SOIL LAND USE AND LAND CAPABILITY ASSESSMENT AS PART OF THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS FOR THE PROPOSED ANGLO PLATINUM DER BROCHEN EXPANSION PROJECT, LIMPOPO PROVINCE

Prepared for

SRK Consulting (Pty) Ltd

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EXECUTIVE SUMMARY

Scientific Aquatic Services (SAS) was appointed to conduct a soil, land use and land capability assessment as part of the Environmental Impact Assessment (EIA) and authorisation process for the proposed Anglo Platinum Der Brochen Expansion Project, Limpopo Province.

The focus area is dominated by shallow soils of Mispah/Outcrop, Milkwood, Glenrosa, Bonheim and Mayo soil forms which collectively constitute of approximately over 60% of the total investigated area, whilst moderately deep soils of Hutton/Mispah occupies less than 5% of the total investigated focus area. The shallow nature of the dominated soil forms can be largely attributed to limited rock weathering or rejuvenation through natural erosion on steeper, convex slopes. The remainder of the focus area is occupied by structures associated with mining (i.e. Mine plant complex, PCD, office areas, tar roads), Witbank (*Anthrosols*) as well as soil types which are associated with freshwater features and these include Kroonstad, Katspruit and Willowbrook. Witbank soil forms were also identified within the proposed focus area. These soils have been extensively disturbed such that no recognisable diagnostic soil morphological characteristics, particularly in the topsoil, could be identified, corresponding to *Anthrosols* in the international soil classification terminology.

Current land use activities associated with the focus area are largely dominated by wildlife and wilderness, with some mining operations in the surrounding areas. No agricultural activities were observed in the surrounding areas. Land capability classification of the identified soils are presented in the table below.

Land capability classes for soil forms identified with the proposed mining sites

Soil Form	Land Capability	Total Area (Ha)	% Areal Extent
Hutton	Arable (Class III)	27.43	2.49
Hutton/Mispah		21.36	1.94
Mispah/Outcrop	Grazing (Class VII)	289.60	26.31
Bonheim/Steendal		5.24	0.48
Mispah/Glenrosa		190.41	17.30
Mispah/milkwood		1.20	0.11
Mispah/Bonheim		25.63	2.33
Mispah/Bonheim/Mayo		204.71	18.60
Bonheim/Valsrivier		8.62	0.78
Steendal/Immerpan		77.69	7.06
Witbank (Anthrosols)	Wilderness	45.16	4.10
Freshwater Features (Kroonstad/katspruit/Willowbrook (Including Dam))	Wetland	116.40	10.57
Other (Stockpile. PCD, Tar Road, Mine Plant Area)	Non-Arable	87.32	7.93
Total Area Investigated	**1100.77**		**100**

***The percentages were rounded off to two (2) decimal places**

The findings of this assessment suggest that the relevant soil limiting factors within the MRA for land capability and land use potential include the following:

- Shallow effective rooting depth due to shallow indurated bedrock of the Mispah, Glenrosa, Milkwood, Mayo, Bonheim soil forms. As such, these soils are not considered to contribute significantly to agricultural productivity;
- Limited rooting depth due to periodic waterlogging of the Katspruit, Willowbrook and Kroonstad soil forms within the inundated zone of the artificial impoundments within the hillslope seep

wetland. Preservation of these soils for conservation purposes takes precedence, according to the National Water Act, 1998 (Act No. 36 of 1998);
- Lack of soil medium for plants and crop growth for the rocky outcrop, mine areas (Offices, PCD and stockpile areas), surface water areas and Witbank (*Anthrosols*) soil types.

From a land capability point of view, the focus area presents relatively small areas of arable soils with a moderate potential for agriculture, comprising just 3.88 % of the total focus area, whilst the rest of the focus area is comprised on very shallow soils not considered prime soils for agricultural production. The extent of Hutton and Hutton/Mispah soils thereof cannot be considered sufficient for viable cultivated small commercial farming, however should be avoided where feasible to minimise the loss of soil resources for current and future agricultural production.

Livestock commercial farming is not considered ideal for this area due to the veld being classified as having a grazing capacity of 3.5 ha Per Large Animal Unit (PLAU). Furthermore, a significant portion of the focus area is located on a moderately steep terrain (medium gradient, further disqualifying this area for livestock commercial farming.

Potential arable soils will be slightly impacted by the proposed north eastern DMS stockpile since the current layout intrudes on these soils. From a soil and land capability point of view, this project is not regarded as being fatally flawed due to various soils constraints for commercial agricultural production, however mitigation measures and recommendations outlined in this document need to be strongly considered and implemented accordingly in efforts to conserve soil resources and for the protection of water resources.

It is the opinion of the specialist therefore that this study provides the relevant information required for the Environmental Impact Assessment phase of the project to ensure that appropriate consideration of the agricultural resources in the study area will be made in support of the principles of Integrated Environmental Management (IEM) and sustainable development.

DOCUMENT GUIDE

This report was compiled according to the following information guidelines for a specialist report in terms of the Environmental Impact Assessment (EIA) Regulation 326 of the National Environmental Management Act (NEMA), as summarised on the Table below.

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

No.	Requirement	Section in report
a)	Details of -	
(i)	The specialist who prepared the report	Appendix B
(ii)	The expertise of that specialist to compile a specialist report including a curriculum vitae	Appendix B
b)	A declaration that the specialist is independent	Appendix B
c)	An indication of the scope of, and the purpose for which, the report was prepared	Section 1.1
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 5
d)	The date of the site investigation	Section 2.3
e)	A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 2
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 alternatives	Section 4
h)	Map of the pre-determined soil and land capability data	Section 3
i)	A description of any assumption made and any uncertainties	Section 1.3
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 5.1
l)	Any conditions for inclusion in the environmental authorisation	None
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 5 and 6
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

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

ACRONYMS

°C	Degrees Celsius.
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
ET	Evapotranspiration
FAO	Food and Agriculture Organization
GIS	Geographic Information System
GPS	Global Positioning System
m	Meter
MAP	Mean Annual Precipitation
MPRDA	Minerals and Petroleum Resources Development Act, Act 28 of 2002
NEMA	National Environmental Management Act
NWA	National Water Act
PSD	Particle Size Distribution
SACNASP	South African Council for Natural Scientific Professions
SAS	Scientific Aquatic Services
WULA	Water Use Licence Application

1. INTRODUCTION

Scientific Aquatic Services (SAS) was appointed to conduct a soil and land capability assessment as part of the Environmental Impact Assessment (EIA) and authorisation process for the proposed Anglo Platinum Der Brochen Expansion Project, Limpopo Province. An area encompassing all the various expansion areas associated with the Anglo Platinum Der Brochen Mine was used to gather all background information that might be relevant to the project, and will hence forth be referred to as the "focus area".

The Anglo Platinum Der Brochen Project is situated northeast of the R555 provincial road, and northwest of the R540, and approximately 24km south-west (40km by road) of the town of Steelpoort. Lydenburg is approximately 31km from the focus area in a southeast direction. The Anglo Platinum Der Brochen Mine is located in the Greater Tubatse Local Municipality which forms part of the Greater Sekhukhune District Municipality.

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 which will affect extensive tracts of land, as per Conservation of Agricultural Resources Act (CARA), 1983 (Act No. 43 of 1983). Agricultural potential is directly correlated to Land Capability Class (LCC), measured on a scale of I to VIII, with classes I to III considered as prime agricultural soils, and classes V to VIII not suitable for cultivation. High potential agricultural land is defined as 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).

A soil and land capability survey was conducted from 21st to the 23rd of February 2018. This date of assessment is acceptable since seasonality has no bearing on the accuracy of land use and land capability assessments. The assessment entailed evaluating physical soil properties and current limitations to various land use purposes. Subsurface soil observations were made using a manual hand auger to assess individual soil profiles.

1.1 Project Description

The focus area comprises the following additional mining-related infrastructure as part of the mine's development strategy (as per the Memorandum for the Der Brochen Amendment Project developed and provided by SRK Consulting, 23 July 2019, Project Reference 533247):

- One new decline shaft (South Decline Shaft) with associated infrastructure including water management infrastructure;
- The previously approved North Opencast Pit area with associated infrastructure as previously approved in 2015, i.e. water management infrastructure and waste rock stockpiles;
- Three up-cast ventilation shafts required for the underground workings associated with the South Decline Shaft;
- A Dense Medium Separation (DMS) Plant to be located within the existing footprint area of the Mototolo Concentrator area;
- A DMS Stockpile with associated water management infrastructure;
- The conversion of the existing Mototolo chrome plant from a final tailings' arrangement to an inter-stage arrangement;
- Additional Run of Mine stockpiles and associated silos;
- Change houses and office complex to be located at the proposed South Decline Shaft area;
- An explosive destruction bay area to be located near the proposed South decline shaft;
- Staff accommodation facilities to be located near the Der Brochen Dam; and
- Additional linear infrastructure, i.e.:
  - **Two conveyor systems.** *One conveyor belt system will be constructed to connect the proposed South Decline Shaft with the proposed DMS Plant that will be located in the existing footprint area of the Mototolo Concentrator Plant, for the purpose of transporting ore from the South Decline Shaft to the plant area. Another conveyor belt system will be required to transport DMS material from the proposed DMS Plant to the proposed DMS Stockpile area. It is currently anticipated that the DMS conveyor system will run along the existing Mareesburg tailings pipeline system.*
  - **Access and haul roads**. *New access roads to the proposed ventilation shafts will be required for maintenance purposes. Certain existing roads will also be required to be upgraded to provide sufficient access roads to the project related infrastructure such as the North Opencast Pit area, the South Decline Shaft and offices. The mine is also considering including a haul road within the proposed corridor associated with the ore conveyor belt system to transport ore from the proposed South Decline Shaft to the Mototolo Concentrator Plant area as an interim measure, whilst the conveyor belt system is being constructed*.

It should be noted that although the scope of this study does not include the previously authorized North Open Pit and associated infrastructure, where necessary, reference is made to the potential cumulative impact that the proposed North Open Pit may have on freshwater resources identified within the focus area.

1.2 Terms of Reference and Scope of Work

The EIA phase of the soil and land capability assessment entailed the following aspects:

- A desktop review of existing land type maps, to establish broad baseline conditions and areas of environmental sensitivity and sensitive agricultural areas;
- Assess spatial distribution of various soil types within the focus area;
- Identify restrictive soil properties on land capability under prevailing conditions;
- Compile various maps depicting the on-site conditions, soil types and land capability based on desktop review of existing data;
- A soil classification survey will be conducted within the focus area;
- Subsurface soil observations and sampling undertaken by means of a manual bucket hand auger;
- Classify the dominant soil types according to the South African Soil Classification System (Soil Classification Working Group, 1991);
- Compile a report presenting the results of the desktop study and a description of the findings during the field assessment; and
- Provide recommended mitigation measures and management practices to implement in order to comply with applicable legislations.

1.3 Assumptions and Limitations

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

- The soil survey conducted as part of the land capability assessment was confined within the focus area, which is considered adequate for the purpose of this investigation;
- Sampling by definition means that not all areas are assessed, and therefore some aspects of soil and land capability may have been overlooked in this assessment. However, it is the opinion of the specialist that this assessment was carried out with sufficient sampling and in sufficient detail to enable the proponent, the Environmental Assessment Practitioner (EAP) and the regulating authorities to make an informed decision regarding the proposed mining activities;
- Land Capability was classified according to 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;

- 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;
- Soil chemical analyses has not yet taken place since the data will be used for baseline purposes and hence chemical analyses will take place once final layouts have been developed to ensure optimal sampling locality choices to allow for the best utilisable baseline soil chemistry data; and
- Soil fertility status was not considered a limitation, seeing as inherent nutrient deficiencies and/or toxicities would be rectified by appropriate liming and/or fertilization prior to cultivation.

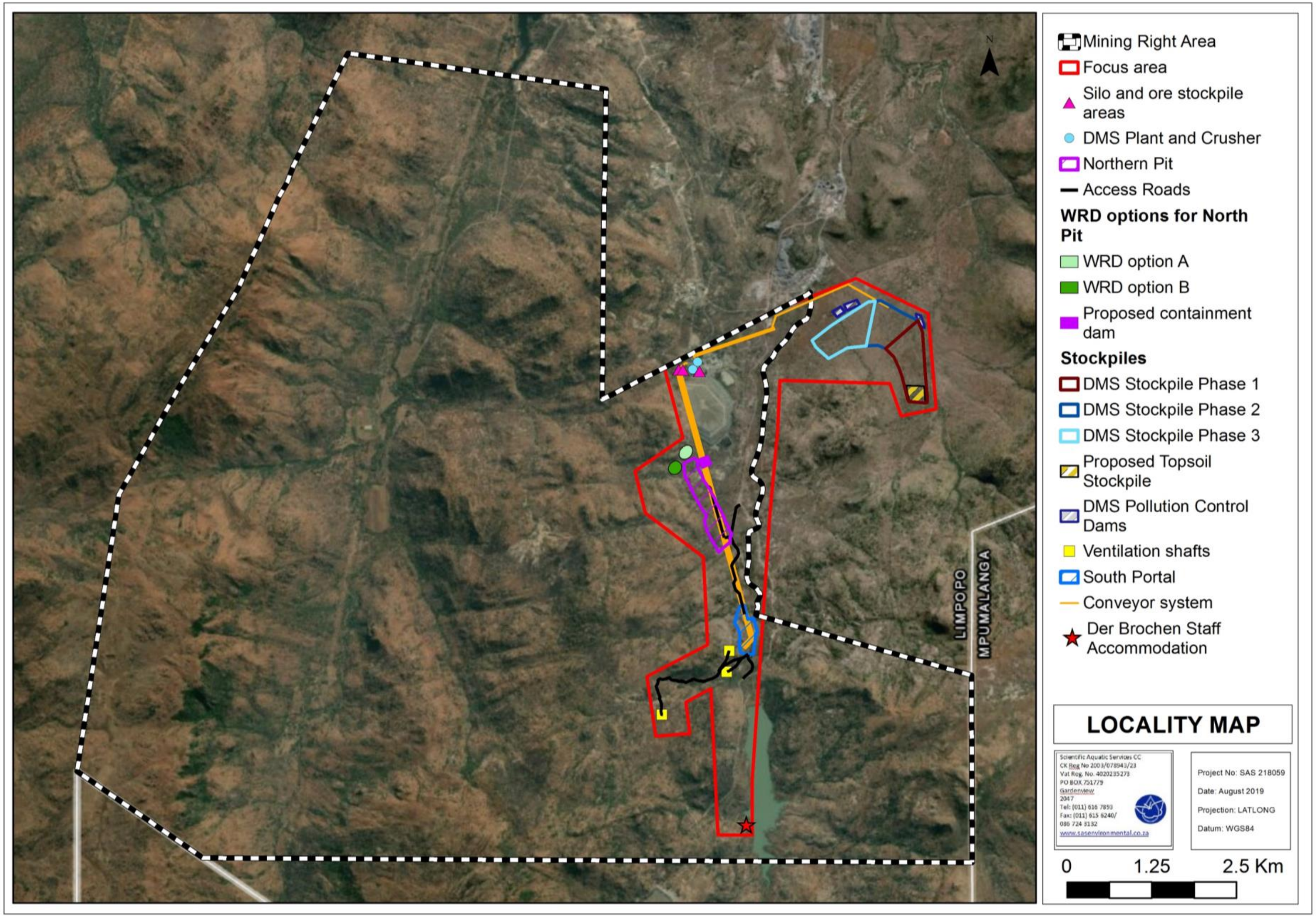

Figure 1: Digital satellite imagery depicting the locality of the focus area in relation to the surrounding areas.

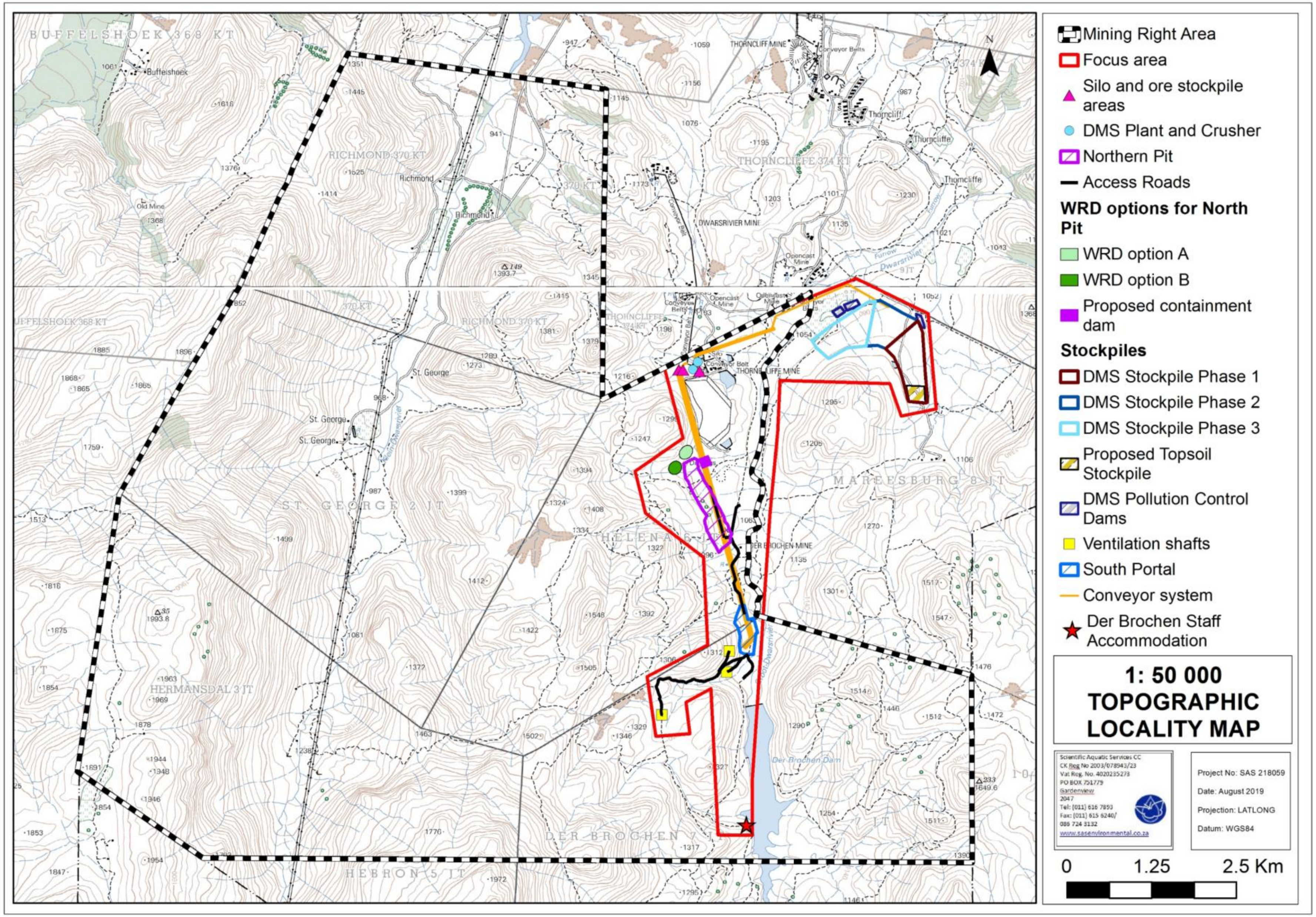

Figure 2: Location of the focus area depicted on a 1:50 000 topographical map in relation to surrounding area.

2. METHOD OF ASSESSMENT

2.1 Literature and Database Review

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

2.2 Desktop Screening

A background study, including a literature review, was conducted prior to commencement of the field assessment, in order to collect the pre-determined soil and land capability data in the vicinity of the investigated focus area. Soil patterns as well as land capability data within the proposed focus area was reviewed on the Agricultural Geo-Referenced Information System (AGIS) and/or Agricultural Research Council Institute for Soil Climate and Water (ARC-ISCW) databases.

2.3 Soil Classification and Sampling

A soil survey was conducted in February 2018 by a qualified soil specialist [, at which time the identified soils within the proposed infrastructure areas were classified into soil forms according to the Taxonomic Soil Classification System for South Africa (2018). This date is deemed acceptable since seasonality does not have a bearing soil and land capability:

- Subsurface soil observations and sampling were made by means of a manual bucket hand auger;
- Dominant soil types were classified according to the South African Soil Classification System (Soil Classification Working Group, 2018);
- Assessed survey and sampling points were recorded on a Global Positioning System (GPS);
- Physical soil properties were described including the following parameters:
  - Terrain morphological unit (landscape position) description;
  - Diagnostic soil horizons and their respective sequence;
  - Depth of identified soil horizons;
  - Soil form classification name(s);
  - Observed land capability limitations of the identified soil forms; and
  - Depth to saturation (water table), if encountered.
- Uniform soil patterns were grouped into map units, according to observed limitations; and

- Soil data was analysed to assess the impacts of the proposed mining project under current conditions.

It was also the objective of the assessment to provide recommended mitigation measures and management practices to implement in order to comply with applicable articles of legislation.

Table 1: Typical Arrangement of Master Horizons in Soil Profile

<table>
<tr><th rowspan="6">Soil</th><th rowspan="6">Zone in which soil processes are maximally expressed</th><th colspan="5">Arrangement of master horizons</th></tr>
<tr><td rowspan="5">O- Organic</td><td rowspan="3">C- Regic sand (c), Stratified alluvium, (c), Man -Made Soil Deposits</td><td rowspan="2">A</td><td colspan="2">Humic, Vertic, Melanic, Orthic</td></tr>
<tr><td colspan="2">E</td></tr>
<tr><td>B</td><td>Red Apedal, yellow Brown Apedal, Soft Plinthic, Hard Plinthic, Prismacutanic, Pedocutanic, Lithocutanic, Neocutanic, Neocarbonate, Podzol, Podzol with placic pan</td><td rowspan="3">G - Horizon</td></tr>
<tr><td>C</td><td colspan="2">Dorbank, Soft Carbonate horizon, Hard Carbonate horizon, Saprolite, Unconsolidated without signs of wetness, Unconsolidated with signs of wetness, Unspecified material with signs of wetness</td></tr>
<tr><td colspan="3">R-Hard Rock</td></tr>
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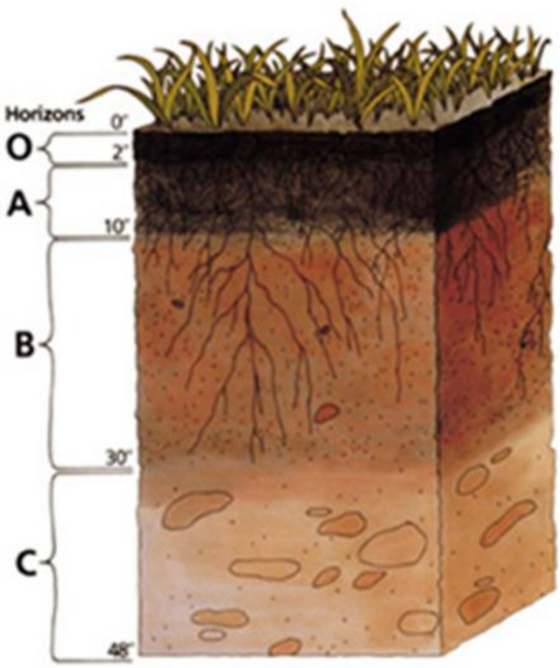

Figure 3: Schematic diagram depicting a conceptual presentation of a typical soil profile

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

Land Capability Group	Land Capability Class	Increased intensity of use									Limitations
Arable	I	W	F	LG	MG	IG	LC	MC	IC	VIC	No or few limitations. Very high arable potential. Very low erosion hazard
	II	W	F	LG	MG	IG	LC	MC	IC	-	Slight limitations. High arable potential. Low erosion hazard
	III	W	F	LG	MG	IG	LC	MC	-	-	Moderate limitations. Some erosion hazards
	IV	W	F	LG	MG	IG	LC	-	-	-	Severe limitations. Low arable potential. High erosion hazard.
Grazing	V	W	-	LG	MG	-	-	-	-	-	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
Wildlife	VIII	W	-	-	-	-	-	-	-	-	Extremely severe limitations. Not suitable for grazing or afforestation.

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

Table 3: 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.

3. DESKTOP ASSESSMENT RESULTS

The following data is applicable to the focus area, according to various data sources including but not limited to the Agricultural Geo-Referenced Information System (AGIS) and the Limpopo Conservation Plan version 2 (2013)

- The Mean Annual Rainfall (MAR) is estimated to range between 401 and 600mm per annum for the northern portion of the focus area, whilst the southern portion ranges between 601 and 800mm per annum;
- The evaporation of the focus area is estimated to range between 2201 to 2400mm;
- A significant portion of the focus area according to the SOTER database is classified as a plain land form, with two portions on the western side considered as medium gradient mountains land reform (Figure 4)';
- According to the soil-terrain (SOTER) database and the 1:250 000 geological map of South Africa, the majority of the focus area is underlain by pyroxenite geological formation while two portions on the western side are considered to be underlain by gabbro formation, as presented in Figure 5;
- According to the Geology 2001 layer, the majority of the focus area is underlain by norite geological formation while a small western portion is underlain by gabbro (Figure 6);
- According to the Soils 2001 Layer, the majority of the focus area is situated within an area where the soils are classified as soils where Prismacutanic and/or Pedocutanic

diagnostic horizons are dominant. In addition, one or more of: Vertic, melanic, red structured diagnostic horizons are also present. The remaining portions of the focus area are situated within Miscellaneous land classes, rocky areas with miscellaneous soils (Figure 7);

- The natural soil pH is estimated to be between 5.5 – 6.4, indicating soils are anticipated to be slightly acidic, as interpolated from topsoil pH values obtained from the National Soil Profile Database (AGIS database);
- Predicted soil loss for the focus area is classified as high;
- According to the AGIS database, soils within the focus area are not susceptible to wind erosion. Furthermore, the majority of the MRA is classified as moderately susceptible to water erosion, with the western portion are associated with steep slopes and soils that can range from low to very high susceptibility to water erosion. Figure 8;
- The desktop assessment results extracted from the AGIS database indicates that the land capability of the majority of the focus is considered to be moderate arable land (class III), while the remaining area is considered wilderness (class VIII) (Figure 9)
- According to the AGIS database, the focus area has an estimated grazing capacity potential of approximately 3.5 hectares per large animal unit,

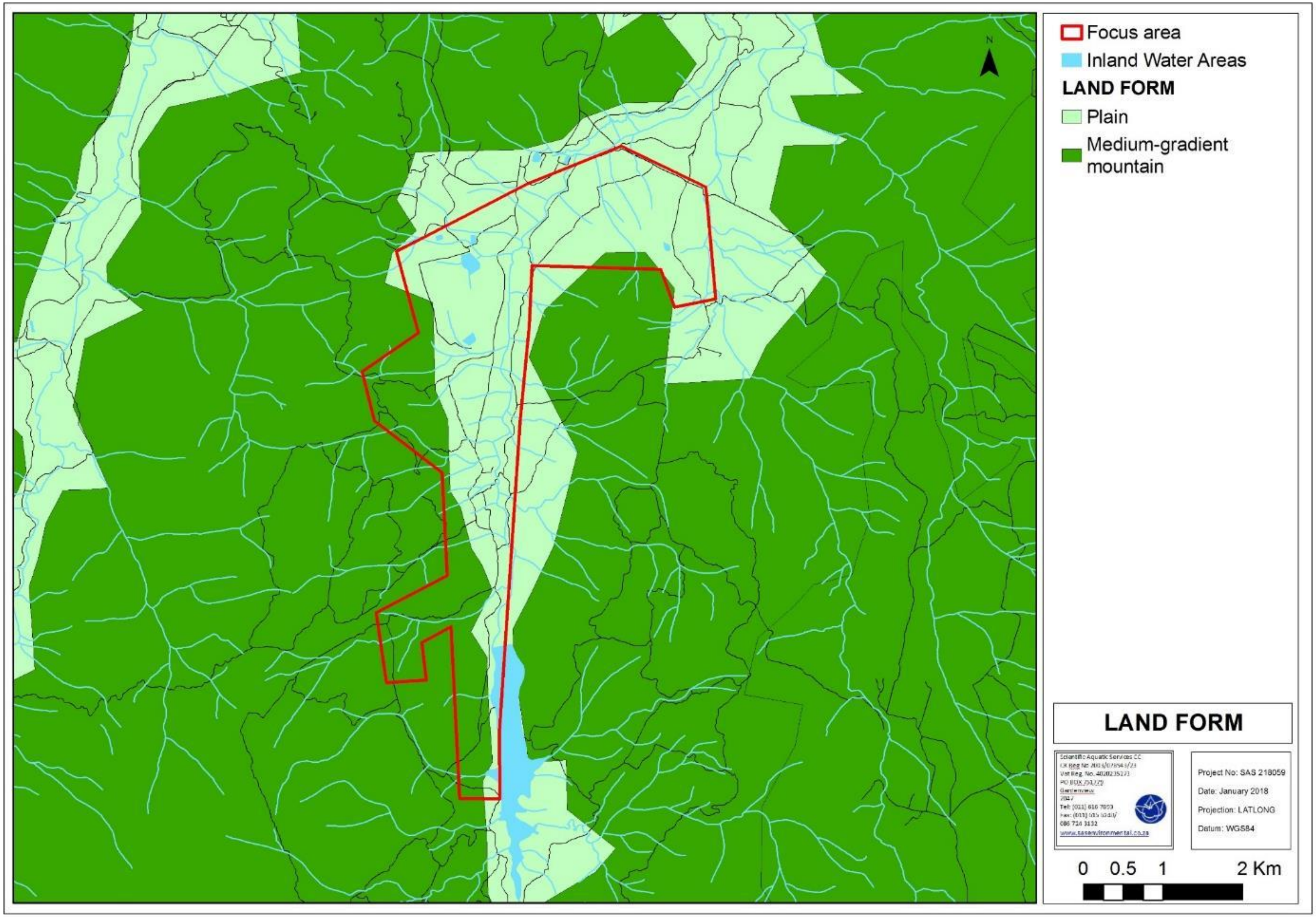

Figure 4: Land form associated with the focus area and surrounding areas.

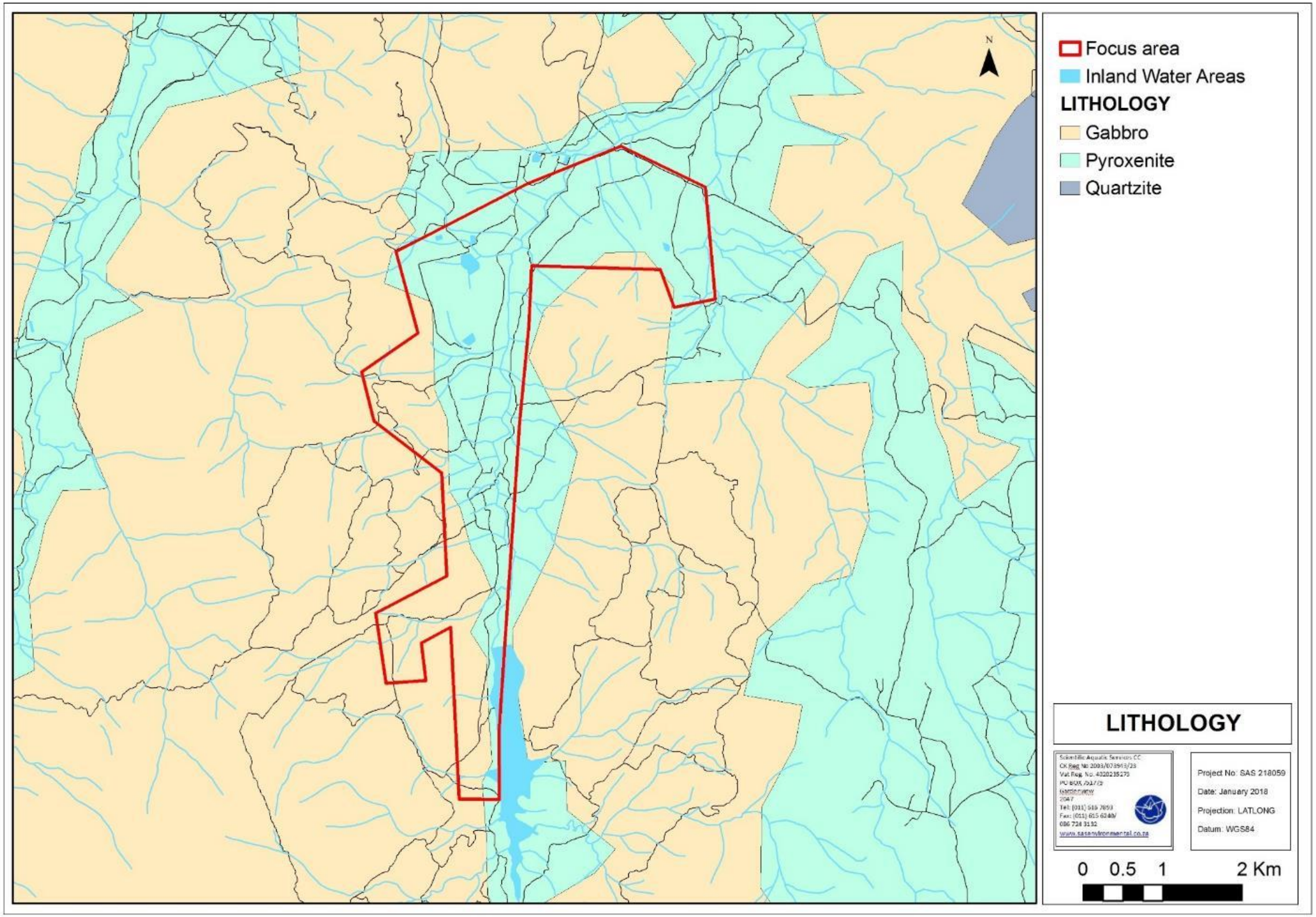

Figure 5: Lithology associated with the focus area and surrounding areas.

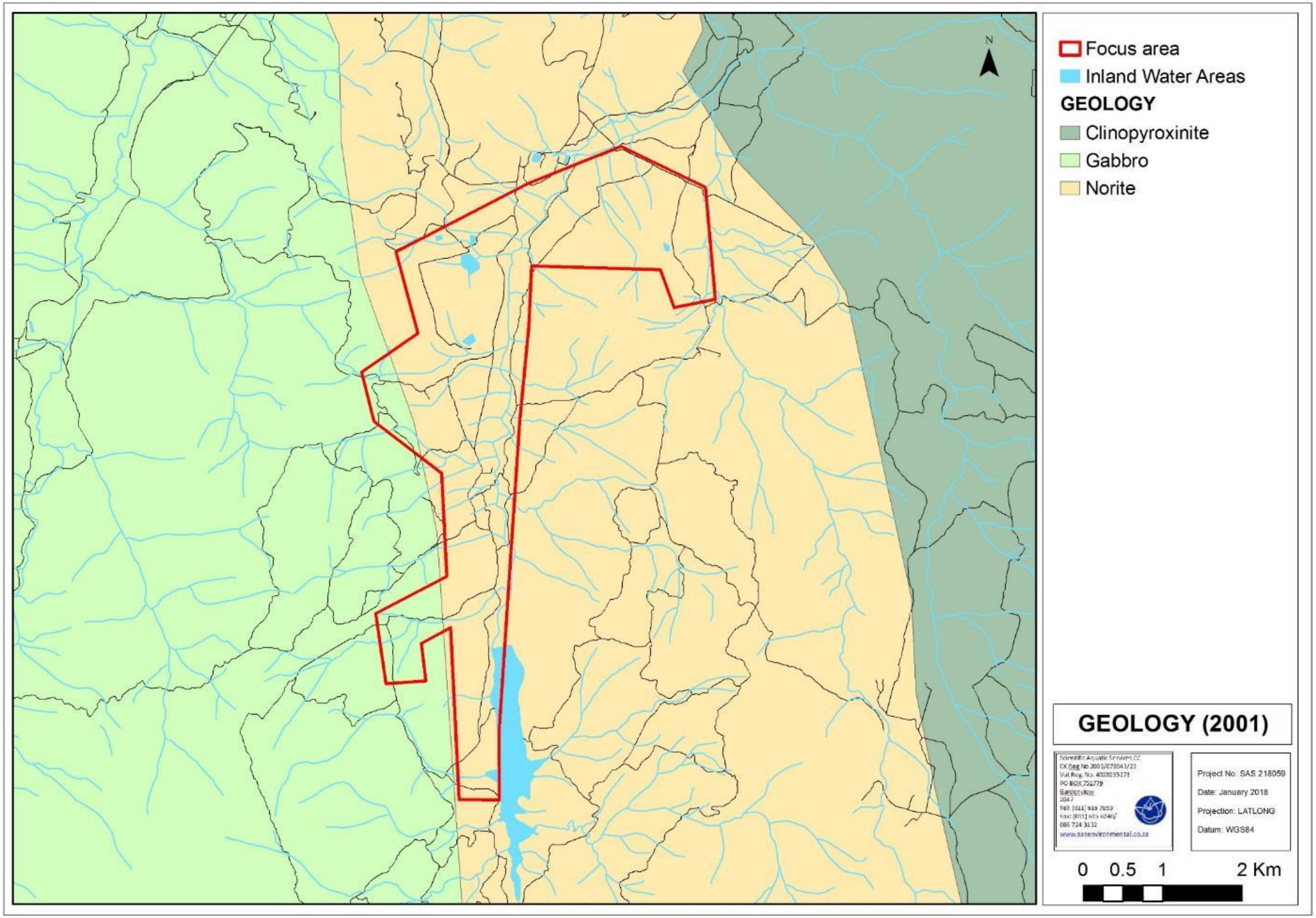

Figure 6: Geology (2001) associated with the focus area and surrounding areas.

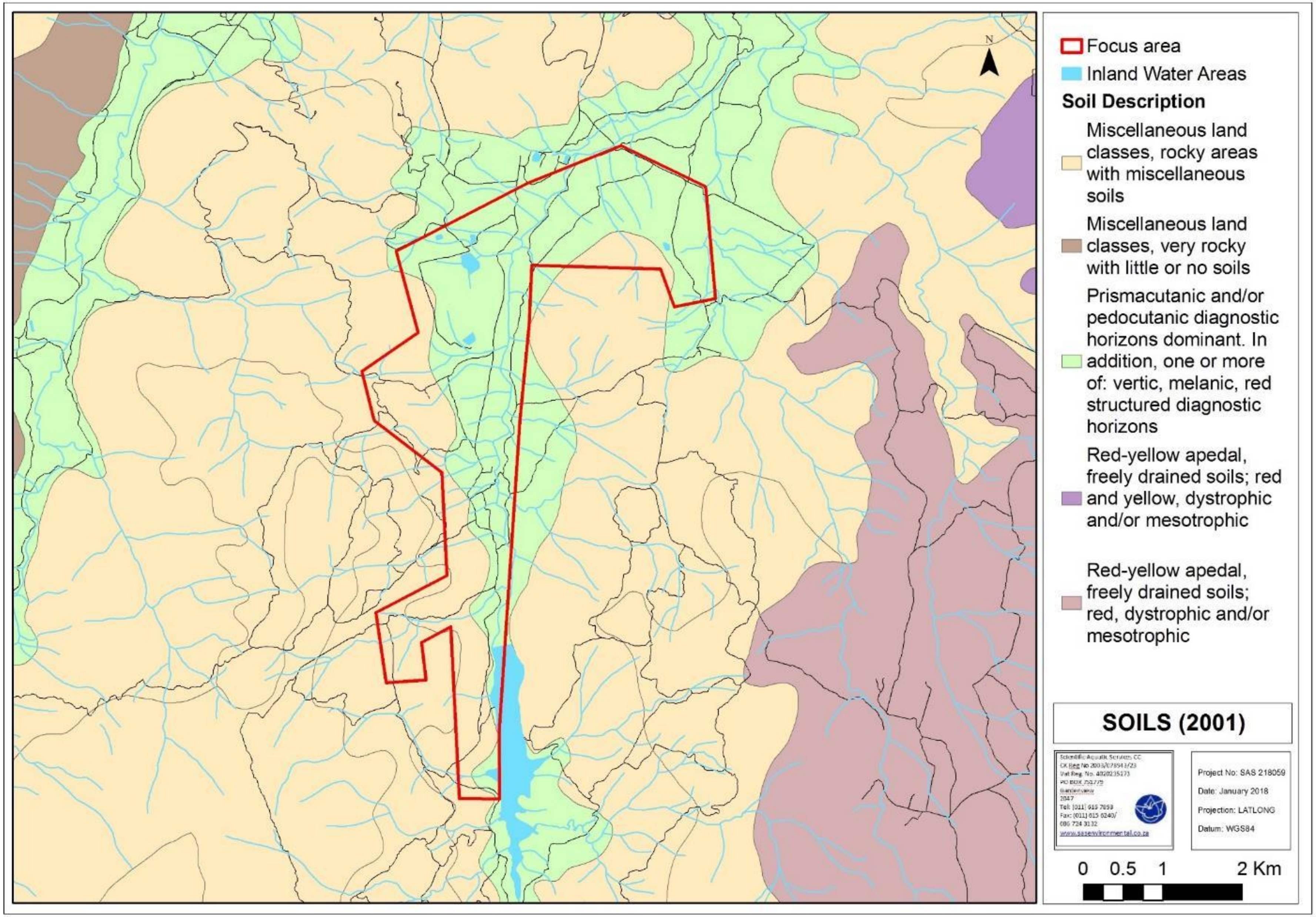

Figure 7: Soils (2001) associated with the focus area) and surrounding areas.

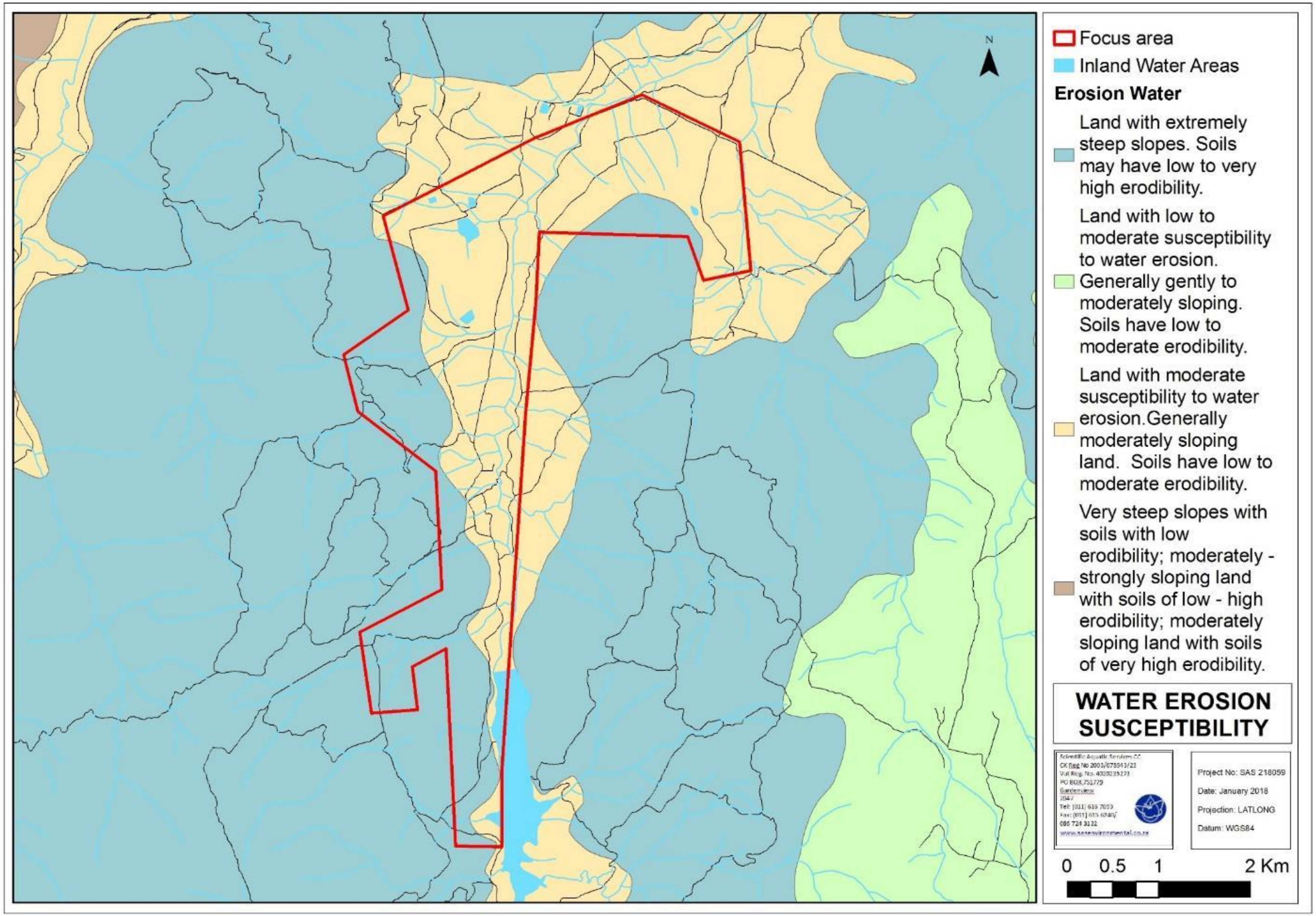

Figure 8: Soil susceptibility to water erosion within the focus area and surrounding areas.

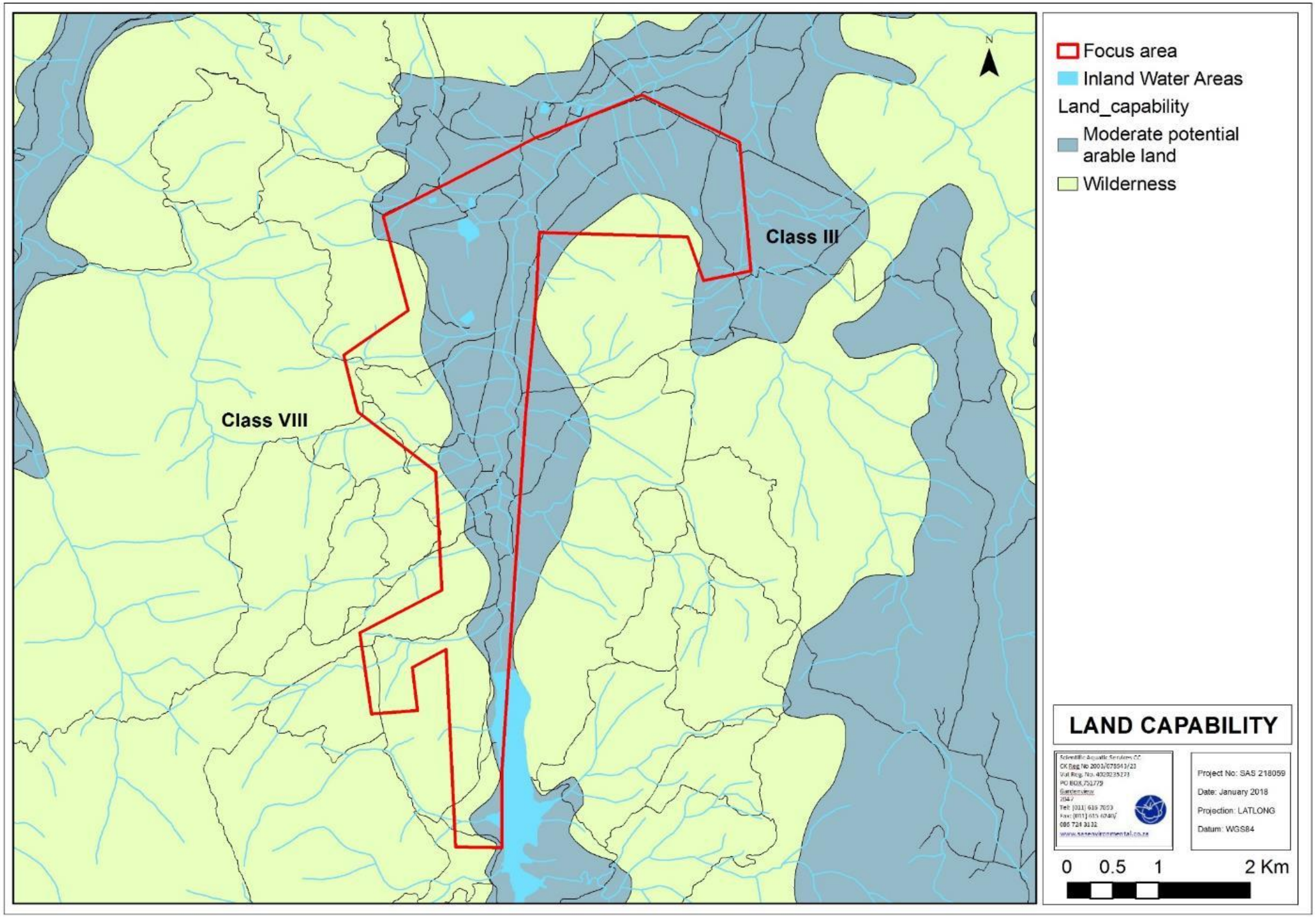

Figure 9: land capability associated with the focus area and surrounding areas.

4. FIELD ASSESSMENT RESULTS

4.1 Dominant Soil Types

The focus area is dominated by shallow soils of Mispah/Outcrop, Milkwood, Glenrosa, Bonheim and Mayo soil forms which collectively constitute of approximately over 60% of the total investigated area, whilst moderately deep soils of Hutton/Mispah occupies less than 5% of the total investigated focus area. The shallow nature of the dominated soil forms can be largely attributed to limited rock weathering or rejuvenation through natural erosion on steeper, convex slopes. The remainder of the focus area is occupied by mine associated structures (i.e. Mine plant complex, PCD, office areas, tar roads), Witbank (*Anthrosols*) as well as soil types which are associated with freshwater features and these include Kroonstad, Katspruit and Willowbrook. Witbank soil forms were also identified within the proposed focus area. These soils have been extensively disturbed such that no recognisable diagnostic soil morphological characteristics, particularly in the topsoil, could be identified, corresponding to *Anthrosols* in the international soil classification terminology. The spatial distribution of all identified soil forms within the focus area is presented in soil map in Figure **10 and 11** below.

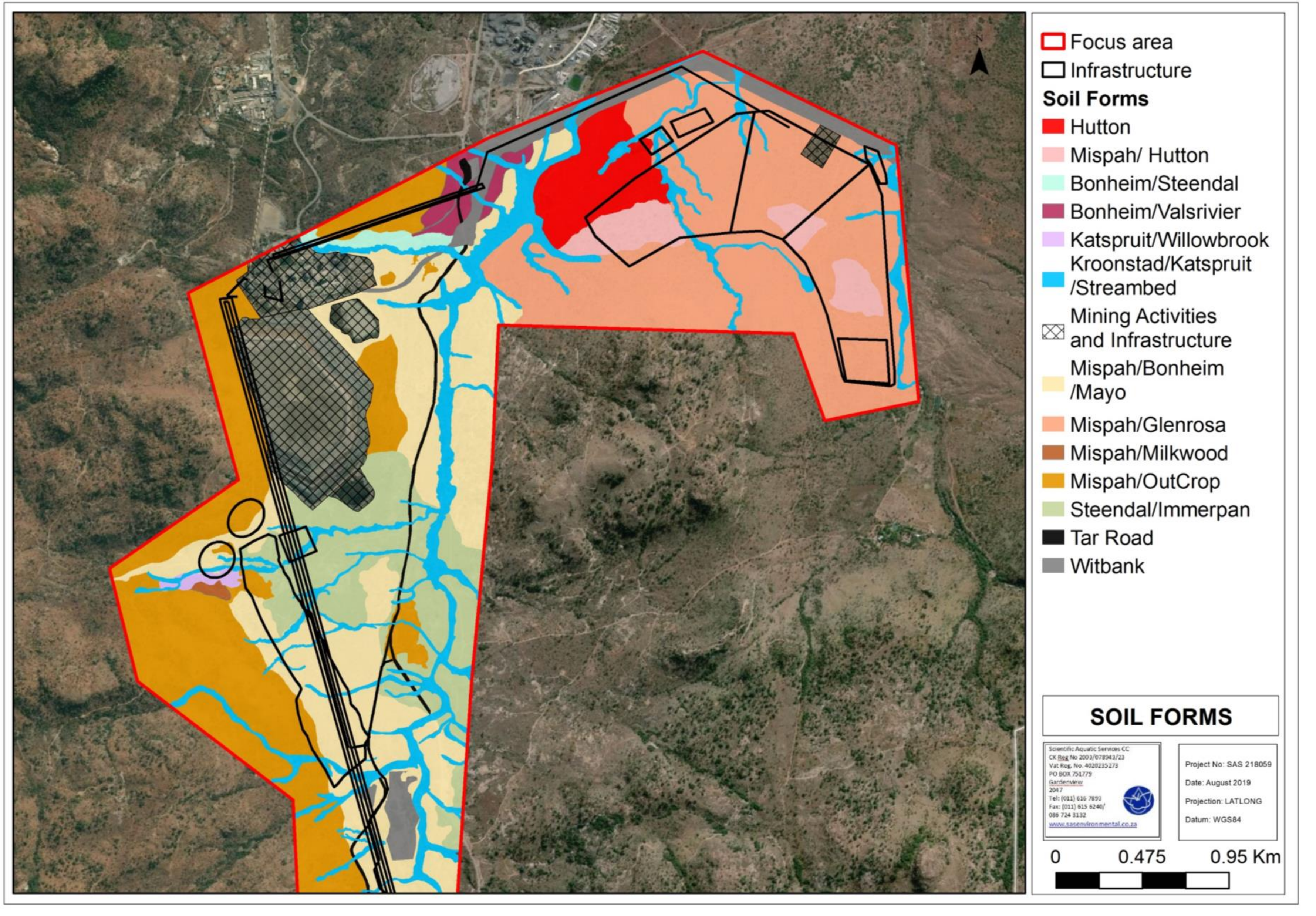

Figure 10: Soil map depicting identified soil forms within the proposed focus area

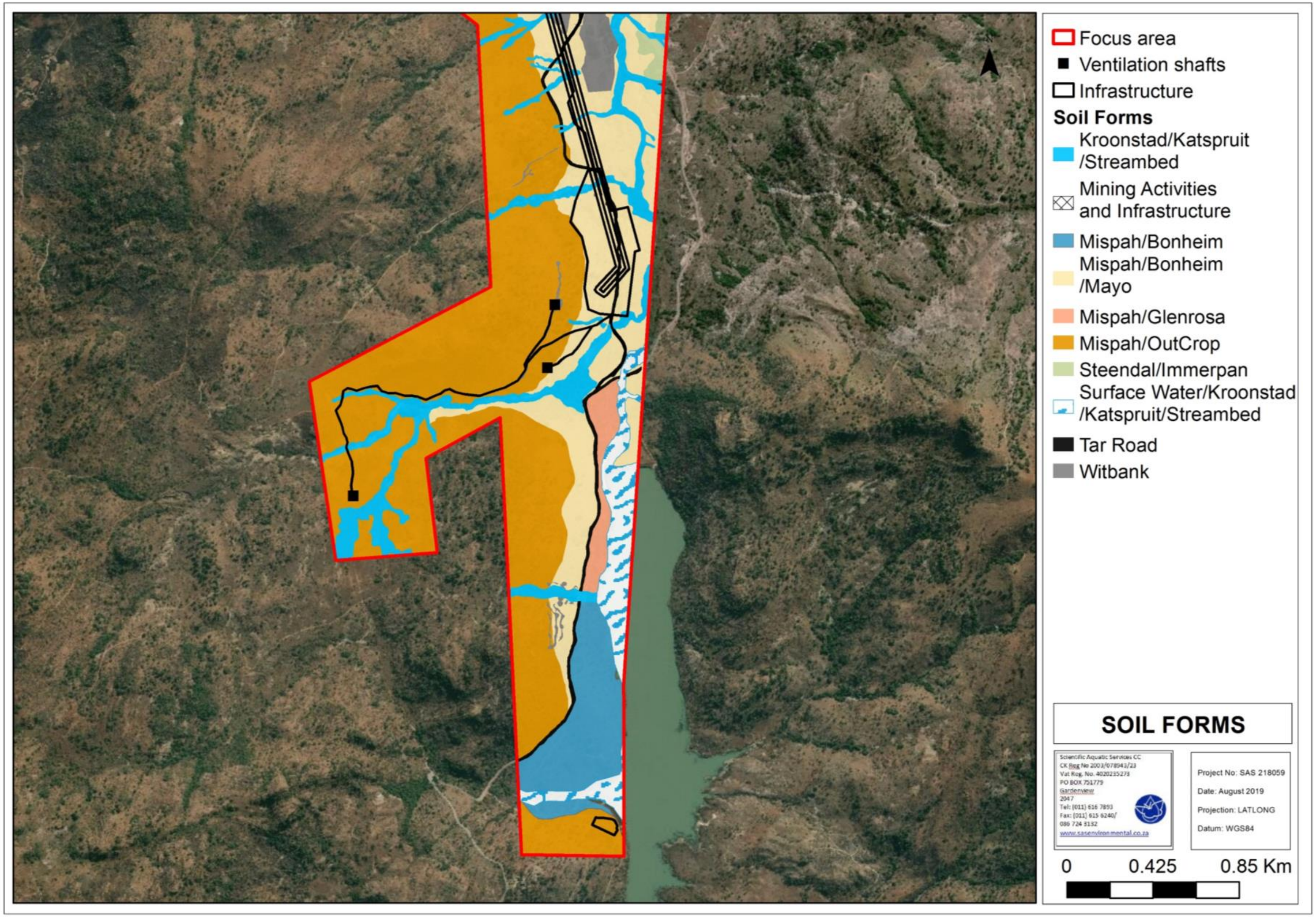

Figure 11: Soil map depicting identified soil forms within the proposed focus area

4.2 Current Land Use

Current land use activities associated with the focus area are largely dominated by wildlife and wilderness, with some mining operations in the surrounding areas. No agricultural activities were observed in the surrounding areas, refer to land use maps on Figure **13 and 14**.

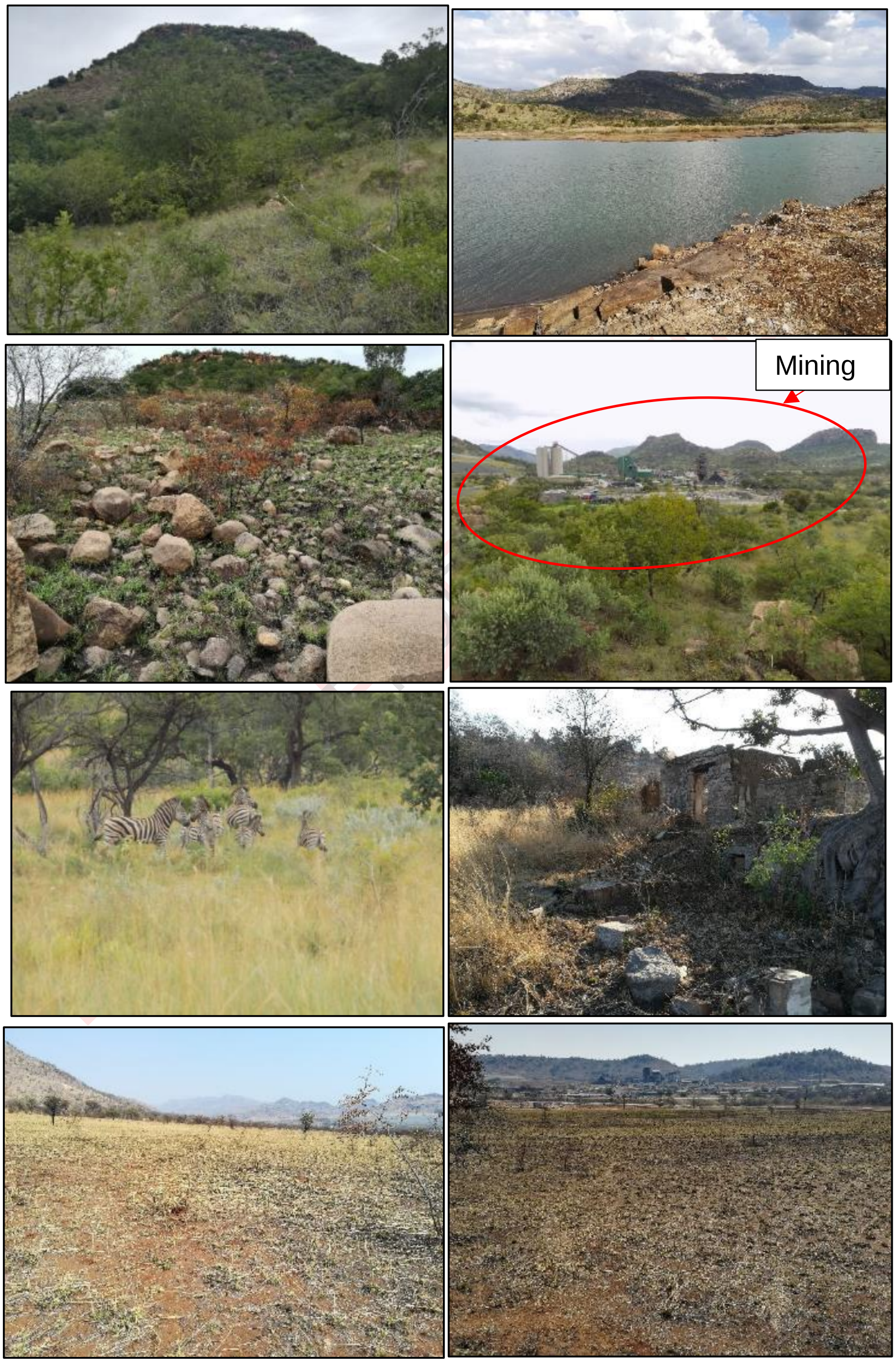

Figure 12: Photographic presentation of the dominant land uses within the focus area

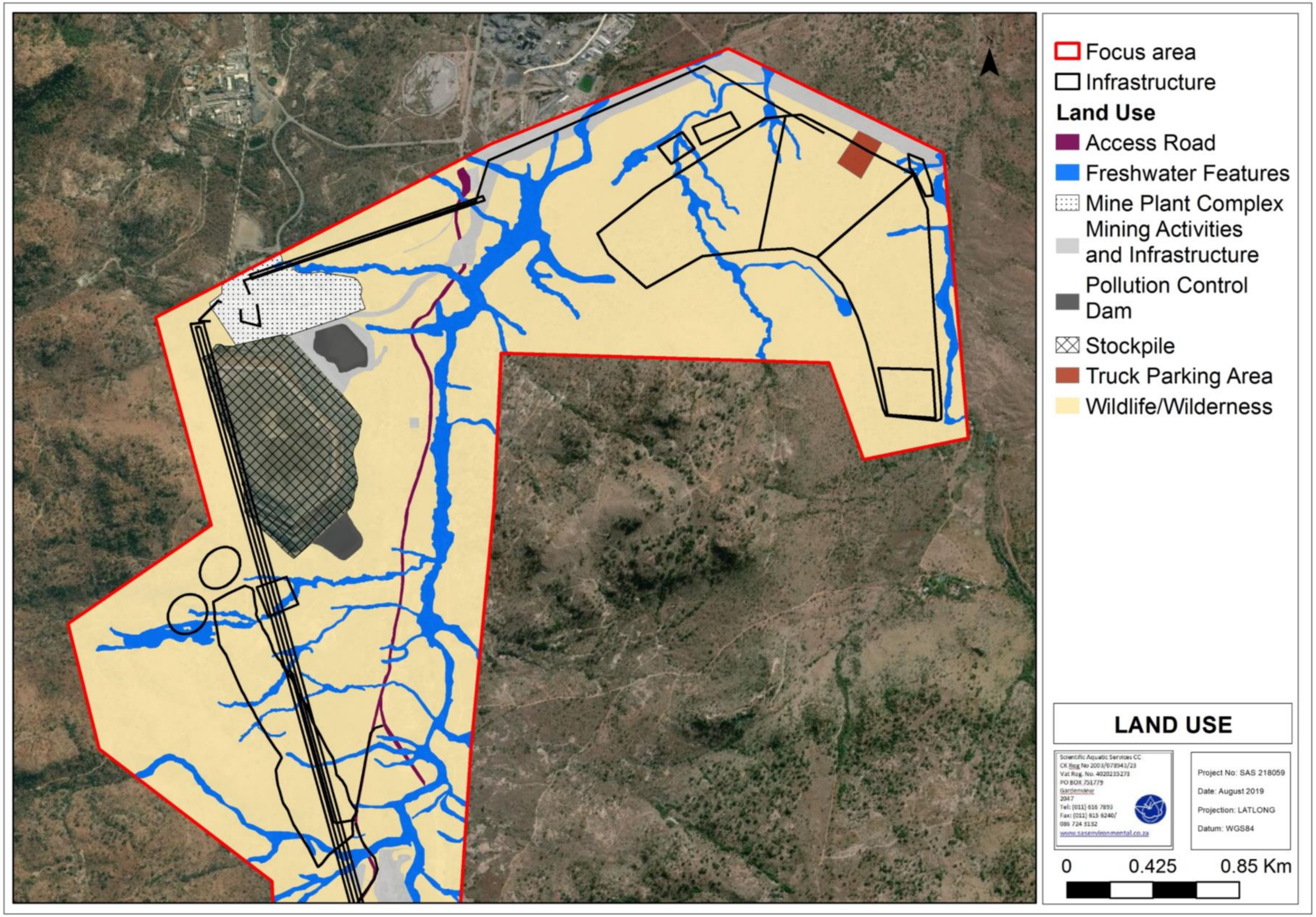

Figure 13: Map depicting identified land use within the northern portion of the focus area

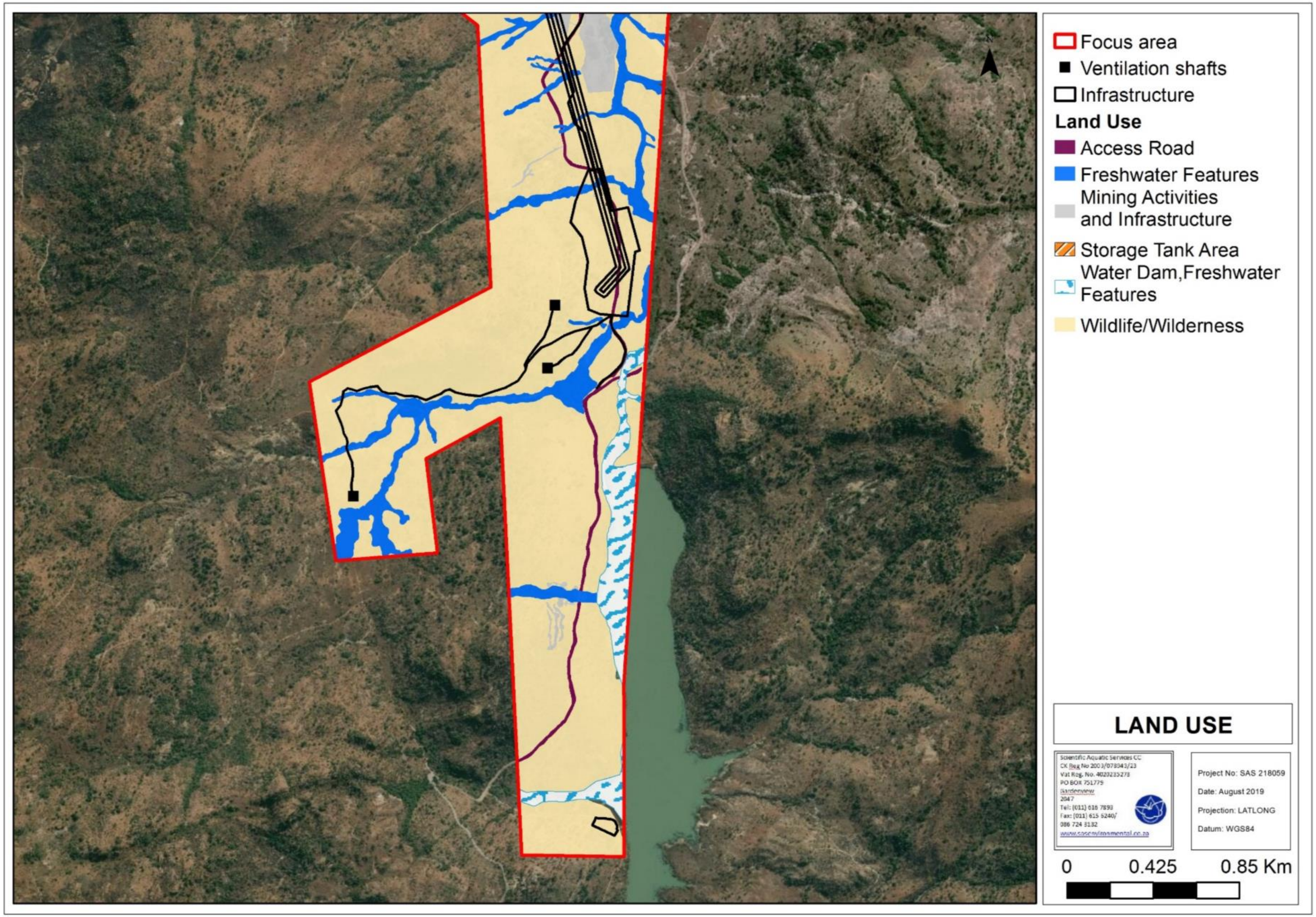

Figure 14: Map depicting identified land use within the southern portion of the focus area

4.3 Land Capability Classification

In South Africa, agricultural land capability is usually restricted by climatic conditions, with specific mention to water availability (Rainfall). Even within similar climatic zones, different soil types typically have different land use capabilities attributed to their inherent characteristics. High potential agricultural land is defined as having the soil and terrain quality, growing season and adequate available moisture supply needed to produce sustained economically high crops yields when treated and managed according to best possible farming practices (Scotney et al., 1987). For 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 focus area falls into Climate Capability Class 5, with moderately restricted growing season due to low temperatures, frost and/or moisture stress. Suitable crops may be grown at risk of some yield loss.

The identified soils were classified into land capability classes using the Scotney et. Al. Land Capability Classification system (Scotney et al., 1987), as presented from **Figure 14 and 15**. The identified land capability limitations for the identified soils are discussed in comprehensive "dashboard style" summary tables presented from Tables 4 to 6 below. The dashboard reports aim to present all the pertinent information in a concise and visually appealing fashion.

Table 4: Summary discussion of the Arable (Class III) land capability class

Land Capability: Arable - Class III			
View of the gently sloping terrain where Hutton/Mispah soil forms were identified 			
Terrain Morphological Unit (TMU)	Gently sloping landscape positions < 2 % slope gradient	**Photograph notes**	View of the identified Hutton/Mispah soil forms
Soil Form(s)	Hutton/Mispah	**Areal Extent**	17.9 ha; which constitutes ≈ 3.88% of the focus area
Diagnostic Horizon Sequence	0 - 28 cm: Orthic A 28 - 60: Red apedal B 60 cm: Hard rock/ Unspecified	**Land Capability** The identified Hutton/Mispah soil forms are considered prime agricultural soils of high (class III) land capability, suitable to arable agricultural land use. Therefore, these soils are considered to contribute significantly to provincial and/or national agricultural productivity if used for crop cultivation, and are essentially 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.	
Physical Limitations	None; these soils have moderate depth 60 cm) to support some cultivated crops and good drainage characteristics. These soils are relatively ideal for crop cultivation.		
Overall impact significance prior to mitigation	**M** — Despite the moderate land capability of these soils, the overall impact of the proposed mining is anticipated to be moderate (M) and low after mitigation measures due to the limited extent of the proposed development.	**Business case, Conclusion and Mitigation Requirements:** Although considered to be suitable for cultivated agriculture, the viability of agricultural crop cultivation of these soils in area is low due to land fragmentation by current mining and associated activities in the surrounding areas. These soils also cover a relatively small area which is not sufficient for commercial agricultural production However, the impact on land capability of these soils can be mitigated to a low significance, provided that the proposed integrated mitigation measures are implemented accordingly.	
Overall impact significance post mitigation	**L**		

Table 5: Summary discussion of the Grazing (Class VII) land capability class

<table>
<tr><td colspan="3">Land Capability: Grazing Class VII</td><td colspan="2" rowspan="2"> </td></tr>
<tr><td colspan="3">Occurrence within the focus area
</td></tr>
<tr><td colspan="2">Terrain Morphological Unit (TMU)</td><td>Relatively flat to medium mountain gradient sloping landscape</td><td>Photograph notes</td><td>View of the morphology of the identified Steendal/Immerpan soil forms</td></tr>
<tr><td colspan="2">Soil Form(s)</td><td>Steendal/Immerpan</td><td>Area Extent</td><td>60.88 ha; which constitutes 13.20% of the total investigated focus area</td></tr>
<tr><td colspan="2">Diagnostic Horizon Sequence</td><td>0-10 cm: Melanic A
10 30 cm: soft carbonation and hard carbonation</td><td colspan="2" rowspan="2">Land Capability
These soil forms are of limited land capability and are not considered as prime agricultural soils. These soils, at best, are suited for grazing, however the soil and terrain constraints attributed to shallow depth relatively steeps slopes of the area disqualify these soils for being suitable for commercial farming.</td></tr>
<tr><td colspan="2">Physical Limitations</td><td>These soils were found to be somewhat shallow with an approximate effective rooting depth of 30 cm before reaching the layer of refusal</td></tr>
<tr><td>Overall impact significance prior to mitigation</td><td>M</td><td rowspan="2">The overall impact of the proposed mining activity on the land capability of these soils is anticipated to be Medium (M) prior to mitigation due to sufficient soil depth for most cultivated crops. However, the impacts can be reduced to acceptable levels post mitigation</td><td colspan="2" rowspan="2">Business case, Conclusion and Mitigation Requirements:
Should the proposed infrastructure encroach on these soils, rehabilitation would be a requirement for these soils as they can be of significant use for potential grazing and/or for supporting wildlife. These sites can at least partially be rehabilitated to ensure the soils and landscape setting is restored to a natural condition to allow for natural land uses to continue.</td></tr>
<tr><td>Overall impact significance post mitigation</td><td>L</td></tr>
</table>

Table 6: Summary discussion of the Grazing (Class VII) land capability class

<table>
<tr><td colspan="3">Land Capability: Grazing Class VII</td><td colspan="2" rowspan="2"> </td></tr>
<tr><td colspan="3">Occurrence within the focus area
The land capability class in which these soils were assigned to is associated with water course or land with wetness limitations. Refer to land capability description below.</td></tr>
<tr><td colspan="2">Terrain Morphological Unit (TMU)</td><td>These soils were identified on a sloping landscape of 6.2% average slope</td><td>Photograph notes</td><td>View of the morphology of the identified Bonheim/Valsrivier soil forms</td></tr>
<tr><td colspan="2">Soil Form(s)</td><td>Bonheim/Valsrivier</td><td>Area Extent</td><td>14.46 ha which constitutes 3.14 % of the total investigated focus area</td></tr>
<tr><td colspan="2">Diagnostic Horizon Sequence</td><td>0-10 cm: Orthic A/Melanic A
10 40 cm: Pedocutanic
40cm: Unspecified</td><td colspan="2" rowspan="2">Land Capability
The identified soil forms are of limited land capability and are not considered as prime agricultural soils. These soils, at best, are suited for grazing, however with terrain constraints where these soils occur disqualify these soils for being suitable for commercial livestock farming.</td></tr>
<tr><td colspan="2">Physical Limitations</td><td>These soils were found to be somewhat shallow with an approximate effective rooting depth of 40 cm before reaching the layer of refusal</td></tr>
<tr><td>Overall impact significance prior to mitigation</td><td>M</td><td rowspan="2">The overall impact of the proposed mining activity on the land capability of these soils is anticipated to be Medium (M) prior to mitigation due to sufficient soil depth for most cultivated crops. However, the impacts can be reduced to acceptable levels post mitigation</td><td colspan="2" rowspan="2">Business case, Conclusion and Mitigation Requirements:
Although these soils are not arable, rehabilitation would still be a requirement to reinstate the natural topography, which will therefore allow for current land uses (wildlife) to commence post closure.</td></tr>
<tr><td>Overall impact significance post mitigation</td><td>L</td></tr>
</table>

Table 7: Summary discussion of the Grazing (Class VII) land capability class

<table>
<tr><td colspan="3">Land Capability: Grazing - Class VII</td><td colspan="2" rowspan="2"> </td></tr>
<tr><td colspan="3">Occurrence within the focus area
Exposed bedrock rocky outcrop
</td></tr>
<tr><td colspan="2">Terrain Morphological Unit (TMU)</td><td>These soils are largely dominant in the crest to the medium gradient mountains</td><td>Photograph notes</td><td>View of the morphology of the identified Mispah/Outcrop soil forms</td></tr>
<tr><td colspan="2">Soil Form(s)</td><td>Mispah/Outcrop</td><td>Area Extent</td><td>102.69 ha; which constitutes 22.27% of the total investigated area</td></tr>
<tr><td colspan="2">Diagnostic Horizon Sequence</td><td>0-35 cm: Orthic A
≥ 35 cm: Miscellaneous hard rocky material</td><td colspan="2" rowspan="2">Land Capability
The identified Glenrosa/Mispah soil forms are considered to be of poor (class VII) land capability and are not suitable for arable agricultural land use. Theses soils are, at best, suitable for natural pastures for light grazing. Therefore, these soils are considered to make a substantial contribution to extensive subsistence farming on a local scale.</td></tr>
<tr><td colspan="2">Physical Limitations</td><td>No soil and shallow depth of these soils hinders penetration of plant roots.</td></tr>
<tr><td>Overall impact significance prior to mitigation</td><td>ML</td><td rowspan="2">The overall impact of the proposed mining activities on the land capability of these soils is anticipated to be Medium Low (ML) due to the limited potential grazing opportunities. These soils are however not ideal for cultivated agriculture due to their low yield contribution to regional and provincial agricultural production</td><td colspan="2" rowspan="2">Business case, Conclusion and Mitigation Requirements:
These soils, at best, suited for grazing and/or wilderness practices. This is due to the relatively shallow parent rock and lithocutanic material. The impact of the proposed mining activities on the land capability of these soils is anticipated to be low after mitigation. As much as these soils are not considered as prime agricultural soils, these soils are important for potential grazing opportunities. Therefore, implementation of rehabilitation and the proposed integrated mitigation measures is recommended to reinstate the natural topography of the area post mining.</td></tr>
<tr><td>Overall impact significance post mitigation</td><td>L</td></tr>
</table>

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

<table>
<tr><td colspan="3">Land Capability: Grazing - Class VII</td><td colspan="2" rowspan="2"> </td></tr>
<tr><td colspan="3">Occurrence within the focus area
The shallow nature of these soils can be largely attributed to limited weathering.</td></tr>
<tr><td colspan="2">Terrain Morphological Unit (TMU)</td><td>Relatively flat to gently sloping landscape of < 2% slope gradient</td><td>Photograph notes</td><td>View of the morphology of the identified Glenrosa/Mayo//Mispah soil forms</td></tr>
<tr><td colspan="2">Soil Form(s)</td><td>Glenrosa/Mayo//Mispah</td><td>Area Extent</td><td>89.26 ha which constitutes 19.35% of the total investigated area</td></tr>
<tr><td colspan="2">Diagnostic Horizon Sequence</td><td>0-35 cm: Orthic A/Melanic A
≥ 35 cm: Miscellaneous hard rocky material</td><td colspan="2" rowspan="2">Land Capability
The identified Glenrosa/Mispah soil forms are considered to be of poor (class VII) land capability and are not suitable for arable agricultural land use. Theses soils are, at best, suitable for natural pastures for light grazing. Therefore, these soils are considered to make a substantial contribution to extensive subsistence farming on a local scale.</td></tr>
<tr><td colspan="2">Physical Limitations</td><td>Shallow effective rooting depth is the primary limitation of the land capability of the Glenrosa/Mispah soil forms, which is due to the occurrence of a rocky layer at relatively shallow depth, which would hinder penetration of plant roots.</td></tr>
<tr><td>Overall impact significance prior to mitigation</td><td>ML</td><td rowspan="2">The overall impact of the proposed mining activities on the land capability of these soils is anticipated to be Medium Low (ML) due to the limited potential grazing opportunities. These soils are however not ideal for cultivated agriculture due to their low yield contribution to regional and provincial agricultural production</td><td colspan="2" rowspan="2">Business case, Conclusion and Mitigation Requirements:
The identified soil forms are, at best, suited for grazing and/or wilderness practices. This is due to the relatively shallow parent rock and lithocutanic material. The impact of the proposed mining activities on the land capability of these soils is anticipated to be low after mitigation. As much as these soils are not considered as prime agricultural soils, these soils are important for potential grazing opportunities. Therefore, implementation of rehabilitation and the proposed integrated mitigation measures is recommended to reinstate the natural topography of the area post mining.</td></tr>
<tr><td>Overall impact significance post mitigation</td><td>L</td></tr>
</table>

Table 9: Summary discussion of the Wetlands (Class VIII) land capability class

<table>
<tr><td colspan="3">Land Capability: Wetlands - Class VIII</td><td colspan="2" rowspan="2"></td></tr>
<tr><td colspan="3">View of the area where Kroonstad/Katspruit/Willowbrook soil forms were encountered
</td></tr>
<tr><td>Terrain Morphological Unit (TMU)</td><td colspan="2">Valley bottoms and gently sloping landscapes of < 0.5% slope gradient</td><td>Photograph notes</td><td>View of the identified Kroonstad/Katspruit/Willowbrook soil forms</td></tr>
<tr><td>Soil Form(s)</td><td colspan="2">Kroonstad/Katspruit/Willowbrook</td><td>Areal Extent</td><td>39.8 ha; which constitutes 2.0% of the surveyed area</td></tr>
<tr><td>Diagnostic Horizon Sequence</td><td colspan="2">0 - 6 cm: Orthic A/ Melanic A
≥ 6 cm: Plinthite/G horizon</td><td colspan="2" rowspan="2">Land Capability
These soil forms were classified as class VIII land capability due to land use limitations related to prolonged waterlogging attributed to inherently poor internal drainage of the G-horizon encountered at extremely shallow depth. The prolonged waterlogging of these soils limits their land use largely to wetland habitats for various wetland plant species that are inherently tolerant and/or obligate to anoxic conditions. These soils are therefore not considered to contribute significantly to provincial and/or national agricultural productivity.</td></tr>
<tr><td>Physical Limitations</td><td colspan="2">Plant root development and water infiltration are largely impeded by the clayey, slowly permeable soft plinthite and/or G horizon occurring at extremely shallow depths of less than 10 cm below ground surface (bgs). Prolonged saturation of these soils are typically induce anoxic (oxygen deficiency) conditions which hamper root development of most arable crops.</td></tr>
<tr><td>Overall impact significance prior to mitigation</td><td>L</td><td rowspan="2">The overall impact of the proposed infrastructure development on the land capability of these soils is anticipated to be low (L), due to their inherently poor land capability. The ecological functionality of these soils as an essential medium for wetland habitats is considered to be highly significant, and therefore, the recommendations and management measures of the wetland assessment report should be considered and implemented.</td><td colspan="2" rowspan="2">Business case, Conclusion and Mitigation Requirements:
Although not considered to be of significant agricultural productivity, these soils are however considered to be of significant ecological conservation as they are characteristically unique to wetland habitats; and as such the recommendations and management measures of the wetland assessment report conducted as part of the environmental assessment and authorisation process take precedence. Furthermore, the susceptibility to prolonged waterlogging conditions (inundation), as implied by the occurrence of the plinthite and G-horizon at relatively shallow depth, should be considered and avoided where possible for soil structural integrity.</td></tr>
<tr><td>Overall impact significance post mitigation</td><td>VL</td></tr>
</table>

Table 10: Summary discussion of the Wildlife/Wilderness (Class VIII) land capability class

<table>
<tr><td colspan="3">Land Capability: Wildlife/Wilderness - Class VIII</td><td colspan="2" rowspan="2"> </td></tr>
<tr><td colspan="3">Occurrence within the focus area
These soils were observed within the focus area. Anthropogenically transformed soils were all classified as Witbank (Anthrosols)</td></tr>
<tr><td colspan="2">Terrain Morphological Unit (TMU)</td><td>Not applicable; highly disturbed areas</td><td>Photograph notes</td><td>View of the identified Witbank soil forms</td></tr>
<tr><td colspan="2">Soil Form(s)</td><td>Witbank (Anthrosols)</td><td>Area Extent</td><td>12.44 ha; which constitutes 0.36 % of the total investigated area</td></tr>
<tr><td colspan="2">Diagnostic Horizon Sequence</td><td>Not applicable; highly disturbed soils</td><td colspan="2" rowspan="2">Land Capability
These identified Witbank soils have very poor (class VIII) land capability attributed to the potential leakages from vehicles transporting material from the forestry and mining areas. In addition, some of these soils have been subjected to long term compaction and erosion. This land capability class also includes area where the original soil has been buried and/or extensively modified by anthropogenic activities. These soils are therefore not considered to make a significant contribution to agricultural productivity even on a local scale.</td></tr>
<tr><td colspan="2">Physical Limitations</td><td>Comprises of significantly disturbed areas due from anthropogenic activities to an extent that no recognisable diagnostic soil horizon properties could be identified. These soils are characterised by various limitations, primarily the absence of soil as a growth medium for arable agriculture.</td></tr>
<tr><td>Overall impact significance prior to mitigation</td><td>L</td><td rowspan="2">The overall impact of the proposed development on the land capability of these soils is anticipated to be low due to their very poor land capability attributable to anthropogenic disturbances.</td><td colspan="2" rowspan="2">Business case, Conclusion and Mitigation Requirements:
The current state of these soils requires significant rehabilitation already. 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>

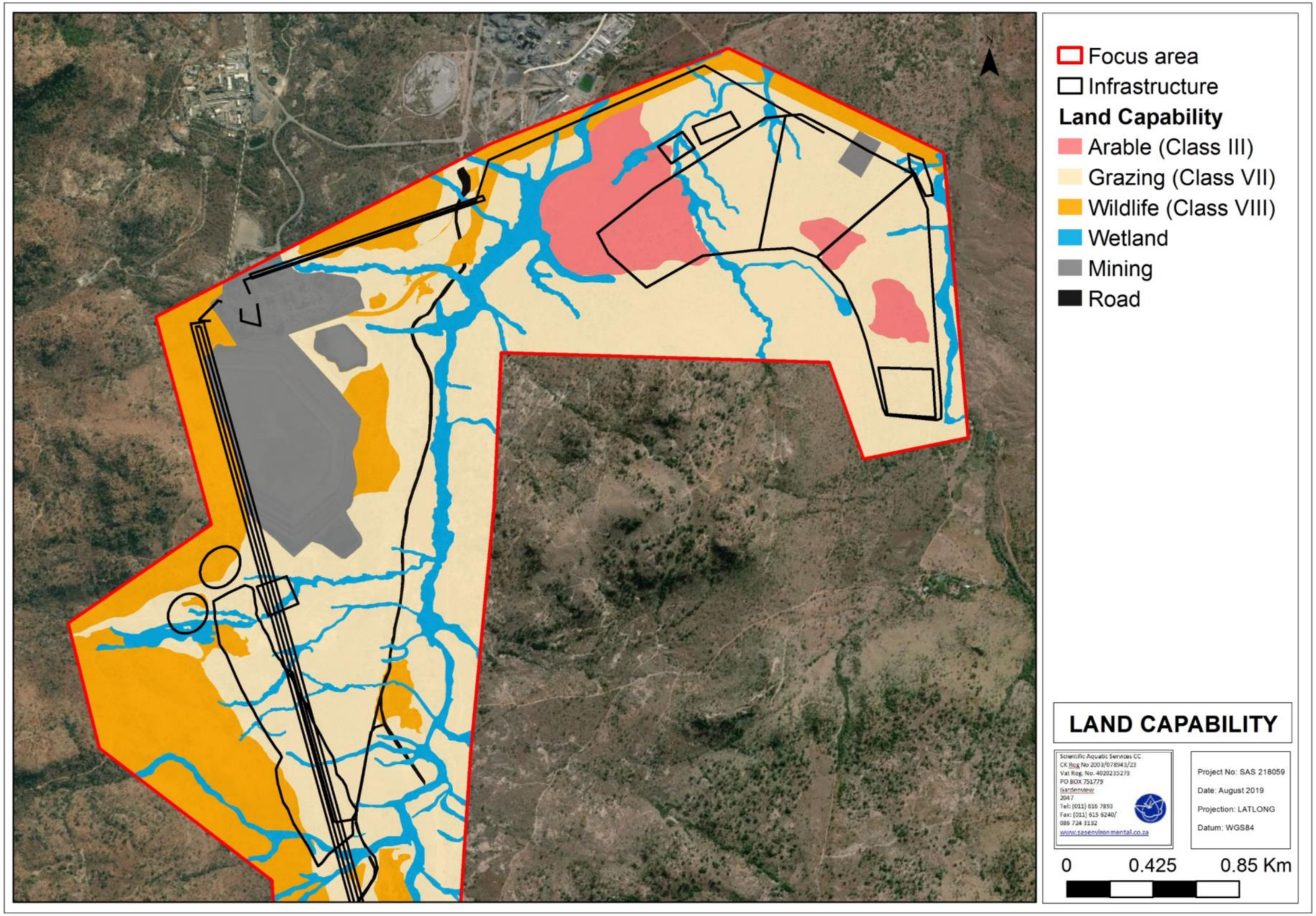

Figure 15: A map depicting land capability within the northern portion of the focus area

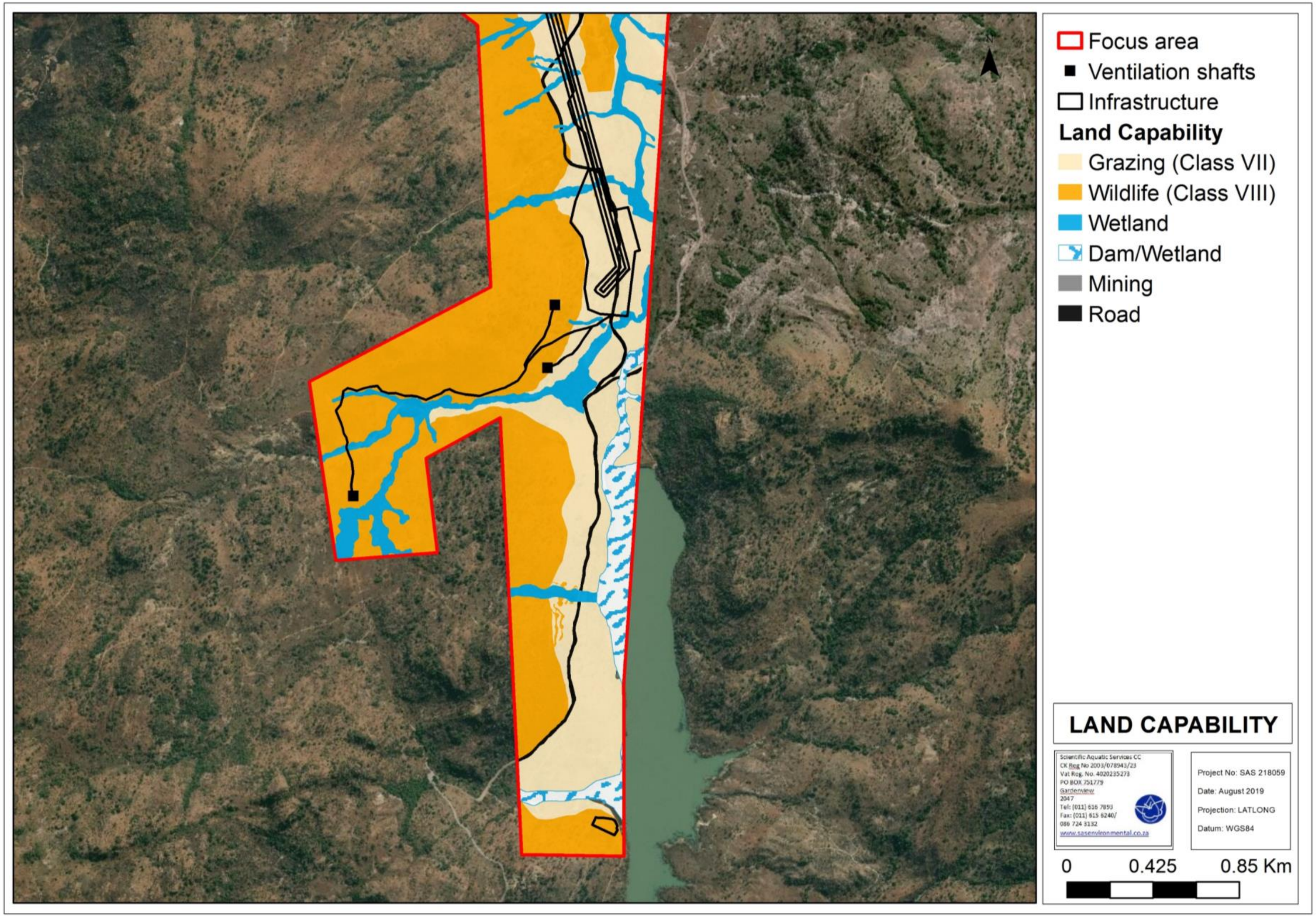

Figure 16: A map depicting land capability within the southern portion of the focus area

5. IMPACT ASSESSMENT AND MITIGATION MEASURES

The focus area is currently used for mining and for game farming with no crop agriculture due to soil constraints, with specific mention of soil depth. As the focus area is predominantly comprised of low potential agricultural soils, low impact is foreseen on these soils from a land capability perspective after mitigation measures have been implemented. These soils have little bearing on agricultural productivity, with limited contribution to the local, regional, provincial as well as national food production. However, their protection, where feasible is deemed important to ensure that the area remains functional post closure. Witbank soils *(Anthrosols*) are not regarded as important for cultivated agricultural production, as these soils are affected by anthropogenic activities such that their genic character has been largely destroyed. Thus, these soils could not be assigned to neither arable nor grazing land capability classes.

5.1 Mining Activities

The potential impact triggers at various phases of the proposed development are presented in Table 11 below.

Table 11: Summary of the anticipated Activities for the proposed development

Phase	Activities and associated impacts on soils and land capability
Preconstruction and construction	- Planning Phase - Site clearing of all footprint areas associated with the proposed project infrastructure - Stockpiling of Topsoil - Use of existing gravel roads for pre-construction activities - Construction of infrastructure - Construction of gravel maintenance roads to the proposed ventilation shafts - Upgrading of existing gravel roads to tar roads to serve as main access roads
Operational	- Underground mechanised mining at South Shafts - Temporary hauling of ore - Operation of Conveyor Systems - Stockpiling of ore material at Mototolo Concentrator - Operation of the Chrome Recovery Inter-Stage Plant - Operation of the DMS Plant - Deposition of DMS material onto the DMS Stockpile Area - Utilisation of storm water management infrastructure at shafts, and PCD's at DMS stockpile - Utilisation of the Staff Accommodation near the Der Brochen Dam - Utilisation of tar access roads - Utilisation of gravel maintenance roads associated with the ventilation shafts - Dangerous Goods storage (including hydrocarbons/chemicals/explosives) - Waste Management
Decommissioning and closure	- Pre-Decommissioning planning - Removal of all plant equipment including conveyor belt systems and staff accommodation - Closure of the Shafts and underground workings - Rehabilitation of the DMS Stockpile and PCD
Post-closure	- Resumption of former land use activities; and - Potential latent impact on soil chemistry.

5.1.1 Impact: Soil erosion

Parameters determining the extent and severity of soil erosion are highly complex, with water and wind as the main geomorphic agents, and soil erosion is largely dependent on land use and soil management and is generally accelerated by human activities such as tillage practices.

The entire focus area is located on a relatively steep terrain at most, consisting of shallow soils, thus erosion is considered moderately high for this area. The natural and undisturbed soils will become more vulnerable to erosion once the vegetation is cleared for construction activities, and the soils will inevitably be exposed to wind and some surface runoff during intensive rainfall events. The significance of this impact is anticipated to be moderate and will be reduced to moderately low impact if mitigation measures outlined in this document are adhered to, as illustrated on the impact rating table below.

5.1.2 Impact: Soil compaction

Heavy equipment traffic during construction activities is anticipated to cause soil compaction. The severity of this impact is anticipated to be moderate for Hutton soils to loamy sand texture. Whereas soils with a relatively shallow bedrock and lithocutanic character (partly weathered rock material) such as the Glenrosa/Mispah soil forms are anticipated to be less impaired due to the resistance offered by the underlying bedrock.

5.1.3 Impact: Potential Soil Contamination

All the identified soils are considered equally predisposed to potential contamination, as contamination sources are generally unpredictable and often occur as incidental spills or leak for construction developments. The significance of soil contamination is considered to be medium-high for all identified soils, largely depending on the nature, volume and/or concentration of the contaminant of concern. Therefore, strict waste management protocols and activity specific Environmental Management Programme (EMP) guidelines should be adhered to during the construction activities.

5.1.4 Impact: Loss of Agricultural Land Capability

The proposed mining activities is not anticipated to result in significant loss of agricultural land capability since the majority of the soils where mining and associated infrastructure is to occur are not considered to contribute substantially to the provincial and national grid. Low crop yields are foreseen for this area due to shallow and poor quality soils as well as the steep gradient sin the majority of the study area. The land capability loss is anticipated to range between medium low for Hutton, and low for Mispah and Glenrosa as these soils are not considered ideal for cultivation, attributable to their shallow nature and high erosion hazard. Thus, it is imperative that the Hutton soils be avoided, if feasible, since they arable and present an opportunity for cultivated agricultural production. From a land capability perspective, Witbank (*Anthrosols*) soils have no bearing on agricultural production, and as such the impacts on these soils is anticipation to be low.

5.1.5 Cumulative impacts

The surrounding areas within which the proposed mine is to occur are dominated by wildlife and wilderness land uses, and no significant cultivated agricultural activities were observed in the vicinity. This is largely attributable to the shallow nature of the surrounding soils. Therefore, the proposed mining project is anticipated to insignificantly contribute to the cumulative loss of arable land and low cumulative loss of the herbaceous material for grazing after mitigation measures have been put in place. Therefore, from a soil and land capability point of view, the addition to the cumulative impact footprint of the region is considered relatively minor.

Surrounding areas can be broadly defined as non-arable land, thus the already approved Northern Pit and WRDs will lead to a negligibly low cumulative loss of arable land. However, high cumulative loss of herbaceous material for grazing is foreseen during the life/operation of these infrastructures due to their nature and extent in area. It is therefore imperative that mitigation measures, as outlined in this document, are carefully implemented during all phases of development to ensure that pre mining landuses commence post closure to avoid significant negative impacts.

1.1 Aspects and potential impacts common to all activities (shafts and shaft complexes, DMS facility, concentrator plant)																	
Nature of the impact		Significance of potential impact BEFORE mitigation							Mitigation Measures	Significance of potential impact AFTER mitigation							degree of mitigation (%)
		Probability	Duration	Extent	Magnitude	Loss of Resources (%)		Significance		Probability	Duration	Extent	Magnitude	Loss of Resources (%)		Significance	
Pre-Construction Phase																	
*Site preparation prior to construction of activities related to the proposed surface infrastructure *Poor planning (i.e. no rehabilitation strategy in place to mitigate the impact post closure) may potentially result in permanent loss of soil resources	-	4	4	1	6	3	**44**	**Moderate**	**Optimisation of proposed infrastructure layouts: All effort should be made to ensure that the proposed mining footprint is as small as possible; and *The footprint of the proposed infrastructure areas should be clearly demarcated to restrict vegetation clearing activities as far as practically possible.*	1	4	1	4	1	**9**	**Low**	79.5
Loss of approximately 1.49 % Class III arable land (i.e. Hutton soils) for potential cultivation and grazing opportunities associated with the DMS plant (particularly Phase 1 and 3)	-	4	4	2	6	3	**48**	**Moderate**	**DMS footprint should avoid Hutton soils (Arable class III) if feasible to ensure that high potential soils are conserved; *Should avoidance be impractical, minimise the disturbance of these soils*	3	2	1	4	2	**21**	**Low**	56.3
Site preparation activities will lead to disturbance of soils suitable for grazing (Class VII) and disruption of current land uses activities (i.e. wildlife)	-	4	2	2	6	1	**40**	**Moderate**	**The footprint of the proposed infrastructure area should be clearly demarcated to restrict vegetation clearing activities within the infrastructure footprint. *Pre mining topography should be re-instated post closure to allow for current landuses to commence post closure.*	3	2	1	2	3	**15**	**Low**	62.5

Construction Phase																	
Vegetation clearing within the proposed mining and infrastructure areas as part of site preparation prior to commencement mining and related of activities which will lead to soil erosion	**-**	5	2	1	8	4	**55**	**Moderate**	**Clearing of vegetation should take place in a phased manner as to keep bare soil areas as small as possible to limit the erosion potential; *Moisture control will be necessary on large bare areas during dry season construction, in order to reduce the frequency and amount of dust suspended in the ambient air; and *All disturbed areas adjacent to the infrastructural areas can be re-vegetated with an indigenous grass mix, to re-establish a protective cover, in order to minimise soil erosion and dust emission. This can be achieved by conducting a vegetation assessment.*	3	2	1	2	2	**15**	**Low**	72.7
Construction of surface infrastructure increasing the potential risk of soil erosion, dust emission, sedimentation and disposal of waste on soil resources. The impact related to this include altered soil chemistry	**-**	4	2	1	8	4	**44**	**Moderate**	**All vehicular traffic should be restricted to the existing service roads and the selected haul road servitude as far as practically possible; *A regulated speed limits of 40km/hr must be maintained on gravel roads to minimize dust generation; *The mine should implement adequate wet suppression techniques to limit dust release;*	2	2	1	2	2	**10**	**Low**	77.3
Construction activities leading to disposal of waste. The impact related to this is soil contamination and altered soil chemistry	**-**	4	2	1	8	4	**44**	**Moderate**	**Burying of waste should be avoided; and *All waste should be dispose of at a legal landfill site in order to prevent soil contamination.*	1	2	1	2	2	**5**	**Low**	88.6
Movement of heavy machinery / construction vehicles off existing/demarcated roads, leading to soil compaction and potential spillage from machinery / construction vehicles	**-**	4	2	1	6	1	**36**	**Moderate**	**Compacted soils adjacent to the mining and related infrastructure footprint should be lightly ripped to at 25 cm below ground surface to alleviate compaction prior to re-vegetation.*	2	2	1	2	2	**10**	**Low**	72.2

Excavation and removal of topsoil from the proposed infrastructure areas, and stockpiling, leading to an increased risk of transportation of sediment from exposed soils in storm water runoff, leading to loss of natural topography, soil depth, soil volume and alteration of natural drainage pattern.	-	5	2	2	6	3	**50**	**Moderate**	**Soils should be stockpiled on the designated topsoil stockpile area; *Prevent mixing of high-quality topsoil (A and B-horizons) with low quality underlying material to ensure sufficient volumes of high quality soil for rehabilitation. For instance, A horizon (0-30cm) and B horizon (30 - 60 cm) of the Hutton Soils should be stockpiled separately; *Separate stockpiling of different soil type groups (to obtain the highest post-mining land capability *Separate stripping, stockpiling and replacing of soil horizons (A and B horizon) in the original natural sequence to combat hardsetting and compaction, and maintain soil fertility; *The topsoil stockpile should be vegetated and while vegetating, measures will be needed to contain erosion of the stockpile during rain events; *Stockpiles should also be kept alien vegetation free at all times to prevent loss of soil quality; *Temporary berms can be installed, if necessary, around stockpile areas whilst vegetation cover has not established to avoid soil loss through erosion; *The recovered soils should be re-used to rehabilitate the mine footprint following mine closure; *Soil resources of similar characteristics must be imported back to the site to compensate for soil loss that will occur during mining activities; and *Stockpile height should not exceed 3 metres.*	3	2	1	2	1	**15**	**Low**	70.0
Operational Phase																		
Potential contamination soils from the concentrator plant resulting from stormwater runoff or leaking pipes, resulting in contamination of soils,	-	5	2	2	8	3	**60**	**Moderate**	**Pipelines conveying waste material must be monitored for leaks on a regular basis; *Leaks are to be immediately attended to in accordance with the Emergency Response Plan and/or approved Environmental Management plan as applicable. *All PCDs and storage facilities must be lined with bentonite sealant to prevent seepage*Clean and dirty water separation systems to be implemented prior to the commencement of activities and to be maintained throughout the LOM. *Dirty stormwater runoff must be pumped to a Pollution Control Dam (PCD).*	3	4	1	4	2	**27**	**Low**	55.0

Potential soil contamination resulting from leakages/spill from mine vehicles	-	3	3	1	4	3	**24**	**Low**	**All vehicles must be regularly inspected for leaks. Re-fueling must take place on a sealed surface area to prevent ingress of hydrocarbons into topsoil; *Regular maintenance of vehicles must take place with care and the recollection of spillage should be practiced near the surface area to prevent ingress of hydrocarbons into topsoil and subsequent habitat loss; and * All spills should be immediately cleaned up and treated accordingly.*	2	4	1	4	1	**18**	**Low**	25.0
Operations and maintenance of planned waste management systems (e.g. sewage infrastructure), which may lead to possible contamination of soils	-	3	2	2	8	3	**36**	**Moderate**	**Ensure that regular maintenance takes place to prevent failure; and *Develop emergency response plan to be implemented in case of emergency.*	3	5	1	2	2	**24**	**Low**	33.3
Closure/Rehabilitation Phase																	
*Re-sloping and restoration of natural topography will likely lead to further soil erosion, compaction and contamination *Resurfacing will also lead to water ponding if not done properly.	-	4	2	1	6	3	**36**	**Moderate**	**All areas of disturbed and compacted soils during construction needs to be ripped, re-profiled and reseeded with indigenous vegetation; *Stored topsoil should be replaced (if any) and the footprint graded to a smooth surface; *The landscape should be backfilled and reprofiled so as to mimic the natural topography for potential grazing opportunities post mining. If possible ensure a continuation of the pre mining surface drainage pattern; *Slopes of the backfilled surface should therefore change gradually since abrupt changes in slope gradient increase the susceptibility for erosion initiation; *The soil fertility status should be determined by soil chemical analysis after levelling (before seeding/re-vegetation). Soil amelioration should be done according to the soil analyses as recommended by a soil specialist, in order to correct the pH and nutrition status before revegetation; and *Revegetate with an indigenous grass mix, to re-establish a protective cover, in order to minimise soil erosion and dust emissions.*	2	1	1	4	1	**12**	**Low**	66.7
Successful implementation of the rehabilitation plan will lead to reinstatement of the natural topography and commencement of pre mining land uses.	+	4	2	1	6	3	**36**	**Moderate**	Rehabilitation plan should aim to rehabilitate the soils for grazing land use post closure	2	1	1	4	1	**12**	**Low**	**66.7**

Post-Closure Phase																	
Poor rehabilitation strategy may result in permanent loss of soil resources.	**-**	4	4	2	8	3	**56**	**Moderate**	**Monitoring of backfilled sites should be undertaken to ensure that the landscape is free draining to prevent water logging condition *Undertake inspection of rehabilitated area to ascertain level of success of rehabilitation efforts and effectiveness (vegetation growth, erosion monitoring). *A short-term fertilizer program should be implemented based on the findings of the soil chemical status after the first year in order to maintain the fertility status Fertility treatment should take place for a maximum of 2 to 3 years after rehabilitation until the area can be declared self-sustaining.*	2	3	1	4	1	**16**	**Low**	71.4
Good rehabilitation strategy will lead to commencement of pre-mining landuses such as wildlife/wilderness as well as subsistence grazing in some areas post closure	**+**	4	3	2	6	3	**44**	**Moderate**	**Surface should be thoroughly cleaned of all waste material; *Rubble and waste material should be disposed of at an authorized landfill site; and *Excavated areas should be backfilled, and natural topography be reinstated to allow for free movement of livestock and wildlife.*	3	3	1	4	1	**24**	**Low**	**45.5**
Good rehabilitation strategy will to a subsistence grazing and wildlife/wilderness land capability post closure	**+**	4	3	1	8	4	**48**	**Moderate**		2	3	1	4	1	**16**	**Low**	66.7

Closure/Rehabilitation Phase																
*Demolition of structures such as shaft complexes and concentrator plants leading to further soil disturbances (i.e. loosening of soil particles, compaction and possible contamination. *Ripping of soil and hard surfaces, re sloping, restoration of natural topography and revegetation leading to further soil erosion, compaction and contamination. Resurfacing may lead to water ponding if not done properly	-	4	2	1	6	3	**36**	**Moderate**	**The footprint should be ripped to alleviate compaction; *Stored topsoil should be replaced (if any) and the footprint graded to a smooth surface; *The landscape should be backfilled and reprofiled so as to mimic the natural topography for potential agricultural activities and grazing opportunities post mining. If possible, ensure a continuation of the pre mining surface drainage pattern; *Slopes of the backfilled surface should therefore change gradually since abrupt changes in slope gradient increase the susceptibility for erosion initiation *The topsoil should be ameliorated according to soil chemical analysis and monitoring data. The soil fertility status should be determined by soil chemical analysis after levelling (before seeding/re-vegetation. Soil amelioration should be done according soil analyses as recommended by a soil specialist, in order to correct the pH and nutrition status before revegetation; and *The footprint should be re-vegetated with a grass seed mixture as soon as possible, preferably in spring and early summer to stabilize the soil and prevent soil loss during the rainy season. *The impact of the DMS stockpile is regarded as permanent in the footprint, therefore efforts should be made to avoid Hutton/Mispah soils as they present the opportunity for cultivated agricultural production*	2	1	1	4	1	**12**	**Low**	66.7
Post-Closure Phase																
Potential poor rehabilitation strategy may result in permanent loss of soil resources.	-	4	4	2	8	3	**56**	**Moderate**	**A short-term fertilizer program should be implemented based on the findings of the soil chemical status after the first year in order to maintain the fertility status Fertility treatment should take place for a maximum of 1 to 2 years after rehabilitation until the area can be declared self-sustaining.*	2	3	1	4	1	**16**	**Low**	71.4

1.3 Activity 2: DMS Stockpile

Nature of the impact		Significance of potential impact BEFORE mitigation							Mitigation Measures	Significance of potential impact AFTER mitigation							degree of mitigation (%)
		Probability	Duration	Extent	Magnitude	Loss of Resources (%)	Significance			Probability	Duration	Extent	Magnitude	Loss of Resources (%)	Significance		
Pre-construction Phase																	
Loss of arable soils due to potential placement of DMS Stockpiles within Hutton/Mispah soils, leading to loss agricultural land capability.	-	4	5	2	8	3	60	Moderate	**Direct surface disturbance of the identified arable soils (i.e. Hutton) should be avoided where possible to minimise since they are considered prime agricultural soils since they are currently overlain by DMS phase 1 plant; *All effort should be made to ensure that the proposed mining footprint is as small as possible.*	3	4	1	4	3	27	Low	55.0
Construction Phase																	
Mine machinery increasing the potential risk of soil erosion, dust emission, sedimentation and disposal of waste on soil resources, leading to altered soil chemistry and quality and/or altered flow patterns due to instream blockages.	-	4	5	1	8	4	56	Low	**The footprint of the proposed infrastructure area should be clearly demarcated to restrict vegetation clearing activities within the infrastructure footprint; *Vegetation clearance and commencement of construction activities should be scheduled to coincide with low rainfall conditions when the erosive stormwater and wind are anticipated to be low; *The mine will implement adequate wet suppression techniques to limit dust release; *All disturbed areas adjacent to the infrastructural and open cast areas should be re-vegetated with an indigenous grass mix, if necessary, to re-establish a protective cover, in order to minimise soil erosion and dust emission; and *Temporary erosion control measures should be used to protect the disturbed soils during the construction phase until adequate vegetation has established.*	3	4	1	4	3	27	Low	51.8

Operational Phase																		
*Seepage and runoff from DMS Stockpiles, leading to possible contamination of soil resources, leading to impaired soil chemistry and quality and salinations of soils *Sedimentation resulting from loosening of soil by heavy vehicles and mine machinery a	-	4	4	1	6	3	**44**	Moderate	**A spill prevention and emergency spill response plan, as well as dust suppression, and fire prevention plans must be developed and be implemented.; and *An emergency response contingency plan should be put in place to address clean-up measures should a spill and/or a leak occur, as well as preventative measures*	3	4	2	2	2	**24**	**Low**	45.5
Alteration of the hydrological patterns of the land scape due to the deposition of the waste rock leading to ponding of water behind DMS Stockpile, creating water logging conditions in the soil.	-	4	5	2	6	4	**52**	Moderate	**Clean and dirty water diversion structures must be installed in line with GN 704 regulations *DMS Stockpile should be placed outside of freshwater features to prevent any water ponding paths which may reach the freshwater resources. *Monitoring of erosion must take place throughout the life of mine, in order to prevent the formation of erosion gullies as a result of altered flow paths, and the possible sedimentation of the freshwater resources.*	3	4	1	2	2	**21**	**Low**	59.6
Closure/Rehabilitation Phase																		
Ripping of soil and hard surfaces, re sloping, restoration of natural topography and revegetation leading to further soil erosion, compaction and contamination. Resurfacing may lead to water ponding if not done properly	-	4	5	2	10	5	**68**	High	**All areas of disturbed and compacted soils during construction needs to be ripped, re-profiled and reseeded with indigenous vegetation;; *Stored topsoil should be replaced (if any) and the footprint graded to a smooth surface; *The landscape should be backfilled and reprofiled so as to mimic the natural topography for potential grazing opportunities post mining. If possible ensure a continuation of the pre mining surface drainage pattern; *Slopes of the backfilled surface should therefore change gradually since abrupt changes in slope gradient increase the susceptibility for erosion initiation; and *The footprint should be re-vegetated with a grass seed mixture as soon as possible, preferably in spring and early summer to stabilize the soil and prevent soil loss during the rainy season.*	4	4	2	8	3	**56**	**Low**	17.6
Post-Closure Phase																		
Inadequate rehabilitation efforts leading to permanent loss of soils resources, water ponding conditions	-	4	5	2	8	3	**60**	Moderate	*Please refer to Table 1.1*						**0**	**#N/A**	100.0

1.3 Activity 3: Concentrator PlantB1:S10

Nature of the impact		Significance of potential impact BEFORE mitigation							Mitigation Measures	Significance of potential impact AFTER mitigation							degree of mitigation (%)
		Probability	Duration	Extent	Magnitude	Loss of Resources (%)	Significance			Probability	Duration	Extent	Magnitude	Loss of Resources (%)	Significance		
Construction Phase																	
Vegetation clearing within the proposed mining and infrastructure areas as part of site preparation prior to commencement mining and related of activities leading to soil erosion	-	5	2	1	8	4	**55**	**Moderate**	*"*The footprint of the proposed infrastructure area should be clearly demarcated to restrict vegetation clearing activities within the infrastructure footprint; * The mine will implement adequate wet suppression techniques to limit dust release; and *All disturbed areas adjacent to the infrastructural areas can be re-vegetated with an indigenous grass mix, if necessary, to re-establish a protective cover, in order to minimise soil erosion and dust emission.*	4	2	1	4	2	**28**	**Low**	49.1
Operational Phase																	
Potential contamination soils from the concentrator plant resulting from stormwater runoff or leaking pipes, resulting in contamination of soils,	-	5	2	2	8	3	**60**	**Moderate**	**Pipelines conveying waste material must be monitored for leaks on a regular basis; *Leaks are to be immediately attended to in accordance with the Emergency Response Plan and/or approved Environmental Management plan as applicable. *All PCDs and storage facilities must be lined with bentonite sealant to prevent seepage*Clean and dirty water separation systems to be implemented prior to the commencement of activities and to be maintained throughout the LOM. *Dirty stormwater runoff must be pumped to a Pollution Control Dam (PCD).*	3	4	1	4	2	**27**	**Low**	55.0
Closure/Rehabilitation Phase																	
Ripping of soil and hard surfaces, re sloping, restoration of natural topography and revegetation leading to further soil erosion, compaction and contamination. Resurfacing may lead to water ponding if not done properly	-	4	2	1	6	3	**36**	**Low**	**During the decommissioning phase the footprint should be thoroughly cleaned and all building material should be removed to a suitable disposal facility; *The footprint should be ripped to alleviate compaction; *Stored topsoil should be replaced (if any) and the footprint graded to a smooth surface*	3	5	1	2	2	**24**	**Low**	33.3

Post-Closure Phase																	
Poorly rehabilitation strategy may result in permanent loss of soil resources.	**-**	4	5	2	4	3	**44**	**Moderate**	**Undertake inspection of rehabilitated area to ascertain level of success of rehabilitation efforts and effectiveness (vegetation growth, erosion monitoring); *Additional top soiling and revegetation of affected areas should be undertaken if required; and *A short-term fertilizer program should be implemented based on the findings of the soil chemical status after the first year in order to maintain the fertility status Fertility treatment should take place for a maximum of 2 to 3 years after rehabilitation until the area can be declared self-sustaining.*	2	3	1	4	1	**16**	**Low**	63.6

1.4 Activity 4: Central Complex																	
Nature of the impact		**Significance of potential impact BEFORE mitigation**							**Mitigation Measures**	**Significance of potential impact AFTER mitigation**							**degree of mitigation (%)**
		Probability	**Duration**	**Extent**	**Magnitude**	**Loss of Resources**	**Significance**			**Probability**	**Duration**	**Extent**	**Magnitude**	**Loss of Resources**	**Significance**		
Construction Phase																	
Vegetation clearing within the proposed mining and infrastructure areas as part of site preparation prior to commencement mining and related of activities leading to soil disturbance and subsequent erosion.	-	5	2	1	8	4	**55**	**Moderate**	*"*The footprint of the proposed infrastructure area should be clearly demarcated to restrict vegetation clearing activities within the infrastructure footprint; *The mine should implement adequate wet suppression techniques to limit dust release; and *All disturbed areas adjacent to the infrastructural areas should be re-vegetated with an indigenous grass mix, if necessary, to re-establish a protective cover, in order to minimise soil erosion and dust emission"*	4	2	1	4	1	**28**	**Moderate**	49.1
Operational Phase																	
Operations and maintenance of planned waste management systems (e.g. sewage infrastructure), which may lead to possible contamination of soils	-	3	2	2	8	3	**36**	**Moderate**	**Ensure that regular maintenance takes place to prevent failure; and *Develop emergency response plan to be implemented in case of emergency.*	3	5	1	2	2	**24**	**Low**	33.3
Closure/Rehabilitation Phase																	

Ripping of soil and hard surfaces, re sloping and revegetation efforts, decant management preparation: Increased traffic from vehicles and disturbance of surface areas will likely result in	-	5	2	2	8	3	**60**	**Low**	**All areas of disturbed and compacted soils during construction needs to be ripped, re-profiled and reseeded with indigenous vegetation; *Stored topsoil should be replaced (if any) and the footprint graded to a smooth surface; *The landscape should be backfilled and reprofiled so as to mimic the natural topography for potential agricultural activities and grazing opportunities post mining. If possible ensure a continuation of the pre mining surface drainage pattern; *Slopes of the backfilled surface should therefore change gradually since abrupt changes in slope gradient increase the susceptibility for erosion initiation; *The soil fertility status should be determined by soil chemical analysis after levelling (before seeding/re-vegetation). Soil amelioration should be done according to the soil analyses as recommended by a soil specialist, in order to correct the pH and nutrition status before revegetation; and *Revegetate with an indigenous grass mix to re-establish a protective cover, in order to minimise soil erosion and dust emissions*	3	5	1	2	2	**24**	**Low**	60.0
Post-Closure Phase																	
Poorly rehabilitation strategy may result in permanent loss of soil resources.	-	4	2	1	6	3	**36**	**Moderate**	**Undertake inspection of rehabilitated area to ascertain level of success of rehabilitation efforts and effectiveness (vegetation growth, erosion monitoring). *A short-term fertilizer program should be implemented based on the findings of the soil chemical status after the first year in order to maintain the fertility status Fertility treatment should take place for a maximum of 2 to 3 years after rehabilitation until the area can be declared self-sustaining.*	3	5	1	2	2	**24**	**Low**	33.3

Closure/Rehabilitation Phase																	
*Demolition of structures leading to further soil disturbances (i.e. loosening of soil particles, compaction and possible contamination. *Ripping of soil and hard surfaces, re sloping and revegetation efforts, decant management preparation: Increased traffic from vehicles and disturbance of surface areas will likely result in	-	5	2	2	8	3	**60**	**Moderate**	*"*The footprint should be ripped to alleviate compaction; *Stored topsoil should be replaced (if any) and the footprint graded to a smooth surface; *The landscape should be backfilled and reprofiled to mimic the natural topography for potential agricultural activities and grazing opportunities post mining. If possible ensure a continuation of the premining surface drainage pattern; *Slopes of the backfilled surface should therefore change gradually since abrupt changes in slope gradient increase the susceptibility for erosion initiation *The topsoil should be ameliorated according to soil chemical analysis and monitoring data. The soil fertility status should be determined by soil chemical analysis after levelling (before seeding/re-vegetation. Soil amelioration should be done according soil analyses as recommended by a soil specialist, to correct the pH and nutrition status before revegetation; and *The footprint should be re-vegetated with a grass seed mixture as soon as possible, preferably in spring and early summer to stabilize the soil and prevent soil loss during the rainy season."*	3	5	1	2	2	**24**	**Low**	60.0
Post-Closure Phase																	
Poorly rehabilitation strategy may result in permanent loss of soil resources.	-		2	1	6	3	**36**	**Moderate**	**Monitoring of backfilled sites should be undertaken to ensure that the landscape is free draining to prevent water logging condition * Re vegetated areas should also be monitored to ensure vegetation is establishing properly as a measure to prevent soil loss *A short-term fertilizer program should be implemented based on the findings of the soil chemical status after the first year in order to maintain the fertility status Fertility treatment should take place for a maximum of 2 to 3 years after rehabilitation until the area can be declared self-sustaining.*	3	5	1	2	2	**24**	**Low**	33.3

1.6 Activity 5: Conveyor

Nature of the impact		Significance of potential impact BEFORE mitigation							Mitigation Measures	Significance of potential impact AFTER mitigation							degree of mitigation (%)
		Probability	Duration	Extent	Magnitude	Loss of Resources (%)	Significance			Probability	Duration	Extent	Magnitude	Loss of Resources (%)	Significance		
Construction Phase																	
*Vegetation clearing and excavation within supporting structure areas leading to soil disturbance and subsequent erosion;	-	4	1	1	4	3	**24**	Low	**Limit excavations to ensure that natural drainage patterns in the surrounding landscape return to normal after construction activities have commenced and been completed;*	2	2	1	4	1	**14**	Low	41.7
Operational Phase																	
Transportation/transfer of platinum ore via the conveyor, potentially resulting in spillages from the conveyor in turn leading to contamination of soils	-	4	4	2	6	2	**48**	Moderate	**Conveyor should be monitored on a regularly basis for spillages; *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 occur.*	2	4	1	4	1	**18**	Low	62.5
Land withdrawal and creation of barrier for potential grazing and wildlife	-	3	4	2	6	2	**36**	Moderate	**Conveyor should be at least 3 meters high to allow for migration of wildlife *Conveyor footprint should be kept as small as possible to prevent land windrawal for potential grazing and wildlife*	2	5	1	4	1	**20**	Low	44.4

Closure/Rehabilitation Phase																	
Alteration of chemical status of the soils	-	3	4	1	6	2	**33**	Moderate	**The topsoil should be ameliorated according to soil chemical analysis and monitoring data. Soil amelioration should be done according soil analyses as recommended by a soil specialist, in order to correct the pH and nutrition status before revegetation; and *The footprint should be re-vegetated with a grass seed mixture as soon as possible, preferably in spring and early summer to stabilize the soil and prevent soil loss during the rainy season.*	2	3	1	4	2	**16**	Low	51.5
Post-Closure Phase																	
Poorly rehabilitation strategy may result in permanent loss of soil resources.	-	4	1	1	6	3	**32**	moderate	**Undertake inspection of rehabilitated area to ascertain level of success of rehabilitation efforts and effectiveness (vegetation growth, erosion monitoring).*	2	3	1	4	2	**16**	Low	50.0
Good rehabilitation strategy will lead to commencement of pre-mining landuses such as wildlife/wilderness as well as subsistence grazing in some areas post closure	+	4	3	2	6	3	**44**	Moderate	**All infrastructure should be decommissioned to all for free movement of livestock and wildlife*	3	3	1	4	1	**24**	Low	**45.5**
Closure/Rehabilitation Phase																	
*Demolition of structures leading to further soil disturbances (i.e. loosening of soil particles, compaction and possible contamination.	-	3	4	1	6	2	**33**	Moderate	**The topsoil should be ameliorated according to soil chemical analysis and monitoring data. Soil amelioration should be done according soil analyses as recommended by a soil specialist, to correct the pH and nutrition status before revegetation; and *The footprint should be re-vegetated with a grass seed mixture as soon as possible, preferably in spring and early summer to stabilize the soil and prevent soil loss during the rainy season.*	2	3	1	4	2	**16**	Low	51.5

Post-Closure Phase																		
Poorly rehabilitation strategy may result in permanent loss of soil resources.	-	4	1	1	6	3	**32**	**moderate**	**Soil monitoring should be undertaken to ensure that the natural chemical status of the soil is re-instated *Re vegetated areas should also be monitored to ensure vegetation is establishing properly as a measure to prevent soil loss*	2	3	1	4	2	**16**	**Low**	50.0

6. SUMMARY OF MITIGATION MEASURES

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

6.1 Soil Erosion and Dust Emission Management

- The footprint of the proposed infrastructure area must be clearly demarcated to restrict vegetation clearing activities within the infrastructure footprint;
- Clearing of vegetation should take place in a phased manner as to keep bare soil areas as small as possible to limit the erosion potential;
- Moisture control will be necessary on large bare areas during dry season construction, in order to reduce the frequency and amount of dust suspended in the ambient air;
- The mine should implement adequate wet suppression techniques to limit dust release;
- Regulated speed limits of 40km/hr must be maintained on gravel roads to minimize dust generation;
- All disturbed areas adjacent to the infrastructural areas can be re-vegetated with an indigenous grass mix, if necessary, to re-establish a protective cover, to minimise soil erosion and dust emission; and
- Temporary erosion control measures may be used to protect the disturbed soils during the construction phase until adequate vegetation has established.

6.2 Sedimentation and Soil Compaction management

- All vehicular traffic should be restricted to the existing service roads and the selected road servitude as far as practically possible;
- Vegetation clearance and commencement of construction activities can be scheduled to coincide with low rainfall conditions when soil moisture is anticipated to be relatively low, such that the soils are less prone to compaction; and
- Compacted soils adjacent to the mining and associated infrastructure footprint should be lightly ripped to at least 25 cm below ground surface to alleviate compaction prior to re-vegetation.

6.3 Soil Contamination Management

- Baseline soil sampling should be undertaken prior to any mining activities;

- Regular monitoring of site activities and machinery must be undertaken to identify spills or leaks;
- A spill prevention and emergency spill response plan, as well as dust suppression, and fire prevention plans must be developed and be implemented;
- Withdraw equipment for maintenance if change in emission characteristics is noticeable;
- Spill kits (such as spill-sorb or a similar type product) must be kept on site and used to clean up hydrocarbon spills in the event that they should occur; and
- Burying of any waste including rubble, domestic waste, empty containers on the site should be strictly prohibited and all construction rubble waste must be removed to an approved disposal site.

6.4 Loss of Natural Topography, Soil Depth, Soil Volume and Drainage Pattern Management

- Infrastructure sites should be accessed through existing road network, where feasible to avoid unnecessary excavation;
- Temporary berms can be installed, if necessary, around stockpile areas whilst vegetation cover has not established to avoid soil loss through erosion;
- The recovered soils should be re-used to rehabilitate the mine footprint following mine closure;
- Soil resources of similar characteristics must be imported back to the site to compensate for soil loss that will occur during mining activities: and
- The landscape should be resurfaced as to mimic the natural topography, in a manner that allows water to freely drain to the downgradient receiving environment post closure to avoid water ponding which will subsequently lead to water logging conditions.

6.5 Stockpile and Stripping Management

- Excavation and long-term stockpiling of soil should be limited within the demarcated areas;
- Ensure all stockpiles (especially topsoil) are clearly and permanently demarcated and located in defined no-go areas;
- Restrict the amount of mechanical handling, as each handling event increases that compaction level and the changes to the soil structure. Wherever possible, the ‘cut and cover’ technique (where the stripped soils is immediately placed in an area already prepared for rehabilitation, thus avoiding stockpiling) should be used, and

- Use of heavy machinery such as bulldozers should be avoided as far as possible;
- Sol stripping should be done in conjunction with a soil specialist and careful consultation of the pre-mining soil survey is essential. This will ensure optimal soil availability and avoid excessive mixing of soil due to over-stripping, as well as loss of available cover soil due to under-stripping. Such consultation is recommended for the whole soil handling process, from stripping through stockpiling to final rehabilitation;
- Separate stockpiling of different soil to obtain the highest post-mining land capability;
- The A and B-horizons should be stripped separately and replaced in the same sequence on top of the soil material. The fairly higher organic carbon content of the A-horizons provides a buffer against compaction and hardsetting and serves as a seed source which will enhance the re-establishing of natural species. B-horizons replaced on the surface tend to seal and compact severely which increases runoff and triggers erosion;
- Separate stripping, stockpiling and replacing of soil horizons [A (0-30 cm) and B (30-60 cm)] in the original natural sequence to combat hardsetting and compaction, and maintain soil fertility;
- Stockpile height should be restricted to that which can deposited without additional traversing by machinery. A Maximum height of 2-3 m is therefore proposed, and the stockpile should be treated with temporary soil stabilisation methods; such as the application of organic matter to promote soil aggregate formation, leading to increased infiltration rate, thereby reducing soil erosion. Also, the use of lime to stabilise soil pH levels;
- Soil erosion should be controlled on stockpiles by having control measures to reduce erosion risk such as erosion control blankets, soil binders, revegetation, contours, diversion banks and spillways;
- Stockpiled soils should be stored for a maximum of 3-5 years. in addition, concurrent rehabilitation should strongly be considered to reduce the duration of stockpile storage to ensure that the quality of stored soil material does not deteriorate excessively; especially with regard to leaching and acidification;
- The topsoil stockpile should be vegetated and while vegetating, measures will be needed to contain erosion of the stockpile during rain events.
- Temporary berms can be installed, around stockpile areas whilst vegetation cover has not established to avoid soil loss through erosion;
- The recovered soils should be re-used to rehabilitate the mine footprint following mine closure;
- During rehabilitation replace soil to appropriate soil depths in the correct order, and cover areas to achieve an appropriate topographic aspect and attitude so as to achieve

a free draining landscape that is as close as possible the pre-mining land capability rating as possible; and

- A short-term fertilizer 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.

6.6 Loss of Land Capability Management

- Direct surface disturbance of the identified arable soils can be avoided where possible to minimise loss of arable soils;
- During the decommissioning phase the footprint should be thoroughly cleaned, and all building material should be removed to a suitable disposal facility;
- The footprint should be ripped to alleviate compaction;
- Stored topsoil should be replaced (if any) and the footprint graded to a smooth surface;
- The landscape should be backfilled and reprofiled to mimic the natural topography for potential grazing opportunities post mining. If possible, ensure a continuation of the pre-mining surface drainage pattern;
- Slopes of the backfilled surface should change gradually since abrupt changes in slope gradient increase the susceptibility for erosion initiation
- The topsoil should be ameliorated according to soil chemical analysis;
- The soil fertility status should be determined by soil chemical analysis after levelling (before seeding/re-vegetation). Soil amelioration should be done according to the soil analyses as recommended by a soil specialist, in order to correct the pH and nutrition status before revegetation; and
- Revegetate with an indigenous grass mix, to re-establish a protective cover, in order to minimise soil erosion and dust emissions...

7. CONCLUSION

Scientific Aquatic Services (SAS) was appointed to conduct a soil, land use and land capability assessment as part of the Environmental Impact Assessment (EIA) and authorisation process for the proposed Anglo Platinum Der Brochen Expansion Project, Limpopo Province.

The focus area is dominated by shallow soils of Mispah/Outcrop, Milkwood, Glenrosa, Bonheim and Mayo soil forms which collectively constitute of approximately over 60% of the total investigated area, whilst moderately deep soils of Hutton/Mispah occupies less than 5% of the total investigated focus area. The shallow nature of the dominated soil forms can be largely attributed to limited rock weathering or rejuvenation through natural erosion on steeper, convex slopes. The remainder of the focus area is occupied by structures associated with mining (i.e. Mine plant complex, PCD, office areas, tar roads), Witbank (*Anthrosols*) as well as soil types which are associated with freshwater features and these include Kroonstad, Katspruit and Willowbrook. Witbank soil forms were also identified within the proposed focus area. These soils have been extensively disturbed such that no recognisable diagnostic soil morphological characteristics, particularly in the topsoil, could be identified, corresponding to *Anthrosols* in the international soil classification terminology.

Current land use activities associated with the focus area are largely dominated by wildlife and wilderness, with some mining operations in the surrounding areas. No agricultural activities were observed in the surrounding areas. Land capability classification of the identified soils are presented in the table below.

Land capability classes for soil forms identified with the proposed mining sites

Soil Form	Land Capability	Total Area (Ha)	% Areal Extent
Hutton	Arable (Class III)	27.43	2.49
Hutton/Mispah		21.36	1.94
Mispah/Outcrop	Grazing (Class VII)	289.60	26.31
Bonheim/Steendal		5.24	0.48
Mispah/Glenrosa		190.41	17.30
Mispah/milkwood		1.20	0.11
Mispah/Bonheim		25.63	2.33
Mispah/Bonheim/Mayo		204.71	18.60
Bonheim/Valsrivier		8.62	0.78
Steendal/Immerpan		77.69	7.06
Witbank (Anthrosols)	Wilderness	45.16	4.10
Freshwater Features (Kroonstad/Katspruit/Willowbrook (Including Dam))	Wetland	116.40	10.57
Other (Stockpile. PCD, Tar Road, Mine Plant Area)	Non-Arable	87.32	7.93
Total Area Investigated	**1100.77**		**100**

***The percentages were rounded off to two (2) decimal places**

The findings of this assessment suggest that the relevant soil limiting factors within the MRA for land capability and land use potential include the following:

- Shallow effective rooting depth due to shallow indurated bedrock of the Mispah, Glenrosa, Milkwood, Mayo, Bonheim soil forms. As such, these soils are not considered to contribute significantly to agricultural productivity;
- Limited rooting depth due to periodic waterlogging of the Katspruit, Willowbrook and Kroonstad soil forms within the inundated zone of the artificial impoundments within the hillslope seep wetland. Preservation of these soils for conservation purposes takes precedence, according to the National Water Act, 1998 (Act No. 36 of 1998);
- Lack of soil medium for plants and crop growth for the rocky outcrop, mine areas (Offices, PCD and stockpile areas), surface water areas and Witbank (*Anthrosols*) soil types.

From a land capability point of view, the focus area presents relatively small areas of arable soils with a moderate potential for agriculture, comprising just 3.88 % of the total focus area, whilst the rest of the focus area is comprised on very shallow soils not considered prime soils for agricultural production. The extent of Hutton and Hutton/Mispah soils thereof cannot be considered sufficient for viable cultivated small commercial farming, however should be avoided where feasible to minimise the loss of soil resources for current and future agricultural production.

Livestock commercial farming is not considered ideal for this area due to the veld being classified as having a grazing capacity of 3.5 ha Per Large Animal Unit (PLAU). Furthermore, a significant portion of the focus area is located on a moderately steep terrain (medium gradient, further disqualifying this area for livestock commercial farming.

Potential arable soils will be slightly impacted by the proposed north eastern DMS stockpile since the current layout intrudes on these soils. From a soil and land capability point of view, this project is not regarded as being fatally flawed due to various soils constraints for commercial agricultural production, however mitigation measures and recommendations outlined in this document need to be strongly considered and implemented accordingly in efforts to conserve soil resources and for the protection of water resources.

It is the opinion of the specialist therefore that this study provides the relevant information required for the Environmental Impact Assessment phase of the project to ensure that appropriate consideration of the agricultural resources in the study area will be made in support of the principles of Integrated Environmental Management (IEM) and sustainable development

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APPENDIX A: METHOD OF ASSESSMENT

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 focus 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 from 11 September to 14 September 2017 by a qualified soil specialist, at which time the identified soils within the infrastructure areas and associated access roads were classified into soil forms according to the Taxonomic Soil Classification System 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 (Scotney et al., 1987)

Land Capability Group	Land Capability Class	Increased intensity of use									Limitations
Arable	I	W	F	LG	MG	IG	LC	MC	IC	VIC	No or few limitations. Very high arable potential. Very low erosion hazard
	II	W	F	LG	MG	IG	LC	MC	IC	-	Slight limitations. High arable potential. Low erosion hazard
	III	W	F	LG	MG	IG	LC	MC	-	-	Moderate limitations. Some erosion hazards
	IV	W	F	LG	MG	IG	LC	-	-	-	Severe limitations. Low arable potential. High erosion hazard.
Grazing	V	W	-	LG	MG	-	-	-	-	-	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
Wildlife	VIII	W	-	-	-	-	-	-	-	-	Extremely severe limitations. Not suitable for grazing or afforestation.

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

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.

Impact Assessment Methodology

The anticipated impacts associated with the proposed project have been assessed according to SRK's standardised impact assessment methodology which is presented below. This methodology has been formalised to comply with Regulation 31(2) (l) of the National Environmental Management Act (Act 107 of 1998) (NEMA), which states the following:

"An environmental impact assessment report must contain all information that is necessary for the competent authority to consider the application and to reach a decision, and must include;

I. An assessment of each identified potentially significant impact, including:
   a. Cumulative impacts;
   b. The nature of the impact;
   c. The extent and duration of the impact;
   d. The probability of the impact occurring;
   e. The degree to which the impact can be reversed;
   f. The degree to which the impact may cause irreplaceable loss of resources; and
   g. The degree to which the impact can be mitigated."

Based on the above, the EIA Methodology will require that each potential impact identified is clearly described (providing the nature of the impact) and be assessed in terms of the following factors:

- **Extent** (spatial scale) - will the impact affect the national, regional or local environment, or only that of the site;

- **Duration** (temporal scale) - how long will the impact last;
- **Magnitude** (severity) - will the impact be of high, moderate or low severity; and
- **Probability** (likelihood of occurring) - how likely is it that the impact may occur.

To enable a scientific approach for the determination of the environmental significance (importance) of each identified potential impact, a numerical value has been linked to each factor.

The following ranking scales are applicable:

Occurrence	**Duration:**	**Probability:**
	5 – Permanent	5 – Definite/don't know
	4 – Long-term (ceases with the operational life)	4 – Highly probable
	3 – Medium-term (5-15 years)	3 – Medium probability
	2 – Short-term (0-5 years)	2 – Low probability
	1 – Immediate	1 – Improbable
		0 – None
Severity	**Extent/scale:**	**Magnitude:**
	5 – International	10 – Very high/uncertain
	4 – National	8 – High
	3 – Regional	6 – Moderate
	2 – Local	4 – Low
	1 – Site only	2 – Minor
	0 – None	

Once the above factors had been ranked for each identified potential impact, the environmental significance of each impact can be calculated using the following formula:

Significance = (duration + extent + magnitude) x probability

The maximum value that can be calculated for the environmental significance of any impact is 100.

The environmental significance of any identified potential impact is then rated as either: high, moderate or low on the following basis:

- More than 60 significance value indicates a high (H) environmental significance impact;
- Between 30 and 60 significance value indicates a moderate (M) environmental significance impact; and
- Less than 30 significance value indicates a low (L) environmental significance impact.

In order to assess the degree to which the potential impact can be reversed, and be mitigated, each identified potential impact will need to be assessed twice;

- Firstly, the potential impact will be assessed and rated prior to implementing any mitigation and management measures; and

- Secondly, the potential impact will be assessed and rated after the proposed mitigation and management measures have been implemented.

The purpose of this dual rating of the impact before and after mitigation is to indicate that the significance rating of the initial impact is and should be higher in relation to the significance of the impact after mitigation measures have been implemented.

In order to assess the degree to which the potential impact can cause irreplaceable loss of resources, the following classes (%) will be used and will need to be selected based on your informed decision and discretion:

5 100% - Permanent loss
4 75% - 99% - significant loss
3 50% - 74% - moderate loss
2 25% - 49% - minor loss
1 0% - 24% - limited loss

Please note that the Loss of Resources aspect will not affect the overall significance rating of the impact.

In terms of assessing the cumulative impacts, it must be addressed in a sentence/paragraph fashion as the spatial extent of the cumulative impacts will vary from project to project. Cumulative impact, in relation to an activity, means the impact of an activity that in itself may not be significant, but may become significant when added to the existing or potential impacts eventuating from similar or diverse activities or undertakings in the area.

Legislative, Policy and Best Practice Framework for Impact Mitigation

'Mitigation' is a broad term that covers all components of the 'mitigation hierarchy' defined hereunder. It involves selecting and implementing measures – amongst others – to conserve biodiversity and to protect, the users of biodiversity and other affected stakeholders from potentially adverse impacts as a result of mining or any other landuse. The aim is to prevent adverse impacts from occurring or, where this is unavoidable, to limit their significance to an acceptable level. Offsetting of impacts is considered to be the last option in the mitigation hierarchy for any project.

The mitigation hierarchy in general consists of the following in order of which impacts should be mitigated (DEA *et. al* 2013):

1. **Avoid/prevent impact:** can be done through utilising alternative sites, technology and scale of projects to prevent impacts. In some cases, if impacts are expected to be too high the “no project” option should also be considered, especially where it is expected that the lower levels of mitigation will not be adequate to limit environmental damage and eco-service provision to suitable levels;
2. **Minimise impact:** can be done through utilisation of alternatives that will ensure that impacts on biodiversity and ecoservices provision are reduced. Impact minimisation is considered an essential part of any development project;
3. **Rehabilitate impact** is applicable to areas where impact avoidance and minimisation are unavoidable where an attempt to re-instate impacted areas and return them to conditions which are ecologically similar to the pre-project condition or an agreed post project land use, for example arable land. Rehabilitation can however not be considered as the primary mitigation toll as even with significant resources and effort rehabilitation that usually does not lead to adequate replication of the diversity and complexity of the natural system. Rehabilitation often only restores ecological function to some degree to avoid ongoing negative impacts and to minimise aesthetic damage to the setting of a project. Practical rehabilitation should consist of the following phases in best practice:
   a. **Structural rehabilitation** which includes physical rehabilitation of areas by means of earthworks, potential stabilisation of areas as well as any other activities required to develop a long terms sustainable ecological structure;
   b. **Functional rehabilitation** which focuses on ensuring that the ecological functionality of the ecological resources on the subject property supports the intended post closure land use. In this regard special mention is made of the need to ensure the continued functioning and integrity of wetland and riverine areas throughout and after the rehabilitation phase;
   c. **Biodiversity reinstatement** which focuses on ensuring that a reasonable level of biodiversity is re-instated to a level that supports the local post closure land uses. In this regard special mention is made of re-instating vegetation to levels which will allow the natural climax vegetation community of community suitable for supporting the intended post closure land use; and
   d. **Species reinstatement** which focuses on the re-introduction of any ecologically important species which may be important for socio-cultural reasons, ecosystem functioning reasons and for conservation reasons. Species re-instatement need only occur if deemed necessary.

4. **Offset impact:** refers to compensating for latent or unavoidable negative impacts on biodiversity. Offsetting should take place to address any impacts deemed to be unacceptable which cannot be mitigated through the other mechanisms in the mitigation hierarchy. The objective of biodiversity offsets should be to ensure no net loss of biodiversity. Biodiversity offsets can be considered to be a last resort to compensate for residual negative impacts on biodiversity.

According to the DEA *et. al* (2013) 'Closure' refers to the process for ensuring that mining operations are closed in an environmentally responsible manner, usually with the dual objectives of ensuring sustainable post-mining land uses and remedying negative impacts on biodiversity and ecosystem services.

The significance of residual impacts should be identified on a regional as well as national scale when considering biodiversity conservation initiatives. If the residual impacts lead to irreversible loss or irreplaceable biodiversity the residual impacts should be considered to be of very high significance and when residual impacts are considered to be of very high significance, offset initiatives are not considered an appropriate way to deal with the magnitude and/or significance of the biodiversity loss. In the case of residual impacts determined to have medium to high significance, an offset initiative may be investigated. If the residual biodiversity impacts are considered of low significance no biodiversity offset is required.

APPENDIX B: DETAILS, EXPERTISE AND CURRICULUM VITAE OF SPECIALISTS

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

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

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

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

Company of Specialist:	Scientific Aquatic Services		
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 Project Manager

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF STEPHEN VAN STADEN

PERSONAL DETAILS

Position in Company	Managing member, Ecologist with focus on Freshwater Ecology
Date of Birth	13 July 1979
Nationality	South African
Languages	English, Afrikaans
Joined SAS	2003 (year of establishment)
Other Business	Trustee of the Serenity Property Trust and emerald Management Trust

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 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

COUNTRIES 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 Leone
Central Africa – Democratic Republic of the Congo

PROJECT EXPERIENCE (Over 2500 projects executed with varying degrees of involvement)

1 Mining: Coal, Chrome, PGM's, Mineral Sands, Gold, Phosphate, river sand, clay, fluorspar
2 Linear developments
3 Energy Transmission, telecommunication, pipelines, roads
4 Minerals beneficiation
5 Renewable energy (wind and solar)
6 Commercial development
7 Residential development
8 Agriculture
9 Industrial/chemical

REFERENCES

- Terry Calmeyer (Former Chairperson of IAIA SA)
  Director: ILISO Consulting Environmental Management (Pty) Ltd
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- Marietjie Eksteen
  Managing Director: Jacana Environmental
  Tel: 015 291 4015

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF BRAVEMAN MZILA

PERSONAL DETAILS

Position in Company	Wetland Ecologist and Soil Scientist
Date of Birth	03 January 1991
Nationality	South African
Languages	IsiZulu, English
Joined SAS	2017

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, KwaZulu-Natal, Eastern Cape

SELECTED PROJECT EXAMPLES

Freshwater Ecological Assessments

- Freshwater ecological assessment as part of the water use authorisation relating to stormwater damage of a tributary of the Sandspruit, Norwood, Gauteng province.
- Wetland verification as part of the environmental assessment and authorization process for the proposed development in Crowthorne extension 67, Gauteng province.
- Freshwater assessment as part of the section 24g rectification process for unauthorised construction related activities that took place on erf 411, Ruimsig extension 9, Gauteng province
- Baseline aquatic and freshwater assessment as part of the environmental assessment and authorisation process for the N11 Ring Road, Mokopane, Limpopo Province
- Wetland Resource Scoping Assessment as Part of the Environmental Assessment and Authorisation Process for the Kitwe TSF Reclamation Project, Kitwe, Zambia
- Wetland delineation as part of the environmental assessment and authorization process for the proposed development in Boden Road, Benoni, Ekurhuleni Metropolitan Municipality, Gauteng Province.

Soil, Land Use and Land Capability Assessments

- Soil, Land Use and Land Capability Assessment as part of the environmental assessment and authorisation process for the proposed Witfontein Railway Siding Project Near Bethal, Mpumalanga Province
- Soil, Land Use and Land Capability Assessment as part of the environmental assessment and authorisation process for the proposed Heuningkranz Mine, Postmasburg, Northern Cape Province

Hydropedological Wetland Impact Assessments

- Hydropedological Assessment as Part of the Environmental Assessment and Authorisation Process for the proposed Vandyksdrift Central Dewatering Project
- Hydropedological Assessment for the Proposed Evander Gold Elikhulu Tailings Storage Facility (TSF) Expansion, Mpumalanga Province
- Hydropedological Assessment as part of the environmental assessment and authorisation process for the proposed Palmietkuilen Mine, Springs, Gauteng Province
- Hydropedological Assessment as part of the environmental assessment and authorisation process for the proposed Uitkomst Colliery Mine expansion, Newcastle, KwaZulu-Natal Province

Soil Rehabilitation Assessments
Soil rehabilitation plan, a water resource assessment and develop a management plan in support of the water use license for the Driefontein operations, Carletonville, Gauteng