Soil, Land use and Land Capability Assessment

FOR THE PROPOSED SOLAR PLANT AT MARULA PLATINUM MINE, LIMPOPO PROVINCE.

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EXECUTIVE SUMMARY

The Zimpande Research Collaborative (ZRC) was appointed to conduct a soil, land use, land capability and agricultural potential assessment as part of the environmental impact assessment and authorisation process for the proposed photovoltaic (PV) facility at the Marula Platinum Mine (MPM), which is located near Burgersfort within the Limpopo Province, hereafter referred to as the "study area".

The objective of this study was to evaluate:

- Climatic conditions within the context of agricultural productivity and constraints;
- Landscape setting and land use,
- Soil physical properties; and
- Other current limitations to various agricultural related land use purposes.

The climatic conditions associated with the study area and surroundings are characterised by significant climatic limitations with the Mean Annual Precipitation ranging between 401 – 600 mm per annum. The surrounding areas under these climatic conditions have a moderately restricted growing season due to low temperatures, frost and/or moisture stress. This results in limited suitable crops which frequently experience yield loss. Therefore, crops under rainfed conditions should be cultivated with extreme caution, and management practices such as irrigation are likely to be required to ensure a sustainable yield.

Based on the observations during the site assessment, the dominant land uses within the study area are mining related activities, with the sub-dominant uses being residential areas and wilderness/wildlife. No agricultural activities were observed in the immediate vicinity of the study area.

The study area is dominated by marginal to low agricultural potential soils (Spionberg/Valsrivier). In total, two (2) soil forms were identified within the study area and these include the Spionberg/Valsrivier, and Witbank formations.

The dominant soils of Spionberg/Valsrivier, Witbank are not considered ideal for cultivation due to:

- Poor drainage characteristics;
- Shallow rooting depth due to high clay content in the B horizon;
- Inadequate moisture;
- Bleached topsoil associated with the Dundee soil form which lack nutrient retention capacity to support optimum growth and production; and
- Disturbed soils due to anthropogenic influences.

Table A below represents the soil forms identified within the study area as well as their diagnostic horizons, respectively.

Table A: Identified soil forms within the study area and their respective land capability and land potential.

Soil Form	Land capability	Land Potential	Area (ha)	Percentage
Spionsberg/Valsrivier	Grazing (Class VI)	Restricted Potential (L5)	48.56	93.80
Witbank	Wilderness (Class VII)	Restricted Potential (L5)	3.21	6.20
Total enclosed			**51.77**	**100**

The cumulative loss from a soil and land capability point of view is not anticipated to be significant as the dominant soils identified within the study are not suitable for cultivation unless intense management practices are implemented. In addition, considering the climatic conditions of the area which is associated with limited rainfall as per the review of desk based data sources and the absence of any irrigation scheme, this renders the study area not suitable for any large-scale agricultural cultivation. However, some areas used for subsistence grazing will potentially be impacted, which will ultimately impact on the local livestock production. The overall impact on the soil and land capability is anticipated to be Medium-Low without mitigation measures and Low with mitigation measures in place under the condition that the integrated mitigation measures are implemented accordingly, with the aim of minimising the potential loss of valuable top soil material.

The screening tool analysis was conducted, which presented the findings as the impact on agricultural resources being of a high sensitivity in terms of agricultural potential. Based on the outcomes of the field assessment this was found to be of a lower significance impact than that presented on the screening tool due to the types of soils identified on site and the study area positioned in a water stressed area here dryland agriculture is only viable on a subsistence scale. In addition, the historical digital satellite imagery revealed that no prior commercial cultivation was observed within the study area for the past 5 years and thus the proposed development is not likely to have an unacceptable impact on the agricultural production capability and contribution to local, regional or national food production.

Key mitigation measures to minimise impacts on the soil regime include but are not limited to:

- The project operations be kept within the demarcated footprint areas which must be well defined;
- Bare soils within the access roads should 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;
- A soil monitoring programme should be initiated within the access roads and adjacent areas to ascertain whether the dust suppression has an impact on the soil chemistry;
- Soil Compaction is usually greatest when soils are moist. Therefore, soils should be stripped when moisture content is as low as possible. If soil must be moved when wet, truck and shovel should be used as bowlscrapers create excessive compaction when moving wet soils;
- Restrict the amount of mechanical handling, as each handling event increases that 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;
- Soil erosion should be controlled on stockpiles by having control measures to reduce erosion risk such as erosion control blankets, soil binders, revegetation, contours, diversion banks and spillways.

From a soil, land use and land capability point of view, this project is regarded as being of low impact significance to current and future land use and especially to agricultural production due to the ongoing disturbances as a result of the current land use activities the soils are subjected to and the prevailing harsh climatic conditions. However, mitigation measures and recommendations outlined in this document need to be strongly considered and implemented accordingly in efforts to conserve soil resources and allow use of valuable topsoil in other areas.

DOCUMENT GUIDE

Table A: Document guide according to the amended 2017 EIA Regulations (No. R. 326)

No.	Requirement	Section in report
a)	Details of -	
(i)	The specialist who prepared the report	Appendix B
(ii)	The expertise of that specialist to compile a specialist report including a curriculum vitae	Appendix B
b)	A declaration that the specialist is independent	Appendix B
c)	An indication of the scope of, and the purpose for which, the report was prepared	Section 1
cA)	An indication of the quality and age of base data used for the specialist report	Section 3
cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 4 and 5
d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 3
e)	A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 3
f)	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternative	Section 4
g)	An identification of any areas to be avoided, including buffers	Section 4
h)	A map superimposing the activity including the associated structure and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers	Section 4
i)	A description of any assumption made and any uncertainties or gaps in knowledge	Section 1.1
j)	A description of the findings and potential implication\s of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities	Section 4 and 5
k)	Any mitigation measures for inclusion in the EMPr	Section 5.2
l)	Any conditions for inclusion in the environmental authorisation	Section 4.1
m)	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	None
n)	A reasoned opinion -	
(i)	As to whether the proposed activity, activities or portions thereof should be authorised	Section 5 and 6
(iA)	Regarding the acceptability of the proposed activity or activities	Section 6
(ii)	If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Section 4 and 5
o)	A description of any consultation process that was undertaken during the course of preparing the specialist report	None
p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	None
q)	Any other information requested by the competent authority	None

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GLOSSARY OF TERMS

Albic	Grey colours, apedal to weak structure, few mottles (<10 %)
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.
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.
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.
Ferralic:	Having a ferralic horizon starting ≤150 cm of the soil surface.
Ferralic horizon:	A subsurface horizon resulting from long and intense weathering, with a clay fraction that is dominated by low-activity clays and contains various amounts of resistant minerals such as Fe, Al, and/or Mn hydroxides.
Gleying:	A soil process resulting from prolonged soil saturation which is manifested by the presence of neutral grey, bluish or greenish colours in the soil matrix.
Hard Plinthic	Accumulative of vesicular Fe/Mn mottles, cemented
Hydrophytes:	Plants that are adaptable to waterlogged soils
Lithic	Dominantly weathering rock material, some soil will be present.
Mottles:	Soils with variegated colour patterns are described as being mottled, with the "background colour" referred to as the matrix and the spots or blotches of colour referred to as mottles.
Plinthic Catena	South African plinthic catena is characterised by a grading of soils from red through yellow to grey (bleached) soils down a slope. The colour sequence is ascribed to different Fe-minerals stable at increasing degrees of wetness
Red Apedal	Uniform red colouring, apedal to weak structure, no calcareous
Runoff	Surface runoff is defined as the water that finds its way into a surface stream channel without infiltration into the soil and may include overland flow, interflow and base flow.
Orthic	Maybe dark, chromic or bleached
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.
Soil Map Unit	A description that defines the soil composition of a land, identified by a symbol and a boundary on a map
Soft Plinthic	Accumulation of vesicular Fe/Mn mottles (>10%), grey colours in or below horizon, apedal to weak structure

ACRONYMS

AGIS	Agricultural Geo-Referenced Information Systems
°C	Degrees Celsius.
CARA	Conservation of Agricultural Resources Act
CEC	Cation Exchange Capacity
DEA	Department of Environmental Affairs
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
ET	Evapotranspiration
IUSS	International Union of Soil Sciences
FAO	Food and Agriculture Organization
GIS	Geographic Information System
GPS	Global Positioning System
m	Meter
MAP	Mean Annual Precipitation
NWA	National Water Act
PSD	Particle Size Distribution
SACNASP	South African Council for Natural Scientific Professions
SAS	Scientific Aquatic Services
SOTER	Soil and Terrain
ZRC	Zimpande Research Collaborative

1. INTRODUCTION

The Zimpande Research Collaborative (ZRC) was appointed to conduct a soil, land use, land capability and agricultural potential assessment as part of the environmental impact assessment and authorisation process for the proposed photovoltaic (PV) facility at the Marula Platinum Mine (MPM), which is located near Burgersfort within the Limpopo Province, hereafter referred to as the “study area”.

The study area, is located approximately 5 kilometres (km) north of the R516 and approx. 7.5 km west of the R101 within the Greater Tubatse local Municipality in the Limpopo Province. The R37 runs approximately 4 km east of the MPM. Figures 1 and 2 indicate the locality of the study area in relation to surrounding areas.

The proposed PV facility will be installed within the study area along with internal roads, offices, a control room, and a laydown area (see Figure 3 below). The proponent had proposed a Battery Energy Storage System (BESS) at the time of assessment, but it was unclear whether this technology would be utilised and also the type of battery (Sodim Sulphur Battery, Lithium Ion Battery, Redox (Vanadium) Flow Battery and etc) and the location thereof was unknown. It is however, assumed that the BESS (if utilised) will be within the study area footprint area.

The the proposed photovoltaic (PV) facility is located in soils, classified on a regional scale, which may potentially support agricultural practice and food production. Thus, it is imperative to understand the surrounding soils, land uses and land capability as well as the land potential to ensure that the proposed solar PV project takes into consideration the high potential agricultural land parallel with the Conservation of Agricultural Resources Act (CARA), 1983 (Act No. 43 of 1983). High agricultural potential land is a scarce non-renewable resource, which necessitates an Agricultural Potential assessment prior to land development, particularly for purposes other than agricultural land use, as per Conservation of Agricultural Resources Act (CARA), 1983 (Act No. 43 of 1983).

Figure 1: Digital satellite imagery depicting the locality of the study area in relation to the surrounding area.

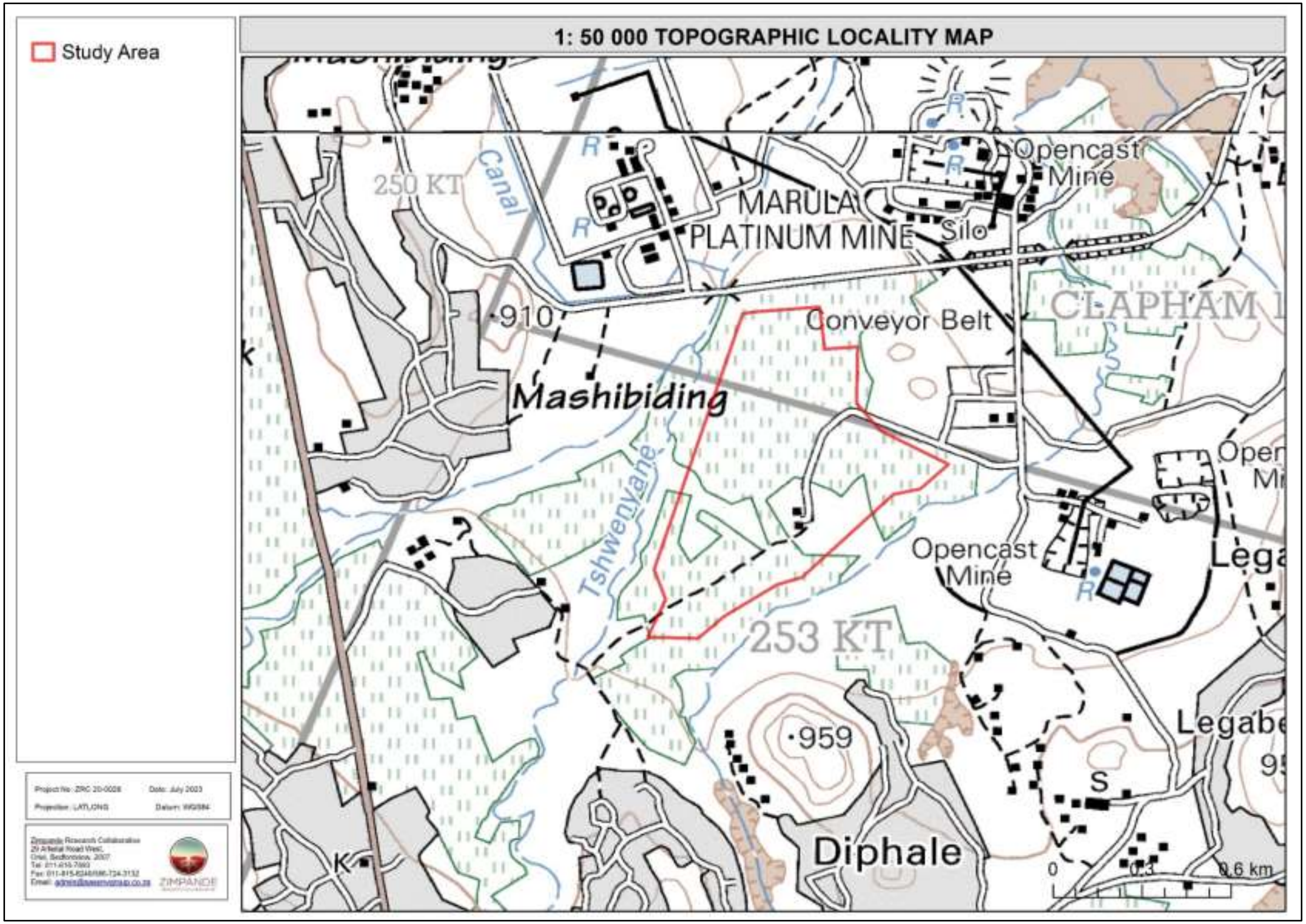


Figure 2: Location of the study area depicted on a 1:50 000 topographical map in relation to surrounding area.

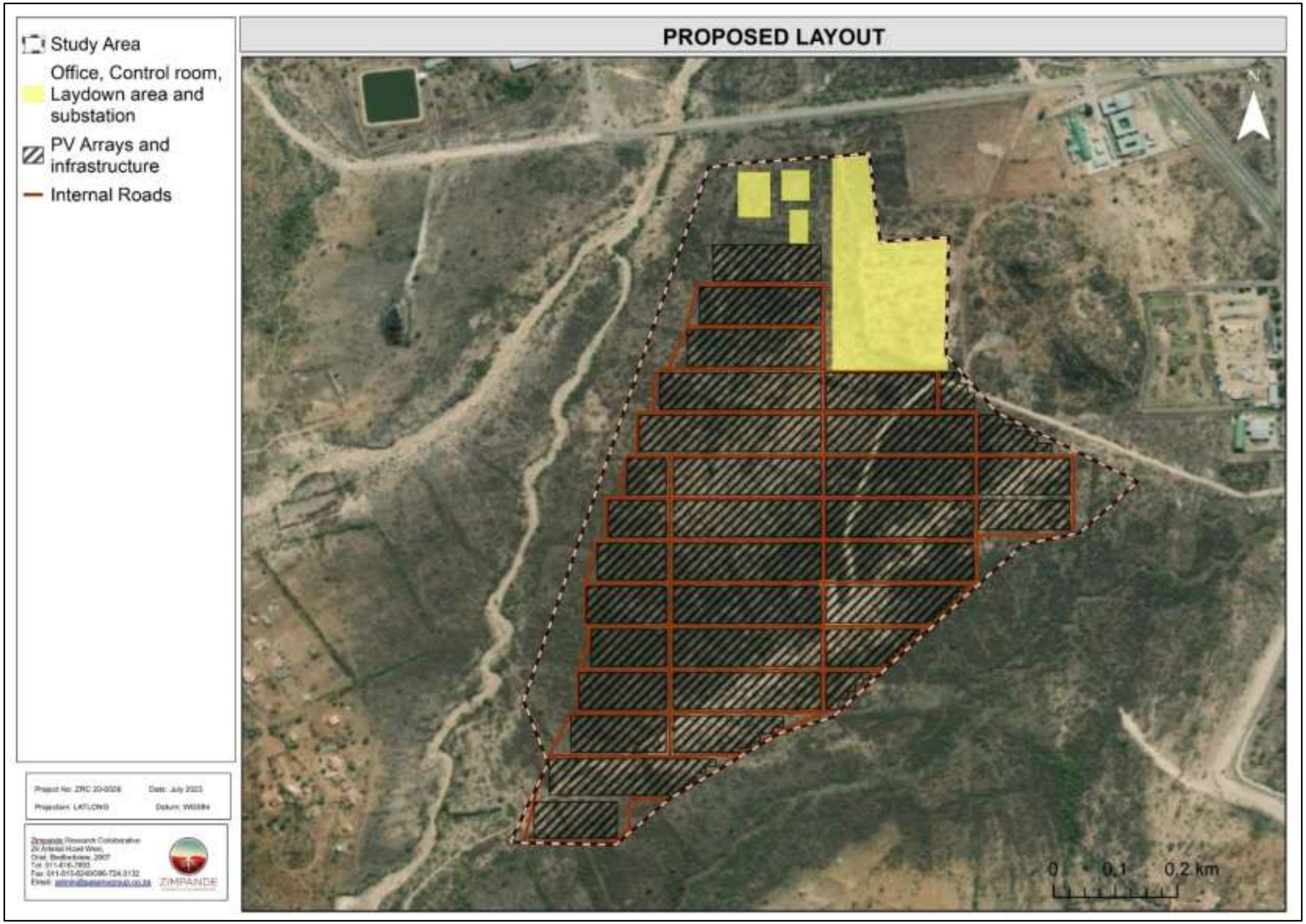


Figure 3: Proposed Layout. The BESS is not shown on the map as its locality was not know at the time of the assessment but it is assumed it will be located within the study area.

1.2 Terms of Reference and Scope of Work

The soil, land use, land capability and agricultural potential assessment which formed part of the Environmental Authorisation process entailed the following aspects:

- As part of the desktop study various data sets were consulted which includes but not limited to Soil and Terrain dataset (SOTER) to review the geology, landform and land capability to establish broad baseline conditions and sensitivity of study area both on environmental and agricultural perspective;
- Compile various maps depicting the on-site conditions based on desktop review of existing data;
- Classification of the climatic conditions occurring within the study area;
- Conduct a soil classification survey within the proposed development footprint;
- Assess the spatial distribution of various soil types within the study 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 using pre-defined impact assessment methodology; and
- Compile soil, land use and land capability report under current on-site conditions based on the field finding data.

1.3 Assumptions and Limitations

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

- The soil survey conducted as part of the land capability assessment was confined within the study area outline. This includes linear and surface infrastructure; and
- Land capability was classified according to the current soil restrictions, with respect to prevailing climatic conditions on site; however, it is virtually impossible to achieve 100% purity in soil mapping, the delineated soil map units could include other soil type(s) as the boundaries between the mapped soils are not absolute but rather form a continuum and gradually change from one type to another. Soil mapping and the findings of this assessment were therefore inferred from extrapolations from individual observation points ; and
- The proponent had proposed a Battery Energy Storage System (BESS) at the time of assessment, but it was unclear whether this technology would be utilised and also the type of battery (Sodim Sulphur Battery, Lithium Ion Battery, Redox (Vanadium) Flow

Battery and etc) and the location thereof was unknown. It is however, assumed that the BESS (if utilised) will be within the study area footprint area. The impact assessment has been undertaken under the assumption that the remaining areas were the BESS could be placed (within the footprint area) will be transformed (as no location has been provided for such infrastructure).

2. METHOD OF ASSESSMENT

2.1 Literature and Database Review

Prior to commencement of the field assessment, a background study, including a literature review, was conducted to collect the pre-determined soil and land capability data in the vicinity of the investigated study area. Various data sources including but not limited to the Agricultural Geo-Referenced Information System (AGIS) and other sources as listed under references were utilised to fulfil the objectives for the assessment. This was followed by a field investigation exercise to ground truth the pre-determined soil results which were undertaken at a desktop level.

2.2 Soil Classification and Sampling

A soil survey was conducted in November 2020, at which time the identified soils within the study area classified into soil forms according to the Soil Classification System: A Natural and Anthropogenic System for South Africa Soil Classification System (2018). This survey period is deemed appropriate since seasonality does not have an effect on the soil characteristics. Subsurface soil observations were made using a manual hand auger in order to assess individual soil profiles, which entailed evaluating physical soil properties and prevailing limitations to various land uses.

2.3 Land Capability Classification

Agricultural potential is directly related to Land Capability, as measured on a scale of I to VIII, as presented in Table 1 below; with Classes I to III classified as prime agricultural land that is well suited for annual cultivated crops, whereas, Class IV soils may be cultivated under certain circumstances and specific or intensive management practices, and Land Classes V to VIII are not suitable to cultivation. Furthermore, the climate capability is also measured on a scale of C1 to C8, 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 assessed in order to inform the necessary mitigation measures.

Table 1: Land Capability Classification (Smith, 2006).

Land Capability Class	Increased Intensity of Use									Land Capability Groups	Limitations
I	W	F	LG	MG	IG	LC	MC	IC	VIC	**Arable land**	No or few limitations
II	W	F	LG	MG	IG	LC	MC	IC			Slight limitations
III	W	F	LG	MG	IG	LC	MC	IC			Moderate limitations
IV	W	F	LG	MG	IG	LC					Severe limitations
V	W	F	LG	MG						**Grazing land**	Water course and land with wetness limitations
VI	W	F	LG	MG							Limitations preclude cultivation. Suitable for perennial vegetation
VII	W	F	LG								Very severe limitations. Suitable only for natural vegetation
VIII	W									**Wildlife**	Extremely severe limitations. Not suitable for grazing or afforestation.
W- Wildlife				MG- Moderate grazing						MC- Moderate cultivation	
F- Forestry				IG- Intensive grazing						IC- Intensive cultivation	
LG- Light grazing				LC- Light cultivation						VIC- Very intensive cultivation	

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 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 (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 DEA 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 authorisation. The assessment requirements of this protocol are associated

with a level of environmental sensitivity determined by the national web-based environmental screening tool which for agricultural resources is based on the most recent land capability evaluation values as provided by the Department of Agriculture, Forestry and Fisheries. The national web-based environmental screening tool can be accessed at:
The main purpose of the Agricultural Agro-Ecosystem Assessment is to ensure that the sensitivity of the site to the proposed land use change (from potential agricultural land to the proposed solar energy facility) is sufficiently considered. The information provided in this report aims to enable the Competent Authority to come to a sound conclusion on the impact of the proposed photovoltaic solar energy facility on the food production potential of the site.

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 was 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 study area;
- All data and conclusions are submitted together with the main report for the proposed photovoltaic solar energy facility;
- It must indicate whether or not the proposed photovoltaic solar energy facility 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; and
- The report is prepared in accordance with the requirements of the Environmental Impact Assessment Regulations.

The report is thus compiled in a manner that meets the minimum report content requirements for impacts on agricultural resources by the proposed photovoltaic solar energy facility.

3. DESKTOP ASSESSMENT RESULTS

The following data is applicable to the study area, according to various data sources including but not limited to the Agricultural Geo-referenced Information System (AGIS):

*It is important to note that although all data sources used provide useful and often verifiable, high-quality data, the various databases used do not always provide an entirely accurate indication of the actual site characteristics associated with the study area at the scale required to inform an environmental process. However, this information is useful as background information to the study and, if desktop results are considered with the outcome of the soil and land capability assessment, sufficient decision making can take place.

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

Parameters	Description
Mean Annual precipitation (MAP)	Mean Annual Precipitation (MAP) between 401 and 600mm per annum. This rainfall is deemed moderately adequate for most cultivated crops with a moderate yield potential. These conditions have a moderate to very low yield potential for a limited range of adapted crops but planting date options are limited for supporting rain fed agriculture.
Mean Annual Evaporation (MAE)	Mean Annual Evaporation is between 2201 mm and 2400 mm. The high evaporation rates pose risks to plant yield due possible plant permanent wilting resulting in plant desiccation and lack of adequate soil moisture. The high evaporation rates pose risks to plant yield due possible plant permanent wilting resulting in plant desiccation and lack of adequate soil moisture.
Geology	According to the geological map of South Africa 2001, the proposed solar plant areas are underlain by the Rustenburg, Lebowa and Rashoop geological setting.
Landform type	The entire study area is classified to have a Plain Landform. This means the terrain is suitable to allow agricultural activities.
Soil pH	Neutral to alkaline with pH range of 7.5 - 8.4. High pH can make most micronutrients nutrients such as iron, manganese, boron, copper and zinc less soluble and unavailable for plant uptake.
The Soil and Terrain (SOTER) soil classification	The entire study area is characterised by Calcic Vertisols. These soils are associated with poor physical properties induced by strong structure and high clay content which may effectively reduce water infiltration. These soils are more prone to waterlogging conditions or prone to intensified runoff during high intensity rainfall. This intensified runoff makes the soils more prone to erosion and thus the formation of gullies making the soil conditions not favorable for most cultivated crops.
Landtype Class	The entire study area is characterised by the Ea88 landtype. Which is associated with structured, black, swelling clays
Desktop land capability	The land capability for the entire study area is of moderate potential arable land (Class III).
Historical Land use	The historical land use of the entire study area is vacant or unspecified.
Clay Content	The clay content for the entire study area is classified to be greater than 35%.
Grazing Capacity (ha/LSu)	14 - 17 hectares per large animal for the east and southern portions 18–21 hectares per large animal for the north and western portions(Figure 3). This area is therefore not considered ideal for commercial livestock farming due to sparsity of vegetation and associated low carrying capacity, extreme temperatures and scarcity of water sources which might cause harm to livestock and subsequent loss of profit (Figure 3(
Alkalinity and Sodicity of the soils	The soils are neither alkaline nor sodic, this indicates soils are not affected by high concentration of salts.
Probability of soil loss	The soil loss for the entire study area is predicted to be very high, due to high velocity water causing channels into the soils.
Soil Water Retaining Characteristics below the root zone	Scarce or Absent.

Parameters	Description
Soil Depth	Soil depth for the entire study area is considered to be between 450 and 750 mm. This soil depth is not considered sufficient for the majority of cultivated crops.
Department of Environmental Affairs (DEA) screening tool	High Sensitivity (Figure 4).

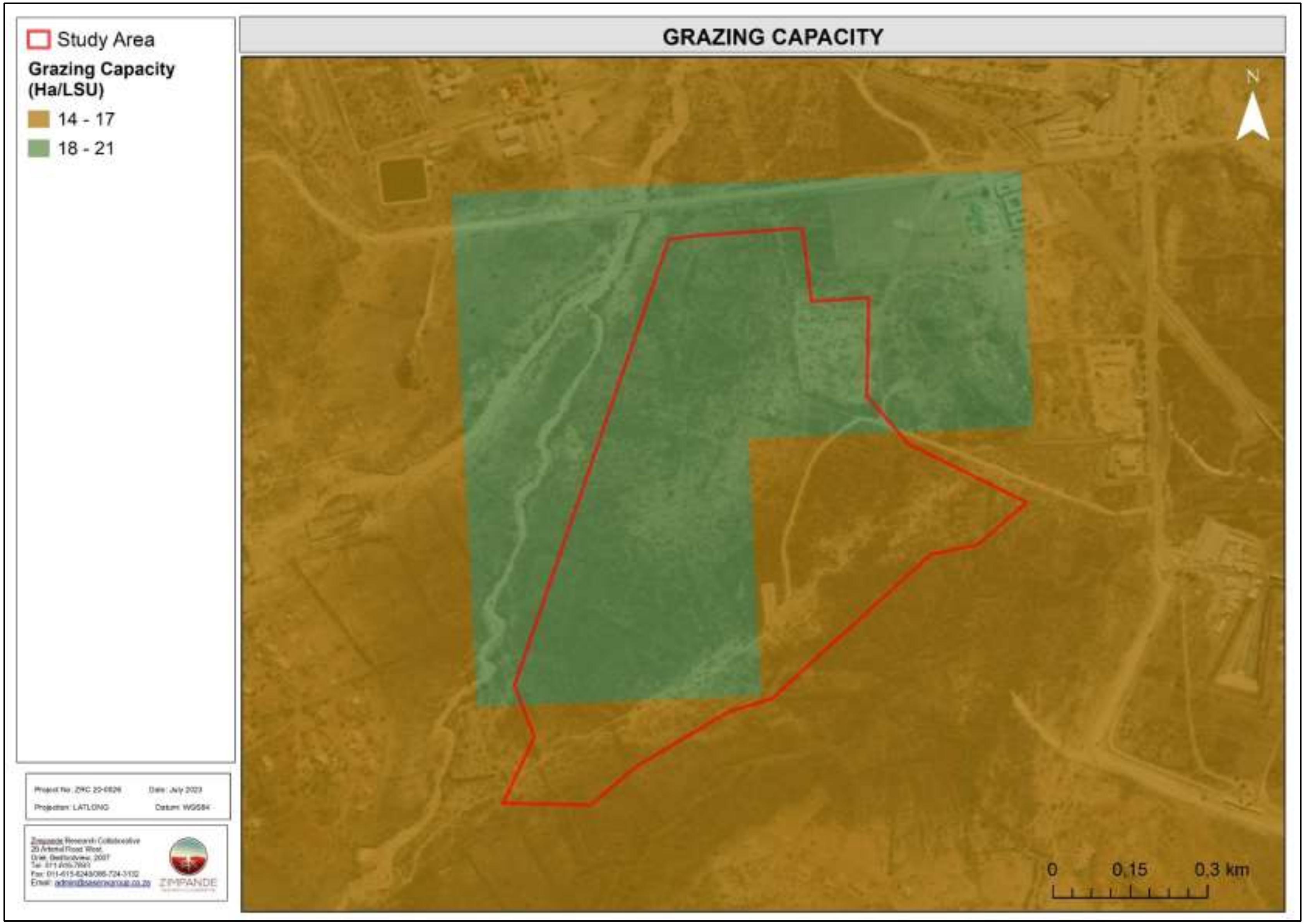
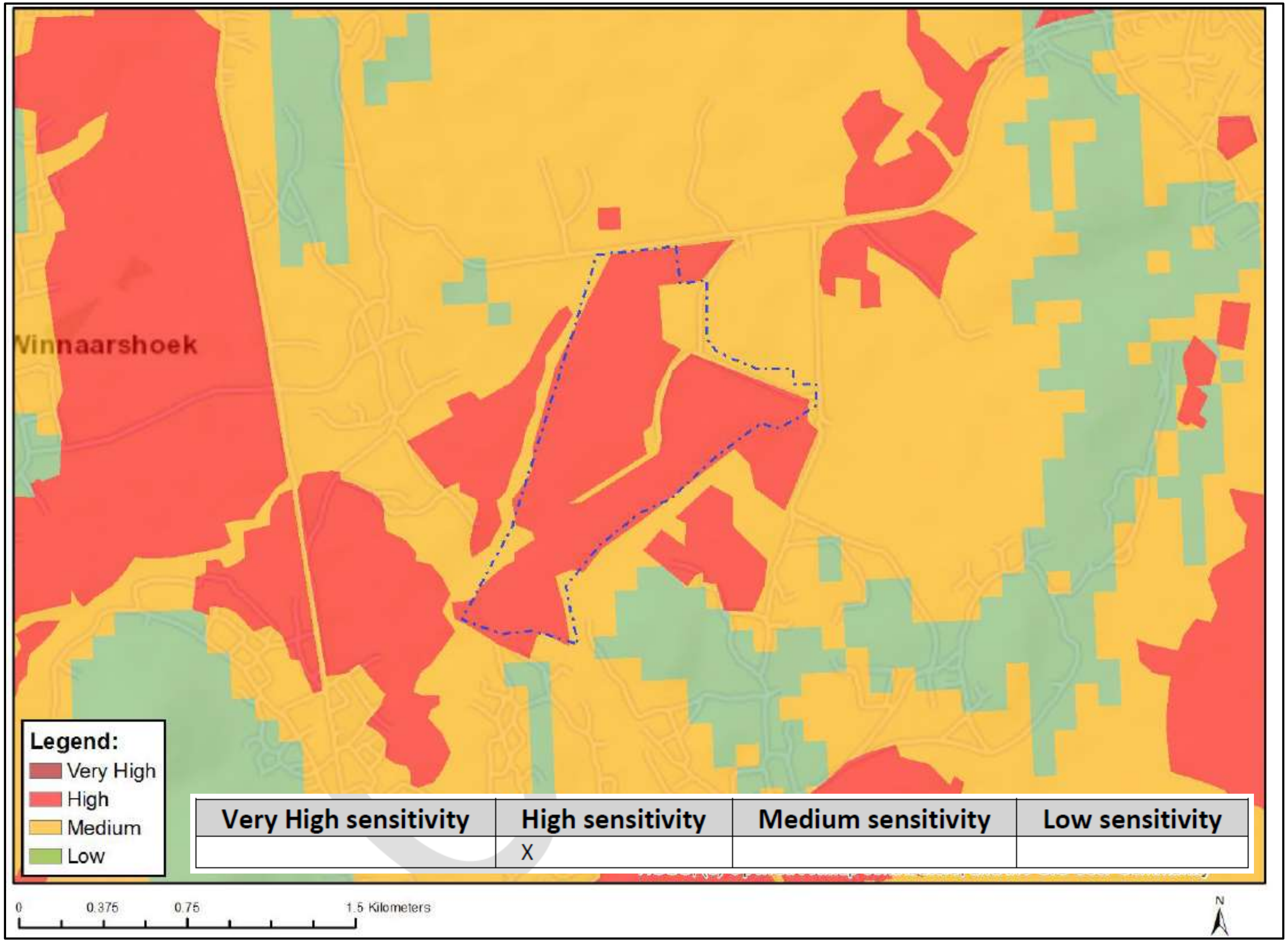


Figure 4: Map depicting the grazing capacity (Ha/LSU) associated with the study area.



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Figure 5: Screening tool analysis for agricultural sensitivity.

4. ASSESSMENT RESULTS

4.1 Current Land Use

Based on the observations during the site assessment, the dominant land uses within the study area are mining related activities, with the sub-dominant uses being residential areas and wilderness/wildlife. No agricultural activities were observed in the immediate vicinity of the study area. Refer to Figure 5 for examples of the current land uses associated with the study area.

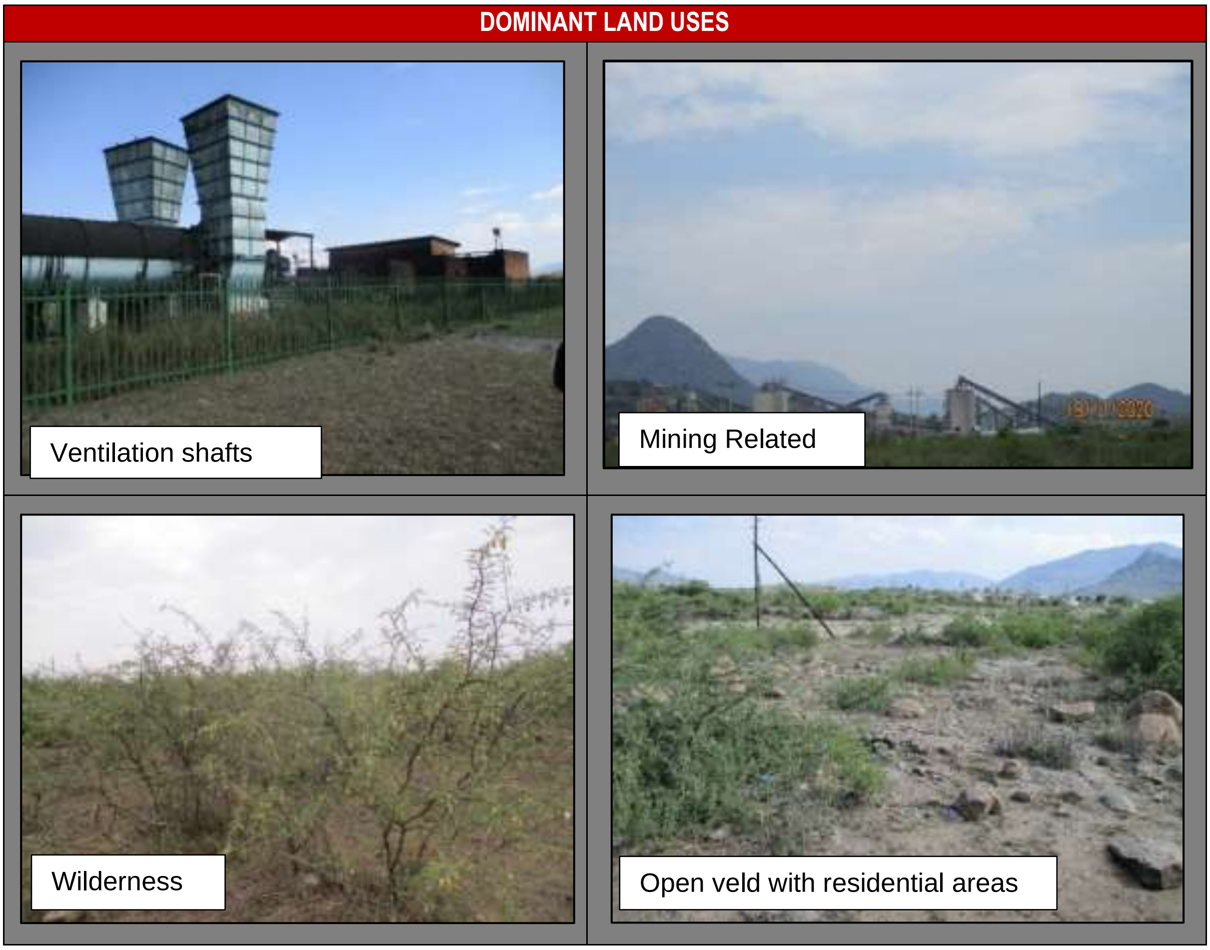


Figure 6: Photographs illustrating the dominant land use associated with the study area.

4.2 Dominant Soil Forms

The study area is dominated by marginal to low agricultural potential soils (Spionberg/Valsrivier). In total, two (2) soil forms were identified within the study area and these include the Spionberg/Valsrivier and the Witbank formations.

The dominant soils of Spionberg/Valsrivier, Witbank are not considered ideal for cultivation due to:

- Poor drainage characteristics;
- Shallow rooting depth due to high clay content in the B horizon;
- Inadequate moisture;
- Bleached topsoils associated with the Dundee soil form which lack nutrient retention capacity to support optimum growth and production; and
- Disturbed soils due to anthropogenic influences.

The soils of the Spionberg/Valsrivier are associated with poor physical properties induced by high clay content and very strong structure. The high clay content may effectively reduce water infiltration and thus these soils are more prone to waterlogging conditions as well as intensified runoff during high intensity rainfall. This intensified runoff makes the soils more prone to erosion and thus the formation of gullies which are not favourable for most cultivated crops. The strongly developed structure of the soils may impede root growth and thus limit the area to mostly grazing and/or forestry capability. Nutrient uptake by plants may be limited as these soils tend to bind nutrients tightly to the soil colloids due to the high cation exchange capacity (CEC) caused by high clay content, meaning that more nutrients are held by the soil and are not readily available for plant uptake. Nonetheless, should the soils be cultivated, intensive management practices will have to be implemented.

Witbank soils are considered of very low agricultural potential due to the soils having been subjected to physical disturbance because of human interventions. Such interventions include transportation and deposition of the earth material containing soil. As a result, these soils are unable to support agricultural production unless significant amelioration and rehabilitation takes place.

The soils within the study area can be broadly classified as not capable of supporting agricultural cultivation practices unless an intensive management practice is applied. However, grazing activities as well as wildlife/wilderness can be supported. Table 6 below represents the soil forms identified within the study area as well as their diagnostic horizons respectively. Figures 6 illustrates the dominant soil forms associated with the study area.

Table 6: Dominant soil forms within the study area.

Soil Form	Code	Diagnostic Horizon Sequence
Spionsberg/Valsrivier	Sb/Va	Orthic A/Pedocutanic or Hardrock
Witbank	Wt	Anthrosols

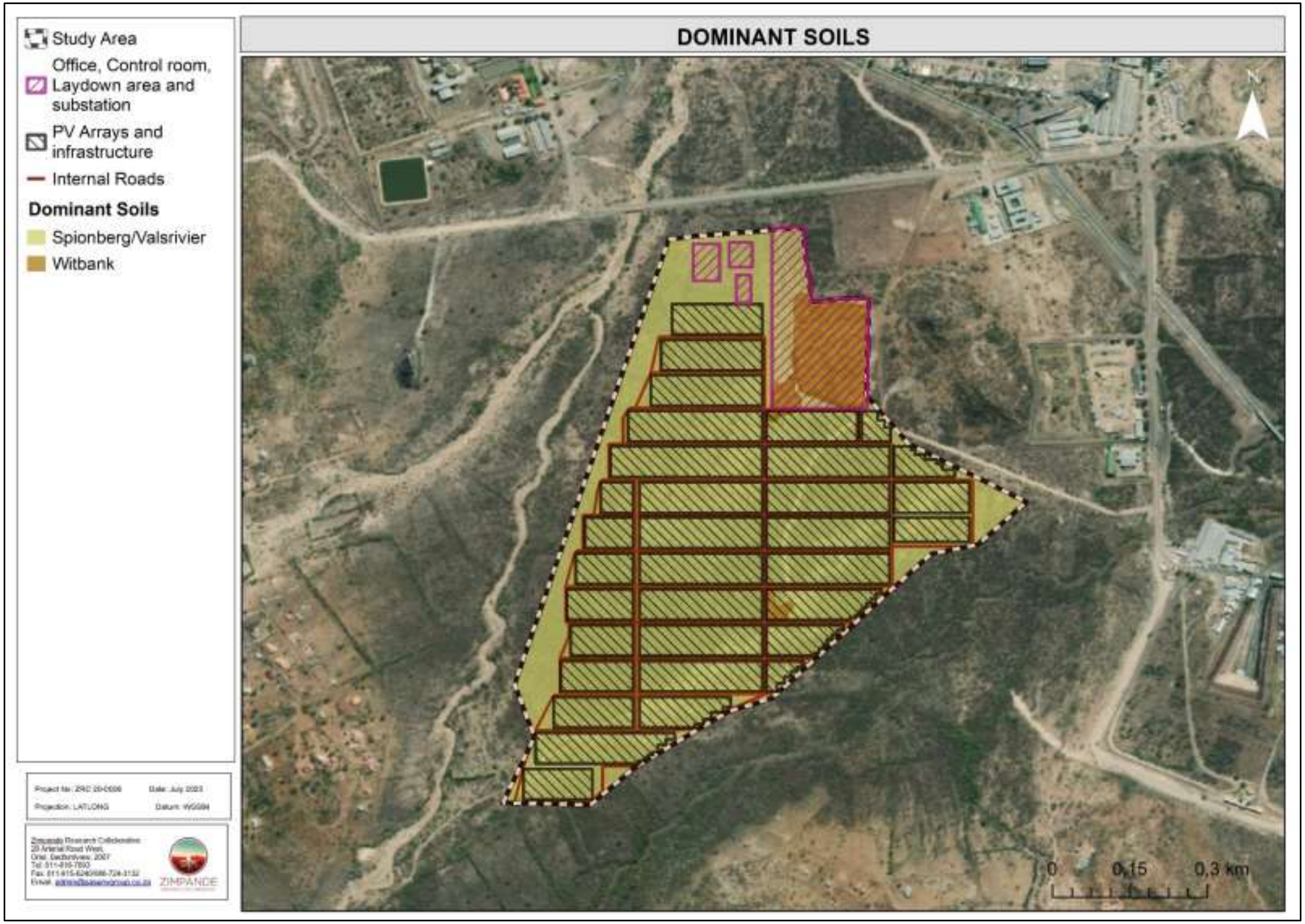


Figure 7: Dominant soils forms within the study area.

4.3 Land Capability Classification

Agricultural land capability in South Africa is generally restricted by climatic conditions, with specific mention to water availability (rainfall). Even within similar climatic zones, different soil types typically have different land use capabilities attributed to their inherent characteristics. High potential agricultural land is defined as having the soil and terrain quality, growing season and adequate available moisture supply needed to produce sustained economically high crop yields when treated and managed according to best possible farming practices (Scotney *et al*., 1987).

For the purpose of this assessment, land capability was inferred in consideration of observed limitations to land use due to physical soil properties and prevailing climatic conditions. Climate Capability (measured on a scale of 1 to 8) was therefore considered in the agricultural potential classification. The study area falls into Climate Capability Class 5 due to low rainfall and high temperatures, with low yield potential for a limited range of adapted crops.

The identified soils were classified into land capability and land potential classes using the Camp *et. al*, and Guy and Smith Classification system (Camp *et al.,* 1987; Guy and Smith, 1998), as presented from Figure **7**. The identified land capability limitations for the identified soils are discussed in comprehensive "dashboard style" summary tables presented from Tables **8 and 9** below. The dashboard reports aim to present all the pertinent information in a concise and visually appealing fashion. Table **7** below presents the dominant soil forms and their respective land capability, land potential as well as areal extent expressed as hectares as well as percentages. Figure **8 below** depicts the land potential of the soils in terms of agriculture attributable to their cultivability.

Table 7: Identified soil forms within the study area and their respective land capability and land potential.

Soil Form	Land capability	Land Potential	Area (ha)	Percentage
Spionsberg/Valsrivier	Grazing (Class VI)	Restricted Potential (L5)	48.56	93.80
Witbank	Wilderness (Class VII)	Restricted Potential (L5)	3.21	6.20
Total enclosed			**51.77**	**100**

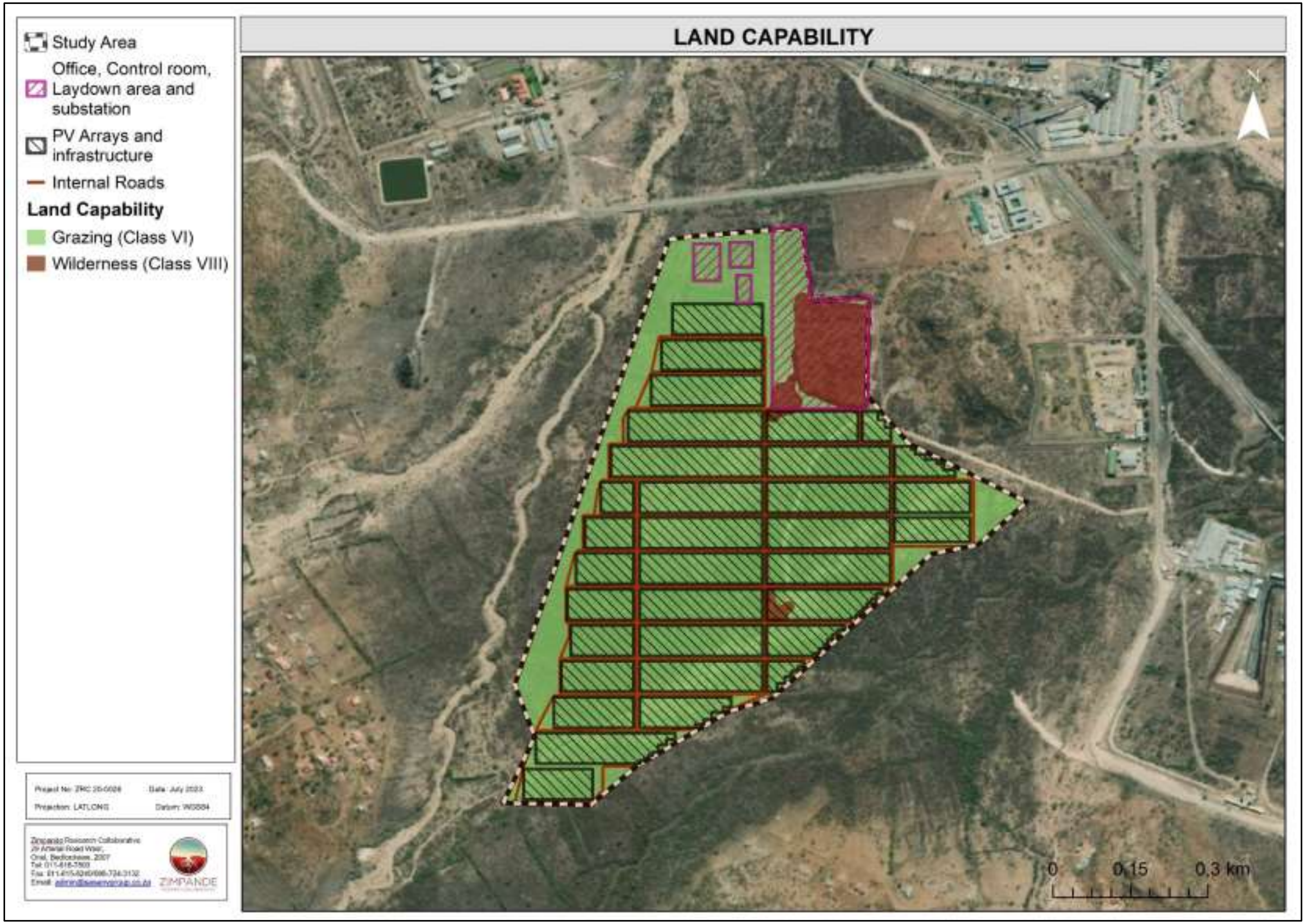


Figure 8: Map depicting Land capability of soils occurring within the study area.

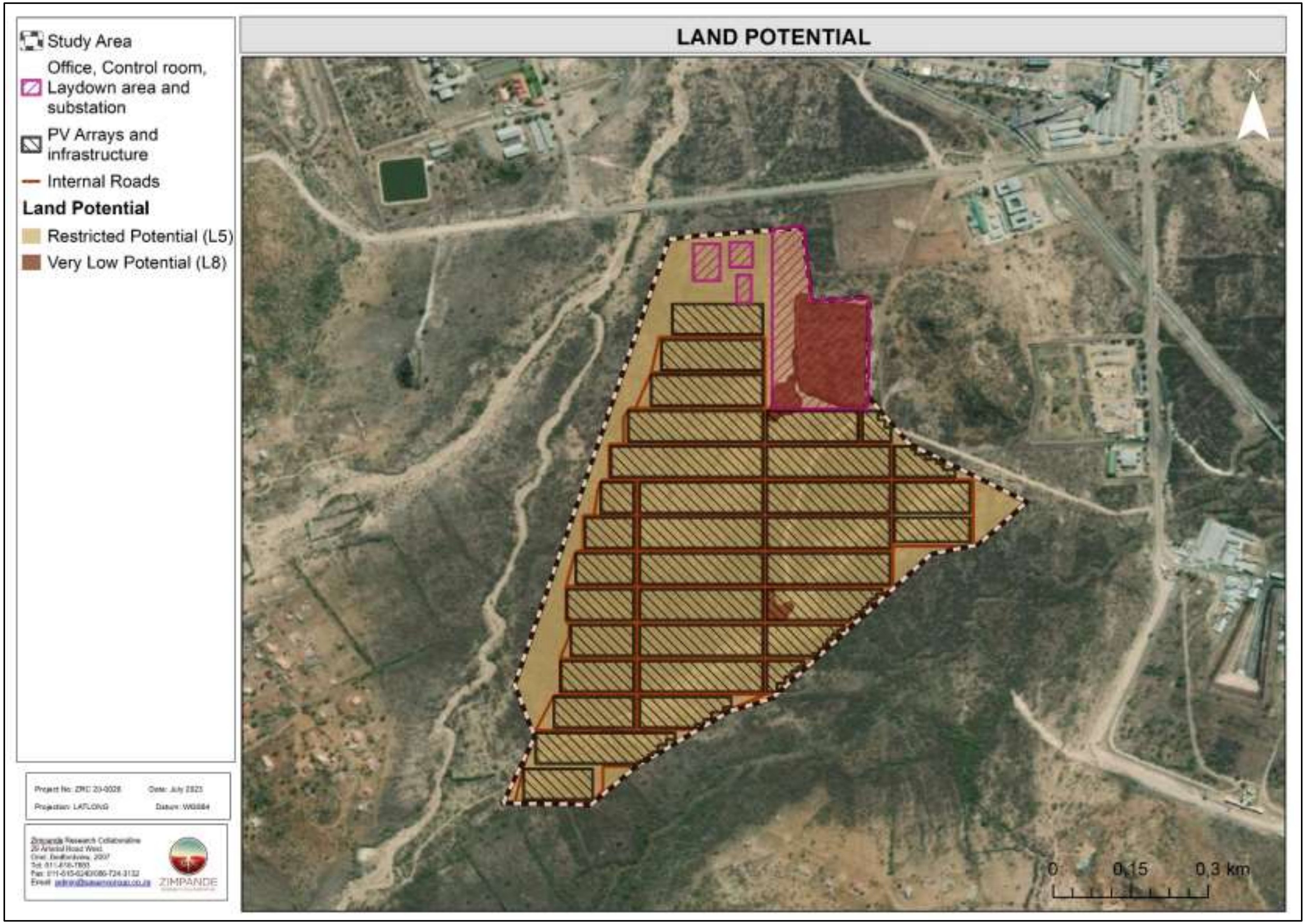


Figure 9: Map depicting agricultural sensitivity of soils occurring within the study area.

Table 8: Summary discussion of the Grazing (Class VI) land capability class

<table>
<tr><th colspan="5">Land Capability: Grazing (Class VI) and Restricted land potential</th></tr>
<tr><td colspan="5">  </td></tr>
<tr><td>Terrain Morphological Unit (TMU)</td><td colspan="2">Relatively flat landscapes of < 0.2% slope gradient</td><td>Photograph notes</td><td>View of the sandy topsoil, pedocutanic and soft carbonate soil horizons associated with soil forms occurring within the soil profile of the identified soil forms.</td></tr>
<tr><td>Soil Form(s)</td><td colspan="2">Spionberg/Valsrivier</td><td>Area Extent</td><td>48.56 ha which constitutes 93.8% of the study area</td></tr>
<tr><td>Physical Limitations</td><td colspan="2">Spionberg/Valsrivier are characterized by high clay (>35%) content in the subsoil and strong structure which will ultimately impede root penetration.</td><td colspan="2" rowspan="2">Land Capability and Land Potential
Land has very serious permanent limitations that restrict the choice of alternative crops or the intensity of crop production to a great extent.</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>Overall impact significance prior to mitigation</td><td>M</td><td rowspan="2">The overall impact of the proposed solar PV facilities on land capability and land potential is anticipated to be Medium without mitigation measures and Low with mitigation measures in place. Due to the inherently low land capability of the identified dominant soil forms. The proposed developments will result in a permanent change of land use. If this area is clearly demarcated the impact could potentially be reduced to low since the adjacent area could potentially be used as grazing land by subsistence farmers in the neighbouring communities or even co-exist with the proposed development.</td><td colspan="2" rowspan="2">Consideration of Integrated Environmental Management and Sustainable Development principles:
The identified soils are generally not considered significant in terms of agricultural productivity. Should agricultural production be considered intense management practices have to be applied, which are usually costly and not economical based on the expected yields from these soils. This is exacerbated by the climate of the area. However, plant and animal species habitat is likely to be affected. These soils are best suited for grazing, rangeland and wildlife. The proposed developments are viable on these soils considering the agricultural potential of these soils. Mitigation measures should this put in place to minimise further disruption of other adjacent soils which can potentially be used for grazing, rangeland and wildlife.</td></tr>
<tr><td>Overall impact significance post mitigation</td><td>L</td></tr>
</table>

Table 9: Summary discussion of the Wilderness (Class VII) land capability class

<table>
<tr><th colspan="5">Land Capability: Grazing (Class VII) and Very Low land potential.</th></tr>
<tr><td colspan="5"> </td></tr>
<tr><td colspan="2">Terrain Morphological Unit (TMU)</td><td>Gently sloping landscapes of < 0.5% slope gradient</td><td>Photograph notes</td><td>View of the shallow soil horizon, rock outcrop and physically disturbed soils associated with the Mispah and Witbank soil forms.</td></tr>
<tr><td colspan="2">Soil Form(s)</td><td>Witbank</td><td>Area Extent</td><td>3.21 ha which constitutes 6.2% of the total study area.</td></tr>
<tr><td colspan="2">Physical Limitations</td><td>Comprises of significantly disturbed areas due from anthropogenic 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 appropriate soil to provide a growth medium due to the rocky outcrops</td><td colspan="2" rowspan="2">Land Capability and Land Potential
The Lithic soils (Mispah) are also considered to be of poor (Class VI) land capability and are not suitable for arable agriculture. These soils are therefore considered to have low land potential. Low land potential has permanent limitations that exclude it from commercial plant production and the use thereof is limited to wildlife, recreation, water provision and aesthetic qualities.</td></tr>
<tr><td colspan="2">Land Potential</td><td>L8 (Very low potential): Very severe limitations due to soil, slope, temperature or rainfall. Non-arable.</td></tr>
<tr><td>Overall impact significance prior to mitigation</td><td>L</td><td rowspan="2">The overall impact of the proposed development on the land capability of these soils is anticipated to be low due to their very poor land capability .</td><td colspan="2" rowspan="2">Consideration of Integrated Environmental Management and Sustainable Development principles:

These identified Witbank soils have very poor (class VIII) land capability due to the significant disturbance that has occurred as a result of sand extraction activities. This has led to the long-term alteration of the soil physical chemical properties such that these soils are no longer viable for agriculture. These soils are therefore not considered to make a significant contribution to agricultural productivity even on a local scale.</td></tr>
<tr><td>Overall impact significance post mitigation</td><td>L</td></tr>
</table>

5. IMPACT ASSESSMENT AND MITIGATION MEASURES

This section presents the significance of potential impacts on the identified soil resources associated with the proposed developments. In addition, it also indicates the required mitigatory measures needed to minimise the perceived impacts associated with the proposed development and presents 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 on Table 10 and Table 11.

Table 10: Description of the impact significance in relation to the to the proposed activities and developments within the study area.

PART D: INTERPRETATION OF SIGNIFICANCE	
Significance	**Decision guideline**
Very High	Potential fatal flaw unless mitigated to lower significance.
High	It must have an influence on the decision. Substantial mitigation will be required.
Medium	It should have an influence on the decision. Mitigation will be required.
Low	Unlikely that it will have a real influence on the decision. Limited mitigation is likely required.
Very Low	It will not have an influence on the decision. Does not require any mitigation
Insignificant	Inconsequential, not requiring any consideration.

Table 11: : Description of terms used in the impact assessment rating for the proposed activities and developments within the study area.

PART A: DEFINITIONS AND CRITERIA*		
Definition of SIGNIFICANCE		**Significance = consequence x probability**
Definition of CONSEQUENCE		**Consequence is a function of intensity, spatial extent and duration**
Criteria for ranking of the INTENSITY of environmental impacts	**VH**	Severe change, disturbance or degradation. Associated with severe consequences. May result in severe illness, injury or death. Targets, limits and thresholds of concern continually exceeded. Substantial intervention will be required. Vigorous/widespread community mobilization against project can be expected. May result in legal action if impact occurs.
	H	Prominent change, disturbance or degradation. Associated with real and substantial consequences. May result in illness or injury. Targets, limits and thresholds of concern regularly exceeded. Will definitely require intervention. Threats of community action. Regular complaints can be expected when the impact takes place.
	M	Moderate change, disturbance or discomfort. Associated with real but not substantial consequences. Targets, limits and thresholds of concern may occasionally be exceeded. Likely to require some intervention. Occasional complaints can be expected.
	L	Minor (Slight) change, disturbance or nuisance. Associated with minor consequences or deterioration. Targets, limits and thresholds of concern rarely exceeded. Require only minor interventions or clean-up actions. Sporadic complaints could be expected.
	VL	Negligible change, disturbance or nuisance. Associated with very minor consequences or deterioration. Targets, limits and thresholds of concern never exceeded. No interventions or clean-up actions required. No complaints anticipated.

<table>
<tr><th colspan="3">PART A: DEFINITIONS AND CRITERIA*</th></tr>
<tr><td colspan="2">Definition of SIGNIFICANCE</td><td>Significance = consequence x probability</td></tr>
<tr><td rowspan="5"></td><td>VL+</td><td>Negligible change or improvement. Almost no benefits. Change not measurable/will remain in the current range.</td></tr>
<tr><td>L+</td><td>Minor change or improvement. Minor benefits. Change not measurable/will remain in the current range. Few people will experience benefits.</td></tr>
<tr><td>M+</td><td>Moderate change or improvement. Real but not substantial benefits. Will be within or marginally better than the current conditions. Small number of people will experience benefits.</td></tr>
<tr><td>H+</td><td>Prominent change or improvement. Real and substantial benefits. Will be better than current conditions. Many people will experience benefits. General community support.</td></tr>
<tr><td>VH+</td><td>Substantial, large-scale change or improvement. Considerable and widespread benefit. Will be much better than the current conditions. Favourable publicity and/or widespread support expected.</td></tr>
<tr><td rowspan="5">Criteria for ranking the DURATION of impacts</td><td>VL</td><td>Very short, always less than a year. Quickly reversible</td></tr>
<tr><td>L</td><td>Short-term, occurs for more than 1 but less than 5 years. Reversible over time.</td></tr>
<tr><td>M</td><td>Medium-term, 5 to 10 years.</td></tr>
<tr><td>H</td><td>Long term, between 10 and 20 years. (Likely to cease at the end of the operational life of the activity)</td></tr>
<tr><td>VH</td><td>Very long, permanent, +20 years (Irreversible. Beyond closure)</td></tr>
<tr><td rowspan="5">Criteria for ranking the EXTENT of impacts</td><td>VL</td><td>A part of the site/property.</td></tr>
<tr><td>L</td><td>Whole site.</td></tr>
<tr><td>M</td><td>Beyond the site boundary, affecting immediate neighbours</td></tr>
<tr><td>H</td><td>Local area, extending far beyond site boundary.</td></tr>
<tr><td>VH</td><td>Regional/National</td></tr>
</table>

5.1 Activities

Proposed Activity Description:

At the time of the field assessment, no layouts for the proposed development had been provided to the ZRC. Thus, for the impact assessment, as per the precautionary principle, it was assumed that the entire study area would be developed (i.e., transformed).

The impact assessment rating is applicable to the following activities:

Table 12: Activities associated with study area during different phases

<table>
<tr><th>Phase</th><th>Activities</th></tr>
<tr><td rowspan="2">Pre- Construction Phase</td><td>Planning and design of the footprint areas.</td></tr>
<tr><td>Preparation for the construction activities</td></tr>
<tr><td rowspan="3">construction</td><td>Clearing of the footprint area associated for the proposed developments</td></tr>
<tr><td>Soil striping</td></tr>
<tr><td>Construction of various infrastructure</td></tr>
<tr><td>Operational</td><td>Operation of the photovoltaic (PV) facility</td></tr>
</table>

5.1.1 Impact: Removal and Stockpiling of Soil and Subsequent Loss of Land Capability

Vegetation clearing and soil stripping prior to the commencement of construction activities can possibly result potential loss and degradation of productive topsoil material if not managed and mitigated properly. Stripped and stockpiled soils are prone to compaction, loss of soil structure, nutrient degradation by mixing topsoil with lower quality subsoil, and salinisation through heavy machinery handling. Refer to Table 13 for the impact significance ratings.

The anticipated loss of land capability for soils occurring within the study area is anticipated to be Medium because of site clearing, followed by soil stripping which will potentially result in loss of fertile topsoil, reduced soil quality and soil erosion. The Low impact with mitigation measures takes into account that the applicant will adhere to the integrated mitigation measures on Section 5.2 of this report.

Table 13: Summary of the impact significance for soil land capability during all phases of development.

Description of Impact		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	All phases	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Moderate change (Medium)	Minor change (Low)
Duration	Short-term (1 to 5 years)	Short-term (1 to 5 years)
Extent	Confined within the project site	Immediate footprint of activity
Consequence	Medium	Low
Probability	Definite / Continuous (Very high)	Probable
gnificance	**Medium -**	**Low -**
Additional Assessment Criteria		
Degree to which impact can be reversed	Partially reversable. Upon removal of solar facility the soils could be re-instated overtime through rehabilitation efforts.	
Degree to which impact may cause irreplaceable loss of resources	Medium: The soils which are stripped my not be replaced during the decommissioning phase	
Degree to which impact can be avoided	Low: Not avoidable but rehabilitation efforts in the remaining footprint extent to ensure that the soils are conserved.	
Degree to which impact can be mitigated	Medium: This depends entirely on the rehabilitation plan if the soils of similar land capability will be replaced.	
Cumulative Impact		
Extent to which a cumulative impact may arise	Possible	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Medium -	**Low -**

5.1.2 Soil Erosion

Soil erosion is largely dependent on land use and soil management and is generally accelerated by anthropogenic activities. In the absence of detailed South African guidelines on erosion classification, the erosion potential and interpretation are based on field observations as well as observed soil profile characteristics. In general, soils with high clay content have a high-water retention capacity, thus less prone to erosion in comparison to sandy textured soils, which in contrast are more susceptible to erosion.

The proposed development is located on a relatively flat to gently sloping terrain, which decreases the erosion hazard. Although the soils identified within the study area less susceptible to erosion due to their high clay content as these soils have strong cohesive forces between the particles. However, due to their low infiltrability these soils are more prone to erosion during heavy rains as a result of surface runoff. Their susceptibility to erosion is likely to increase once the land is cleared for excavation, and the soils will inevitably be exposed to wind and stormwater. The overall soil erosion impact is therefore anticipated to be Medium during the pre-construction, construction and operational phases. Hence mitigation measures will be required.

Refer to 14, 15 and 16 for the different impact significance ratings on soil erosion for the study area.

Aspects and activities register

Pre-Construction	Construction	Operational
Potential poor planning leading to placement of waste management sites and infrastructure on moderate potential agricultural soils.	Site clearing, removal of vegetation, and associated disturbances to soils, leading to, increased runoff, soil compaction and consequent loss of land capability in	Constant disturbances of soils, resulting in risk of erosion
	Potential frequent movement of construction machinery within the project footprint, leading to excessive soil compaction.	

Table 14: Summary of the impact significance on soil erosion for the study area during the pre construction phase.

Description of Impact		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Pre-construction	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Prominent change (High)	Minor change (Low)
Duration	Short-term (1 to 5 years)	Short-term (1 to 5 years)
Extent	Whole site and nearby surroundings	Whole site and nearby surroundings
Consequence	Medium	Low

Probability	Probable (High)	Probable (High)
Significance	**Medium -**	**Low -**
Additional Assessment Criteria		
Degree to which impact can be reversed	Partially reversable. Upon removal of solar facility the soils could be re-instated overtime through rehabilitation efforts.	
Degree to which impact may cause irreplaceable loss of resources	Medium: The soils which are stripped my not be replaced during the decommissioning phase	
Degree to which impact can be avoided	Low: Not avoidable but rehabilitation efforts in the remaining footprint extent to ensure that the soils are conserved.	
Degree to which impact can be mitigated	Medium: This depends entirely on the rehabilitation plan if the soils of similar land capability will be replaced.	
Cumulative Impact		
Extent to which a cumulative impact may arise	Possible	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Medium -	Low -

Table 15: Summary of the impact significance on soil erosion for the study area during the construction phase.

Description of Impact		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Construction	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Prominent change (High)	Minor change (Low)
Duration	Short-term (1 to 5 years)	Short-term (1 to 5 years)
Extent	Beyond site	Whole site and nearby surroundings
Consequence	Medium	Low
Probability	Probable (High)	Probable (High)
Significance	**Medium -**	**Low -**
Additional Assessment Criteria		
Degree to which impact can be reversed	Partially reversable. Upon removal of solar facility the soils could be re-instated overtime through rehabilitation efforts.	
Degree to which impact may cause irreplaceable loss of resources	Medium: The soils which are stripped my not be replaced during the decommissioning phase	
Degree to which impact can be avoided	Low: Not avoidable but rehabilitation efforts in the remaining footprint extent to ensure that the soils are conserved.	
Degree to which impact can be mitigated	Medium: This depends entirely on the rehabilitation plan if the soils of similar land capability will be replaced.	
Cumulative Impact		
Extent to which a cumulative impact may arise	Possible	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Medium -	Low -

Table 16: Summary of the impact significance on soil erosion for the study area during the operational phase.

Description of Impact		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Operational	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Moderate change (Medium)	Minor change (Low)
Duration	Long-term (10 to 20 years)	Long-term (10 to 20 years)
Extent	Beyond site	Part of site/property
Consequence	Medium	Low
Probability	Probable (High)	Probable (High)
Significance	**Medium -**	**Low -**
Additional Assessment Criteria		
Degree to which impact can be reversed	Partially reversable. Upon removal of solar facility the soils could be re-instated overtime through rehabilitation efforts.	
Degree to which impact may cause irreplaceable loss of resources	Medium: The soils which are stripped my not be replaced during the decommissioning phase	
Degree to which impact can be avoided	Low: Not avoidable but rehabilitation efforts in the remaining footprint extent to ensure that the soils are conserved.	
Degree to which impact can be mitigated	Medium: This depends entirely on the rehabilitation plan if the soils of similar land capability will be replaced.	
Cumulative Impact		
Extent to which a cumulative impact may arise	Possible	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Medium -	**Low -**

5.1.3 Potential Soil Compaction

Heavy equipment traffic during construction and activities is anticipated to cause soil compaction. The severity of this impact is likely to be significant for most of the soils due to amount of disturbance that could occur due to the clayey texture of the soils which dominate the study area. The impact significance can be reduced significantly, should the proposed activities be restricted to access roads, vehicle hard stand areas and equipment and machinery laydown areas. Soil compaction will potentially lead to:

- Increased bulk density and soil strength, reduced aeration and lower infiltration rate
- Destroyed soil structure, causing it to become more massive with fewer natural voids with a high possibility of soil crusting.
- Soil biodiversity is also influenced by reduced soil aeration. Severe soil compaction may cause reduced microbial biomass. Soil compaction may not influence the quantity, but the distribution of macro fauna that is vital for soil structure including earthworms due to reduction in large pores.

Refer to Tables 17, 18 and 19 for the different impact significance ratings on soil compaction for the study area.

Aspects and activities register

Pre-Construction	Construction	Operational
Potential poor planning leading to placement of waste management sites and infrastructure on moderate potential agricultural soils.	Site clearing, removal of vegetation, and associated disturbances to soils, leading to, increased runoff, soil compaction and consequent loss of land capability in cleared	Constant disturbances of soils, resulting in risk of compaction
	Potential frequent movement of construction machinery within the project footprint, leading to excessive soil compaction.	

Table 17: Summary of the impact significance on soil compaction for the study area during the pre-construction phase.

Description of Impact		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Pre-construction	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Moderate change (Medium)	Minor change (Low)
Duration	Short-term (1 to 5 years)	Short-term (1 to 5 years)
Extent	Beyond site	Whole site and nearby surroundings
Consequence	Medium	Low
Probability	Probable (High)	Probable (High)
Significance	**Medium -**	**Low -**
Additional Assessment Criteria		
Degree to which impact can be reversed	Partially reversable. Upon removal of solar facility the soils could be re-instated overtime through rehabilitation efforts.	
Degree to which impact may cause irreplaceable loss of resources	Medium: The soils which are stripped my not be replaced during the decommissioning phase	
Degree to which impact can be avoided	Low: Not avoidable but rehabilitation efforts in the remaining footprint extent to ensure that the soils are conserved.	
Degree to which impact can be mitigated	Medium: This depends entirely on the rehabilitation plan if the soils of similar land capability will be replaced.	
Cumulative Impact		
Extent to which a cumulative impact may arise	Possible	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Medium -	**Low -**

Table 18: Summary of the impact significance on soil compaction for the study area during the construction phase.

Description of Impact		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Construction	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Prominent change (High)	Moderate change (Medium)
Duration	Short-term (1 to 5 years)	Short-term (1 to 5 years)
Extent	Beyond site	Whole site and nearby surroundings
Consequence	Medium	Low
Probability	Probable (High)	Probable (High)
Significance	**Medium -**	**Low -**
Additional Assessment Criteria		
Degree to which impact can be reversed	Partially reversable. Upon removal of solar facility the soils could be re-instated overtime through rehabilitation efforts.	
Degree to which impact may cause irreplaceable loss of resources	Medium: The soils which are stripped my not be replaced during the decommissioning phase	
Degree to which impact can be avoided	Low: Not avoidable but rehabilitation efforts in the remaining footprint extent to ensure that the soils are conserved.	
Degree to which impact can be mitigated	Medium: This depends entirely on the rehabilitation plan if the soils of similar land capability will be replaced.	
Cumulative Impact		
Extent to which a cumulative impact may arise	Possible	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Medium -	**Low -**

Table 19: Summary of the impact significance on soil compaction for the study area during the operational phase.

Description of Impact		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Operational	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Moderate change (Medium)	Minor change (Low)
Duration	Long-term (10 to 20 years)	Long-term (10 to 20 years)
Extent	Beyond site	Whole site and nearby surroundings
Consequence	Medium	Medium
Probability	Probable (High)	Possible / frequent (Medium)
Significance	**Medium -**	**Low -**
Additional Assessment Criteria		
Degree to which impact can be reversed	Partially reversable. Upon removal of solar facility the soils could be re-instated overtime through rehabilitation efforts.	

Degree to which impact may cause irreplaceable loss of resources	Medium: The soils which are stripped my not be replaced during the decommissioning phase	
Degree to which impact can be avoided	Low: Not avoidable but rehabilitation efforts in the remaining footprint extent to ensure that the soils are conserved.	
Degree to which impact can be mitigated	Medium: This depends entirely on the rehabilitation plan if the soils of similar land capability will be replaced.	
Cumulative Impact		
Extent to which a cumulative impact may arise	Possible	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Medium -	**Low -**

5.1.4 Potential Soil Contamination

Contamination sources are mostly unpredictable and often occur as incidental spills or leaks during both the construction and operational phase. Thus, all the identified soils are considered equally predisposed to potential contamination. The significance of contamination is largely dependent on the nature, volume and/or concentration of the contaminant of concern as well as the rate at which contaminants are transported by water in the soil. Therefore, strict waste management protocols as well as product stockpile management and activity specific Environmental Management Programme (EMP) and monitoring guidelines should be adhered to during the construction and operational activities. If the management protocols are not well managed this will more likely lead to:

- Contaminants leaching into the soil and thus potentially rendering the soil sterile. reducing the yield potential of soils.
- Potential reduction of water quality used for irrigation and for livestock use.

Refer to Tables 20, 21 and 22 for the different impact significance ratings on soil contamination for the study area.

Aspects and activities register

Pre-Construction	Construction	Operational
Potential poor planning leading to placement of waste management sites and infrastructure on high potential agricultural soils.	Spillage of petroleum hydrocarbons during construction of associated infrastructure	Leaching of hydrocarbons chemicals into the soils from maintenance equipment, leading to alteration of the soil chemical status as well as contamination of ground water
The BESS, if utilised may contain hazardous substances in the form of chemicals; thus accidental leaks would cause soil and water pollution impacts.	Disposal of hazardous and non-hazardous waste, including waste material spills and refuse deposits into the soil.	Potential disposal of hazardous and non-hazardous waste, including waste material spills and refuse deposits into the soil.

Table 20: Summary of the impact significance on soil contamination for the study area during the pre-construction phase.

Description of Impact		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Pre-construction	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Moderate change (Medium)	Moderate change (Medium)
Duration	Short-term (1 to 5 years)	Short-term (1 to 5 years)
Extent	Beyond site	Whole site and nearby surroundings
Consequence	Medium	Low
Probability	Probable (High)	Probable (High)
Significance	**Medium -**	**Low -**
Additional Assessment Criteria		
Degree to which impact can be reversed	Partially reversable. Upon removal of solar facility the soils could be re-instated overtime through rehabilitation efforts.	
Degree to which impact may cause irreplaceable loss of resources	Medium: The soils which are stripped my not be replaced during the decommissioning phase	
Degree to which impact can be avoided	Low: Not avoidable but rehabilitation efforts in the remaining footprint extent to ensure that the soils are conserved.	
Degree to which impact can be mitigated	Medium: This depends entirely on the rehabilitation plan if the soils of similar land capability will be replaced.	
Cumulative Impact		
Extent to which a cumulative impact may arise	Possible	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Medium -	**Low -**

Table 21: Summary of the impact significance on soil contamination for the study area during the construction phase.

Description of Impact		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Construction	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Moderate change (Medium)	Moderate change (Medium)
Duration	Short-term (1 to 5 years)	Short-term (1 to 5 years)
Extent	Beyond site	Whole site and nearby surroundings
Consequence	Medium	Low
Probability	Probable (High)	Probable (High)
Significance	**Medium -**	**Low -**
Additional Assessment Criteria		
Degree to which impact can be reversed	Partially reversable. Upon removal of solar facility the soils could be re-instated overtime through rehabilitation efforts.	

Degree to which impact may cause irreplaceable loss of resources	Medium: The soils which are stripped my not be replaced during the decommissioning phase	
Degree to which impact can be avoided	Low: Not avoidable but rehabilitation efforts in the remaining footprint extent to ensure that the soils are conserved.	
Degree to which impact can be mitigated	Medium: This depends entirely on the rehabilitation plan if the soils of similar land capability will be replaced.	
Cumulative Impact		
Extent to which a cumulative impact may arise	Possible	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Medium -	**Low -**

Table 22: Summary of the impact significance on soil contamination for the study area during the operational phase.

Description of Impact		
Type of Impact	Direct	
Nature of Impact	Negative	
Phases	Operational	
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Moderate change (Medium)	Moderate change (Medium)
Duration	Long-term (10 to 20 years)	Long-term (10 to 20 years)
Extent	Beyond site	Whole site and nearby surroundings
Consequence	Medium	Medium
Probability	Probable (High)	Possible / frequent (Medium)
Significance	**Medium -**	**Low -**
Additional Assessment Criteria		
Degree to which impact can be reversed	Partially reversable. Upon removal of solar facility the soils could be re-instated overtime through rehabilitation efforts.	
Degree to which impact may cause irreplaceable loss of resources	Medium: The soils which are stripped my not be replaced during the decommissioning phase	
Degree to which impact can be avoided	Low: Not avoidable but rehabilitation efforts in the remaining footprint extent to ensure that the soils are conserved.	
Degree to which impact can be mitigated	Medium: This depends entirely on the rehabilitation plan if the soils of similar land capability will be replaced.	
Cumulative Impact		
Extent to which a cumulative impact may arise	Possible	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Medium -	**Low -**

5.1.5 Cumulative Impact

The cumulative loss from a soil and land capability point of view is not anticipated to be significant as the dominant soils identified within the study are not suitable for cultivation unless intense management practices are implemented. In addition, considering the climatic conditions of the area which is associated with limited rainfall as per the review of desk based data sources and the absence of any irrigation scheme, this renders the study area not suitable for any large-scale agricultural cultivation. However, some areas used for subsistence grazing will potentially be impacted, which will ultimately impact on the local livestock production. The overall impact on the soil and land capability is anticipated to be Medium-Low without mitigation measures and Low with mitigation measures in place under the condition that the integrated mitigation measures are implemented accordingly, with the aim of minimising the potential loss of valuable topsoil material.

5.1.6 Screening tool Verification

The screening tool analysis was conducted, which presented the findings as the impact on agricultural resources being of a high sensitivity in terms of agricultural potential. Based on the outcomes of the field assessment this was found to be of a lower significance impact than that presented on the screening tool due to the types of soils identified on site and the study area positioned in a water stressed area here dryland agriculture is only viable on a subsistence scale. In addition, the historical digital satellite imagery revealed that no prior commercial cultivation was observed within the study area for the past 5 years and thus the proposed development is not likely to have an unacceptable impact on the agricultural production capability and contribution to local, regional or national food production.

5.2 Integrated Mitigation Measures

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

5.2.1 Management of Loss of Land Capability

- Direct surface disturbance of the identified arable soils can be avoided where possible to minimise loss of arable soils;
- Maintenance of all components including PV modules, mounting structures, trackers, inverters, substation transformers, BESS, and equipment to avoid further impact on soil material;
- During the decommissioning phase the footprint should be thoroughly cleaned, and all construction material should be removed to a suitable disposal facility;
- The footprint should be ripped to alleviate compaction;
- Revegetate with an indigenous grass mix, to re-establish a protective cover, in order to minimise soil erosion and dust emissions;

- Define cut-off horizons in simple terms that the stripping operator can understand and demarcate boundaries of different soil types;
- Close supervision and monitoring of the stripping process is required to ensure that soils are stripped correctly;
- Strip a suitable distance ahead of mining at all times, to avoid loss and contamination.

5.2.2 Soil Stripping and Stockpile 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 that 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 soil to obtain the highest post-mining 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 2-3 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 lime to stabilise soil pH levels;
- Soil erosion should be controlled on stockpiles by having control measures to reduce erosion risk such as erosion control blankets, soil binders, revegetation, contours, diversion banks and spillways;
- Stockpiled soils should be stored for a maximum of 3-5 years, wherever feasible. in addition, concurrent rehabilitation should strongly be considered to reduce the duration of stockpile storage to ensure that the quality of stored soil material does not deteriorate excessively; especially with regard to leaching and acidification;
- The topsoil stockpile should be vegetated and while vegetating, measures will be needed to contain erosion of the stockpile during rain events;
- Temporary berms can be installed, around stockpile areas whilst vegetation cover has not established to avoid soil loss through erosion;
- The recovered soils should be re-used to rehabilitate the mine footprint following mine closure;

- A short-term amelioration program should be based on the soil chemical status after levelling and should consists of a pre-seeding lime and fertilizer application, an application with the seeding process as well as a maintenance application for 2 to 3 years after rehabilitation or until the area can be declared as self-sustaining by an appropriately qualified soil scientist.

5.2.3 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; and
- Temporary erosion control measures should be used to protect the disturbed soils during the construction phase until adequate vegetation has established.

5.2.4 Soil compaction Management

- Soil Compaction is usually greatest when soils are moist, so soils should be stripped when moisture content is as low as possible. If they have to be moved when wet, shovel and truck should be used as bowlscrapers create excessive compaction when moving wet soils;
- Compaction should be minimised by use of appropriate equipment and replacing soils to the greatest possible thickness in single lifts;
- Heavy equipment movement over replaced soils should be minimised;
- Minimise compaction during smoothing of replaced soils by using dozers rather than graders; and
- Following placement, compacted soils should be ripped to full rooting depth (30cm as the bare minimum seedbed) to allow penetration of plant roots.

5.2.5 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 must be implemented for the BESS (if utilised) to limit the spread of contaminant into the soil in line with the type of battery used; and
- 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. IMPACT STATEMENT

From a soil, land use and land capability point of view, this project is regarded as being of low impact significance to current and future land use and especially to agricultural production due to the ongoing disturbances as a result of the current land use activities the soils are subjected to and the prevailing harsh climatic conditions. However, mitigation measures and recommendations outlined in this document need to be strongly considered and implemented accordingly in efforts to conserve soil resources and allow use of valuable topsoil in other areas.

7. CONCLUSION

The Zimpande Research Collaborative (ZRC) was appointed to conduct a soil, land use, land capability and agricultural potential assessment as part of the environmental impact assessment and authorisation process for the proposed photovoltaic (PV) facility at the Marula Platinum Mine (MPM), which is located near Burgersfort within the Limpopo Province, hereafter referred to as the "study area".

The objective of this study was to evaluate:

- Climatic conditions within the context of agricultural productivity and constraints;
- Landscape setting and land use,
- Soil physical properties; and
- Other current limitations to various agricultural related land use purposes.

The climatic conditions associated with the study area and surroundings are characterised by climatic limitations with the Mean Annual Precipitation ranging between 401 – 600 mm per annum. The surrounding areas under these climatic conditions have a moderately restricted growing season due to low temperatures, frost and/or moisture stress. This results in limited suitable crops which frequently experience yield loss. Therefore, crops under rainfed conditions should be cultivated with extreme caution, and management practices such as irrigation are likely to be required to ensure a sustainable yield.

Based on the observations during the site assessment, the dominant land uses within the study area are mining related activities, with the sub-dominant uses being residential areas and wilderness/wildlife. No agricultural activities were observed in the immediate vicinity of the study area.

The study area is dominated by marginal to low agricultural potential soils (Spionberg/Valsrivier). In total, two (2) soil forms were identified within the study area and these include the Spionberg/Valsrivier and the Witbank formations.

The dominant soils of Spionberg/Valsrivier, Witbank are not considered ideal for cultivation due to:

- Poor drainage characteristics;
- Shallow rooting depth due to high clay content in the B horizon;

- Inadequate moisture;
- Bleached topsoils associated with the Dundee soil form which lack nutrient retention capacity to support optimum growth and production; and
- Disturbed soils due to anthropogenic influences.

Table A below represents the soil forms identified within the study area as well as their diagnostic horizons, respectively.

Table A: Identified soil forms within the study area and their respective land capability and land potential.

Soil Form	Land capability	Land Potential	Area (ha)	Percentage
Spionsberg/Valsrivier	Grazing (Class VI)	Restricted Potential (L5)	48.56	93.80
Witbank	Wilderness (Class VII)	Restricted Potential (L5)	3.21	6.20
Total enclosed			**51.77**	**100**

The cumulative loss from a soil and land capability point of view is not anticipated to be significant as the dominant soils identified within the study are not suitable for cultivation unless intense management practices are implemented. In addition, considering the climatic conditions of the area which is associated with limited rainfall as per the review of desk based data sources and the absence of any irrigation scheme, this renders the study area not suitable for any large-scale agricultural cultivation. However, some areas used for subsistence grazing will potentially be impacted, which will ultimately impact on the local livestock production. The overall impact on the soil and land capability is anticipated to be Medium-Low without mitigation measures and Low with mitigation measures in place under the condition that the integrated mitigation measures are implemented accordingly, with the aim of minimising the potential loss of valuable top soil material.

The screening tool analysis was conducted, which presented the findings as the impact on agricultural resources being of a high sensitivity in terms of agricultural potential. Based on the outcomes of the field assessment this was found to be of a lower significance impact than that presented on the screening tool due to the types of soils identified on site and the study area positioned in a water stressed area here dryland agriculture is only viable on a subsistence scale. In addition, the historical digital satellite imagery revealed that no prior commercial cultivation was observed within the study area for the past 5 years and thus the proposed development is not likely to have an unacceptable impact on the agricultural production capability and contribution to local, regional or national food production.

Key mitigation measures to minimise impacts on the soil regime include but are not limited to:

- The project operations be kept within the demarcated footprint areas which must be well defined;

- Bare soils within the access roads should 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;
- A soil monitoring programme should be initiated within the access roads and adjacent areas to ascertain whether the dust suppression has an impact on the soil chemistry; and
- Soil Compaction is usually greatest when soils are moist. Therefore, soils should be stripped when moisture content is as low as possible. If soil must be moved when wet, truck and shovel should be used as bowlscrapers create excessive compaction when moving wet soils.

From a soil, land use and land capability point of view, this project is regarded as being of low impact significance to current and future land use and especially to agricultural production due to the ongoing disturbances as a result of the current land use activities the soils are subjected to and the prevailing harsh climatic conditions. However, mitigation measures and recommendations outlined in this document need to be strongly considered and implemented accordingly in efforts to conserve soil resources and allow use of valuable topsoil in other areas.

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APPENDIX A: INDEMNITY AND TERMS OF USE

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. The report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken and ZRC (Pty) Ltd and its staff reserve the right to, at their sole discretion, modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

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APPENDIX B: ASSESSMENT METHODOLOGY

Desktop Screening

Prior to commencement of the field assessment, a background study, including a literature review, was conducted in order to collect the pre-determined soil and land capability data in the vicinity of the investigated area Various data sources including but not limited to the Agricultural Geo-Referenced Information System (AGIS) and other sources as listed under references were used for the assessment.

Soil Classification and Sampling

A soil survey was conducted in November 2020 by a qualified soil specialist, at which time the identified soils within the study area were classified into soil forms according to the Soil Classification Working Group for South Africa (2018). Subsurface soil observations were made using a manual hand auger in order to assess individual soil profiles, which entailed evaluating physical soil properties and prevailing limitations to various land uses.

Land Capability Classification

Agricultural potential is directly related to Land Capability, as measured on a scale of I to VIII, as presented in Table **A1** below; with Classes I to III classified as prime agricultural land that is well suitable for annual cultivated crops. Whereas, Class IV soils may be cultivated under certain circumstances and management practices, whereas Land Classes V to VIII are not suitable to cultivation. Furthermore, the climate capability is also measured on a scale of 1 to 8, as illustrated in Table **A2** 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 assessed in order to inform the necessary mitigation measures.

Table A1: Land Capability Classification (Smith, 2006)

Land Capability Class	Increased Intensity of Use									Land Capability Groups
I	W	F	LG	MG	IG	LC	MC	IC	VIC	**Arable land**
II	W	F	LG	MG	IG	LC	MC	IC		
III	W	F	LG	MG	IG	LC	MC	IC		
IV	W	F	LG	MG	IG	LC				
V	W		LG	MG						**Grazing land**
VI	W	F	LG	MG						
VII	W	F	LG							
VIII	W									**Wildlife**

W- Wildlife	MG- Moderate grazing	MC- Moderate cultivation
F- Forestry	IG- Intensive grazing	IC- Intensive cultivation
LG- Light grazing	LC- Light cultivation	VIC- Very intensive cultivation

Table A2: 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 area. The classification of land potential and knowledge of the geographical distribution within an area of interest. This is of importance for making an informed decision about land use. **Table A3** below presents the land potential classes, whilst Table A4 presents description thereof, according to Guy and Smith (1998).

Table A3: Land Potential Classes (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	Vlei	Vlei	Vlei	Vlei	Vlei	Vlei	Vlei	Vlei
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 A4: 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.

Impact Assessment Methodology

In order for the Environmental Assessment Practitioner (EAP) to allow for sufficient consideration of all environmental impacts, impacts were assessed using a common, defensible method of assessing significance that will enable comparisons to be made between risks/impacts and will enable authorities, stakeholders and the client to understand the process and rationale upon which risks/impacts have been assessed. The method to be used for assessing risks/impacts is outlined in the sections below.

The first stage of risk/impact assessment is the identification of environmental activities, aspects and impacts. This is supported by the identification of receptors and resources, which allows for an understanding of the impact pathway and an assessment of the sensitivity to change. The definitions used in the impact assessment are presented below.

- An **activity** is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructure that is possessed by an organisation.
- An **environmental aspect** is an 'element of an organizations activities, products and services which can interact with the environment'[1]. The interaction of an aspect with the environment may result in an impact.
- **Environmental risks/impacts** are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. In the case where the impact is on human health or wellbeing, this should be stated. Similarly, where the receptor is not anthropogenic, then it should, where possible, be stipulated what the receptor is.
- **Receptors** can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as wetlands, flora and riverine systems.
- **Resources** include components of the biophysical environment.
- **Frequency of activity** refers to how often the proposed activity will take place.
- **Frequency of impact** refers to the frequency with which a stressor (aspect) will impact on the receptor.
- **Severity** refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards.
- **Spatial extent** refers to the geographical scale of the impact.
- **Duration** refers to the length of time over which the stressor will cause a change in the resource or receptor.

The significance of the impact is then assessed by rating each variable according to the defined criteria. Refer to the Table A1. The purpose of the rating is to develop a clear understanding of influences and

[1] The definition has been aligned with that used in the ISO 14001 Standard.

processes associated with each impact. The severity, spatial scope and duration of the impact together comprise the consequence of the impact and when summed can obtain a maximum value of 15. The frequency of the activity and the frequency of the impact together comprise the likelihood of the impact occurring and can obtain a maximum value of 10. The values for likelihood and consequence of the impact are then read off a significance-rating matrix and are used to determine whether mitigation is necessary[2].

The assessment of significance is undertaken twice. Initial, significance is based on only natural and existing mitigation measures (including built-in engineering designs). The subsequent assessment considers the recommended management measures required to mitigate the impacts. Measures such as demolishing infrastructure, and reinstatement and rehabilitation of land, are considered post-mitigation.

The model outcome of the impacts was then assessed in terms of impact certainty and consideration of available information. The Precautionary Principle is applied in line with South Africa's National Environmental Management Act 1998 (Act No. 108 of 1998) in instances of uncertainty or lack of information, by increasing assigned ratings or adjusting final model outcomes. In certain instances where a variable or outcome requires rational adjustment due to model limitations, the model outcomes have been adjusted.

Table A1: Criteria and definitions for assessing significance of impacts

LIKELIHOOD DESCRIPTORS

PART A: DEFINITIONS AND CRITERIA*		
Definition of SIGNIFICANCE		**Significance = consequence x probability**
Definition of CONSEQUENCE		**Consequence is a function of intensity, spatial extent and duration**
Criteria for ranking of the INTENSITY of environmental impacts	**VH**	Severe change, disturbance or degradation. Associated with severe consequences. May result in severe illness, injury or death. Targets, limits and thresholds of concern continually exceeded. Substantial intervention will be required. Vigorous/widespread community mobilization against project can be expected. May result in legal action if impact occurs.
	H	Prominent change, disturbance or degradation. Associated with real and substantial consequences. May result in illness or injury. Targets, limits and thresholds of concern regularly exceeded. Will definitely require intervention. Threats of community action. Regular complaints can be expected when the impact takes place.
	M	Moderate change, disturbance or discomfort. Associated with real but not substantial consequences. Targets, limits and thresholds of concern may occasionally be exceeded. Likely to require some intervention. Occasional complaints can be expected.
	L	Minor (Slight) change, disturbance or nuisance. Associated with minor consequences or deterioration. Targets, limits and thresholds of concern rarely exceeded. Require only minor interventions or clean-up actions. Sporadic complaints could be expected.
	VL	Negligible change, disturbance or nuisance. Associated with very minor consequences or deterioration. Targets, limits and thresholds of concern never exceeded. No interventions or clean-up actions required. No complaints anticipated.
	VL+	Negligible change or improvement. Almost no benefits. Change not measurable/will remain in the current range.
	L+	Minor change or improvement. Minor benefits. Change not measurable/will remain in the current range. Few people will experience benefits.
	M+	Moderate change or improvement. Real but not substantial benefits. Will be within or marginally better than the current conditions. Small number of people will experience benefits.
	H+	Prominent change or improvement. Real and substantial benefits. Will be better than current conditions. Many people will experience benefits. General community support.

[2] Some risks/impacts that have low significance will however still require mitigation.

	VH+	Substantial, large-scale change or improvement. Considerable and widespread benefit. Will be much better than the current conditions. Favourable publicity and/or widespread support expected.
Criteria for ranking the DURATION of impacts	VL	Very short, always less than a year. Quickly reversible
	L	Short-term, occurs for more than 1 but less than 5 years. Reversible over time.
	M	Medium-term, 5 to 10 years.
	H	Long term, between 10 and 20 years. (Likely to cease at the end of the operational life of the activity)
	VH	Very long, permanent, +20 years (Irreversible. Beyond closure)
Criteria for ranking the EXTENT of impacts	VL	A part of the site/property.
	L	Whole site.
	M	Beyond the site boundary, affecting immediate neighbours
	H	Local area, extending far beyond site boundary.
	VH	Regional/National

CONSEQUENCE DESCRIPTORS

Table A2: Determining Consequence and Significance

PART B: DETERMINING CONSEQUENCE							
INTENSITY = VL							
DURATION	Very long	VH	Low	Low	Medium	Medium	High
	Long term	H	Low	Low	Low	Medium	Medium
	Medium term	M	Very Low	Low	Low	Low	Medium
	Short term	L	Very low	Very Low	Low	Low	Low
	Very short	VL	Very low	Very Low	Very Low	Low	Low
INTENSITY = L							
DURATION	Very long	VH	Medium	Medium	Medium	High	High
	Long term	H	Low	Medium	Medium	Medium	High
	Medium term	M	Low	Low	Medium	Medium	Medium
	Short term	L	Low	Low	Low	Medium	Medium
	Very short	VL	Very low	Low	Low	Low	Medium
INTENSITY = M							
DURATION	Very long	VH	Medium	High	High	High	Very High
	Long term	H	Medium	Medium	Medium	High	High
	Medium term	M	Medium	Medium	Medium	High	High
	Short term	L	Low	Medium	Medium	Medium	High
	Very short	VL	Low	Low	Low	Medium	Medium
INTENSITY = H							
DURATION	Very long	VH	High	High	High	Very High	Very High
	Long term	H	Medium	High	High	High	Very High
	Medium term	M	Medium	Medium	High	High	High
	Short term	L	Medium	Medium	Medium	High	High
	Very short	VL	Low	Medium	Medium	Medium	High
INTENSITY = VH							
DURATION	Very long	VH	High	High	Very High	Very High	Very High
	Long term	H	High	High	High	Very High	Very High
	Medium term	M	Medium	High	High	High	Very High
	Short term	L	Medium	Medium	High	High	High
	Very short	VL	Low	Medium	Medium	High	High

			VL	L	M	H	VH
			A part of the site/ property	Whole site	Beyond the site, affecting neighbours	Extending far beyond site but localised	Regional/ National
			EXTENT				
PART C: DETERMINING SIGNIFICANCE							
PROBABILITY (of exposure to impacts)	Definite/ Continuous	VH	Very Low	Low	Medium	High	Very High
	Probable	H	Very Low	Low	Medium	High	Very High
	Possible/ frequent	M	Very Low	Very Low	Low	Medium	High
	Conceivable	L	Insignificant	Very Low	Low	Medium	High
	Unlikely/ improbable	VL	Insignificant	Insignificant	Very Low	Low	Medium
			VL	L	M	H	VVH
			CONSEQUENCE				

Table A3: Significance Rating and Interpretation

PART D: INTERPRETATION OF SIGNIFICANCE	
Significance	**Decision guideline**
Very High	Potential fatal flaw unless mitigated to lower significance.
High	It must have an influence on the decision. Substantial mitigation will be required.
Medium	It should have an influence on the decision. Mitigation will be required.
Low	Unlikely that it will have a real influence on the decision. Limited mitigation is likely required.
Very Low	It will not have an influence on the decision. Does not require any mitigation
Insignificant	Inconsequential, not requiring any consideration.

The following points were considered when undertaking the assessment:

- Risks and impacts were analysed in the context of the *project's area of influence* encompassing:
  - Primary project site and related facilities that the client and its contractors develop or controls;
  - Areas potentially impacted by cumulative impacts for any existing project or condition and other project-related developments; and
  - Areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location.
- Risks/Impacts were assessed for all stages of the project cycle including:
  - Pre-construction;
  - Construction; and
  - Operation.
- If applicable, transboundary or global effects were assessed.
- Individuals or groups who may be differentially or disproportionately affected by the project because of their *disadvantaged* or *vulnerable* status were assessed.
- Particular attention was paid to describing any residual impacts that will occur after rehabilitation.

Mitigation measure development

The following points present the key concepts considered in the development of mitigation measures for the proposed development.

- *Mitigation* and *performance improvement measures* and actions that address the risks and impacts[3] are identified and described in as much detail as possible.
- Measures and actions to address negative impacts will favour avoidance and prevention over minimisation, mitigation or compensation.

Recommendations

Recommendations were developed to address and mitigate impacts associated with the proposed development. These recommendations also include general management measures which apply to the proposed development as a whole. Mitigation measures have been developed to address issues in all phases throughout the life of the operation from planning, through to construction and operation.

[3] *Mitigation measures should address both positive and negative impacts*

APPENDIX C: 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)

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. (b) 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

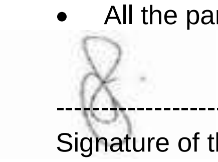
----

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, 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

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

I, Tshiamo Setsipane, 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 –
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

SAS ENVIRONMENTAL GROUP OF COMPANIES (SEGC) –

SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF TSHIAMO SETSIPANE

PERSONAL DETAILS

Position in Company	Soil Scientist/ Hydropedologist
Joined SAS Environmental Group of Companies	2020

MEMBERSHIP IN PROFESSIONAL SOCIETIES

South African Council for Natural Scientist Professions (SACNASP)

EDUCATION

Qualifications

M.Sc. (Agric) Soil Science (*Cum Laude*)	(University of the Free State)	2019
B.Sc. (Agric) Honours Soil Science	(University of the Free State)	2014
B.Sc. (Agric) Soil Science & Agrometeorology	(University of the Free State)	2013

COUNTRIES OF WORK EXPERIENCE

South Africa – Kwa-Zulu Natal, Northern Cape, Mpumalanga and Free State

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