria, Sierra Leona
Central Africa – Democratic Republic of the Congo

KEY SPECIALIST DISCIPLINES

Biodiversity Assessments

- Floral Assessments
- Biodiversity Actions Plan (BAP)
- Biodiversity Management Plan (BMP)
- Alien and Invasive Control Plan (AICP)
- Ecological Scan
- Terrestrial Monitoring
- Protected Tree and Floral Marking and Reporting
- Biodiversity Offset Plan

Freshwater Assessments

- Desktop Freshwater Delineation
- Freshwater Verification Assessment
- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning
- Maintenance and Management Plans
- Plant species and Landscape Plan
- Freshwater Offset Plan
- Hydropedological Assessment
- Pit Closure Analysis

Aquatic Ecological Assessment and Water Quality Studies

- Habitat Assessment Indices (IHAS, HRC, IHIA & RHAM)
- Aquatic Macro-Invertebrates (SASS5 & MIRAI)
- Fish Assemblage Integrity Index (FRAI)
- Fish Health Assessments
- Riparian Vegetation Integrity (VEGRAI)
- Toxicological Analysis
- Water quality Monitoring
- Screening Test
- Riverine Rehabilitation Plans

Soil and Land Capability Assessment

- Soil and Land Capability Assessment
- Soil Monitoring
- Soil Mapping

Visual Impact Assessment

- Visual Baseline and Impact Assessments
- Visual Impact Peer Review Assessments
- View Shed Analyses
- Visual Modelling

Legislative Requirements, Processes and Assessments

- Water Use Applications (Water Use Licence Applications / General Authorisations)
- Environmental and Water Use Audits
- Freshwater Resource Management and Monitoring as part of EMPR and WUL conditions

SAS ENVIRONMENTAL GROUP OF COMPANIES (SEGC) –
SPECIALIST CONSULTANT INFORMATION
CURRICULUM VITAE OF LOURENS TSHABALALA

PERSONAL DETAILS

Position in Company	Soil Scientist/Hydropedologist
Joined SAS Environmental Group of Companies	2023

MEMBERSHIP IN PROFESSIONAL SOCIETIES

South African Council for Natural Scientist Professions (SACNASP) – Reg. No: 144043

Member of the South African Soil Surveyors Organization (SASSO)

EDUCATION

Qualifications

B.Sc. (Agric) Honours Soil Science	(University of the Free State)	2020

COUNTRIES OF WORK EXPERIENCE

South Africa – Kwa-Zulu Natal, Mpumalanga, Limpopo, Western Cape, Gauteng North West, Eastern Cape and Free State

KEY SPECIALIST DISCIPLINES

Hydropedological Assessments:

- Soil Survey & Profile Description
- Soil Delineation
- Hydrological hillslope classification

Soil, Land use, Land Capability and Agricultural Potential Studies

- Soil Desktop assessment
- Soil classification
- Agricultural Soil Potential
- Agricultural Impact Assessments

SAS ENVIRONMENTAL GROUP OF COMPANIES –

SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF BRAVEMAN MZILA

PERSONAL DETAILS

Position in Company	Wetland Ecologist and Soil Scientist
Joined SAS Environmental Group of Companies	2017

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Member of the South African Soil Science Society (SASSO)

Member of the Gauteng Wetland Forum (GWF)

EDUCATION

Qualifications

BSc (Hons) Environmental Hydrology (University of Kwazulu-Natal)	2013
BSc Hydrology and Soil Science (University of Kwazulu-Natal)	2012

COUNTRIES OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, Free State, North West, Limpopo, Northern Cape, Eastern Cape, KwaZulu-Natal

KEY SPECIALIST DISCIPLINES

Hydropedological Assessments:

- Soil Survey
- Soil Delineation
- Hydrological hillslope classification
- Hydropedological loss Quantification
- Hydropedological impact assessment
- Scientific buffer determination

Soil, Land use, Land Capability and Agricultural Potential Studies

- Soil Desktop assessment
- Soil classification
- Agricultural potential
- Agricultural Impact Assessments