APPENDIX O: SOILS, LAND USE AND LAND CAPABILITY ASSESSMENT

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SOIL, LAND USE AND LAND CAPABILITY ASSESSMENT AS PART OF THE ENVIRONMENTAL ASSESSMENT AND AUTHORISATION PROCESS FOR THE PROPOSED ACTIVITY/INFRASTRUCTURE CHANGES TO THE APPROVED SURFACE LAYOUT AT THE MOKALA MINE, NORTHERN CAPE.

Prepared for

SLR Consulting (Pty) Ltd

January 2022

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Report Reference: ZRC 21-0015
Date: January 2022

EXECUTIVE SUMMARY

The Zimpande Research Collaborative (ZRC) was appointed to conduct a soil, land use and land capability assessment as part of the integrated environmental authorisation process for the proposed Mokala Manganese Mine activity/infrastructure changes to the approved surface layout within the jurisdiction of the Joe Morolong Local Municipality, in the Northern Cape Province. Henceforth collectively referred to as the Project Area unless referring to individual infrastructure (i.e., waste rock dumps (WRD), open cast pit).

The Mean Annual Precipitation (MAP) within the Project Area is estimated to range between 201 – 400 mm per annum. These conditions have a low yield potential for a moderate range of adapted crops and planting date options may be limited for supporting rain fed agriculture.

Based on the observations during the site assessment the dominant land use within the Project Area is predominantly mining related activities (i.e., open cast mining, office space, water storage facilities, workshops and etc.) and grazing landuses (Game farm) located within the Mokala mine but operated by Kalagadi mine.

The dominant soil forms occurring within the Project Area are Ermelo/Clovelly, Mispah/Glenrosa and Witbank/Grabouw forms.

The majority of the soils occurring within the Western portion of the Project Area (Ermelo/Clovelly) can be broadly classified as soils ideal for agricultural cultivation practices (with minor limitations), where climate permits, as well as grazing activities as well as wildlife/wilderness.

The above-mentioned soils are considered ideal for agricultural cultivation due to:

- Deep well drained soil characteristics;
- Texture and structure allowing for effective rooting depth;
- Good water holding/storage capacity;

The soils towards the Eastern portion of the Project Area are characterised by the soils not considered ideal for agricultural cultivation practices. These soils include the Mispah/Glenrosa (shallow rocky) and Witbank/Grabouw (anthropogenically disturbed) formations.

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

Table A: Dominant soil forms and their respective land capability

Soil Form	Land Capability	Area (ha)	Percentage (%)
Ermelo/Clovelly	Arable (Class II)	164.05	31.39
Dundee	Grazing (Class V)	8.6	1.65
Mispah/Glenrosa	Grazing (Class VI)	15.41	2.95
Witbank/Grabouw	Wilderness (Class VIII)	334.5	64.01
Cumulative Total		**522.63**	**100**

The loss of land capability is anticipated to be Medium as the significant portion (164.05 ha out of 522.63) of the dominant soils are considered ideal for cultivation. Large portions of arable soils will be stripped and stockpiled and thus potentially reducing the fertility status of the soils and being prone to erosion. The proposed activities will lead to a permanent change of land use if not appropriately mitigated. The cumulative loss from a soil and land capability point of view is anticipated to be Medium pre-mitigation and Low after mitigation. This is due to the significant portion of the Project Area having soils classified as suitable for agricultural cultivation. However, the suitability for successful dry land agriculture is low due to the climatic conditions of the area. This area experiences erratic and very low rainfall which is necessary for successful dryland agriculture. In addition, no large dams or irrigation schemes are available in the area thus limiting the soils in the area to grazing and wildlife uses. The high evaporation rate of the hot, dry climate will result in regular irrigation needed should crops be produced this way. Lastly, the loss of agricultural soils and the permanent change in land use will be localized. The integrated mitigation measures must be implemented accordingly, with the aim of minimizing the potential loss of these valuable soils considering the need for sustainable development.

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 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; and
- 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;
- 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, truck and shovel methods should be used as bowlscrapers create excessive compaction when moving wet soils;
- Usable topsoil from the construction of the surface infrastructure areas must be removed prior to construction and stockpiled separately within the demarcated areas with measures to protect this valuable resource from impacts such as chemical contamination as well as mixing with less valuable overburden types; and
- Revegetate with an indigenous grass mix, to re-establish a protective cover, in order to minimise soil erosion and dust emissions and aid in achieving the desired post closure land use in as short a period as possible following decommissioning and closure.

Based on the stockpile management plan the following measures are proposed in order counteract the problems associated with limited soil material for topsoil stockpile:

- Ideally, removal of infrastructure once mining activities are completed is usually considered. However, all the structures on site should be assessed in conjunction with the ultimate land users, and the authorities, to determine which infrastructure areas and/or components could be used in future. This will aid in the minimisation of the amount of topsoil stockpile required for rehabilitation;
- Where infrastructure is removed all the rubble and residual foundations need to be covered with at least one metre of cover material. Best practice is to cover with 1 metre of inert cover material (which may be “B” or “C” horizon material that can be penetrated by plant roots), which in turn is covered with topsoil material; and
- The topsoil stockpile should be used only in areas where there is a likelihood for post closure use such as grazing, where the slopes are not excessively steep.

DOCUMENT GUIDE

Table B : 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.
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
ha	Hectares
DEAT	Department of Environmental Affairs and Tourism

1. INTRODUCTION

The Zimpande Research Collaborative (ZRC) was appointed by SLR Consulting (South Africa) Pty Ltd to conduct a soil, land use and land capability assessment as part of the integrated environmental authorisation process for the proposed Mokala Manganese Mine activity/infrastructure changes to the approved surface layout within the jurisdiction of the Joe Morolong Local Municipality, in the Northern Cape Province. Henceforth, collectively referred to as the Project Area unless referring to individual infrastructure (i.e., waste rock dumps (WRD), open cast pit).

The Project Area is located approximately 4 km northwest of Hotazel town and the Ga-Mogara River is located on the eastern side of the MR (Figure 1 and 2 below).

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). High potential agricultural land is defined as land having ''*the soil and terrain quality, growing season and adequate available moisture supply to sustain crop production when treated and managed according to best possible farming practices" (*Land Capability report ARC, 2006*).* Land Capability Classes (LCC) are used to determine the agricultural potential of soils within the Project Area due to the positive correlation between the agricultural potential and Land Capability Classification. Land Capability Classification is measured on a scale of I to VIII, with the classes of I to III considered as prime agricultural soils and classes V to VIII not suitable for cultivation. Furthermore, the climate capability is also measured on a scale of 1 to 8, as illustrated in Appendix A.

1.1 Project Description

The information contained in this section is taken from the Scoping Report for the Changes to Surface Infrastructure at the Mokala Mine, March 2021, prepared by SLR Consulting (South Africa) (Pty) Ltd. ZRC does not accept responsibilities for any errors or inaccuracies contained therein.

Please refer to Figure 3 for the layout of the various project components described below.

The Mokala Mine is an open cast manganese mine with approved infrastructure components comprising a dry crushing and screening plant; Waste Rock Dumps (WRDs), Run of Mine (ROM) stockpiles; topsoil stockpiles; water storage facilities; stormwater management infrastructure and mine-related support facilities such as workshops, stores, and offices. Additional approved activities include:

- The realignment of the R380 road on the farm Kipling 271 and across the remaining extent of the farm of Gloria 266;
- Upgrading of the intersection to the mine on portion 1 of the farm Gloria 266 also serving the existing Gloria Mine;
- The realignment of a section of the Ga-Mogara drainage channel within the existing river channel. This realignment extends onto the farm Umtu 281.

The Mokala Mine is currently in the construction and operational phase of the project. In this regard, temporary infrastructure in support of the construction phase is currently on site. Construction facilities will either be removed at the end of the construction phase or incorporated into the layout of the operational mine. The mine has also begun with their open cast strip mining activities.

The mine currently holds the following approvals:

- A Mining Right and an approved Environmental Management Programme (EMPr) in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 or 2002) (MPRDA). Authorisation was granted by the Department of Mineral Resources (DMR) (now the Department of Mineral Resources and Energy (DMRE)) on the 19 September 2017 as per reference NC30/5/1/2/2/10090 MR;
- An EA and an approved EMPr in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). Authorisation was granted by the DMR (now the DMRE) on the 15 August 2016 as per reference NC 30/5/1/2/2/(10090) EM;
- A Waste Management Licence (WML) from the DMR (now the DMRE) in terms of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) (NEM:WA). The WML was approved as part of the EA granted by the DMR on the 15 August 2016 as per reference NC 30/5/1/2/2/ (10090) EM; and
- An Integrated Water Use Licence (IWUL) in terms of the National Water Act, 1998 (Act No. 36 of 1998) (NWA) issued by the Department of Human Settlements, Water and Sanitation (DHSWS) on 14 August 2020 (as per reference number 08/D41K/BCGIJA/9175).

Mokala is proposing to amend the approved mine layout to cater for activity/infrastructure changes that have already taken place and proposed changes. These changes are required optimise their mining operations. Activity/infrastructure changes to the approved infrastructure that have already taken place include:

- The reconfiguration of plant area, ROM and high-grade product stockpiles to accommodate the expansion of the open pit;
- The relocation of the low-grade product stockpile;
- The relocation of support infrastructure (water storage facilities (potable and process water), workshops and washbay, change houses, sewage treatment plant, water treatment plant, fuel storage, administrative block (offices, kitchen, canteen, training centre, mustering centre, clinic, stores and waste storage);
- Relocation of transportation related facilities/infrastructure (internal haul road, weighbridges, parking areas, truck loading and staging facility);
- The relocation of the WRD to accommodate the expansion of the open pit; and
- The relocation of the approved topsoil stockpiles.

Proposed activity/infrastructure changes to the approved surface layout include:

- The proposed expansion of the open pit;
- The proposed increase in the capacity of the WRD and the establishment of an additional WRD;
- The proposed establishment of additional topsoil stockpiles;
- The proposed relocation of stormwater management infrastructure;
- The proposed increase in the capacity of product stockpiles (ROM and Low Grade, High Grade); and
- The proposed mining of the barrier pillar between the Kalagadi Mine and Mokala Mine.

No changes are anticipated to the realignment of the R380, the realignment of the Ga-Mogara drainage channel, or the intersection to the entrance of the mine.

A description of the activities that have already occurred and the proposed activities is provided below.

1.2 Layout/activities that have already taken place.

1.2.1 Reconfiguration of the plant area, ROM stockpiles and product stockpile

The approved 2015 EIA and EMPr (SLR, 2015) makes provision for a plant area (which comprises the Primary Crusher, Secondary Crusher and Screening Plant), ROM stockpiles and product stockpiles. According to the approved 2015 EIA and EMPr, these facilities would be located to the North of the approved open pit footprint. An expansion of the open pit is proposed toward a northerly and westerly direction. Due to this proposed activity, reconfiguration of the plant area, ROM stockpiles and product stockpiles is required.

1.2.2 The relocation of the ROM low grade product stockpile

The approved 2015 EIA and EMPr (SLR, 2015) makes provision for the establishment of a ROM low grade stockpile North of the approved open pit footprint. The ROM low-grade stockpile has been relocated because the open pit expansion will overlap with the approved ROM low grade product stockpile footprint.

1.2.3 The relocation of support infrastructure

The approved 2015 EIA and EMPr (SLR, 2015) makes provision for the following support infrastructure:

- Water storage facilities (potable and process water);
- Workshops and washbay;
- Change houses;
- Sewage treatment plant;
- Water treatment plant;
- Fuel storage;
- Stores;
- Waste storage; and
- Administrative block including:
  - Offices;
  - Kitchen and canteen;
  - Training centre; and
  - Mustering centre; and
  - Clinic.

The above listed support infrastructure has been relocated to cater for the proposed expansion of the open pit.

1.2.4 The relocation of transportation related facilities/infrastructure

The approved 2015 EIA and EMPr (SLR, 2015) makes provision for the following transportation facilities:

- Internal haul roads, turning circle and upgrading the intersection to Gloria Mine;
- Widening of existing gravel roads;
- Realignment of the R380;
- Loading, hauling and transportation of ROM, product and materials; and
- Conveyors and weighbridge.

The approved internal haul roads, weighbridges, parking areas, truck loading and staging facility have been relocated to cater for the optimised mine layout. It is important to note that no changes to the realignment of the R380 and the upgrade of the mine intersection are anticipated.

1.2.5 The relocation of the approved WRD

The approved 2015 EIA and EMPr (SLR, 2015) makes provision for a single WRD. The approved WRD has been relocated to cater for the proposed expansion of the open pit. The approved 2015 EIA and EMPr (SLR, 2015) also makes provision for overburden berms situated along the approved river alignment. No changes to the overburden berms will be required for this project.

1.2.6 The relocation of the approved topsoil stockpiles

The approved 2015 EIA and EMPr (SLR, 2015) makes provision for a designated topsoil stockpile area, a topsoil berm located along the R380 realignment route and a topsoil berm located on the southern edge of the open pit. The topsoil berm located along the R380 realignment route has been established, however the remaining stockpiles have been relocated to cater for the changes and reconfiguration of the layout as discussed in the sections above.

1.3 Proposed activity/infrastructure changes

1.3.1 Expansion of the open pit

The approved 2015 EIA and EMPr (SLR, 2015) makes provision for an open pit with a footprint of 93 ha. Following an updated resource plan, it became apparent that the extent of the approved open pit needs to be expanded. In this regard, Mokala is proposing to expand the open pit by approximately 80 ha in a northerly and westerly direction. Within approximately eight years the open pit would intersect with on-site surface support infrastructure. Once the open pit operations come into close proximity to the surface support infrastructure area, the intention is to relocate this infrastructure to a section of the backfilled open pit.

1.3.2 Increase in the capacity of the approved WRD and the establishment of an additional WRD

The approved 2015 EIA and EMPr (SLR, 2015) authorises a WRD footprint of 16 ha with a capacity of approximately 4 206 375 m^3. Mokala is proposing to expand the approved open pit footprint and as such additional waste rock storage space will be required to store additional waste rock stripped from the increased open pit footprint. Mokala is therefore proposing to increase the capacity of the approved WRD to approximately 15 665 819 m^3 with an additional footprint expansion of 28 ha.

In addition to the above, Mokala is proposing to establish an additional WRD to accommodate the additional waste rock tonnages. It is proposed that the additional WRD would be located to the west of the Project Area and will have a capacity of approximately 35 590 577 m^3 with a footprint area of 83.08 ha. The western part of the Project Area is currently utilised by the Kalagadi Mine for game farming purposes. This area has been fenced off from the rest of the remaining extent of the farm Gloria 266. Mokala will need to enter into discussions with Kalagadi regarding this game farming area as Kalagadi would not be able to make use of this area if it is earmarked for the establishment of the new WRD.

1.3.3 Establishment of additional topsoil stockpiles

The approved 2015 EIA and EMPr (SLR, 2015) makes provision for topsoil stockpiles with a footprint of 5 ha and capacity of 51 114 m^3. Provision has also been made for topsoil berms along the realigned R380 and on the southern edge of the open pit. The total volume of topsoil (stockpiles and berms) approved is 236 812.57 m^3 covering a total topsoil footprint area of 15 ha. Mokala is proposing to expand the approved open pit footprint and as such additional topsoil storage space will be required to store topsoil stripped from the increased open pit footprint. The estimated additional footprint is 15 ha.

1.3.4 Relocation of stormwater management infrastructure

The approved 2015 EIA and EMPr (SLR, 2015) makes provision for the establishment of stormwater management facilities such as recycle water ponds, drains and clean water realignment berms as required in terms of GNR 704. Due to the relocation of surface infrastructure the location of the approved stormwater management facilities will need to be re-evaluated. The locations will be determined during the EIA phase. It is understood from Mokala, that there is no intention of changing the capacities of the recycled water ponds.

1.3.5 Increase in the capacity of product stockpiles (ROM stockpiles and product stockpiles)

The approved 2015 EIA and EMPr (SLR, 2015) makes provision for a ROM Low Grade stockpile and ROM High Grade stockpile. The location of the stockpiles is illustrated in Figure 5. The approved area for the ROM low grade stockpile is approximately 1.03 ha with a capacity of 140 000 m^3. The approved area for the ROM high grade stockpile is approximately 1 ha with a capacity of 140 000 m^3. Mokala now proposes an increase in the capacity of these stockpiles to accommodate the increase in the production tonnages. The increase in capacity of the product stockpiles will be confirmed during the EIA phase. The capacity will be dependent on project mining rates as well as consideration to available surface area.

1.3.6 Mining of the barrier pillar between the Kalagadi Mine and Mokala Mine

The Mokala mining right area borders the farm Umtu 281 to the south, which is owned by Kalagadi Manganese (Pty) Ltd. Kalagadi Manganese (Pty) Ltd owns and operates the Kalagadi Mine. Manganese ore of commercial value is located within the barrier pillar. Mokala and Kalagadi are proposing to establish a joint agreement to mine the boundary pillar. In this regard, an agreement between the two parties will need to be in place outlining how the resources will be mined and stockpiled and how waste rock will be stockpiled, and the area rehabilitated. However, the lack of information will not limit the impact assessment as this study does account for typical measures relating to the proposed activities.

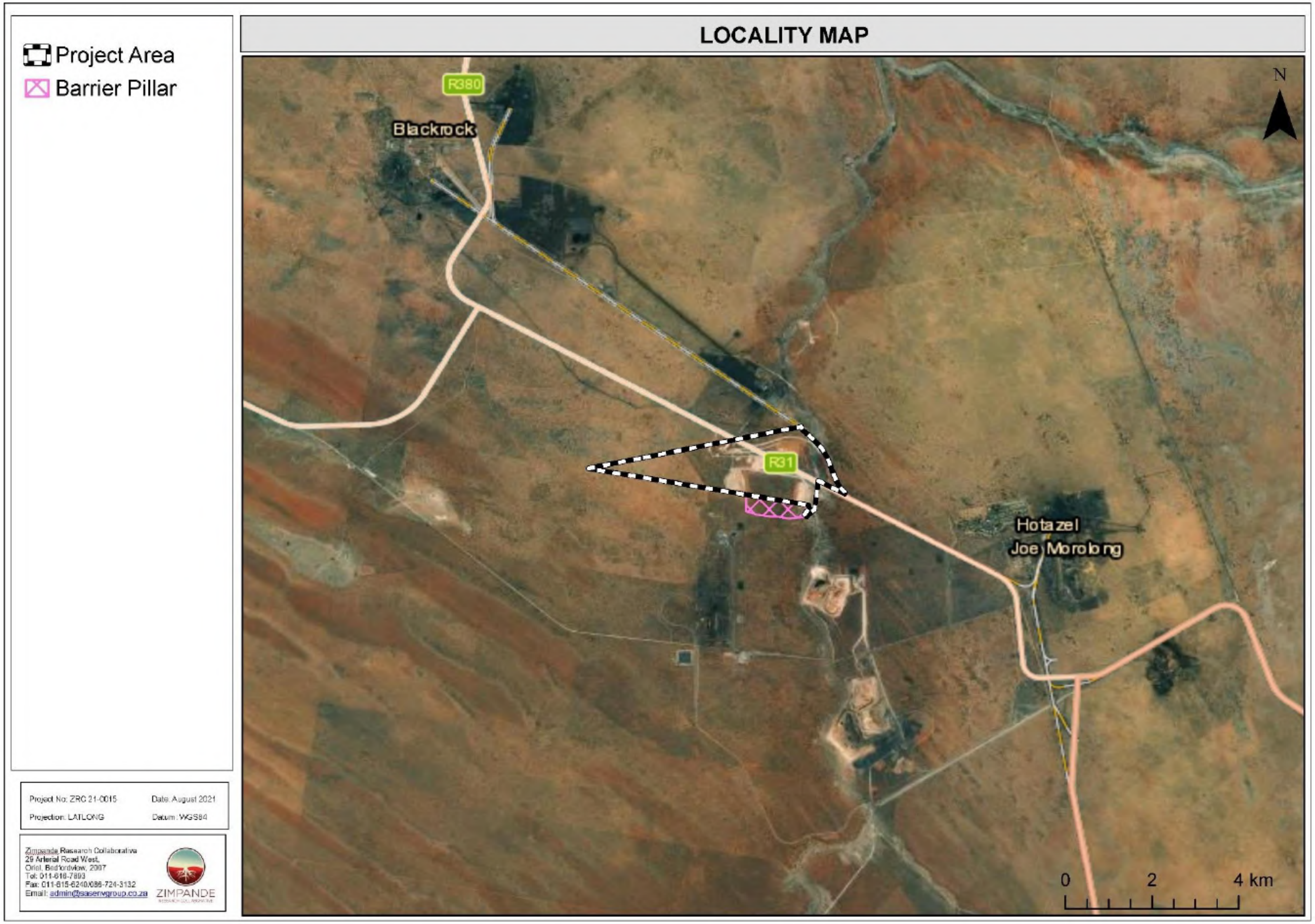

Figure 1: Digital satellite imagery depicting the locality of the Project Area in relation to the surrounding area.

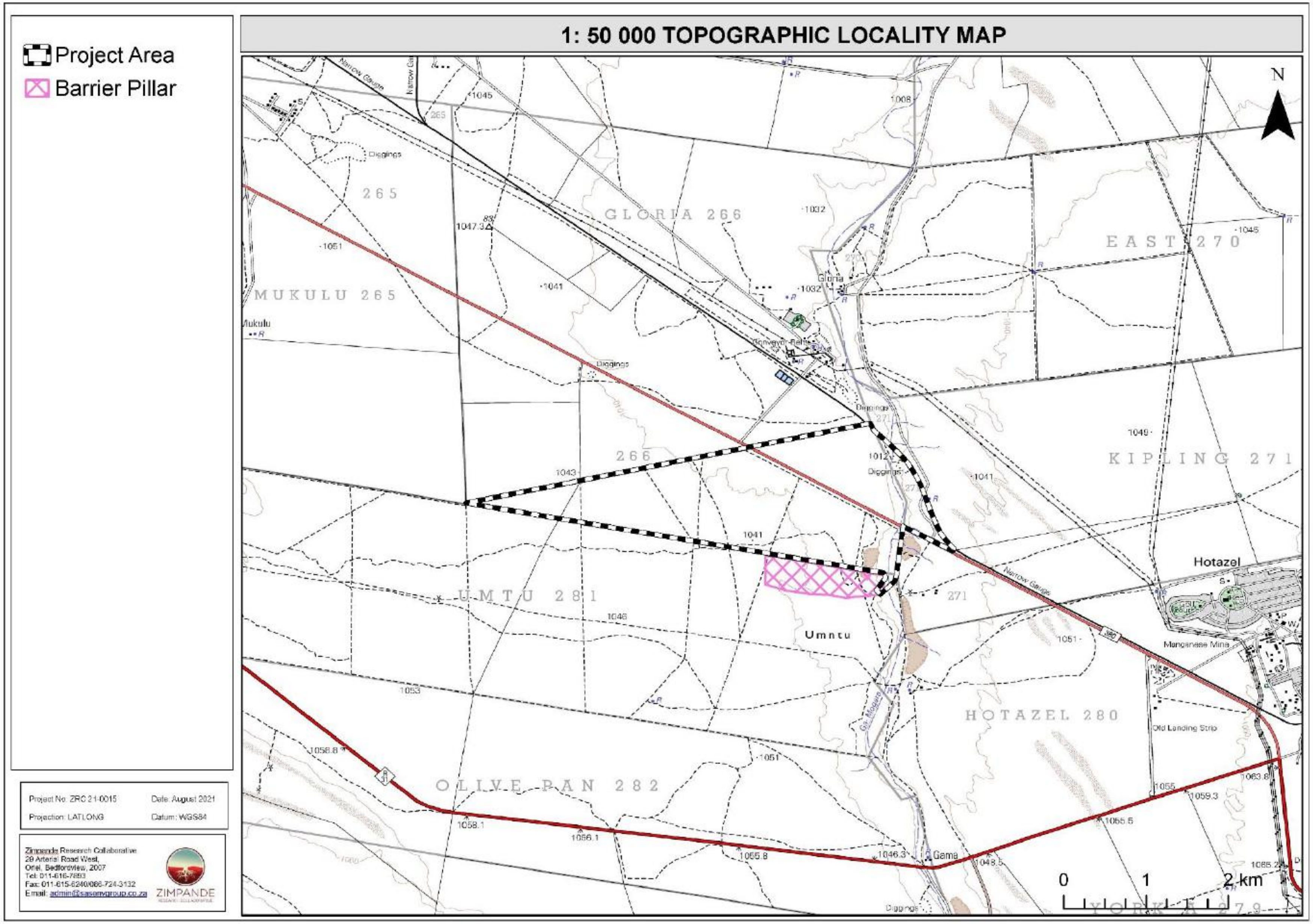

Figure 2: Location of the Project Area depicted on a 1:50 000 topographical map in relation to surrounding area.

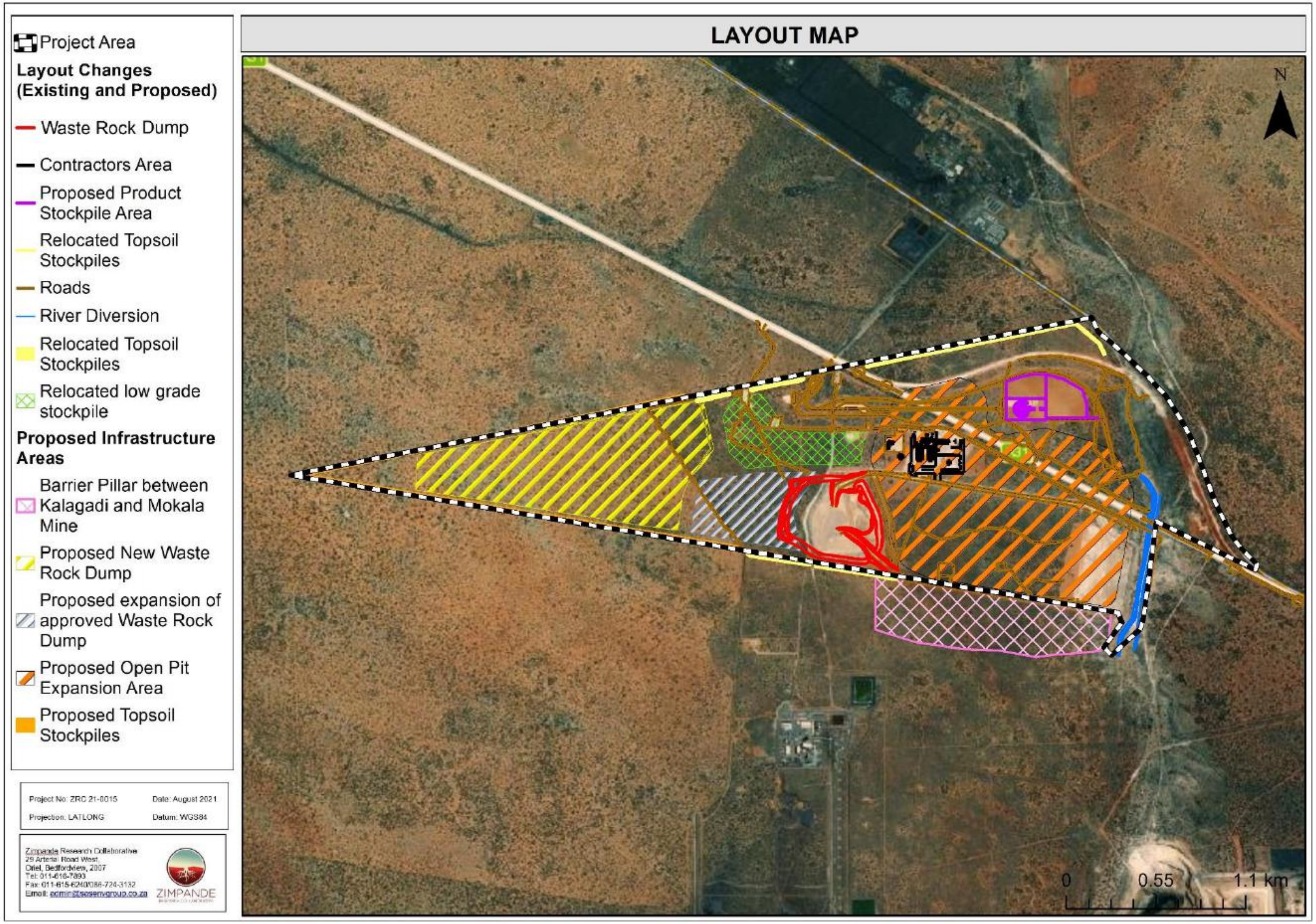

Figure 3: Layout map of the existing and the proposed infrastructure areas.

1.2 Terms of Reference and Scope of Work

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

- As part of the desktop study various data sets were consulted which includes, but not limited to: Soil and Terrain dataset (SOTER), land type and capability maps and soil 2001, to establish broad baseline conditions and sensitivity of Project 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 Project Area;
- Conduct a soil classification survey within the Project Area;
- Assess the spatial distribution of various soil types within the Project 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, land use and land capability desktop assessment are confined to the Project Area and does not include the neighbouring and adjacent properties;
- 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
- Since soils occur in a continuum with infinite variances, it is often problematic to classify any given soils as one form, or another, for this reason, the classifications

presented in this report are based on the "best fit" to the soil classification system of South Africa.

2 METHOD OF ASSESSMENT

2.2 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, land use and land capability data in the vicinity of the investigated Project 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.

2.3 Soil Classification and Sampling

A soil survey was conducted in May 2021, at which time the identified soils within the proposed infrastructure area and the adjacent areas were classified into soil forms according to the Soil Classification System: A Natural and Anthropogenic System for South Africa Soil Classification System (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.

2.4 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	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 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.

3 DESKTOP ASSESSMENT RESULTS

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

- The Mean Annual Precipitation (MAP) within the Project Area is estimated to range between 201 – 400 mm per annum. These conditions have a low yield potential for a moderate range of adapted crops and planting date options may be limited for supporting rain fed agriculture;
- The mean annual evaporation for the majority of the Project Area is 2201-2400 mm per annum and the remaining western portion is greater than 2400 mm. The high evaporation rates pose risks to plant yield due possible plant permanent wilting resulting desiccation and lack of adequate soil moisture (Figure 4);
- The Project Area is dominated by the tillite geological type;

- The Landform type occurring within the majority of the Project Area is classified as a Plain Landform, which means the terrain is suitable to allow agricultural activities. The remaining small portion on the eastern side is classified as a high gradient hill and thus not suitable for agricultural activities (Figure 5);
- The Soil and Terrain (SOTER) database indicates that the majority of the Project Area comprises of Ferralic Arenosols, these soils consisting mainly of sand, with little humus or clay;
- According to the AGIS database, the pH of soil medium occurring within the Project Area is considered slightly acidic to acidic with pH range between 6.5 – 7.4. This means that some nutrients will not be available for plant uptake. This is however not considered a limitation as the soil's pH condition can be ameliorated;
- The soils occurring within the Project Area are not saline or sodic according to the AGIS database;
- Land Capability associated with the Study Area is Non-Arable, Grazing, Woodland or Wildlife;
- According to the AGIS database, the livestock grazing capacity potential within the Project Area is estimated at 13 hectares per livestock Unit (ha/LSU) and this is considered not ideal for commercialised livestock farming;
- The water retention characteristics of the soils within the Project Area is beneficial without the risk of waterlogging according to the AGIS database;
- The clay content in the soils associated with the Project Area is less 15% according to the Northern Cape Soils Database;
- The predicted soil loss for the Project Area is considered very low; and
- The historical land use for the Project Area is mostly vacant/unspecified land.

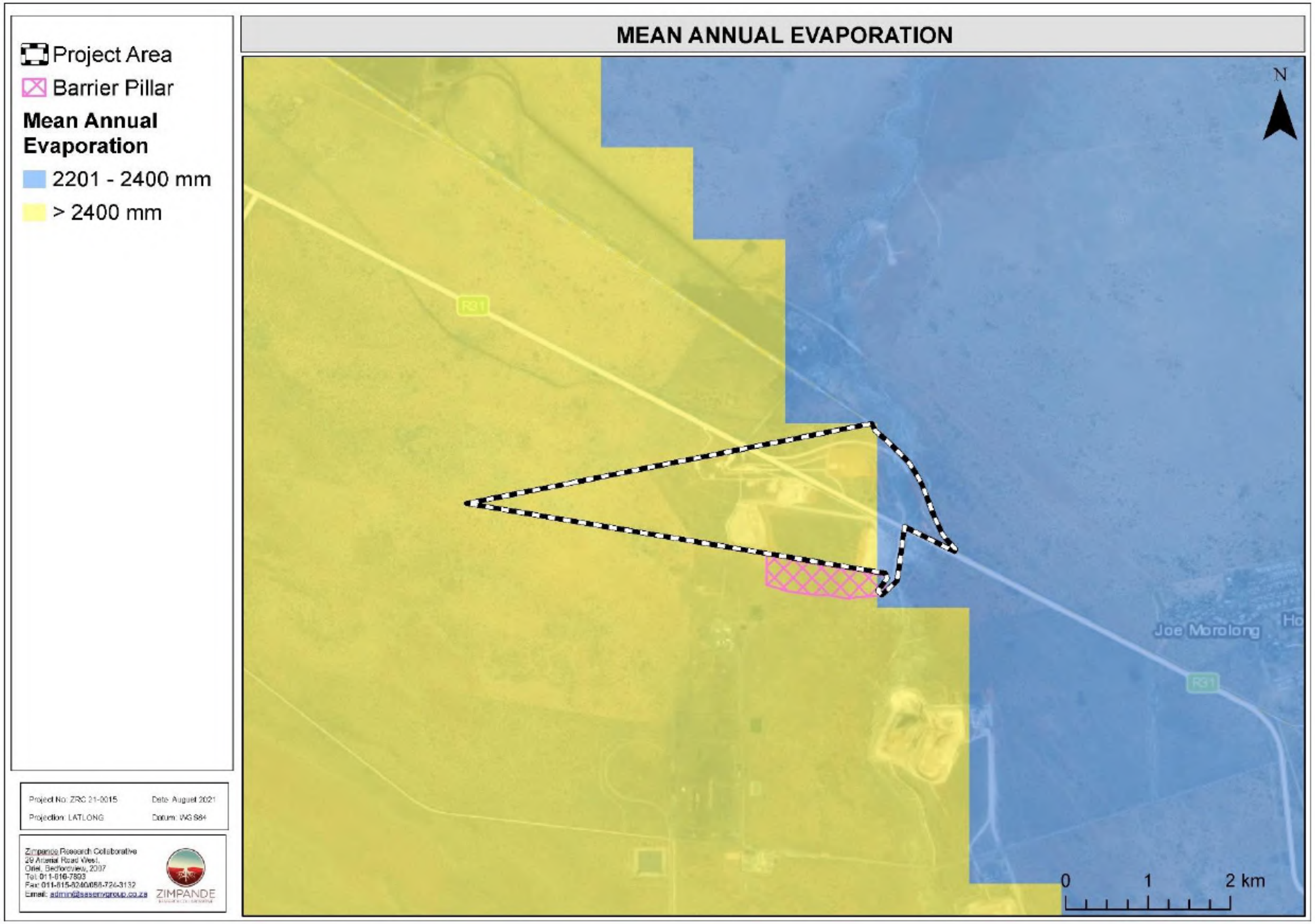

Figure 4: Mean Annual Evaporation associated with the Project Area.

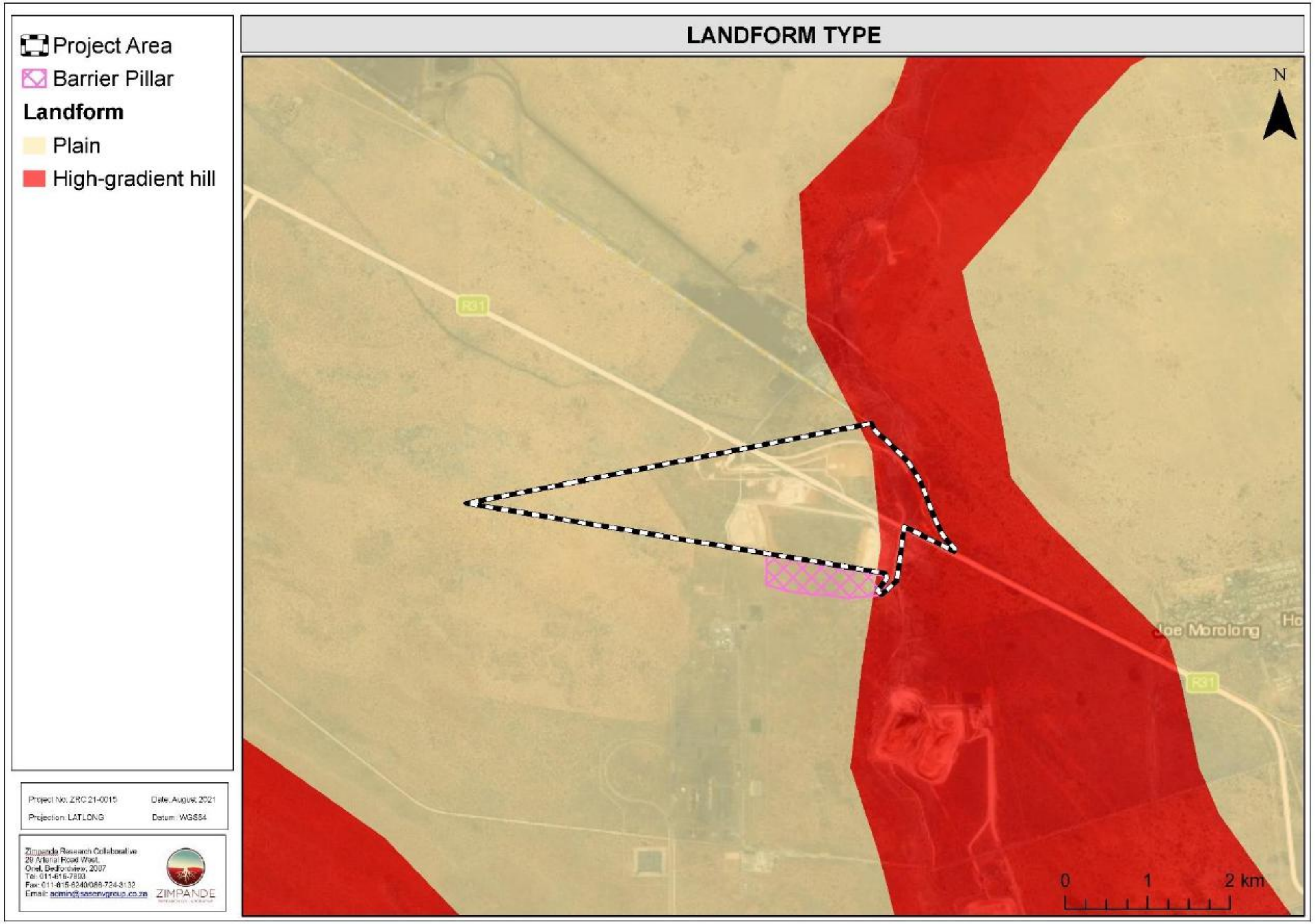

Figure 5: Landform types associated with the Project Area.

4 ASSESSMENT RESULTS

4.1 Current Land Use

Based on the observations during the site assessment the dominant land use within the Project Area is predominantly mining related activities (i.e., open cast mining, office space, water storage facilities, workshops and etc.) and grazing landuses (Game farm) located within the Kalagadi Mine. Figure 6 below depicts the associated land use within the Project Area .

Figure 6: Photographs illustrating the dominant land use within the Project Area.

4.2 Dominant Soil Forms

The dominant soil forms occurring within the Project Area are Ermelo/Clovelly, Mispah/Glenrosa, Dundee (Ga-Mogara River) and Witbank/Grabouw forms.

The majority of the soils occurring within the Western portion of the Project Area can be broadly classified as soils ideal for agricultural cultivation practices (with minor limitations) were climate permits as well as grazing activities as well as wildlife/wilderness. These ideal soil forms include Ermelo/Clovelly.

The above-mentioned soils are considered ideal for agricultural cultivation due to:

- Deep well drained soil characteristics;
- Texture and structure allowing for effective rooting depth; and
- Good water holding/storage capacity.

The soils towards the Eastern portion of the Project Area are characterised by the soils not considered ideal for agricultural cultivation practices. These soils include the Mispah/Glenrosa, Dundee and Witbank/Grabouw formations.

The Mispah/Glenrosa soil types is associated with poor physical properties for plant root system penetration and water infiltration, due to the shallow nature of the soil and/or limiting impeding layer of the underlying parent material. The Mispah soil form is also highly susceptible to erosion due to the poor hydraulic conductivity of these soils and thus not suitable for commercial agricultural cultivation.

The Witbank/Grabouw (Anthrosols) soil forms are soils which have 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 not ideal for agricultural cultivation.

Table 5 below show the dominant soils forms within the study area and their respective diagnostic horizons and Figure 7 below depicts a map of the soil forms.

Table 5: Dominant soil forms within the Project Area.

Soil Form	Code	Diagnostic Horizon Sequence
Ermelo/Clovelly	Er/Cv	Orthic/Yellow Brown or Lithic
Mispah/Glenrosa	Ms/Gs	Orthic/Hardrock or Lithic
Dundee	Du	Orthic A/ Alluvial
Witbank/Grabouw	Wb/Gb	Anthropogenic disturbed soils

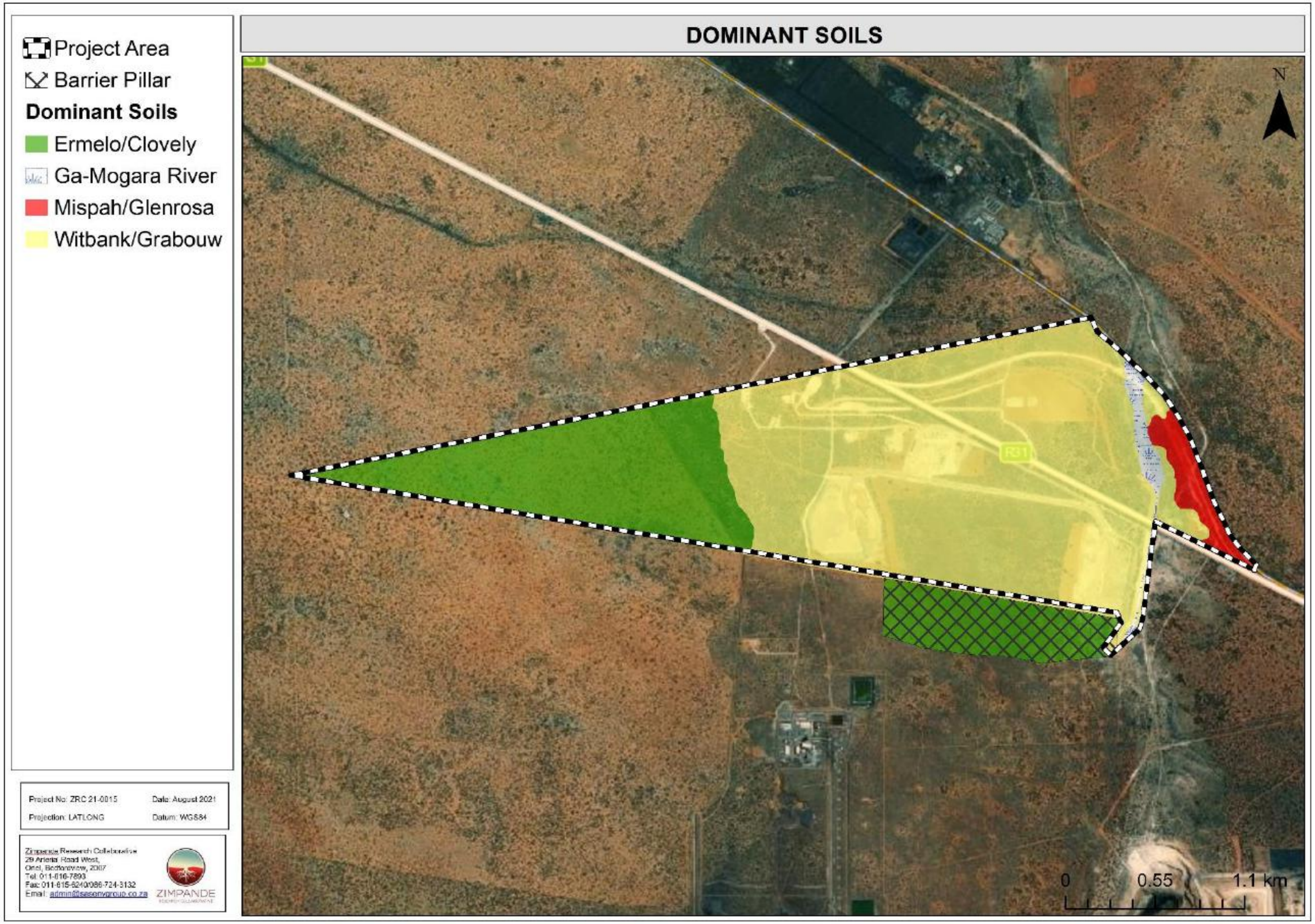

Figure 7: Dominant soil forms identified within the Project Area during the field verification.

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 crops 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 Project Area falls into Climate Capability Class 7 due to the severely restricted choice of crops due to heat, cold and/or moisture stress.

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 **8** below. The identified land capability limitations for the identified soils are discussed in comprehensive "dashboard style" summary tables presented from Tables **7, 8, 9** and **10** below. The dashboard reports aim to present all the pertinent information in a concise and visually appealing fashion. **Table 6** below presents the dominant soil forms and their respective land capability as well as areal extent expressed as hectares as well as percentages. Bases on the climate capability, slope and the land capability the Land Potential of the Project Area is illustrated in Figure 9.

Table 6: Identified soil forms within the proposed infrastructure footprint area and their respective land capability.

Soil Form	Land Capability	Area (ha)	Percentage (%)
Ermelo/Clovelly	Arable (Class II)	164.05	31.39
Dundee	Grazing (Class V)	8.6	1.65
Mispah/Glenrosa	Grazing (Class VI)	15.41	2.95
Witbank/Grabouw	Wilderness (Class VIII)	334.5	64.01
Cumulative Total		**522.63**	**100**

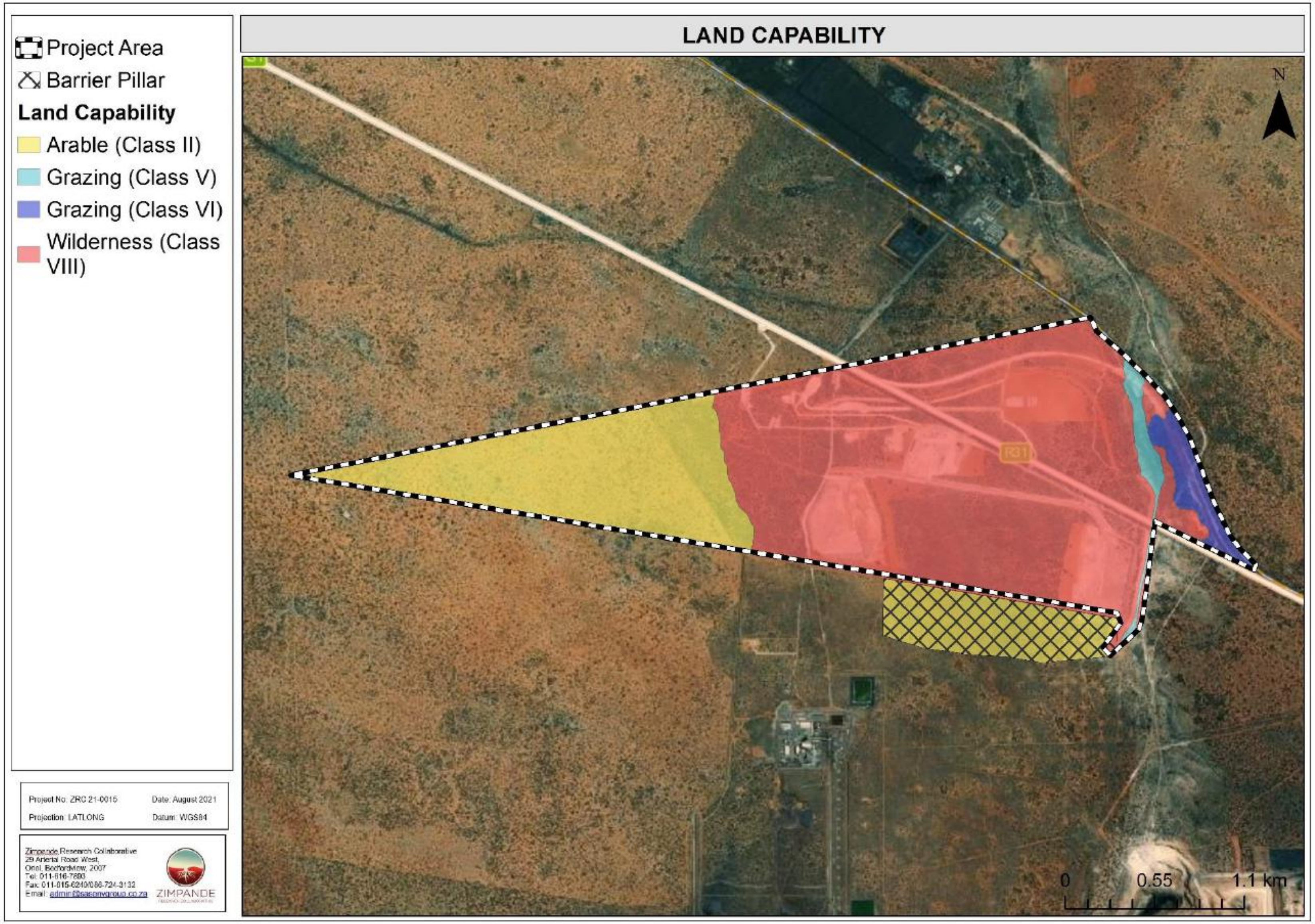

Figure 8: Map depicting Land capability of soils occurring within the Project Area.

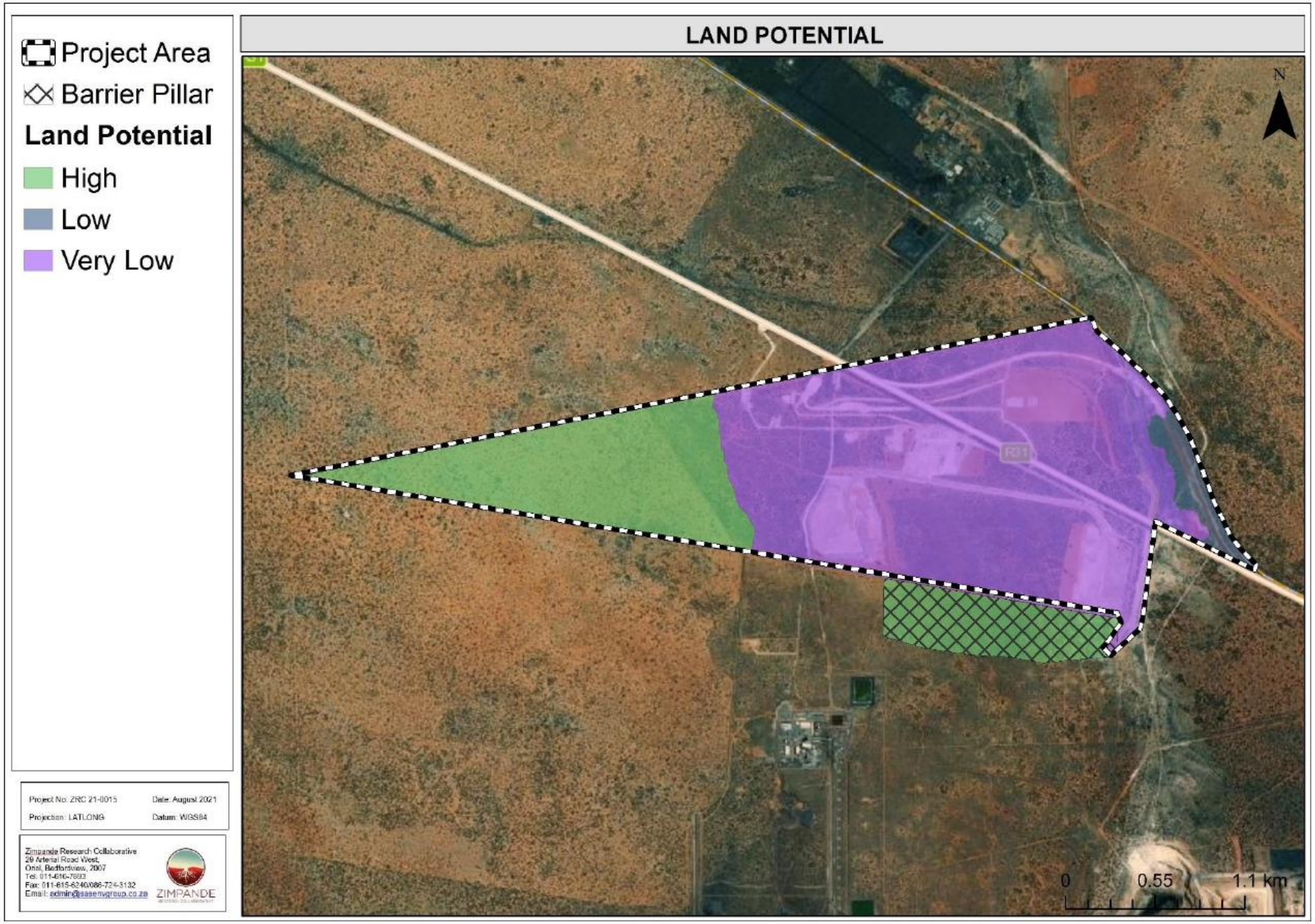

Figure 9: Land Potential associated with the Project Area.

Table 7: Summary discussion of the Arable (Class II) land capability class

Land Capability: Arable (Class II) and High potential with minor limitations


Terrain Morphological Unit (TMU)	<0.5% Relatively flat		**Photograph notes**	View of the yellow brown apedal soil horizon associated with the Ermelo/Clovelly soil forms occurring within the Project Area.
Soil Form(s)	Ermelo/Clovelly		**Area Extent**	164.05 ha (31.34% of the Project Area)
Physical Limitations	None. These soils have enough depth for most cultivated crops and good drainage characteristics.		**Land Capability and Land Potential** These soil forms are considered high potential agricultural soils with high (Class II) land capability, suitable for arable agricultural land use with minimal management interventions. Therefore, these soils are considered suitable for use for crop cultivation, and are also well-suited for other less intensive land uses such as grazing, forestry, etc. However, emphasis is directed to their agricultural crop productivity due to the scarcity of such soil resources on a national scale and food security concerns	
Land Potential	**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.			
Overall impact significance prior to mitigation	**M**	The overall impact of the proposed expansion, barrier pillar and new WRD and the topsoil stockpile activities on land capability and land potential is anticipated to be Moderate (M) prior to mitigation measures and Low (L) post mitigation, due to the inherently high land capability of the identified dominant soil form. The proposed developments will result in a localised permanent change of land use. Thus, the loss of agricultural soils and agriculturally productive land will be somewhat significant considering that arable soils are a non-renewable resource.	**Business case, Conclusion and Mitigation Requirements:** Although these are sensitive soils for potential agricultural use, the suitability for crop production is limited by the climate . This area experiences erratic and very low rainfall which is necessary for successful dryland agriculture. In addition, no large dams or irrigation schemes are available in the area thus limiting the soils in the area to grazing and wildlife uses. The high evaporation rate of the hot, dry climate will result in regular irrigation needed should crops be produced this way. However, the integrated mitigation measures must be implemented accordingly, with the aim of minimizing the potential loss of these valuable soils.	
Overall impact significance post mitigation	**L**			

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

<table>
<tr><th colspan="5">Land Capability: Grazing (Class V)</th></tr>
<tr><td colspan="5"></td></tr>
<tr><td>Terrain Morphological Unit (TMU)</td><td colspan="2">Relatively flat to moderately sloping land of <1.5% slope</td><td>Photograph notes</td><td>View of the bleached sandy soil material associated with the watercourse (i.e., Ga-Mogara River)</td></tr>
<tr><td>Soil Form(s)</td><td colspan="2">Dundee</td><td>Areal Extent</td><td>8.6 ha (1.65% of the Project Area)</td></tr>
<tr><td>Physical Limitations</td><td colspan="2">Soils are very sandy and subject to wind and water erosion and often shallow in depth.</td><td colspan="2" rowspan="2">Land Capability
The identified soils are of poor (Class V) land capability due to wetness limitations during the good rainy seasons. These soils are associated with watercourse features in the arid environments and cultivation on these soils would prove impractical.</td></tr>
<tr><td>Land Potential</td><td colspan="2">Restricted Potential: Due to association with the watercourse.</td></tr>
<tr><td>Overall impact significance prior to mitigation</td><td>M</td><td rowspan="2">The overall impact of the proposed river diversion and roads on land capability and land potential is anticipated to be Moderate (M) without mitigation measures in place and Low (L) post mitigation. This is due to the inherently poor land capability of the identified dominant soil forms. The proposed activity/infrastructure changes in areas with this soil type.</td><td colspan="2" rowspan="2">Business case, Conclusion and Mitigation Requirements:
While these soils are not considered prime agricultural production soils, they are crucial for freshwater systems in the area. Thus, avoidance of these soils is deemed imperative inline with the National Water Act No. 36 of 1998.</td></tr>
<tr><td>Overall impact significance post to mitigation</td><td>L</td></tr>
</table>

Table 9: Summary discussion of the grazing (Class VI) land capability class

<table>
<tr><th colspan="5">Land Capability: Grazing (Class VI)</th></tr>
<tr><td colspan="5"> </td></tr>
<tr><td>Terrain Morphological Unit (TMU)</td><td colspan="2">Gently sloping land of <1% slope</td><td>Photograph notes</td><td>View of the identified rock outcroppings associated with the Mispah and Glenrosa soil forms.</td></tr>
<tr><td>Soil Form(s)</td><td colspan="2">Mispah and Glenrosa</td><td>Areal Extent</td><td>15.41 ha (2.95%)</td></tr>
<tr><td>Physical Limitations</td><td colspan="2">These soils have limitations in terms of water storage, depth and nutrient holding capacity due to limited rock weathering.</td><td colspan="2" rowspan="2">Land Capability
The identified soils are of poor (Class VI) land capability because of the soil depth of this class is very shallow and moderately sloping. These limitations generally makes these soils unsuited to cultivation and limit their use largely to pastures or wood land.</td></tr>
<tr><td>Land Potential</td><td colspan="2">Restricted potential: 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>L</td><td rowspan="2">The overall impact of the proposed river diversion and roads on land capability and land potential is anticipated to be Low (L) both with and without mitigation measures in place, due to the inherently poor land capability of the identified dominant soil forms. The proposed activity/infrastructure changes in this instance will not impact on high potential soils and will be somewhat significant considering the scarcity of arable soils in South Africa.</td><td colspan="2" rowspan="2">Business case, Conclusion and Mitigation Requirements:
While these soils are not considered prime agricultural production soils. Some soils in class VI can be safely used for the common crops, provided unusually intensive management is used.</td></tr>
<tr><td>Overall impact significance post to mitigation</td><td>L</td></tr>
</table>

Table 10: Summary discussion of the Grazing (Class V) land capability class.

<table>
<tr><th colspan="5">Land Capability: Wildlife/Wilderness - Class VIII</th></tr>
<tr><td colspan="5">   </td></tr>
<tr><td>Terrain Morphological Unit (TMU)</td><td colspan="2">Not applicable; highly disturbed areas</td><td>Photograph notes</td><td>View of the identified Witbank soil forms</td></tr>
<tr><td>Soil Form(s)</td><td colspan="2">Witbank/Grabouw (Anthrosols)</td><td>Area Extent</td><td>334.5 ha (64.01%)</td></tr>
<tr><td>Diagnostic Horizon Sequence</td><td colspan="2">Not applicable; highly disturbed soils</td><td colspan="2" rowspan="2">Land Capability
These identified Witbank/Grabouw soils have very poor (class VIII) land capability due to the significant disturbance that has occurred as a result of mining 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>Physical Limitations</td><td colspan="2">Comprises of significantly disturbed areas due from anthropogenic activities (open cast, office areas, WRD and contractors), 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.</td></tr>
<tr><td>Overall impact significance prior to mitigation</td><td>L</td><td rowspan="2">The overall impact of the proposed activity/infrastructure changes 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">Business case, Conclusion and Mitigation Requirements:
The current state of these soils requires significant rehabilitation already. These areas should be targeted for development so as to avoid disturbance of natural soils and landscapes. These areas can be rehabilitated holistically at closure of the surrounding mines.</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 impacts which have already taken place (See section 5.1) and the proposed developments (See section 5.2). 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 11 and Table 12.

Table 11: Description of the impact significance in relation to the to the proposed activities and developments within the Project 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 12: Description of terms used in the impact assessment rating for the proposed activities and developments within the Project 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.
	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.
	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

5.1 Considerations of Layout/Activities already taking place

Mokala Mine is currently holds approval for infrastructure components comprising a dry crushing and screening plant; Waste Rock Dumps (WRDs), Run of Mine (ROM) stockpiles; topsoil stockpiles; water storage facilities; stormwater management infrastructure and mine-related support facilities such as workshops, stores, and offices. Additional approved activities include:

- The realignment of the R380 road on the farm Kipling 271 and across the remaining extent of the farm of Gloria 266;
- Upgrading of the intersection to the mine on portion 1 of the farm Gloria 266 also serving the existing Gloria Mine;
- The realignment of a section of the Ga-Mogara drainage channel within the existing river channel. This realignment extends onto the farm Umtu 281.

The Mokala Mine is currently in the construction and operational phase of the project. In this regard, temporary infrastructure in support of the construction phase is currently on site. Construction facilities will either be removed at the end of the construction phase or incorporated into the layout of the operational mine. The mine has also begun with their open cast strip mining activities.

The changes to the currently approved mine layout were also considered. The changes to the approved infrastructure layout that have already taken place include:

- The reconfiguration of the plant area, ROM stockpile and product stockpile;
- The relocation of the ROM low grade product stockpile;
- The relocation of support infrastructure;

- The relocation of transportation related facilities/infrastructure;
- The relocation of the approved WRD; and
- The relocation of the approved topsoil stockpiles.

The impacts of the above-mentioned activities were also taken into consideration with regards to their impacts on soil and land capability of the Project Area. In this regards a specialist study conducted by TerraAfrica Consult (2015) was consulted in order to gain understanding of the nature of the impacts on soil and land capability. Activities of particular concern are the WRD, relocated topsoil and relocated low-grade stockpile. The reconfiguration of the above-mentioned activities are not anticipated to have caused any cumulative significant impact on the land capability as a result of the impacts that has already taken place due to the active mining operations taking place. The impacts can thus be regarded as Low.

The soil forms identified within the approved project include Clovelly, Molopo, Witbank, Brandvlei and Kinkelbos. The soils forms identified, although they would be moderately to highly suited for crop production, the rainfall in the area is not consistent with long periods of drought from time to time which has the potential to restrict the profitability of large-scale crop production (TerraAfrica Consult, 2015). The significance of impact on land capability was rated Medium after mitigation reason being that the Mokala Manganese mine development falls within a larger area for mining projects intermixed with cattle and game farming. Thus, the proposed mining right area will not impact on any current crop production and will therefore not affect primary grain production provided that soil management measures are followed as outlined and the land be rehabilitated to the highest standard possible (TerraAfrica Consult, 2015).

5.2 Activities and Aspect Register

This section will focus on the proposed activities by Mokala Manganese Mine.

Proposed Activity Description:

- The proposed expansion of the open pit;
- The proposed increase in the capacity of the WRD and the establishment of an additional WRD;
- The proposed establishment of additional topsoil stockpiles;
- The proposed relocation of stormwater management infrastructure;
- The proposed increase in the capacity of product stockpiles (ROM and Low Grade, High Grade); and
- The proposed mining of the barrier pillar between the Kalagadi Mine and Mokala Mine.

The impact assessment rating is applicable to the following activities presented on Table 13:

Table 13: Activities associated with proposed development during different phases.

Phase	Activities
Pre- Construction Phase	Planning and design of the footprint areas.
	Preparation for the construction activities
Construction	Clearing of the footprint area associated for the proposed developments
	Soil stripping and stockpiling
	Construction of the water and power pipelines
Operational	Operation of mining related activities
	Waste generation

5.2.1 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 footprint is located on a relatively flat terrain. The soils of Ermelo/Clovelly and Witbank/Grabouw formation occurring within the Project Area are susceptible to soil erosion due to their sandy nature. Soils which were vegetated prior to the proposed activities will be more susceptible to erosion during the construction phase if left bare or if not vegetated when in stockpile areas before the rainy season; thus, exposed to wind and storm water. The severity of this impact is anticipated to be Moderate for most of the soils and with the appropriate mitigation measures the significance of this impact may be Low. Soil erosion is likely to have some negative impacts on soil and this will most likely lead to:

- Removal of organic matter and important soil nutrients essential for vegetation growth and thus reduced yield potential;
- Possible pollution and sedimentation of nearby water sources consequently affecting the water quality for livestock and
- Limited water availability essential for vegetation growth.

Tables 14 and 15 below presents the impact assessment for soil erosion for the proposed developments.

Pre-Construction	Construction	Operational
Potential poor planning leading to excessive or unnecessary placement of infrastructure outside the Project Area boundary or the demarcated infrastructure areas leading to increased soils erosion.	Site clearing, removal and associated disturbances to soils, leading to, increased runoff, erosion and consequent loss of land capability in cleared areas.	Constant disturbances of soils, resulting in risk of erosion
	Potential frequent movement of digging machinery within lose and exposed soils, leading to excessive erosion	Ongoing disturbances to soils, resulting in increased sedimentation and risk of erosion, arising from mining activities.

Table 14: Summary of the impact significance on soil erosion for the Project Area.

Activity	Probability	Intensity	Spatial extent	Duration	Consequence	Significance
Pre-Construction	VH	M	L	L	**Medium**	**Medium**
Construction	VH	M	L	M	**Medium**	**Medium**
Operational	H	L	L	H	**Medium**	**Medium**

Table 15: Summary of the impact significance on soil erosion for the Project Area post mitigation.

Activity	Probability	Intensity	Spatial extent	Duration	Consequence	Significance
Pre-Construction	H	L	L	L	**Low**	**Low**
Construction	H	L	L	L	**Low**	**Low**
Operational	M	L	L	M	**Low**	**Very Low**

5.2.2 Soil compaction

Heavy equipment traffic during construction and activities is anticipated to cause soil compaction. The Project Area is more prone to compaction as there will be a significant increase in the use of vehicle and heavy machinery during the construction phase and if work is done when the soil is wet this may increase the soils susceptibility to compaction. However, the significance of the impact is considered to be Medium if unmanaged and Low if managed, given that the effect will be localized and restricted to access roads, vehicle hardstand areas and equipment and machinery laydown areas. Soil compaction may potentially lead to:

- Increased bulk density and soil strength, reduced aeration and lower infiltration rate;
- Consequently, it lowers crop performance via stunted aboveground growth coupled with reduced root growth;
- Destroyed soil structure, causing it to become more massive with fewer natural voids with a high possibility of soil crusting. This situation can lead to stunted, drought-stressed plants as a result of restricted water and nutrient uptake, which results in reduced crop yields;
- 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.

Tables 16 and 17 below presents the impact assessment for soil compaction for the proposed developments.

Pre-Construction	Construction	Operational
Potential poor planning leading to excessive or unnecessary placement of infrastructure outside the demarcated proposed layout changes areas leading to increased	Site clearing and associated disturbances to soils, leading to, increased runoff, soil compaction and consequent loss of land capability in cleared areas.	Constant disturbances of soils, resulting in risk of compaction
	Potential frequent movement of digging machinery and construction vehicles within lose and exposed soils, leading to excessive soil compaction	

Table 16: Summary of the impact significance on soil compaction for the Project Area pre mitigation

Activity	Probability	Intensity	Spatial extent	Duration	Consequence	Significance
Pre-Construction	VH	M	L	L	**Medium**	**Medium**
Construction	VH	M	L	M	**Medium**	**Medium**
Operational	H	L	L	H	**Medium**	**Medium**

Table 17: Summary of the impact significance on soil compaction for the Project Area post mitigation

Activity	Probability	Intensity	Spatial extent	Duration	Consequence	Significance
Pre-Construction	H	L	L	L	**Low**	**Low**
Construction	H	L	L	M	**Low**	**Low**
Operational	M	L	L	L	**Low**	**Very Low**

5.2.3 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 soil contamination is considered to be Medium for all identified soils without mitigation and Low with mitigation, largely depending 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 (EMPr) 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.

Tables 18 and 19 below presents the impact assessment for soil contamination for the proposed developments.

Pre-Construction	Construction	Operational
Potential poor planning leading to excessive or unnecessary placement of infrastructure outside the demarcated infrastructure areas leading to increased exposure to soil contamination.	Spillage of petroleum hydrocarbons during construction of associated infrastructure	Leaching of hydrocarbons chemicals into the soils, leading to alteration of the soil chemical status as well as contamination of ground water
	Disposal of hazardous and non-hazardous waste, including waste material spills and refuse deposits into the soil.	Disposal of hazardous and non-hazardous waste, including waste material spills and refuse deposits into the soil.

Table 18: Summary of the impact significance on potential soil contamination for the Project Area.

Activity	Probability	Intensity	Spatial extent	Duration	Consequence	Significance
Pre-Construction	VH	M	L	L	Medium	Medium
Construction	VH	M	L	M	Medium	Medium
Operational	VH	M	L	H	Medium	Medium

Table 19: Summary of the impact significance for soil contamination for the Project Area post mitigation.

Activity	Probability	Intensity	Spatial extent	Duration	Consequence	Significance
Pre-Construction	M	VL	L	L	Very Low	Very Low
Construction	M	L	L	L	Low	Very Low
Operational	M	VL	L	L	Very Low	Very Low

5.2.4 Loss of Agricultural Land Capability

The loss of land capability is anticipated to be Medium as the significant portion (120.8 ha out of 466.8) of the dominant soils are considered ideal for cultivation. Large portions of arable soils will be stripped and stockpiled and thus potentially reducing the fertility status (sterilisation) of the soils and being prone to erosion. The proposed activities will lead to a permanent change of land use if not properly mitigated. Consequently, the loss of agricultural soils and the permanent change in land use will be localized to within the Project Area and also considering that mining related activities are already taking place on a large portion of the Project Area and surrounding areas which may potentially impact on these arable soils.

Tables 20 and 21 below presents the impact assessment for loss of agricultural land capability for the Project Area.

Pre-Construction	Construction	Operational
Potential poor planning leading to excessive or unnecessary placement of infrastructure high potential agricultural soils	Site clearing, the removal of vegetation, and associated disturbances to soils, leading to increased nutrient leaching, runoff	Ongoing disturbances to soils, resulting in increased leaching of soil nutrients and risk of erosion, attributed to mining activities.

Pre-Construction	Construction	Operational
Potential inadequate design of infrastructure leading to risks of contamination of soils due to seepages and runoff.	Potential indiscriminate disposal of hazardous and non-hazardous waste, including waste material spills and refuse deposits into the soil.	Potential increase in concentrations of contaminant concentration in the soil.
		Ongoing disturbance as a result of maintenance activities, leading to altered vegetation community structures, and consequently altering the quality and nutrient status of the soil.

Table 20: Summary of the impact significance for soil land capability.

Activity	Probability	Intensity	Spatial extent	Duration	Consequence	Significance
Pre-Construction	VH	M	L	L	Medium	Medium
Construction	VH	M	L	M	Medium	Medium
Operational	VH	M	L	H	Medium	Medium

Table 21: Summary of the impact significance for soil land capability post mitigation.

Activity	Probability	Intensity	Spatial extent	Duration	Consequence	Significance
Pre-Construction	M	L	L	L	Low	Low
Construction	M	L	L	L	Low	Low
Operational	M	L	L	L	Low	Low

5.2.5 Cumulative Impacts

The loss of land capability is anticipated to be Medium as the significant portion (164.05 ha out of 522.63) of the dominant soils are considered ideal for cultivation. Large portions of arable soils will be stripped and stockpiled and thus potentially reduce the fertility status of the soils and will be prone to erosion. The proposed activities will lead to a permanent change of land use if not appropriately mitigated. The cumulative loss from a soil and land capability point of view is anticipated to be Medium pre-mitigation and Low after mitigation. This is due to the significant portion of the Project Area having soils classified as suitable for agricultural cultivation. However, the suitability for successful dry land agriculture is low due to the climatic conditions of the area. This area experiences erratic and very low rainfall which is necessary for successful dryland agriculture. In addition, no large dams or irrigation schemes are available in the area thus limiting the soils in the area to grazing and wildlife uses. The high evaporation rate of the hot, dry climate will result in regular irrigation needed should crops be produced this way. Lastly, the loss of agricultural soils and the permanent change in land use will be localized to within the Project Area. The integrated mitigation measures must be implemented accordingly, with the aim of minimizing the potential loss of these valuable soils considering the need for sustainable development.

5.2 Integrated Mitigation Measures

5.2.1 Soil Erosion and Dust Emission Management

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

5.2.2 Soil Contamination Management

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

5.2.3 Loss of Land Capability Management

- Close supervision and monitoring of the stripping process is required to ensure that soils are stripped correctly and backfilled after the laying down of water pipelines.
- Revegetate the disturbed soils with an indigenous grass mix, to re-establish a protective cover, in order to minimise soil erosion and dust emissions; and
- The footprint areas should be lightly ripped to alleviate compaction.

5.2.4 Soil Management Plan (SMP)

The effective and appropriate re-use of topsoil is essential in achieving successful rehabilitation outcome for the proposed activities at the Mokala Mine. This soil management plan (SMP) is intended as a guide only and should be reviewed and updated periodically throughout the life of the mine in response to technology changes, research and to address changes to management strategies.

Proposed activity/infrastructure changes to the approved surface layout include:

- The proposed expansion of the open pit;
- The proposed increase in the capacity of the approved WRD and the establishment of an additional WRD;
- The proposed establishment of additional topsoil stockpiles;
- The proposed relocation of stormwater management infrastructure;
- The proposed increase in the capacity of product stockpiles (ROM and Low Grade, High Grade); and
- The proposed mining of the barrier pillar between the Kalagadi Mine and Mokala Mine.

5.2.4.1 Existing Soil Resources

The dominant soil forms occurring within the Project Area are Ermelo/Clovelly, Mispah/Glenrosa and Witbank/Grabouw forms.

The Ermelo/Clovelly soil forms are very sandy in nature with little to no organic matter content on the topsoil and more susceptible to wind erosion. Based on the site observations these soils are not covered by thick and dense vegetation and thus increase the risk of wind erosion. On the other hand, these soils are not highly susceptible to water erosion as these soils are well drained.

Soils of the Grabouw and Witbank are also more susceptible to wind and water erosion as these soils have undergone some level of disturbance due to the mining related activities already taking place in the approved footprint areas.

The Mispah/Glenrosa soils are more susceptible to water erosion and they are located mainly on sloping areas. This is due to their limited water holding capacities which thus result in overland flow and thereby promoting incised erosion gullies.

5.2.4.2 Topsoil Management

Soil investigations were carried out and the soils were characterized according to their morphology and thus ascertain the suitability of the topsoil for rehabilitation. The current EMPR commitment states that stripping of topsoil requires a minimum of 400 mm topsoil unless a soils expert advises otherwise (Department of Environmental Affairs and Tourism, 2004). However, based on the assessment of the Project Area by the specialist it is recommended that this commitment be amended to suit the local conditions where the majority of soils are shallow (less than 0.2 m in average depth). In these areas topsoil stripping should be based on that is achievable in the shallow soils (defined as Mispah/Glenrosa soils in the soil type map). Where deeper soils such as the Ermelo/Clovelly soil forms are present the minimum depth of topsoil stripping should be at least 1 m. The aim is to maximise recovery of topsoil and plant growth media from each cleared area. This top-soil material should be used directly in the rehabilitation of the disturbed areas as the mine activities progresses. Stockpile height should be restricted to that which can deposited without additional traversing by machinery. Topsoil utilisation should be scheduled and planned as part of the detailed rehabilitation programme. Rehabilitation areas must be subject to restricted access. Topsoil should be stored such that it is protected from internal rainfall and runoff using temporary vegetation or mulching and protected from external runoff using diversion banks/drains.

5.2.4.3 Mine Planning

It is important that the total soil resource available is fully utilised and is made available for rehabilitation. Closure objectives must be outlined so that the planning is done with the end use in mind considering that the Mokala mine is currently operational and concluding construction activities. In this way final closure costs may be minimised and design constraints that will prevent full compliance with the legal commitments made in the mine EMPR may be avoided (Chamber of Mines of South Africa, 2007).

The key planning phase activities are as follows:

- Rehabilitation specialist must evaluate the mine plan to assess the extent to which the current plan will debase land use capability, ecological status, or result in long-term (i.e. post-closure) maintenance liabilities;
- Rehabilitation specialist must propose mine plan modifications to mitigate environmental impacts;
- Mine planner must re-assess the mine plan to determine the extent to which the rehabilitation specialist’s requirements can be accommodated;
- The residual impacts of the current activities, and the likely end product must be agreed upon by the mine planner and rehabilitation specialist; and
- An estimate of the cost of rehabilitation should be developed based on the current mining plan.

5.2.4.4 Soil Stripping

Maximising topsoil recovery during development and construction is important to ensure that there is sufficient topsoil available for rehabilitation. These considerations are applicable to future developmental/ surface layout changes on the Mokala mine. Potential impacts from inadequate stripping management procedures include dust emissions, altered soil structure, and the dispersal and spread of weed species. Wherever possible, stripping and replacing of soils should be done in a single action. This is both to reduce compaction and also to increase the viability of the seed bank contained in the stripped surface soil horizons. It is preferable to strip a little too much ahead of the proposed activities rather than too little, particularly where stripping is concentrated in the dry months so as to minimise the potential for compaction. Close supervision of the stripping process is thus also imperative to ensure that all soils are stripped correctly and not mixed. Monitoring requires assessment of the depth stripped, the degree of mixing of soil materials and the volumes of material replaced directly or placed on stockpiles.

A topsoil stockpile quantification analysis was conducted in order to determine the best estimate for the topsoil and total soil material for closure and rehabilitation processes. The average depth for the Ermelo/Clovelly and Witbank soil forms was estimated at 1.5 m. In order to maximise the recovery of topsoil and plant growth media from each cleared area the topsoil stripping should be 1 m. The Mispah/Glenrosa soil forms which are the shallow rocky soil types the average depth was estimated at 0.2 m and due to the shallow nature of the soils the stripping of topsoil can be based on the achievable soil recovery. Based on the available topsoil material in stockpile areas, an approximate area that can be covered per stockpile has been calculated based on the recommended minimum topsoil depth of 0.4m to serve as a seedbed. The 0.4m depth can also be adjusted based on the local conditions.

The estimation calculations for Ermelo/Clovelly were as follows:

120.9 ha= 1209000 m^2

Volume of available soil material = 1209000 m^2 * 1.5 m (Average depth)

= 1813500 m^3

Area (in ha) that can be covered = 1813500 $m^3 \div 0.4$ m

= 4533750 $m^2 \div$ 10 000 m^2

= 453.375 ha

Table 22: Estimation of area that can be covered based on the available topsoil material.

Types of Material	Area in m^2	Volume of available soil material (m^3)	Area that can be covered (in ha) if the minimum depth is 0.4 m
Ermelo/Clovelly	1209000	1 813 500	453.4
Mispah/Glenrosa	28000	5600	1.4
Witbank	3345000	5017500	1 254.4
Total	**4582000**	**5023100**	**1709.2**

5.2.4.5 Soil Storage and Stockpiling

Prior to the commencement of the proposed activities, topsoil should be removed, and stockpiled for future use. Surface and subsoil material should be stockpiled separately. This is to prevent the mixing of the fertile topsoil with the nutrient limited subsoils. Stockpiles will be constructed to minimise deterioration of seed, nutrients and soil biota, by avoiding topsoil collection when saturated following rainfall (this will promote composting), and by creating stockpiles of lower height (one to three metres) where possible. The duration of stockpiling must be minimised where possible. Vegetation debris, logs and leaf litter will be retained where possible for reuse during rehabilitation. 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. Thereafter a short-term topsoil 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. Once established, stockpiles should be managed to ensure that losses from the piles are minimised and that additional damage to the physical, chemical or biotic content is minimised.

5.2.4.6 Limited Topsoil Medium for Adequate Rehabilitation

The soil material identified on the Project Area can be considered very sandy and subject to wind erosion. This is due to the lack of cohesion between the sandy materials of the soils. Therefore, this has led to limited topsoil material being available for use in the rehabilitation programme of the Mokala manganese mine.

The following measures are proposed in order counteract the problems associated with limited topsoil stockpile:

- Ideally, removal of infrastructure once mining activities are completed is usually considered. However, all the structures on site should be assessed in conjunction with the ultimate land users, and the authorities, to determine which infrastructure areas and/or components could be used in future. This will aid in the minimisation of the amount of topsoil stockpile required for rehabilitation;
- Where infrastructure is removed all the rubble and residual foundations need to be covered with at least one metre of cover material. Best practice is to cover with 1 metre of inert cover material (which may be “B” or “C” horizon material that can be penetrated by plant roots), which in turn is covered with topsoil material; and

- The topsoil stockpile should be used only in areas where there is a likelihood for post closure use such as grazing, where the slopes are not excessively steep.

5 CONCLUSION

The Zimpande Research Collaborative (ZRC) was appointed to conduct a soil, land use and land capability assessment as part of the integrated environmental authorisation process for the proposed Mokala Manganese Mine activity/infrastructure changes to the approved surface layout within the jurisdiction of the Joe Morolong Local Municipality, in the Northern Cape Province. Henceforth, collectively referred to as the "Project Area" unless referring to individual infrastructure (i.e., waste rock dumps (WRD), open cast pit, topsoil stockpile, stormwater infrastructure, run of mine (ROM) and low-grade stockpile).

The Mean Annual Precipitation (MAP) within the Project Area is estimated to range between 201 – 400 mm per annum. These conditions have a low yield potential for a moderate range of adapted crops and planting date options may be limited for supporting rain fed agriculture.

Based on the observations during the site assessment the dominant land use within the Project Area is predominantly mining related activities (i.e., open cast mining, office space, water storage facilities, workshops and etc.) and grazing landuses (Game farm) located within the Kalagadi Mine.

The dominant soil forms occurring within the Project Area are Ermelo/Clovelly, Mispah/Glenrosa and Witbank/Grabouw forms.

The majority of the soils occurring within the Western portion of the Project Area can be broadly classified as soils ideal for agricultural cultivation practices (with minor limitations) were climate permits as well as grazing activities as well as wildlife/wilderness. These ideal soil forms include Ermelo/Clovelly.

The above-mentioned soils are considered ideal for agricultural cultivation due to:

- Deep well drained soil characteristics;
- Texture and structure allowing for effective rooting depth;
- Good water holding/storage capacity;

The soils towards the Eastern portion of the Project Area are characterised by the soils not considered ideal for agricultural cultivation practices. These soils include the Mispah/Glenrosa and Witbank/Grabouw formations.

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

Table A: Dominant soil forms and their respective land capability

Soil Form	Land Capability	Area (ha)	Percentage (%)
Ermelo/Clovelly	Arable (Class II)	164.05	31.39
Dundee	Grazing (Class V)	8.6	1.65
Mispah/Glenrosa	Grazing (Class VI)	15.41	2.95
Witbank/Grabouw	Wilderness (Class VIII)	334.5	64.01
Cumulative Total		**522.63**	**100**

The loss of land capability is anticipated to be Medium as the significant portion (164.05 ha out of 522.63) of the dominant soils are considered ideal for cultivation. Large portions of arable soils will be stripped and stockpiled and thus potentially reducing the fertility status of the soils and being prone to erosion. The proposed activities will lead to a permanent change of land use if not appropriately mitigated. The cumulative loss from a soil and land capability point of view is anticipated to be Medium pre-mitigation and Low after mitigation. This is due to the significant portion of the Project Area having soils classified as suitable for agricultural cultivation. However, the suitability for successful dry land agriculture is low due to the climatic conditions of the area. This area experiences erratic and very low rainfall which is necessary for successful dryland agriculture. In addition, no large dams or irrigation schemes are available in the area thus limiting the soils in the area to grazing and wildlife uses. The high evaporation rate of the hot, dry climate will result in regular irrigation needed should crops be produced this way. Lastly, the loss of agricultural soils and the permanent change in land use will be localized. The integrated mitigation measures must be implemented accordingly, with the aim of minimizing the potential loss of these valuable soils considering the need for sustainable development.

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 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; and
- 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;
- 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, truck and shovel methods should be used as bowlscrapers create excessive compaction when moving wet soils;
- Usable topsoil from the construction of the surface infrastructure areas must be removed prior to construction and stockpiled separately within the demarcated areas with measures

to protect this valuable resource from impacts such as chemical contamination as well as mixing with less valuable overburden types and

- Revegetate with an indigenous grass mix, to re-establish a protective cover, in order to minimise soil erosion and dust emissions.

Based on the stockpile management plan the following measures are proposed in order counteract the problems associated with limited topsoil stockpile:

- Ideally, removal of infrastructure once mining activities are completed is usually considered. However, all the structures on site should be assessed in conjunction with the ultimate land users, and the authorities, to determine which infrastructure areas could be used in future; This will aid in the minimization of the amount of topsoil stockpile required for rehabilitation;
- Where infrastructure is removed all the rubble and residual foundations need to be covered with at least one metre of cover material. Best practice is to cover with 1 metre of inert cover material (which may be “B” or “C” horizon material that can be penetrated by plant roots), which in turn is covered with topsoil material; and
- The topsoil stockpile should be used only in areas where there is a likelihood for post closure use such as grazing, where the slopes are not too steep.

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APPENDIX A: 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 by a qualified soil specialist (February 2021), at which time the identified soils within the infrastructure areas and associated access roads 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 4 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 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

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

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.
	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	**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.

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

DURATION of impacts	**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.
- Desired outcomes are defined, and have been developed in such a way as to be *measurable events with performance indicators, targets and acceptable criteria* that can be tracked over *defined periods*, with estimates of the *resources* (including human resource and training requirements) *and responsibilities for implementation.*

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 B: DETAILS, EXPERTISE AND CURRICULUM VITAE OF SPECIALISTS

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

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

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

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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. (c) 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 (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, 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

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