Pedology Environmental Impact Assessment for the Development of the Proposed Pure Source Mine Project

Parys, Free State Province

February 2019

Client

Prepared for:

Van Wyk Development Corporation (Pty) Ltd

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Report Name	**Pedology Environmental Impact Assessment for the Proposed Pure Source Mine Project**
Submitted to	**Shango Solutions**
Report Reviewer	**Andrew Husted** Andrew Husted is Pr Sci Nat registered (400213/11) in the following fields of practice: Ecological Science, Environmental Science and Aquatic Science. Andrew is an Aquatic, Wetland and Biodiversity Specialist with more than 12 years' experience in the environmental consulting field. Andrew has completed numerous wetland training courses, and is an accredited wetland practitioner, recognised by the DWS, and also the Mondi Wetlands programme as a competent wetland consultant.
Report Reviewer	**Wayne Jackson**
Report Writer and Fieldwork	**Ivan Baker** Mr. Ivan Baker obtained his BSc Hons degree in Environmental Science in 2016 at the North-West University of Potchefstroom. Ivan has been part of various wetland assessments, both in conducting the fieldwork as well as writing reports for various projects which include mining, housing developments, roads and infrastructure and rehabilitation. Ivan has experience in soil science which has been part of his BSc. and Honours degree. Ivan completed his MSc degree in soils and hydropedology in 2018 and is Cand. Sci. Nat registered (119315). Additionally, Ivan completed training in Tools for Wetland Assessments (2018) with a certificate of competence.
Declaration	The Biodiversity Company and its associates operate as independent consultants under the auspice of the South African Council for Natural Scientific Professions. We declare that we have no affiliation with or vested financial interests in the proponent, other than for work performed under the Environmental Impact Assessment Regulations, 2017. We have no conflicting interests in the undertaking of this activity and have no interests in secondary developments resulting from the authorisation of this project. We have no vested interest in the project, other than to provide a professional service within the constraints of the project (timing, time and budget) based on the principals of science.

Date: 2018/07/13 Location: 26°44'9.13"S; 27°36'58.48"E

Executive Summary

The Biodiversity Company (TBC) was appointed to conduct a pedology (agricultural potential, land capability and land use) Environmental Impact Assessment (EIA) for the Pure Source Mining project. This specialist study is completed to meet the requirements of a Mining Right Application (MRA) and the associated environmental authorisations for a proposed open pit mine.

The proposed project will involve the development of various open pit mines associated with the "roll-over mining" method, a processing plant and associated infrastructure. Commodities to be mined will include sand, gravel and diamond (alluvial) with the Life of Mine (LoM) being envisaged to last 30 years. Northern, central and southern portions of the project area are proposed for aggregate mining and one central and eastern portion are proposed for sand mining.

The applicant has a Prospecting Right (PR) over the proposed MRA area approximately 859 hectares in size and consists of Portion 1 and Portion 3 of Woodlands 407 (District Parys) of which a prospecting right has being issued in terms of Section 18 of the Minerals and Petroleum Reserve Development Act (N.P.R.D.A.), 2002 (Law 28 OF 2002). Approximately 401.67 ha of the property will be mined for aggregate and 283.1 ha for sand.

The findings from this assessment has indicated the presence of nine identified soils forms, which has been divided into four different land capability classes given the depth, permeability, clay percentage and slope percentage of these soils. These four land capability classes have been divided into three different land potential classes, which takes into consideration any climatic restrictions of the area.

The proposed infrastructure "Alternative 3" is located within the "Vlei" land potential class with Alternative 1 and 2 being located within a "Moderate" sensitivity area in regard to land potential sensitivity. The proposed open cast mining areas cover most of the project area, including the "Low" sensitivity land potential classes, the "Moderate" sensitivity land potential classes and the "Vlei" land potential class.

Impact Assessment Summary

All of the final significance ratings scored "High" is related to open cast mining and associated stockpiling. The impacts associated with the construction and operation of the proposed infrastructure components has been rated "Moderate".

Mitigation measures have been recommended by the specialist herein to ensure that impacts are minimised. It however is the specialist's opinion that these mitigation measures will not be sufficient. It therefore has been recommended that a suitable rehabilitation plan be set up to decrease the degradation of soil resources.

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Declaration

I, **Ivan Baker** 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 Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, 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; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.

Ivan Baker

Soil Specialist

The Biodiversity Company

28th February 2019

1 Introduction

The Biodiversity Company (TBC) was appointed to conduct a pedology (agricultural potential, land capability and land use) Environmental Impact Assessment (EIA) for the Pure Source Mining project. This specialist study is completed to meet the requirements of a Mining Right Application (MRA) and the associated environmental authorisations for a proposed open pit mine.

The proposed project will involve the development of various open pit mines associated with the "roll-over mining" method, a processing plant and associated infrastructure. Commodities to be mined will include sand, gravel and diamond (alluvial) with the Life of Mine (LoM) being envisaged to last 30 years. Northern, central and southern portions of the project area are proposed for aggregate mining and one central and eastern portion are proposed for sand mining.

The applicant has a Prospecting Right (PR) over the proposed MRA area approximately 859 hectares in size and consists of Portion 1 and Portion 3 of Woodlands 407 (District Parys) of which a prospecting right has being issued in terms of Section 18 of the Minerals and Petroleum Reserve Development Act (N.P.R.D.A.), 2002 (Law 28 OF 2002). Approximately 401.67 ha of the property will be mined for aggregate and 283.1 ha for sand.

Mid-dry season surveys were conducted on the 6th July 2018 and the 9th – 12th July 2018. The surveys primarily focussed on the development footprint area, referred to as the project area herein. Furthermore, the identification and description of any sensitive receptors were recorded across the project area, and the manner in which these sensitive receptors may be affected by the activity was also investigated.

This report, after taking into consideration the findings and recommendations provided by the specialist herein, should inform and guide the Environmental Assessment Practitioner (EAP), enabling informed decision making as to the ecological viability of the proposed development and to provide an opinion on the whether any environmental authorisation process or licensing is required for the proposed project.

2 Project Area

The project area is situated about 20 km north-east of Parys, on the border of the Vaal River in the Free State Province, South Africa. The north-eastern and north-western portions of the project area border on the Gauteng and North West provinces respectively. The Applicant has a PR over the proposed MRA area covering approximately 859 hectares. The land uses surrounding the project area consist of agricultural land, natural areas, existing sand mining operations, the urban area of Vaal Oewer with associated houses, livestock and game farming. Infrastructure such as secondary tar roads, gravel roads and homesteads occur within the project area (Figure 1). The Vaal river forms the northern boundary of the proposed project area.

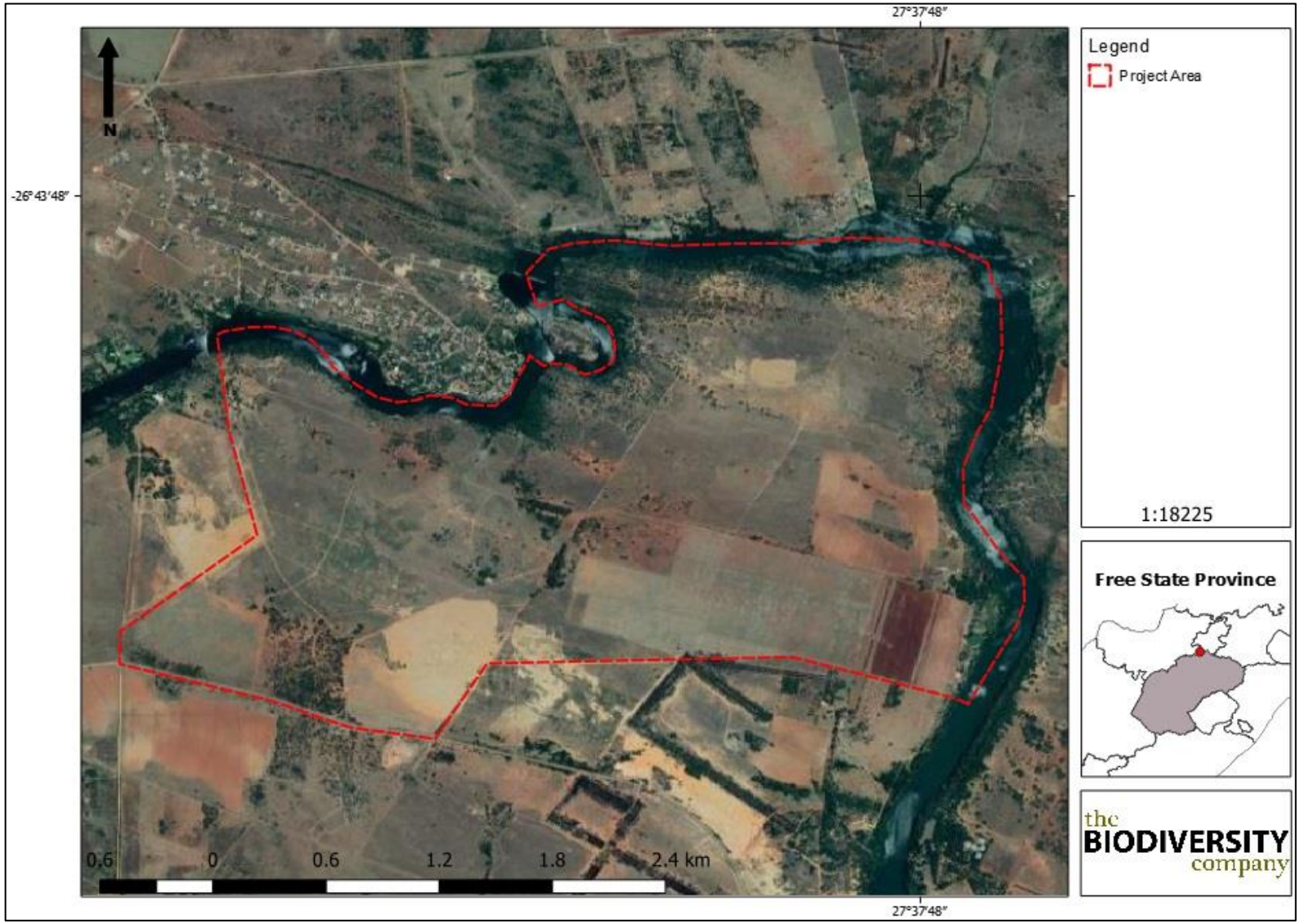

Figure 1: General location of the project area

3 Scope of Work

The following tasks were completed in fulfilment of the terms of reference for this assessment:

- To conduct a soil assessment which includes a description of the physical properties which characterise the soil within the proposed area of development of the relevant portions of the property;
- Using the findings from the soil assessment to determine the existing land capability and current land use of the entire surface area of the relevant portions of the project area;
- Soil resources were analysed in areas where the relief, soil colour and/or physical properties change;
- The soil classification was done according to the Taxonomic Soil Classification System for South Africa, 1991. The following attributes must be included at each observation:
    - Soil form and family (Taxonomic Soil Classification System for South Africa, 1991);
    - Soil depth;
    - Estimated soil texture;
    - Soil structure, coarse fragments, calcareousness;
    - Buffer capacities;
    - Underlying material;
    - Current land use; and
    - Land capability.

4 Methodology

The agricultural assessment was conducted using the Provincial and National Departments of Agriculture recommendations. The assessment was broken into two phases. Phase 1 was a desktop assessment to determine the following:

- Historic climatic conditions;
- The terrain features using 5m contours;
- The base soils information from the land type database (Land Type Survey Staff, 1972 - 2006); and
- The geology for the proposed project site.

Phase 2 of the assessment was to conduct a soil survey to determine the actual agricultural potential. During this phase the current land use was also surveyed.

4.1 Desktop Assessment

As part of the desktop assessment, baseline soil information was obtained using published South African Land Type Data. Land type data for the site was obtained from the Institute for Soil Climate and Water (ISCW) of the Agricultural Research Council (ARC) (Land Type Survey Staff, 1972 - 2006). The land type data is presented at a scale of 1:250 000 and comprises of the division of land into land types.

4.2 Field Survey

A study of the soils present within the project area was conducted during field visit in October 2018. The site was traversed by vehicle and on foot. A soil auger was used to determine the soil form/family and depth. The soil was hand augured to the first restricting layer or 1.5 m. Soil survey positions were recorded as waypoints using a handheld GPS. Soils were identified to the soil family level as per the “Soil Classification: A Taxonomic System for South Africa” (Soil Classification Working Group, 1991). Landscape features such as existing open trenches were also helpful in determining soil types and depth.

4.3 Agricultural Potential Assessment

Land capability and agricultural potential is determined by a combination of soil, terrain and climate features. Land capability is defined by the most intensive long-term sustainable use of land under rain-fed conditions. At the same time an indication is given about the permanent limitations associated with the different land use classes (Smith, 2006)

Land capability is divided into eight classes and these may be divided into three capability groups. Table 1 shows how the land classes and groups are arranged in order of decreasing capability and ranges of use. The risk of use increases from class I to class VIII (Smith, 2006).

Table 1: Land capability class and intensity of use (Smith, 2006)

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

F- Forestry		**IG - Intensive Grazing**	**IC - Intensive Cultivation**			
LG - Light Grazing		**LC - Light Cultivation**	**VIC - Very Intensive Cultivation**			

The land potential classes are determined by combining the land capability results and the climate capability of a region as shown in Table 2. The final land potential results are then described in Table 3.

Table 2: The combination table for land potential classification

Land capability class	**Climate capability class**							
	C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**
I	L1	L1	L2	L2	L3	L3	L4	L4
II	L1	L2	L2	L3	L3	L4	L4	L5
III	L2	L2	L3	L3	L4	L4	L5	L6
IV	L2	L3	L3	L4	L4	L5	L5	L6
V	Vlei	Vlei	Vlei	Vlei	Vlei	Vlei	Vlei	Vlei
VI	L4	L4	L5	L5	L5	L6	L6	L7
VII	L5	L5	L6	L6	L7	L7	L7	L8
VIII	L6	L6	L7	L7	L8	L8	L8	L8

Table 3: The Land Potential Classes.

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

4.4 Current Land Use

Land use was identified using aerial imagery and then ground-truthed while out in the field. The possible land use categories are:

- Mining;
- Bare areas;
- Agriculture crops;
- Natural veld;
- Grazing lands;
- Forest;
- Plantation;
- Urban;
- Built-up;
- Waterbodies; and
- Wetlands.

5 Limitations

The following aspects were considered as limitations:

- The rehabilitation and closure plans for the proposed project is unknown;
- No details regarding the logistics behind the “roll-over mining” activities have been provided;
- No detail to the heights and size of the stockpiles have been provided;
- No detail regarding the construction of infrastructure have been provided (i.e. the installation of the pipeline on plinths instead of underground);
- Disturbed areas typically provide difficulties in identifying soil forms. This phenomenon could cause inaccuracies regarding the delineation of soil forms and land capability; and
- The GPS used for soil form delineations is accurate to within five meters. Therefore, the soil form delineation plotted digitally may be offset by at least five meters to either side.

6 Spatial Context of the Project Area

6.1 Vegetation Types

The project area falls within the Soweto Highveld Grassland (GM 8) type according to Mucina and Rutherford (2006).

The distribution of the GM 8 vegetation type is restricted to Gauteng and Mpumalanga with small portions of this vegetation type occurring in the North-West and Free State provinces. This vegetation type is delineated by the Vaal River, Perdekop in the south-east and the N17 between Johannesburg and Ermelo. The GM 8 vegetation type extends further westward as far as Randfontein and includes parts of Soweto. The GM 8 vegetation type surround parts to the

south as well, including Vanderbijlpark, Vereeniging and Sasolburg, which is located in the northern most parts of the Free State, Mucina and Rutherford (2006).

The vegetation within the GM 8 region is dominated by short to medium-high (<1 m), dense, tufted grassland which includes *Themeda triandra* within gently to moderately undulating landscapes on the Highveld plateau. Other grass species which occur to a lesser extent include *Eragrostis recemosa*, *Elionurus muticus*, *Tristachya leucothrix* and *Heteropogon contortus*, Mucina and Rutherford (2006).

The conservation status of this vegetation type is endangered with a target percentage of 24. Half of the area which is covered in this vegetation type has been transformed into agriculture, mining and urban land uses.

6.2 Climate

The mean annual precipitation for this region reaches approximately 662 mm and is characterised by summer rainfall, Mucina and Rutherford (2006). This area is characterised by high and low extreme temperatures during the summer and winter periods respectively and has frequent frost during the winters, see Figure 2.

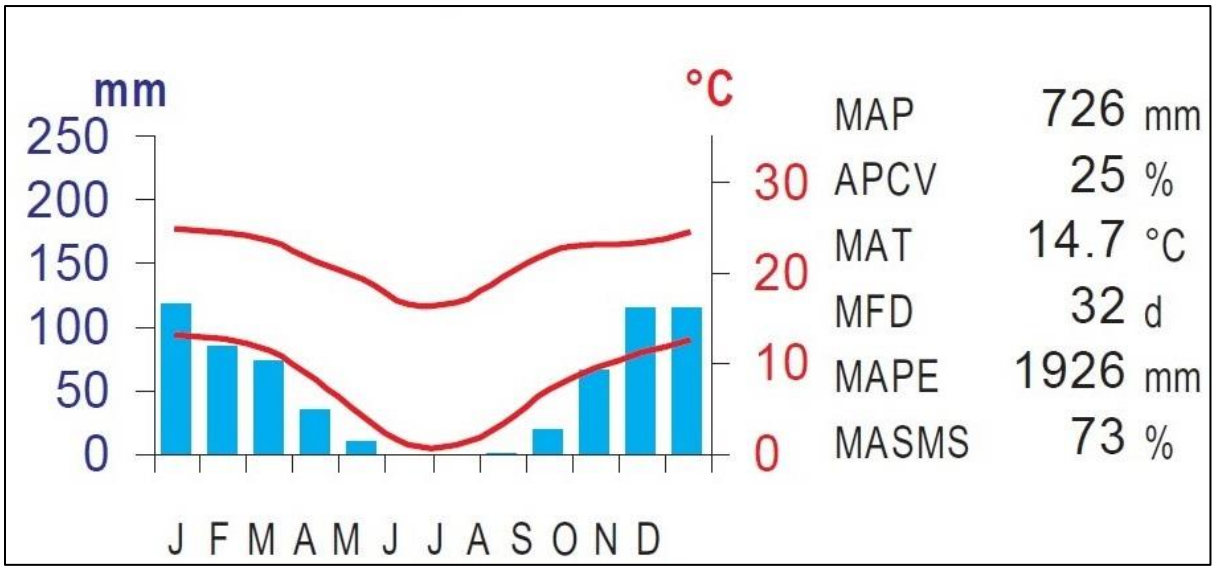

Figure 2: Climate diagram for the project area, Mucina & Rutherford (2006).

6.3 Soils and Geology

According to the land type database (Land Type Survey Staff, 1972 - 2006) the project area falls within the Bc36 land type. This land type is characterised by plinthic catena. Upland duplex with margalitic soils are rare within this land type. Eutrophic red soils are known to be wide spread across this area.

The geology of this area is characterised by the Madzaringwe Formation shale, mudstone and sandstone from the Karoo Supergroup or the Karoo Suite dolerites which feature prominently in this area. To the west, the rocks of Ventersdorp, old Transvaal and Witwatersrand Supergroups

are significant with the south being characterised by the Volksrust Formation from the Karoo Supergroup. Deep soils occur in this area and is typically labelled by Ea, Ba and Bb land types.

7 Results and Discussion

The following sections include desktop results and the results from field observations relevant to the agricultural potential of the study area.

7.1 Desktop Assessment- Terrain

A National Aeronautics and Space Administration (NASA) Shuttle Radar Topography Mission (SRTM) (V3.0, 1 arcsec resolution) Digital Elevation Model (DEM) was obtained from the United States Geological Survey (USGS) Earth Explorer website. Basic terrain analysis was performed on this DEM using the SAGA GIS software that encompassed a slope and channel network analyses in order to detect catchment areas and potential drainage lines respectively. The following processes have been considered for the desktop assessment:

- The relief map (Figure 3): The Vaal River is characterised by an altitude of 1 405 Metres Above Sea Level (MASL) to 1 420 MASL. A wetland area (TBC, 2019) forms a depression which results in the accumulation of water, which also is characterised by a lower altitude of approximately 1 415 MASL with a ridge through the middle parts of the project area's northern section, which features as the highest area within the project area at an altitude of approximately 1 475 MASL.
- The slope map (Figure 4): The project area is non-uniform with slope percentages ranging from 0% to 35 % due to the extent of the ridges present within the project area.The southern portion is reatively flat with a slope percentage of less than 4%.
- The aspect map (Figure 5): The map shows that the entire project area is non-uniform with the south-western and northern areas facing north. The ridges are characterised by an aspect facing all direction depending on the geology of these ridges.

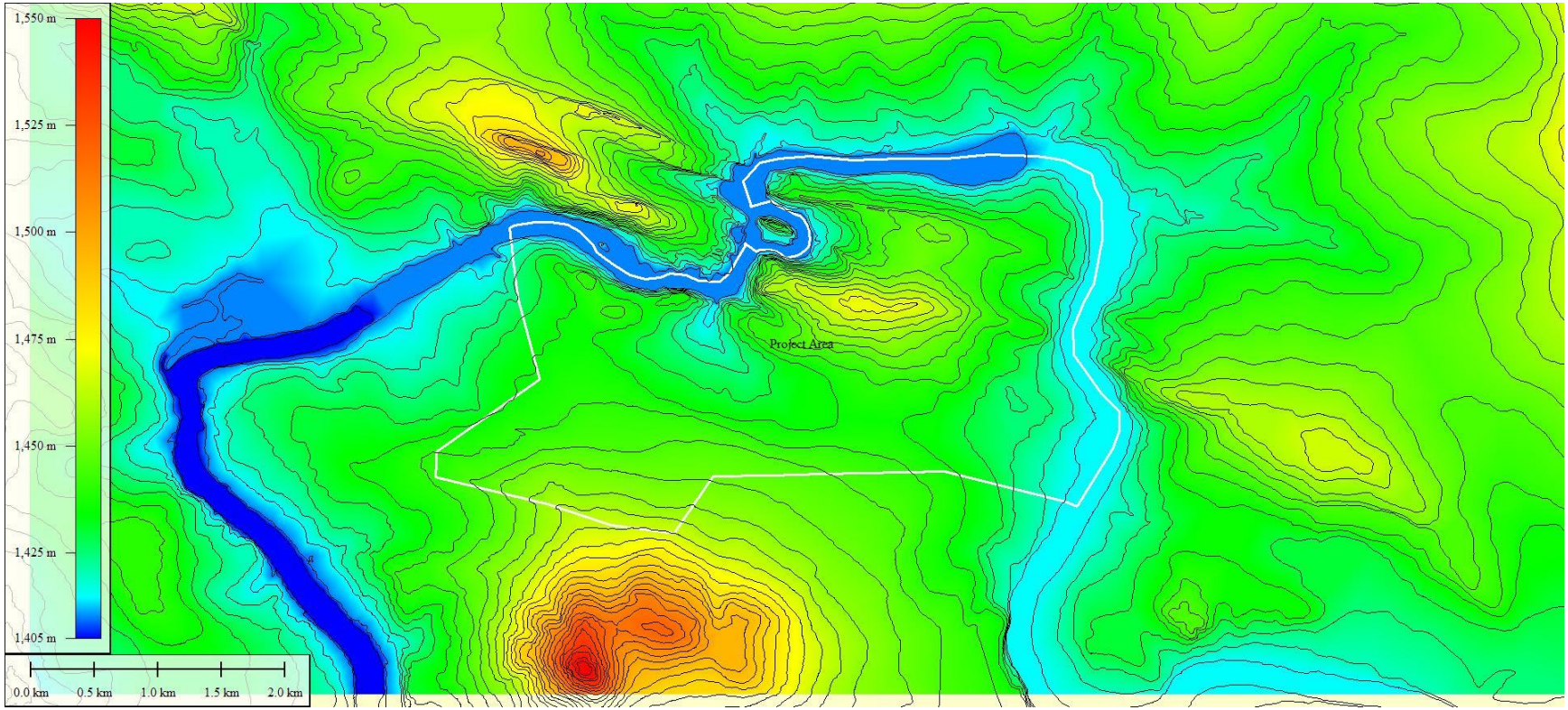

Figure 3: The relief map for the project area

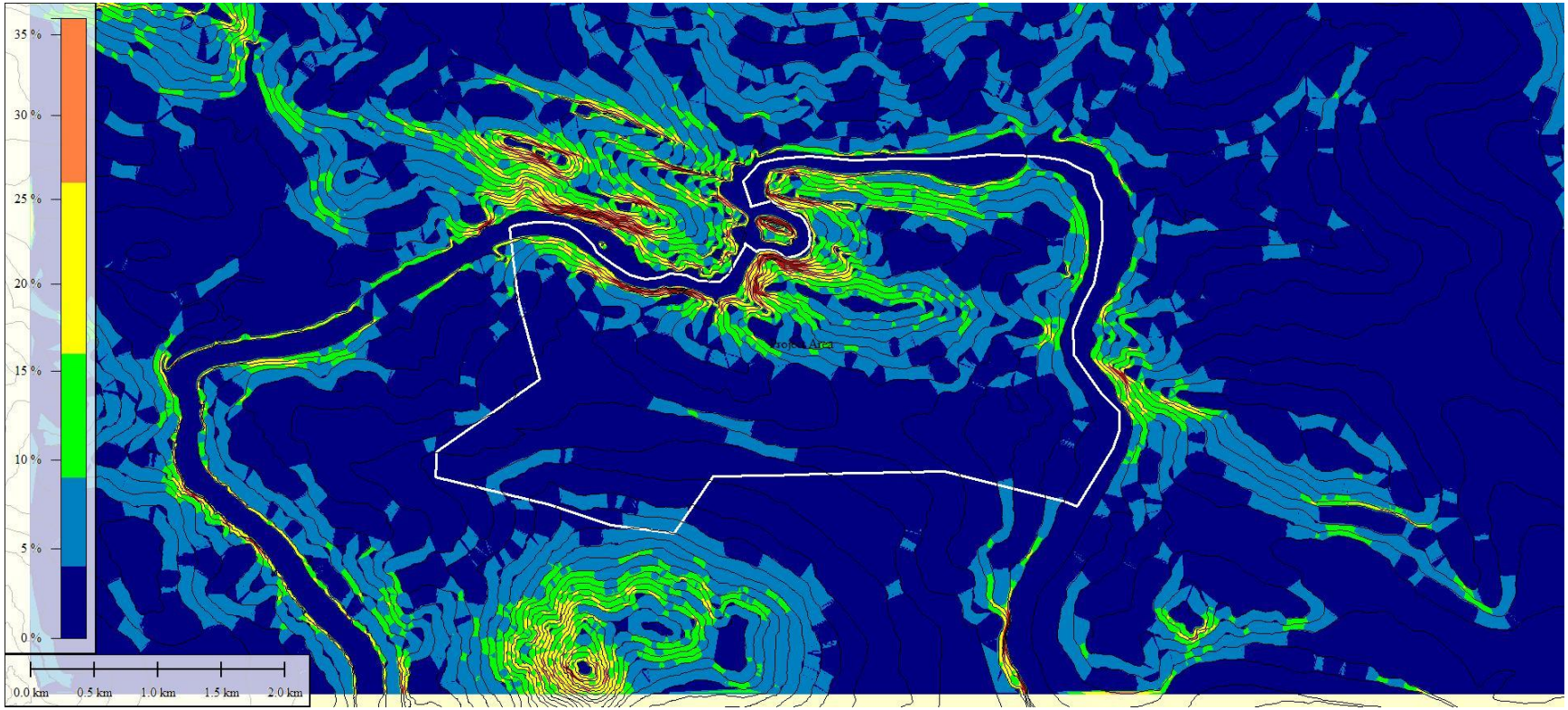

Figure 4: The Slope Percentage map for project area

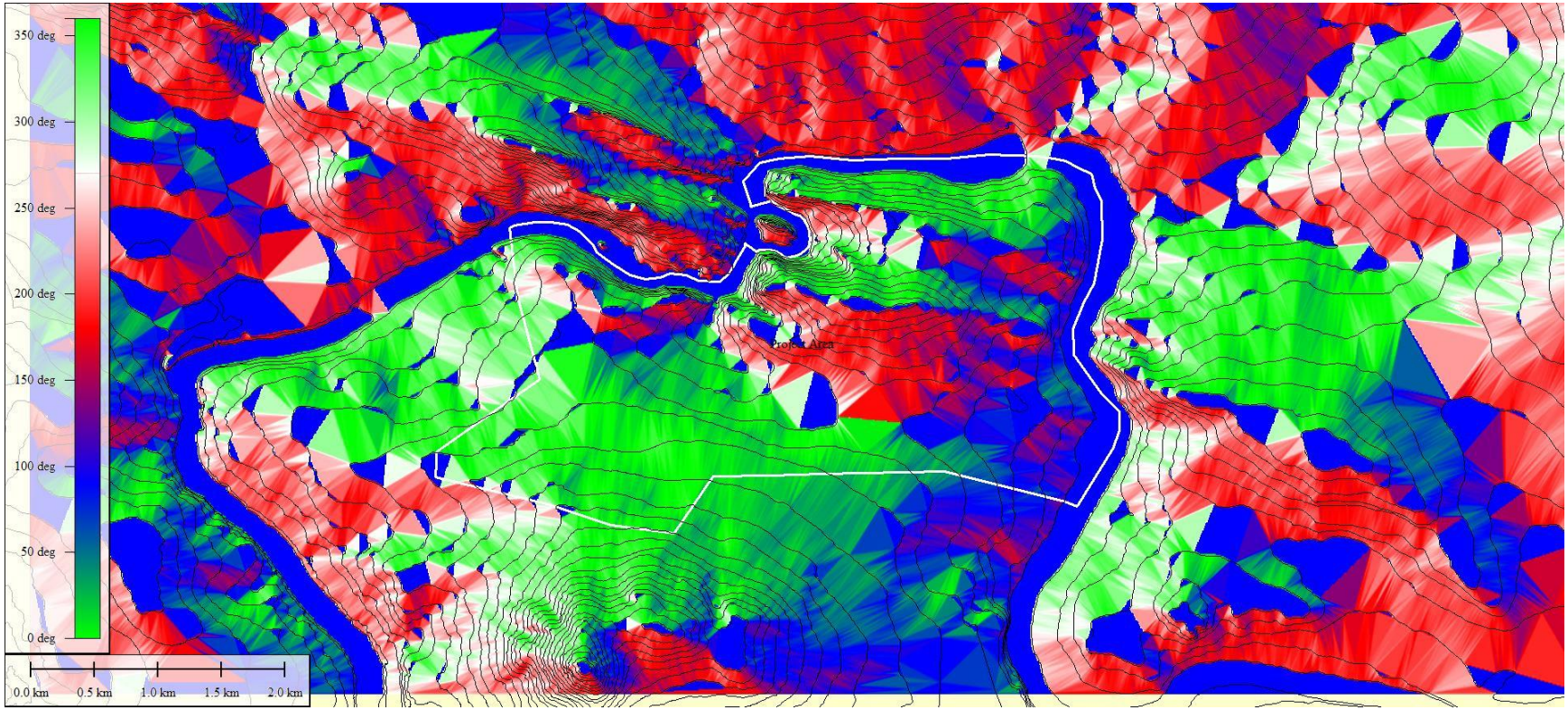

Figure 5: The Slope Aspect map for project area

7.2 Field Survey

7.2.1 Description of Identified Soil Profiles and Diagnostic Horizons

Soil profiles were sampled and studied up to a depth of 1.5 m to identify specific diagnostic horizons which are vital in the soil classification process as well as determining the agricultural potential and land capability. The following diagnostic horizons were identified during the site assessment;

- Orthic A-horizon;
- Litocutanic B-horizon;
- Hard rock;
- Unspecified material;
- E-horizon;
- Soft Plinthic B-horizon;
- Yellow-Brown Apedal B-horizon;
- Neocutanic B-horizon; and
- Red Apedal B-horizon.

7.2.1.1 Orthic A-Horizon

This diagnostic soil type is termed as a “normal” soil given the fact that this soil horizon does not have any diagnostic properties related to other diagnostic soil horizons. The Orthic A-horizon does not have specific characteristics regarding colour, texture, base status etc. due to this diagnostic soil horizon’s wide range throughout South African Landscapes.

7.2.1.2 Lithocutanic B-Horizon

For the Lithocutanic B-horizon, *in-situ* weathering of rock underneath a top soil results in a well-mixed soil-rock layer. The colour, structure and consistency of this material must be directly related to the parent material of the weathered rock. The Lithocutanic B-horizon is usually followed by a massive rock layer at shallow depths. Hard rock, permeable rock and horizontally layered shale usually is not associated with the weathering processes involved with the formation of this diagnostic B-horizon.

7.2.1.3 Hard Rock

This diagnostic horizon disallows the infiltration of water or root systems and occurs in shallow profiles. Horizontally layered, hard sediments without evidence of vertical seems fall under this category.

7.2.1.4 Unspecified Material

An unspecified material refers to a material that has diagnostic characteristics similar to an E-horizon, a G-horizon, a Litocutanic horizon etc., but is not expected to occur in a certain position within a given soil profile, (Soil Classification Working Group, 1991).

7.2.1.5 E-Horizon

The E-horizon is characterised by a leached colour and lacks the colour from the top soil and/or the soil horizon underneath the E-horizon. The E-horizon's iron oxides and organic material has been leached out by lateral sub-surface flows (hence the grey colour and rough texture). Rusty marks (mottles) are common in E-horizons and indicate a temporary to seasonally saturated soil, (Soil Classification Working Group, 1991).

7.2.1.6 Soft Plinthic B-Horizon

The accumulations of iron (and in some cases manganese) as hydroxides and oxides with the presence of high chroma striations and concretions with black matrixes is associated with the Soft Plinthic B-horizon. This diagnostic horizon is a result of a fluctuating levels of saturation. The iron and manganese concentration results in soft marks within the soil matrix which transform in concretions with high consistencies.

If this process continues for long enough periods, a massive continues impermeable layer of hard plinthite forms. A Soft Plinthic B-horizon and a Hard Plinthic B-horizon can be distinguished from one another by means of a simple spade test. A Soft Plinthic B-horizon can be penetrated by means of a spade in wet conditions whereas a Hard Plinthic B-horizon cannot, (Soil Classification Working Group, 1991).

7.2.1.7 Red Apedal B-Horizon

This diagnostic soil horizon has no well-formed peds, but rather small porous aggregates. The poor structure associated with this diagnostic profile is a result of weathering processes under well drained oxidising conditions. Iron-oxide precipitations form on the outside of soil particles (hence the red colour) with non-swelling clays dominating the clay particles. This diagnostic soil horizon is widely spread across South Africa and can be associated with any parent material, (Soil Classification Working Group, 1991).

7.2.1.8 Yellow-Brown Apedal B-horizon

The Yellow-Brown Apedal B-horizon is similar to that of the Red Apedal B-horizon in all aspects except for the colour and the iron-oxide processes involved with the colouration thereof. This diagnostic soil horizon rarely occurs in parent rock high in iron-oxides and will rather be associated with Quartzite, Sandstone, Shale and Granites, (Soil Classification Working Group, 1991).

7.2.1.9 Neocutanic B-Horizons

This diagnostic horizon is associated with recent depositions and unconsolidated soils. Any soil form can develop out of a Neocutanic B-horizon, depending on the climatic and topographical

conditions. Some properties pertaining to other diagnostic soil horizons will be present within a Neocutanic B-horizon but will lack main properties necessary to classify the relevant soil type, (Soil Classification Working Group, 1991).

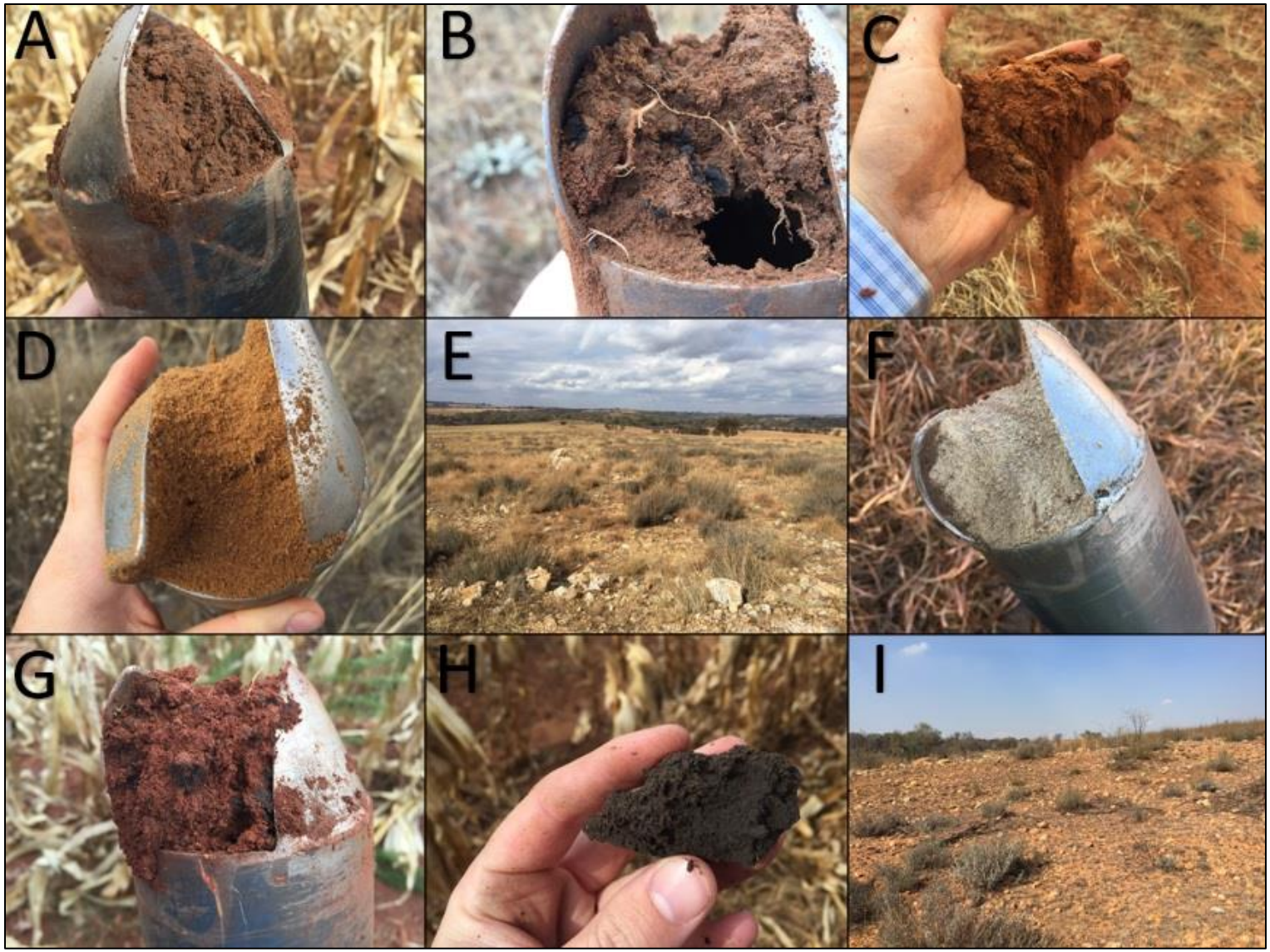

Figure 6: Soil characteristics identified within the project area. A: Orthic A-horizon. B: Soft Plinthic B-horizon. C: Yellow-Brown Apedal B-horizon. D: Neocutanic B-horizon. E: Exposed Lithocutanic B-horizon. F: E-horizon. G: Red Apedal B-horizon. H: Unspecified material. I: Exposed Lithocutanic B-horizon.

7.2.2 Description of Soil Forms and Soil Families

During the site assessment, various soil forms were identified. These soil forms have been delineated and illustrated in Figure 7 and described in Table 4 according to depth, clay percentage, indications of surface crusting, signs of wetness and percentage rock.

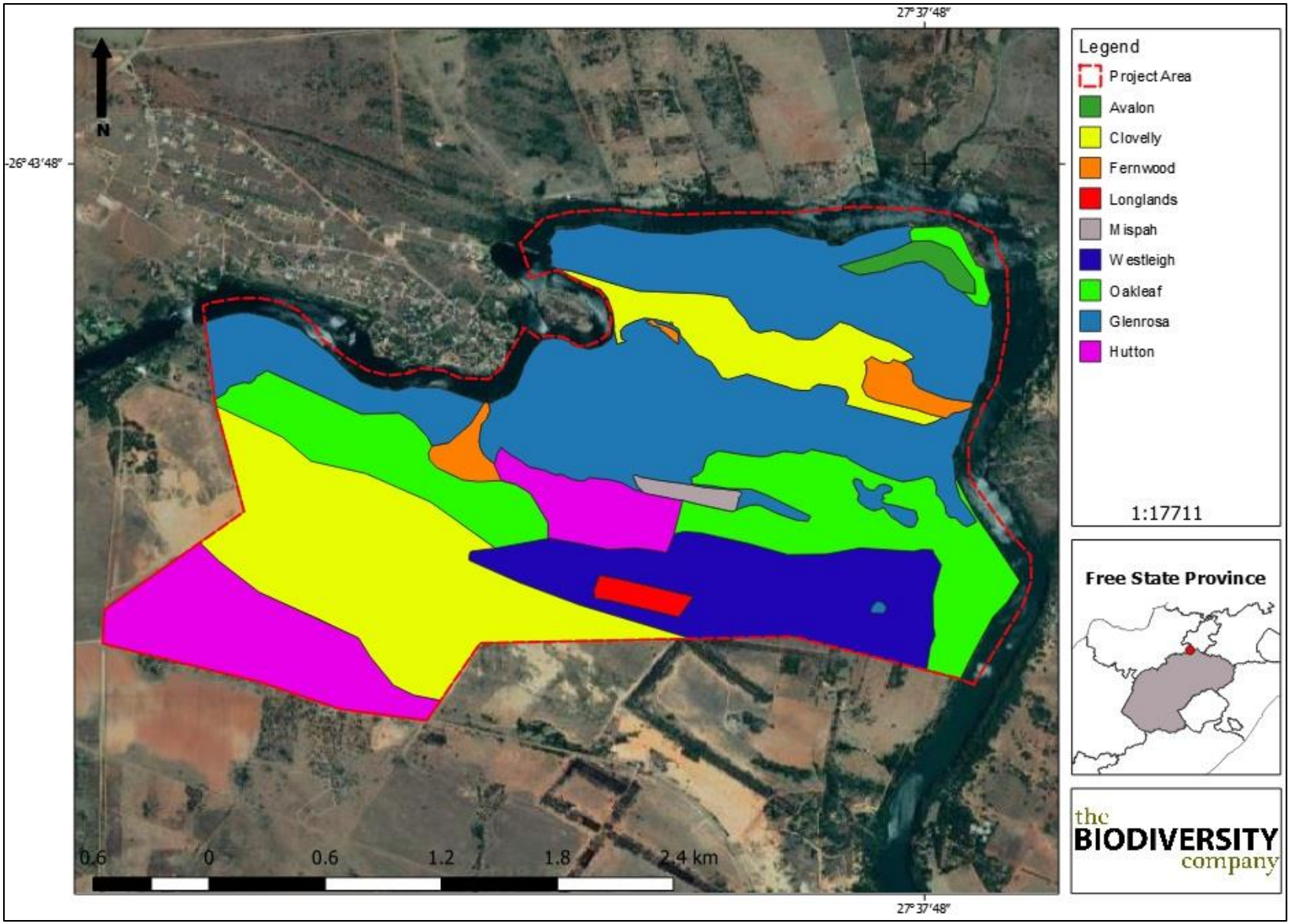

Figure 7: Soil delineations within the project area

Table 4: Summary of soils identified within the project area

	A-horizon					B-horizon				B-horizon/C-horizon			
	Depth (mm)	**Clay (%)**	**Signs of wetness**	**Rock %**	**Surface crusting**	**Depth (mm)**	**Clay (%)**	**Signs of wetness**	**Rock %**	**Depth (mm)**	**Clay (%)**	**Signs of wetness**	**Rock %**
Mispah	200	0 - 15	None	0		N/A				N/A			
Westleigh	400	0 - 15	None	0		N/A				N/A			
Glenrosa	300	0 - 15	None	10 - 20		N/A				N/A			
Hutton	300	0 - 15	None	0		300- 1 300	0 - 15	None	2 - 10	N/A			
Clovelly	300	0 - 15	None	0		300- 1 500	0 - 15	None	0	N/A			
Oakleaf	300	0 - 15	None	0		300 - 1100	0 - 15	None	0	N/A			
Avalon	200	0 - 15	None	0		200 - 700	0 - 15	None	0	N/A			
Longlands	200	0 - 15	None	0		200 - 800	0 - 15	None	0	N/A			
Fernwood	200	0 - 15	Within 200 mm	0		200 - 600	0 - 15	Throughout	0	600 - 1500	0 - 15	Throughout	0

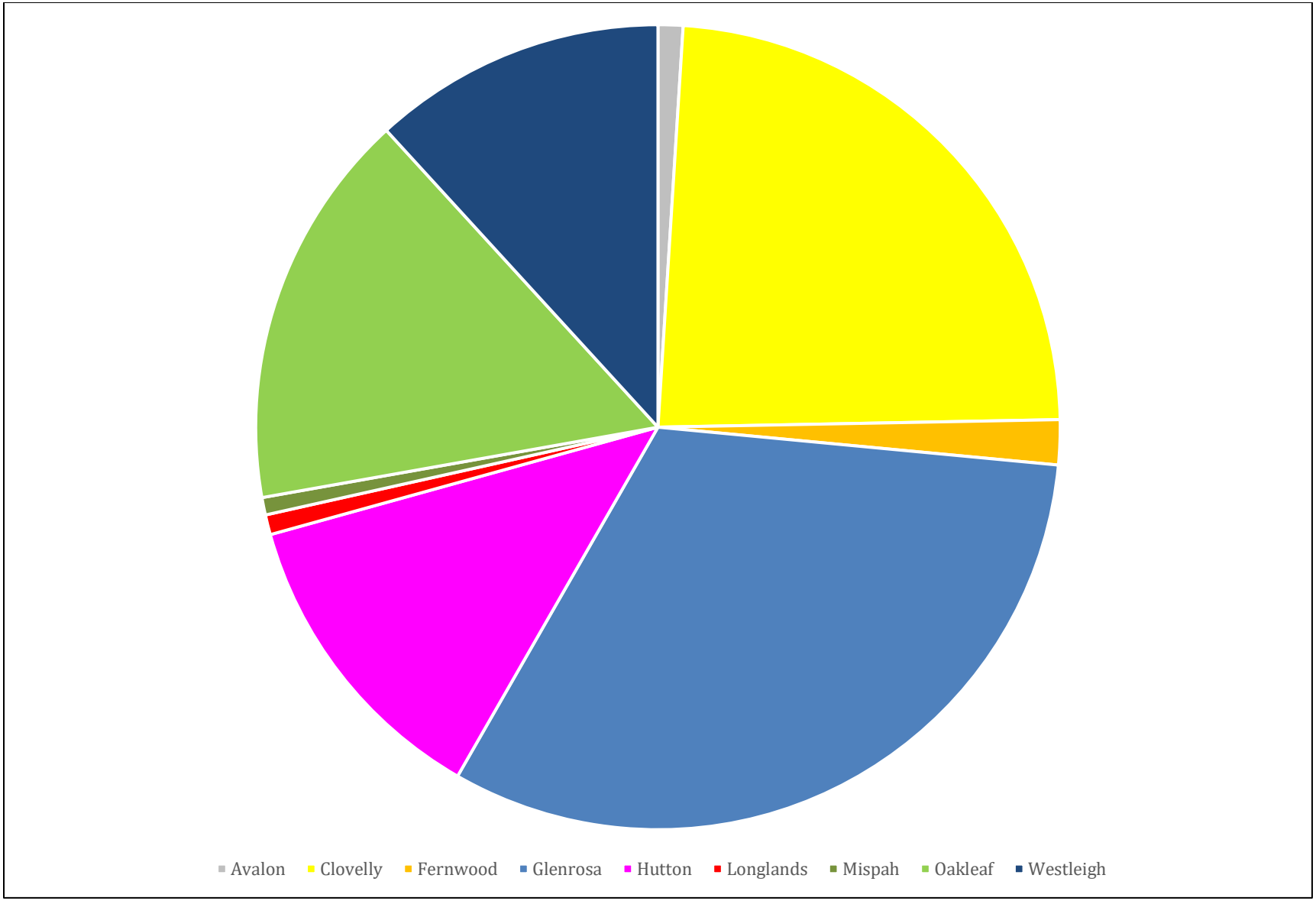

Figure 8: Soil form coverage within the project area

7.2.2.1 Westleigh

The Westleigh soil form consists of an Orthic A-horizon on top of a Soft Plinthic B-horizon. The soil family group identified for the Westleigh soil form on-site has been classified as the Helena (1000) soil family given the lack of evidence pertaining to luvic processes.

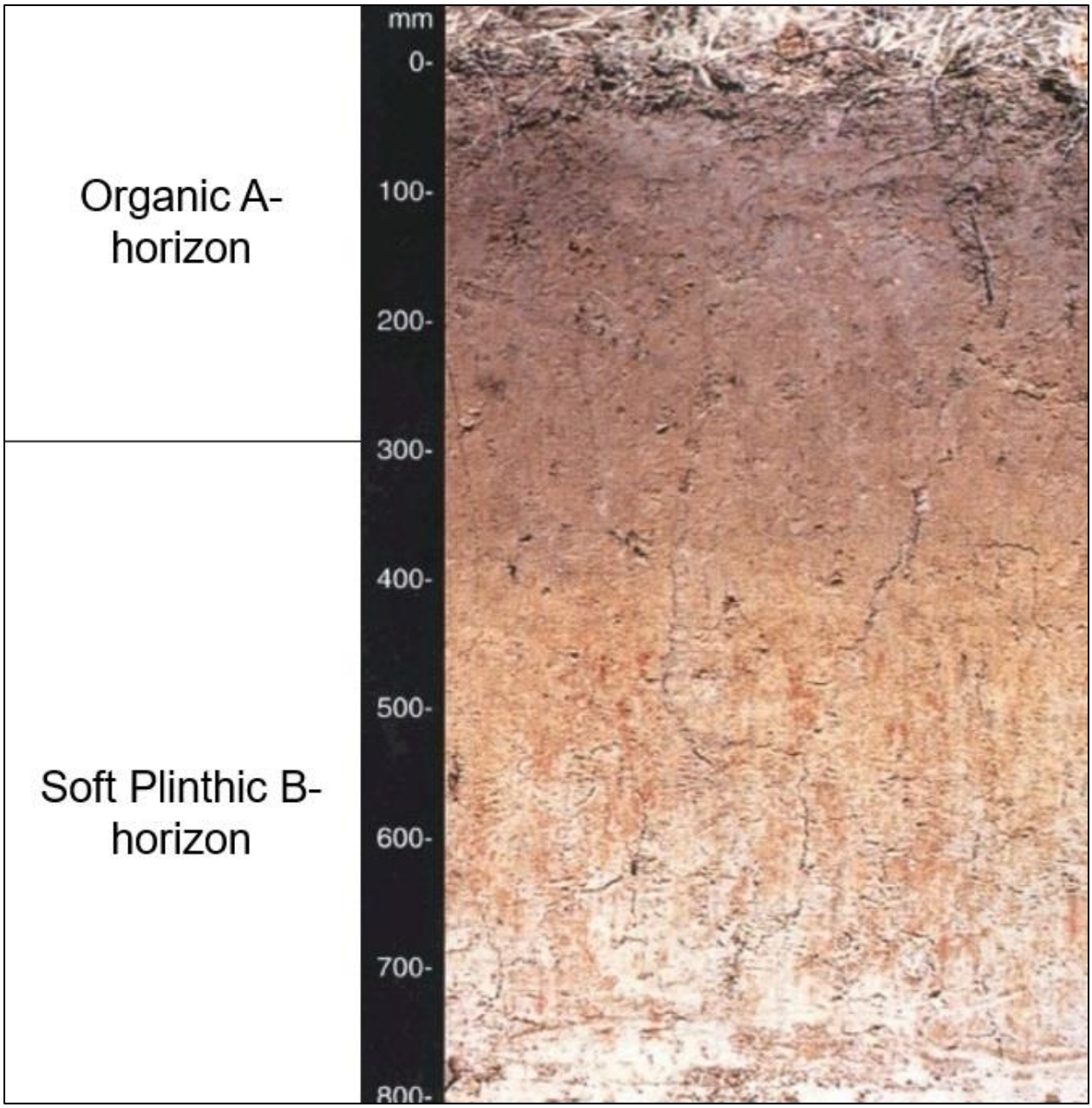

Figure 9: Example of a Westleigh soil form, (SASA, 1999).

7.2.2.2 Clovelly

The Clovelly soil form consists of an Orthic A-horizon on top of a Yellow-Brown B-horizon. The soil family group identified for the Clovelly soil form on-site has been classified as the Buckland (2100) soil family given the soil's non-luvic and mesotrophic nature.

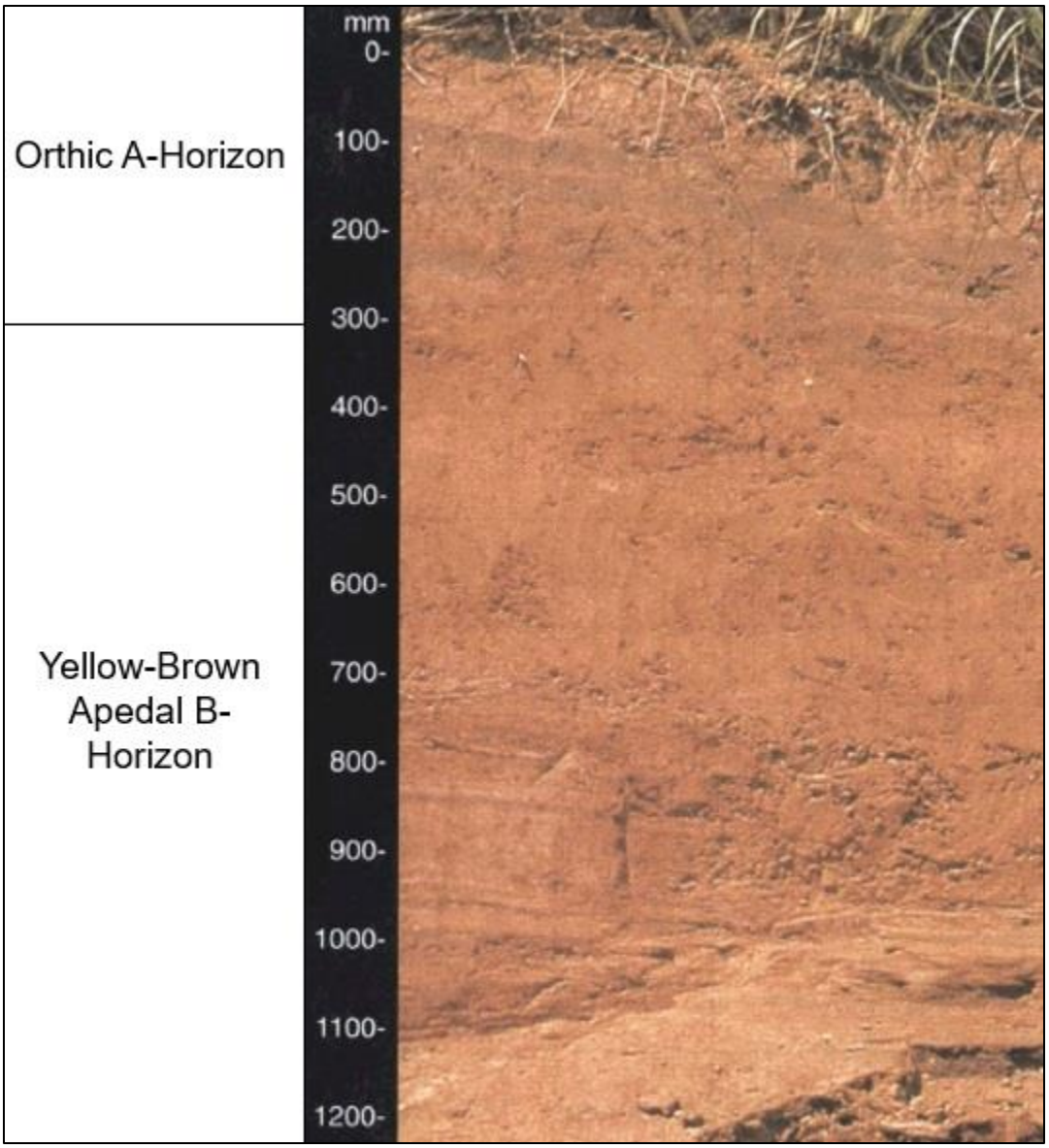

Figure 10: Example of a Clovelly soil form, (SASA, 1999).

7.2.2.3 Hutton

The Clovelly soil form consists of an Orthic A-horizon on top of a Red Apedal B-horizon. The soil family group identified for the Hutton soil form on-site has been classified as the Hayfield (2100) soil family given the soil's non-luvic and mesotrophic nature.

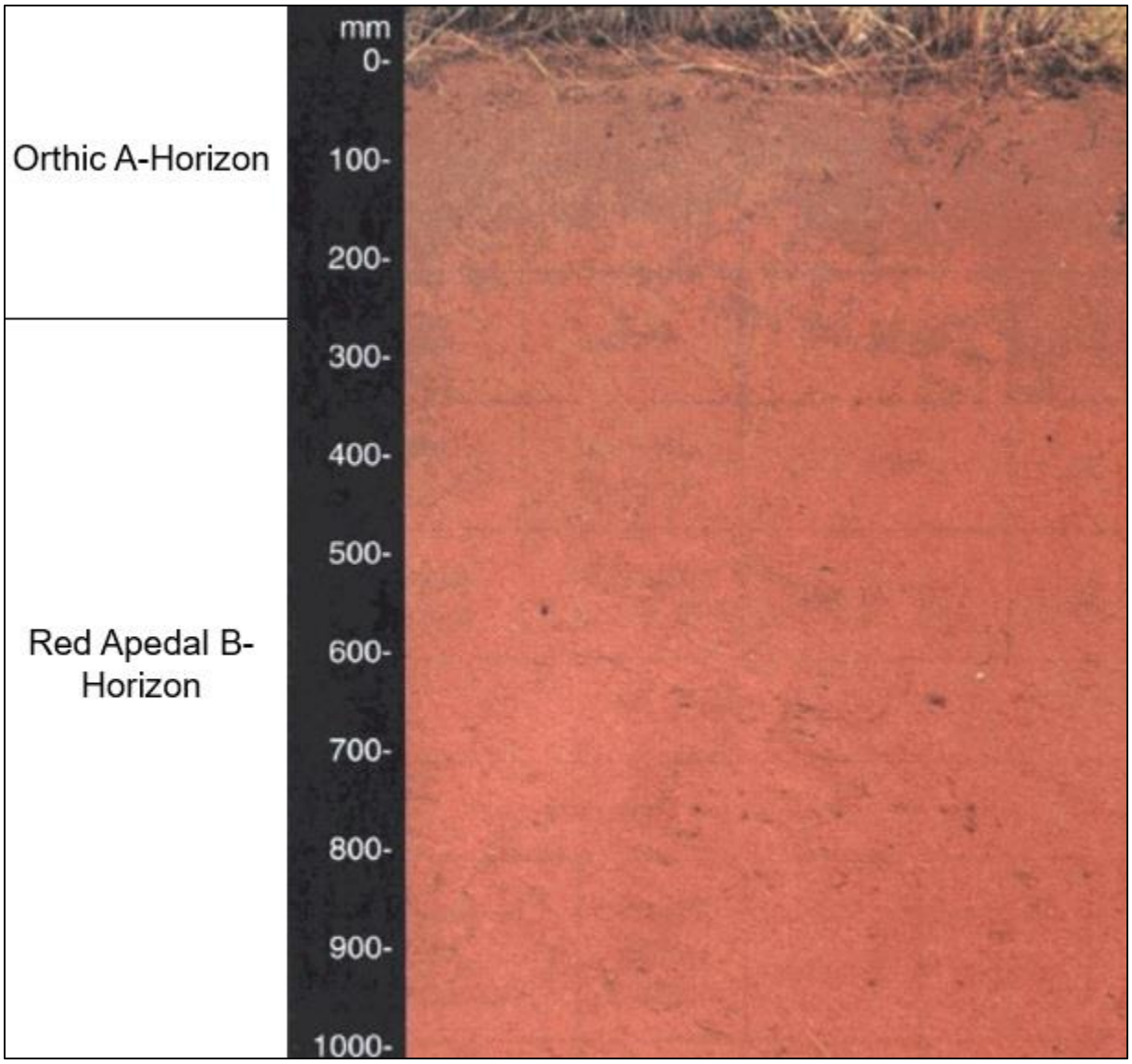

Figure 11: Example of a Hutton soil form, (SASA, 1999).

7.2.2.4 Longlands

The Longlands soil form consists of an Orthic A-horizon on top of a n E-horizon, which in turn is underlain by a Soft Plinthic B-horizon. The soil family group identified for the Longlands soil form on-site has been classified as the Sherbrook (1000) soil family due to the grey colour of the soil in wet conditions.

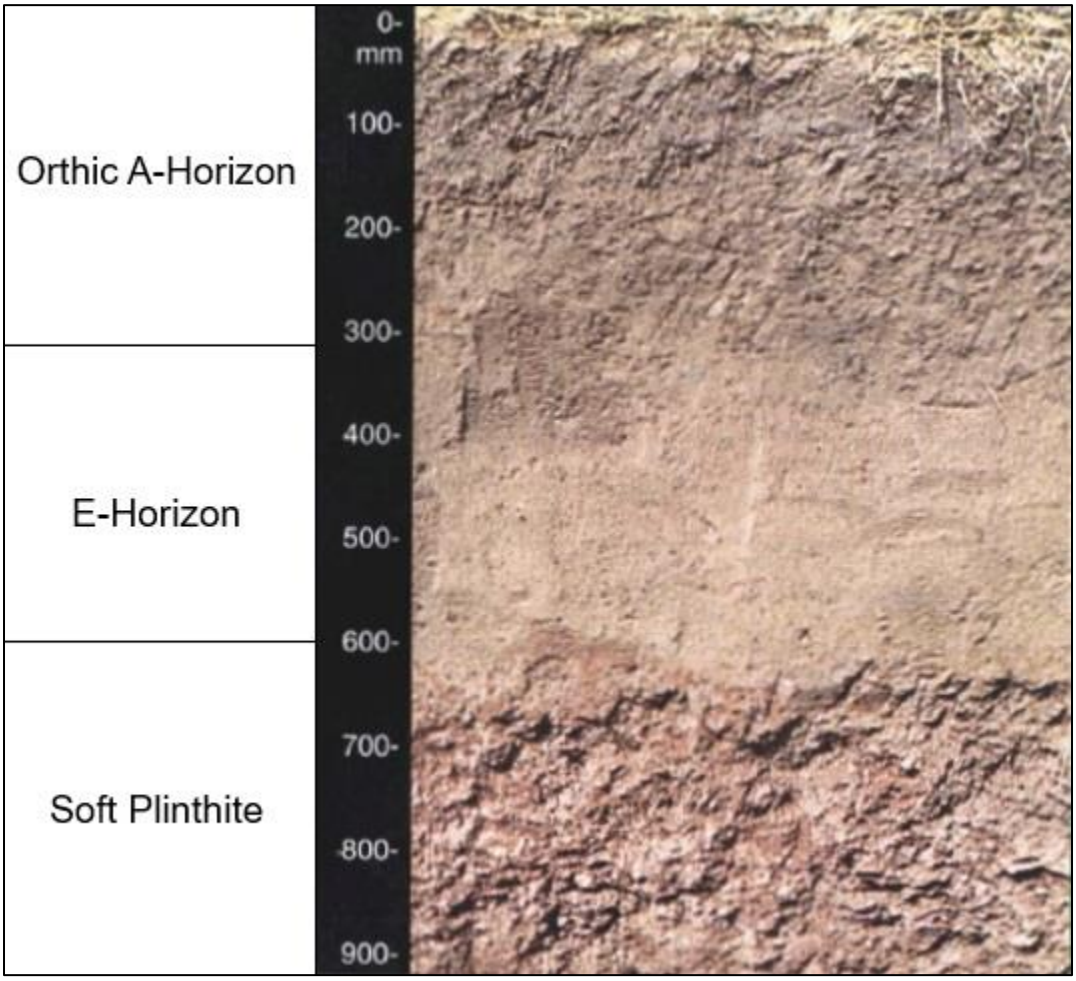

Figure 12: Example of a Longlands soil form, (SASA, 1999).

7.2.2.5 Oakleaf

The Oakleaf soil form consists of an Orthic A-horizon on top of a Neocutanic B-horizon, which in turn is underlain by an unspecified material without signs of wetness. The soil family group identified for the Tukulu soil form on-site has been classified as the Caledon (1210) soil family due to the red colour of the soil and the non-luvic processes involved in this soil form.

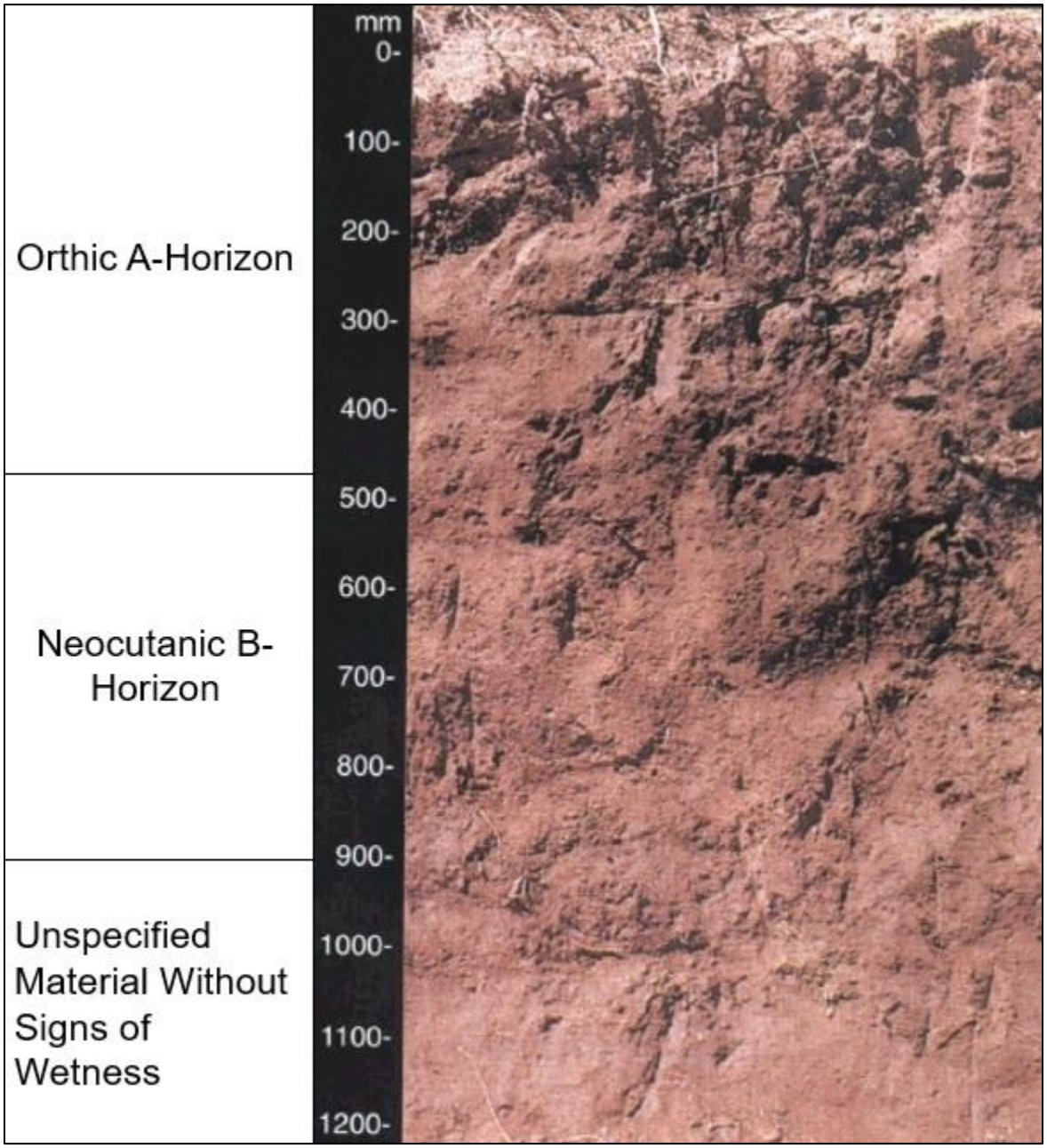

Figure 13: Example of an Oakleaf soil form, (SASA, 1999).

7.2.2.6 Fernwood

The Fernwood soil form consists of an Orthic A-horizon on top of an E-horizon, which in turn is underlain by an unspecified material. The soil family group identified for the Fernwood soil form on-site has been classified as the Penicuik (1110) soil family due to the light colour of the top soil and the grey colour of the E-horizon.

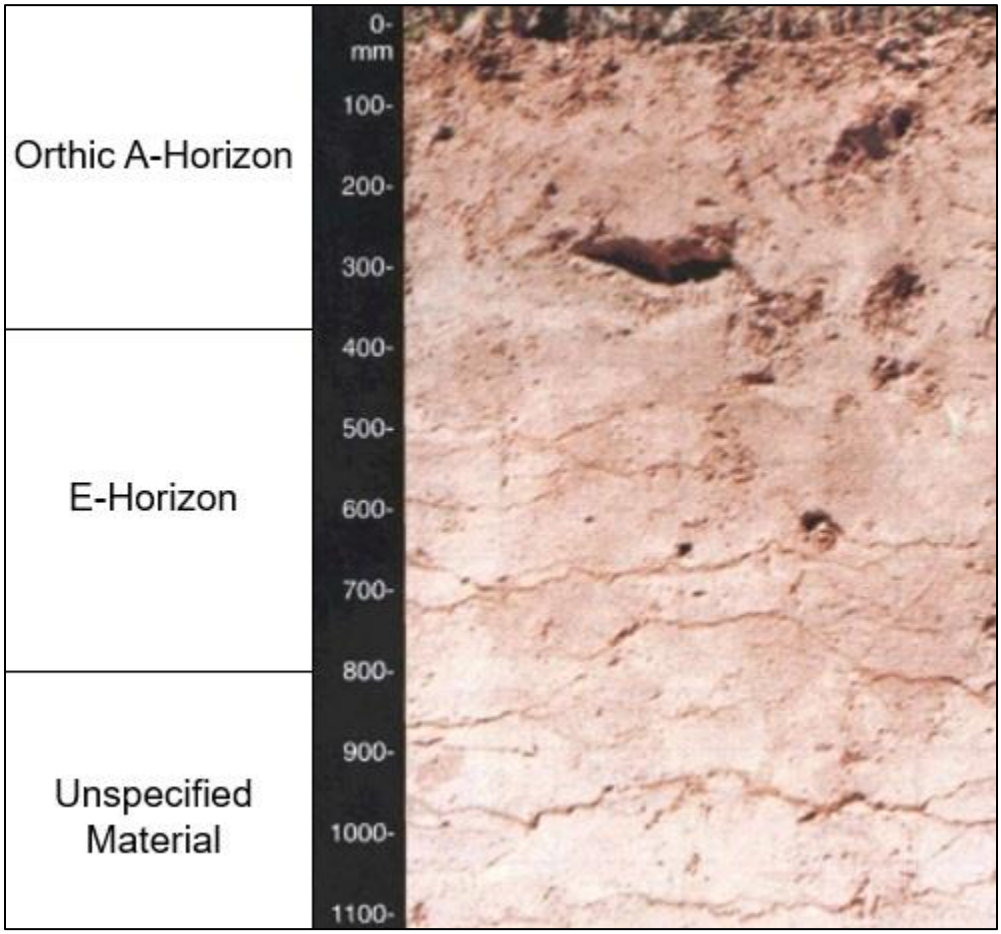

Figure 14: Example of a Fernwood soil form, (SASA, 1999).

7.2.2.7 Avalon

The Avalon soil form consists of an Orthic A-horizon on top of a Yellow-Brown Apedal B-horizon, which in turn is underlain by a Soft Plinthic B-horizon. The soil family group identified for the Avalon soil form on-site has been classified as the Avondale (2100) soil family due to the non-luvic and mesotrophic nature of the soil form.

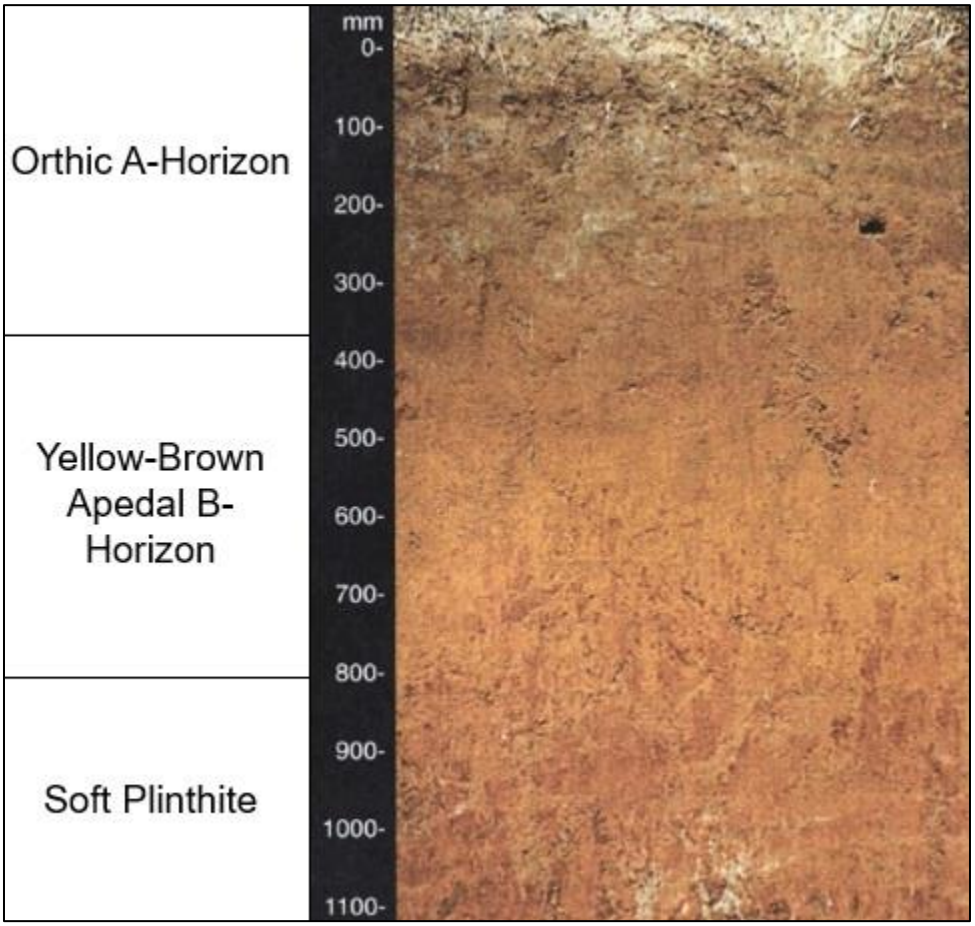

Figure 15: Example of an Avalon soil form, (SASA, 1999).

7.2.2.8 Mispah

The Mispah soil form consists of an Orthic A-horizon on top of a Hard Rock layer. The soil family group identified for the Mispah soil form on-site has been classified as the Myhill (1100) soil family due to the absence of lime and leached horizons.

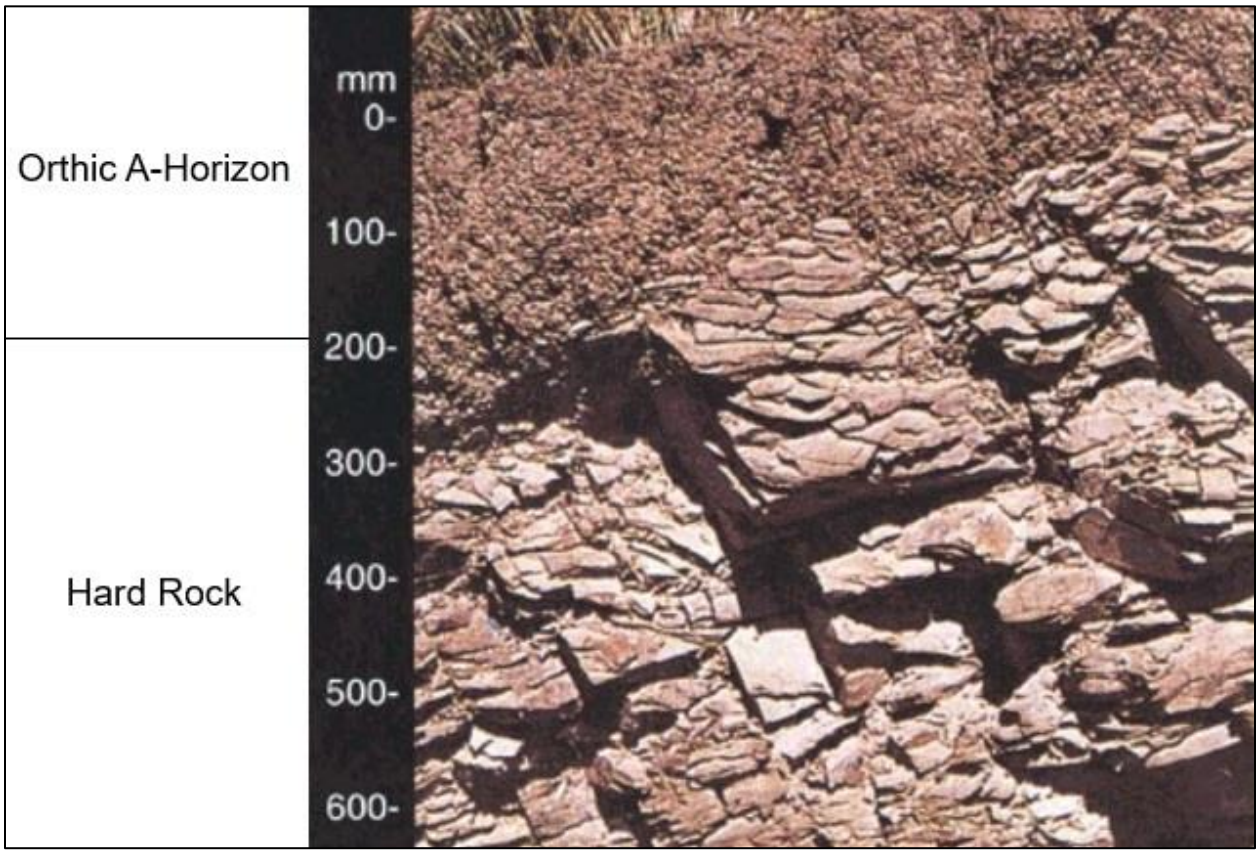

Figure 16: Example of a Mispah soil form, (SASA, 1999).

7.2.2.9 Glenrosa

The Glenrosa soil form consists of an Orthic A-horizon on top of a Lithocutanic B-horizon. The soil family group identified for the Glenrosa soil form on-site has been classified as the Tsende (1211) soil family due to the non-calcareous nature. The lack of wetness, the hard nature of the B-horizon and tha fact that the top soil is not leached.

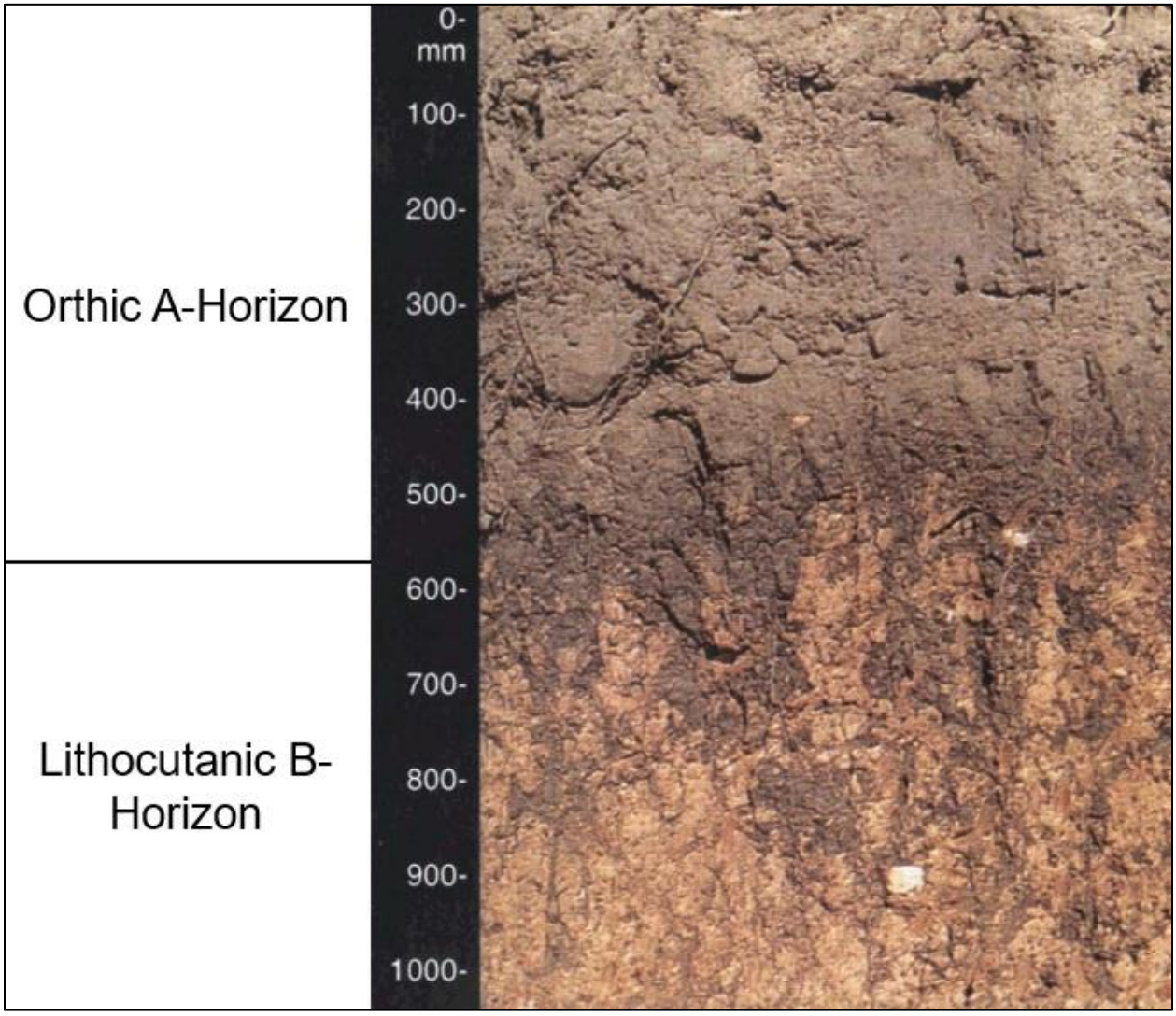

Figure 17: Example of a Glenrosa soil form, (SASA, 1999).

7.2.3 Agricultural Potential

Agricultural potential is determined by a combination of soil, terrain and climate features. Land capability classes reflect the most intensive long-term use of land under rain-fed conditions.

The land capability is determined by the physical features of the landscape including the soils present. The land potential or agricultural potential is determined by combining the land capability results and the climate capability for the region.

7.2.3.1 Climate Capability

The climate capability for this region was determined to be C7 classification. The C7 climate capability class has a severe to very severe rating. This climate capability class is characterised by a severely restricted choice of crops due to heat, cold and/or moisture stress (Smith, 2006).

7.2.3.2 Land Capability

The land capability was determined by using the guidelines described in "The farming handbook" (Smith, 2006). A breakdown of the land capability classes is shown in Table 1. The land capability for the project area is illustrated in Figure 18 and described in Table 5. It is worth noting that the land capability of Longlands has been decreased from a Class IV to a Class V due to the fact that signs of wetness is present within the first 200 m from the surface.

Table 5: Land capability for the soils within the project area

Soil Forms	Land Capability Class	Definition of Class	Conservation Need	Use-Suitability	Percentage Within Project Area	Land Capability Group
Hutton	Class III	Moderate limitations with some erosion hazard	Special conservation practice and tillage methods	Rotation of crops and ley (50%)	52.1	Arable land
Clovelly						
Oakleaf						
Westleigh	Class IV	Severe limitations with low arable potential and high erosion hazard	Intensive conservation practice	Long-term leys (75%)	13.6	
Avalon						
Longlands						
Fernwood	Class V	Watercourse and land with wetness limitations	Protection and control of water table	Improved pastures, suitable for wildlife	1.8	Grazing land
Glenrosa	Class VI	Limitations preclude cultivation. This land class is suitable for perennial vegetation	Protection measures for establishment e.g., sod-seeding.	Veld, pasture and afforestation	32.5	
Mispah						

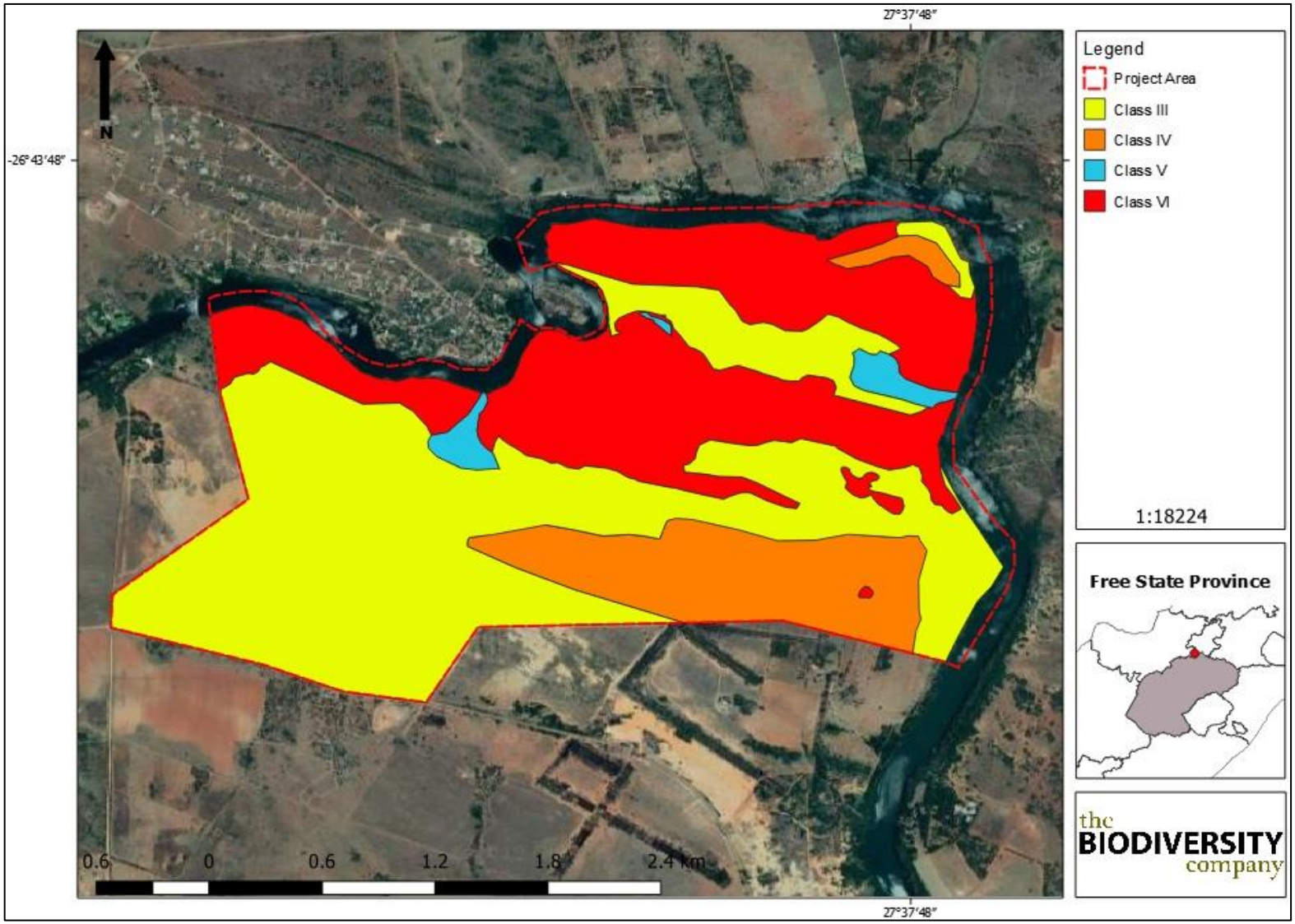

Figure 18: Soil classes for the project area

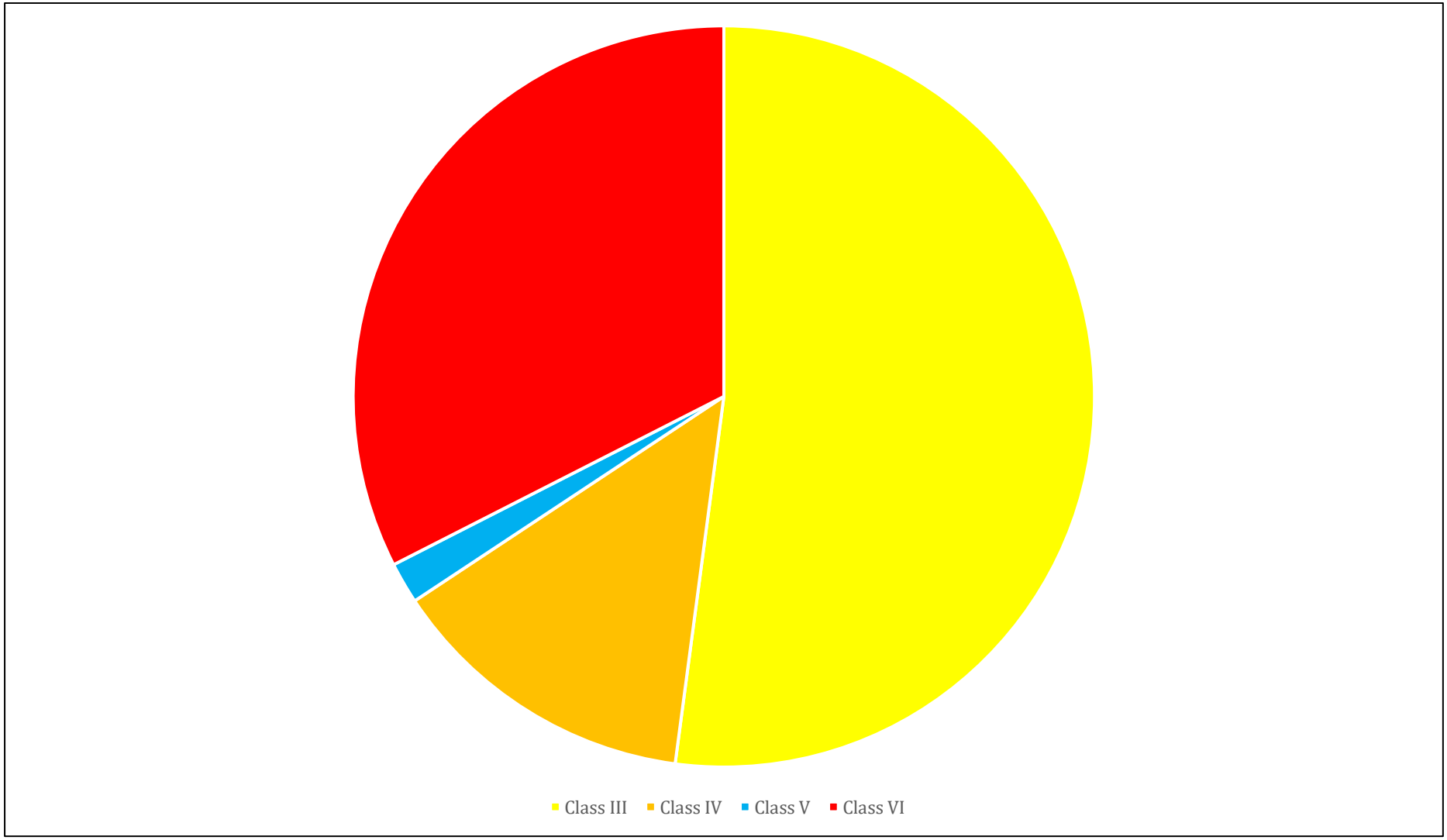

Figure 19: Land capability coverage of the project area

7.2.3.3 Land Potential

The land potential of the project area is illustrated in Figure 20 and described in Table 6. Classes III and IV have been merged into a land potential of "L5" whereas class VI has been determined to have a land potential of "L6". Lastly, the wetland areas classified as class V have been classified as having a land potential of "Vlei".

Table 6: Land potential for the soils within the project area

Soil Forms	Land Capability Class	Land Potential	Percentage	Description of Land Potential Class
Hutton	**Class III**	**L5**	**65.7**	This land potential class has restricted potential. Regular and/or severe to moderate limitations due to soil, slope, temperatures or rainfall.
Clovelly				
Oakleaf				
Westleigh	**Class IV**			
Avalon				
Longlands				
Fernwood	**Class V**	**"Vlei"**	**1.8**	This land potential class is characterised by wetland conditions and has been assessed in (TBC, 2019).
Glenrosa	**Class VI**	**L6**	**32.5**	This land potential class has very restricted potential. Regular and/or severe limitations due to soil, slope, temperatures or rainfall. Non-arable
Mispah				

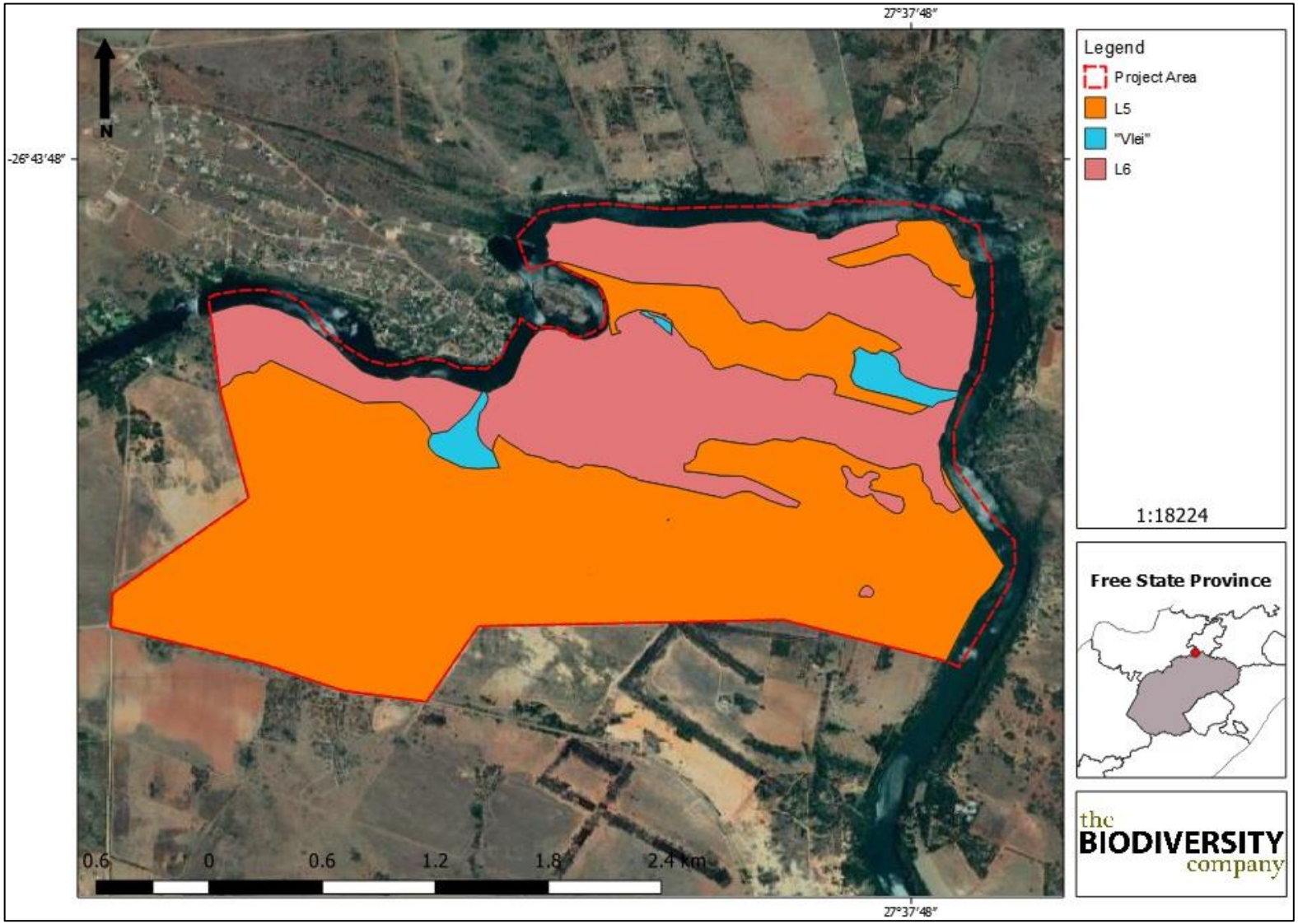

Figure 20: Land potential determined for the project area

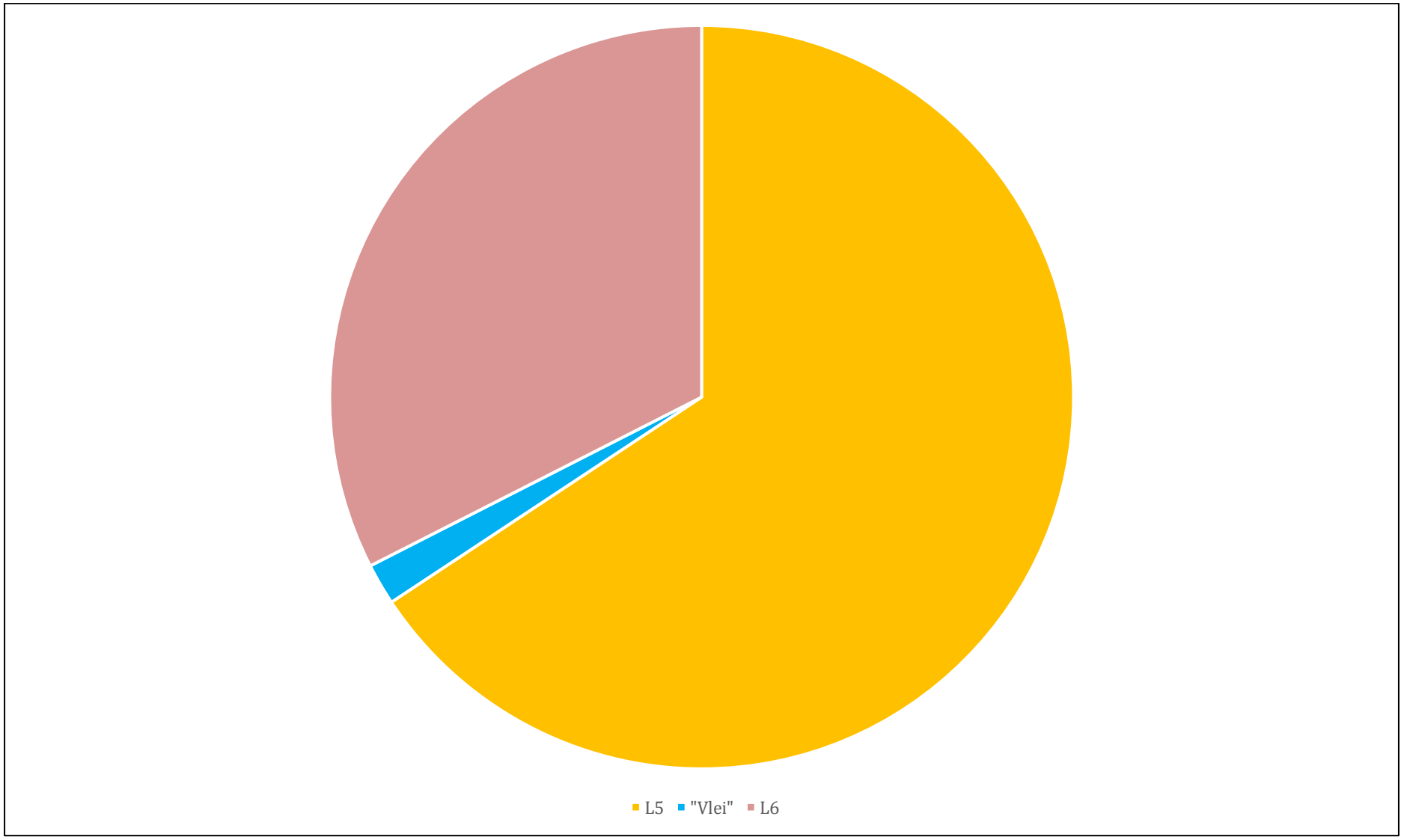

Figure 21: Land potential coverage of the project area

7.2.4 Current Land Use

The project area is roughly 900 ha in size with grazing taking up approximately 55%, mining taking up 10%, the water bodies taking up roughly 10%, wetlands taking up 5%, agriculture taking up roughly 15% and built-up areas taking up approximately 5% of the project area, see Figure 22 to Figure 24. The wetland areas have been devided into five different HGM units given their difference in hydrology and geomorphology (TBC, 2019).

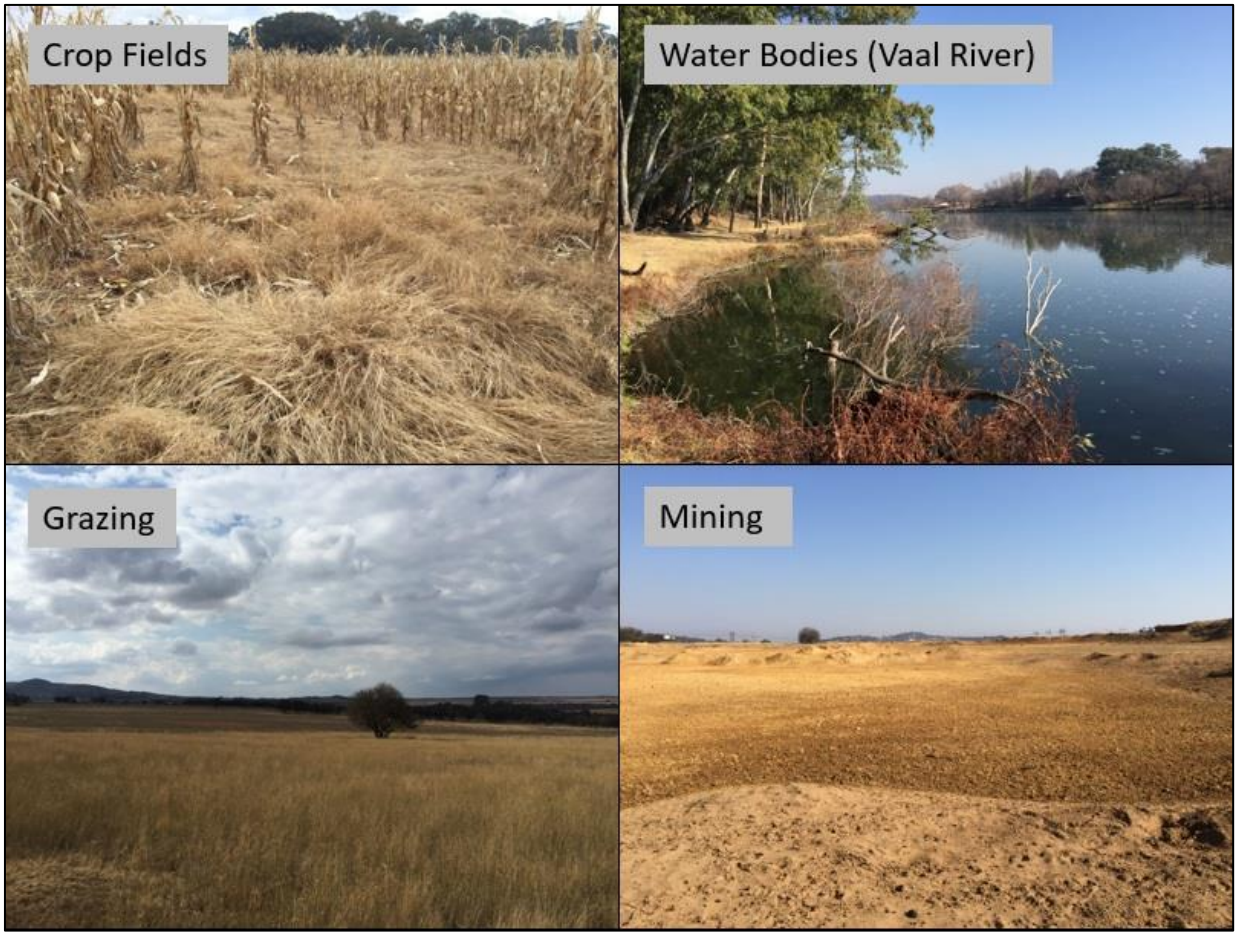

Figure 22: Land use identified within the project area

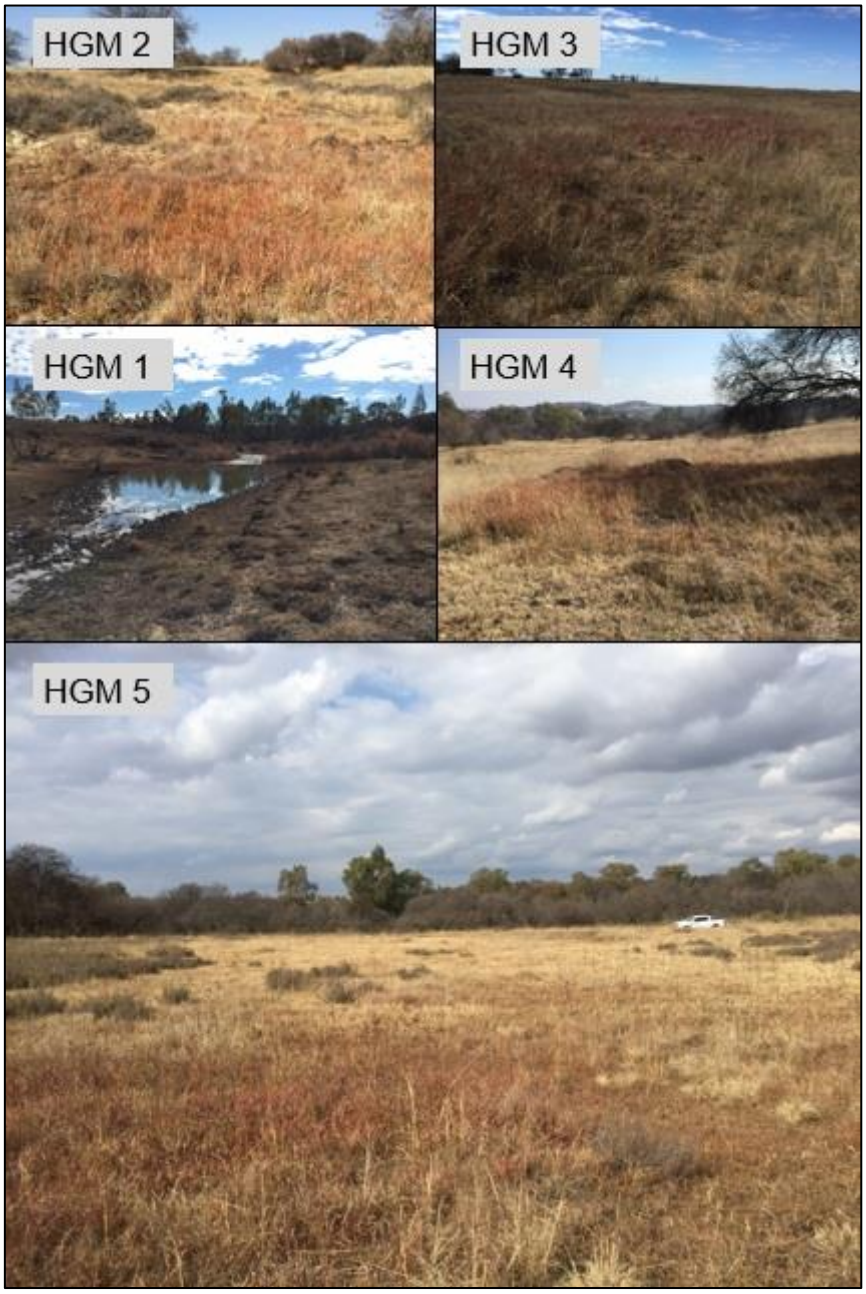

Figure 23: Wetlands identified within the project area (TBC, 2019)

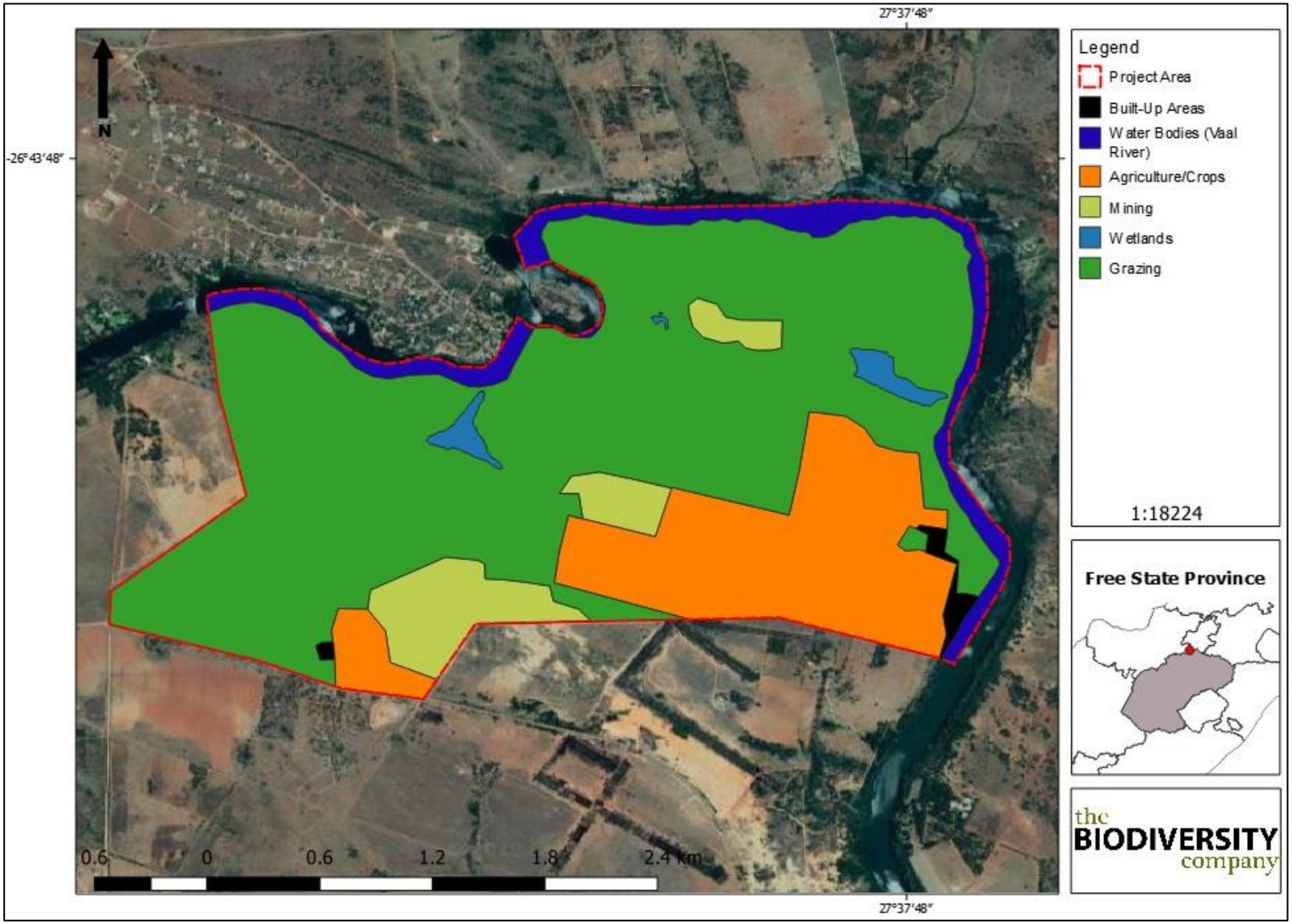

Figure 24: Land use for the project area

8 Sensitivity Mapping

As per the terms of reference for the project, a GIS sensitivity map is required in order to identify sensitive features in terms of the specialist discipline/s. The sensitivity scores identified during the field survey for the land potential classes is illustrated in Figure 25.

The land potential class “L5” has been rated a sensitivity of “Moderate” with “L6” rated “Low”. The “Vlei” land potential class has not been assessed for sensitivity given the fact that an in-depth assessment of all delineated wetlands has been completed by (TBC, 2019).

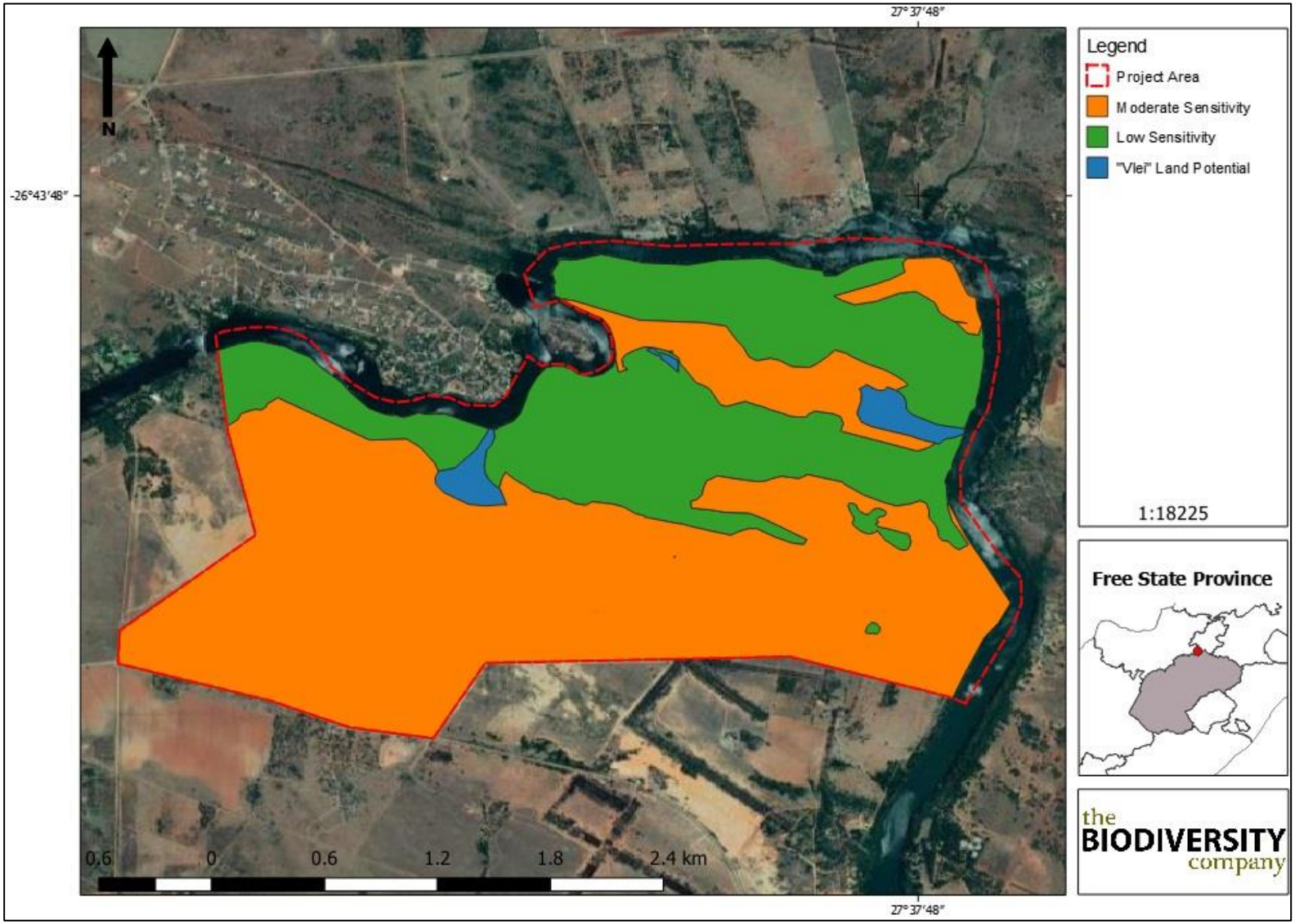

Figure 25: Sensitivity map of the area

9 Impact Assessment

Mining and related activities have significant impacts on soil resources, often causing irreversible and large-scale degradation across large areas or areas important for the provision of land capability, depending on the logistics behind the mining operations. These disturbances have numerous direct, indirect, short- and long-term potentially adverse effects on the landscape. The mining methodology for this particular project has been deemed to be “roll-over mining”, which allows for continues backfilling and rehabilitation.

The proposed development is associated with open cast mining and associated infrastructure which could result in the direct or indirect loss of land capability or and potential of the project area. The cumulative impacts have been increased due to the presence of a sand mine directly east of the project area, named *Barage Bulk Sand Mine* (Greenmined Environmental, 2018).

The resources intended to be mined includes diamonds, sand and aggregates. The proposed mining activities include associated infrastructure for which three different alternatives exist. The proposed infrastructure includes a 2MVA Power Supply, a cut off trench, a drying plant, a fuel bunker, offices, a Pollution Control Dam (PCD), a raw product stockpile, roads, a security check point, two settling ponds, a TMM parking, a wash plant, a water supply line, a weigh bridge with an office and a workshop.

As per the ullistration in Figure 26, “Site Alternative 3” is located within the “Vlei” land potential class. No sensitivity has been rated for this land potential class given the fact that an in-depth assessment on all wetlands has been completed by (TBC, 2019). Dependend on the results from the latter mentioned study, this alternative can be preferred or excluded.

As for “Site Alternative 1” and “Site Alternative 2”, both layouts are located within a “Moderate” sensitivity area. Therefore, these two alternatives will be assessed as a whole in regard to the impacts posed by infrastructure to a “Moderate” sensitivity land potential class.

The affect of the proposed open cast mining will be assessed seperately from that of the infrastructure to determine the impacts towards the land potential of the area. Figure 26 illustrates the proposed open cast mining areas of sand, aggregates and diamonds throughout the project area within the “Moderate” sensitivity areas, the “Low” sensitivity areas and the “Vlei” land potential class.

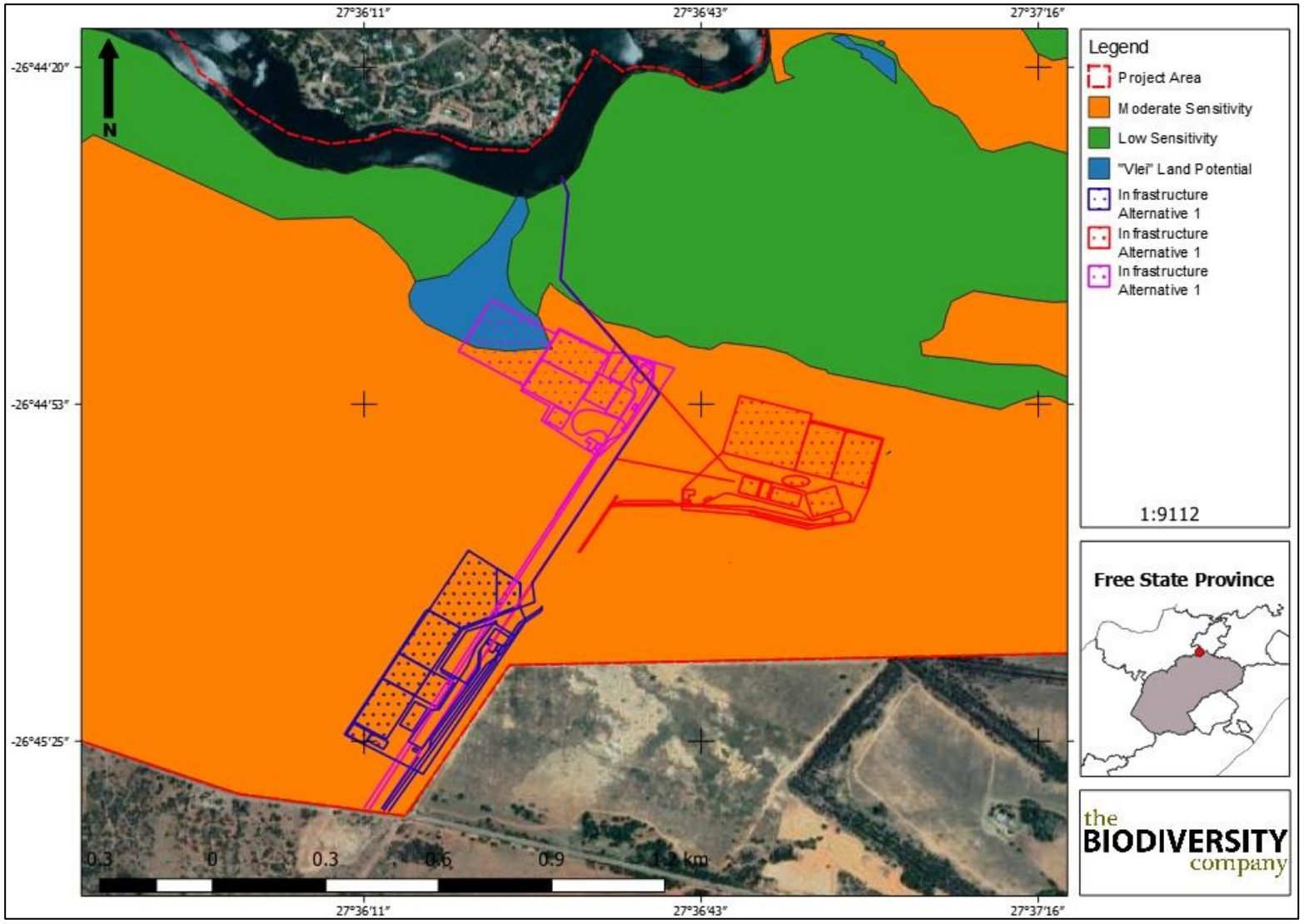

Figure 26: Locality of sensitive land potential classes in comparison to the proposed alternative infrastructure layouts

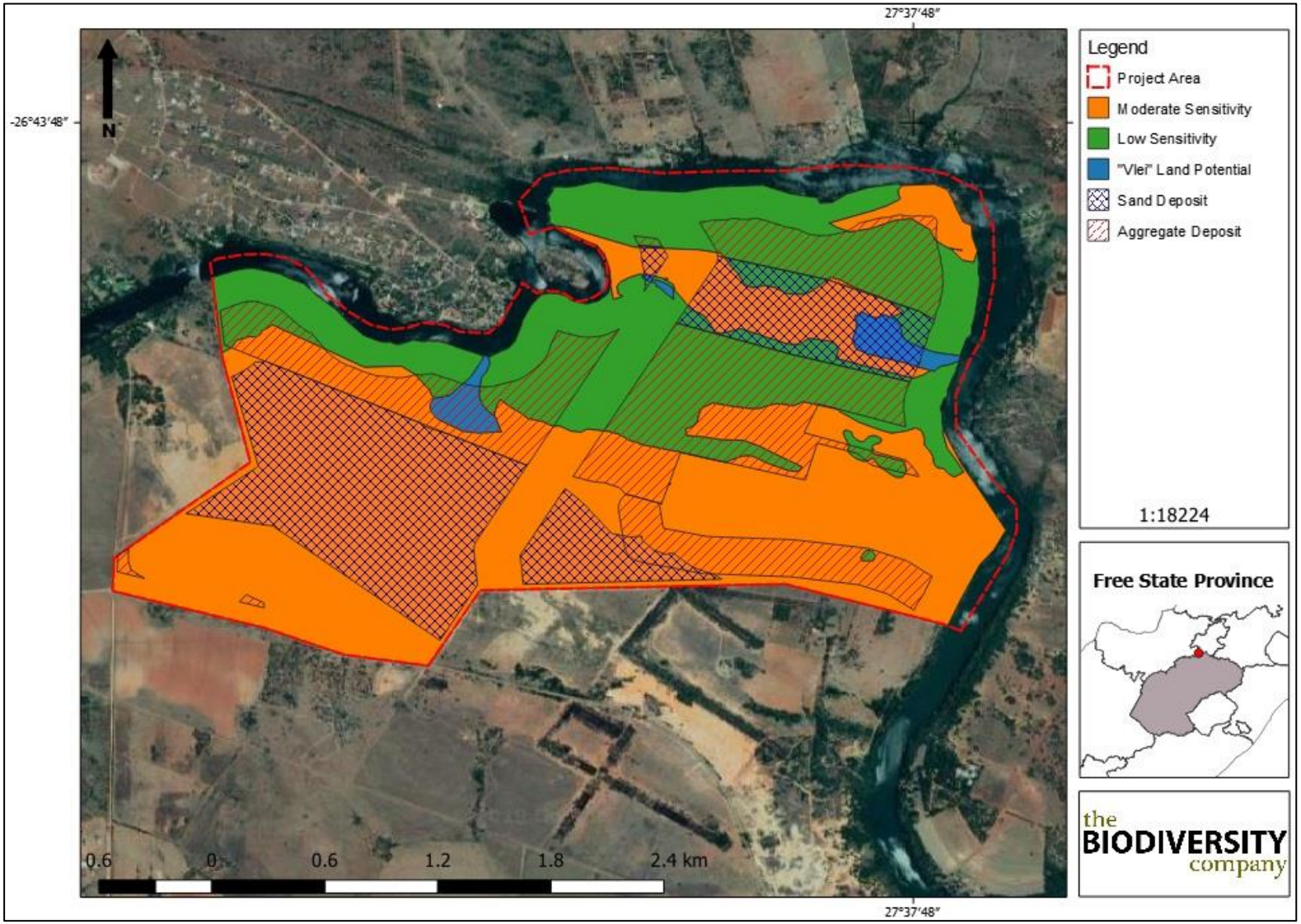

Figure 27: Extent of the proposed open cast areas

9.1 Current Impacts

During the field survey the current impacts that have a negative impact on the area were identified. These impacts include mining, agriculture and built-up areas (see Figure 22 and Figure 24) which has resulted in the degradation of soil resources.

9.2 Expected Impacts

The following sections include the expected impacts relevant to each of the relevant phases (planning, construction, operational, decommissioning as well as rehabilitation and closure) and the proposed activities (open cast mining and associated infrastructure).

9.2.1 Planning Phase

- Planning for the proposed open cast mining operations; and
- Planning for the proposed infrastructure areas.

9.2.2 Construction Phase

The following potential impacts are expected to impact upon natural soil resources:

- The construction of the open cast pits;
- Stockpiling during the construction phase;
- The construction of access roads;
- The construction of infrastructure; and
- Construction related traffic.

9.2.3 Operational Phase

- The operation of the open cast pits;
- Stockpiling during the operational phase;
- The operation of access roads; and
- The operation of infrastructure.

9.2.4 Decommissioning

- Backfilling of the open cast pits;
- The decommissioning of access roads;
- Decommissioning of all infrastructure; and
- Decommissioning related traffic.

9.2.5 Rehabilitation and Closure

- Rehabilitation of all degraded areas; and
- Annual monitoring.

9.3 Assessment of Significance

A summary of the final significance ratings and the priority factor relevant to the open cast mining activities and the associated infrastructure is illustrated in Table 7.

During the planning phase, all of the expected impacts have been scored a final significance rating of “Low Negative”. During the construction phase, two impacts have been scored “High Negative”, namely “the excavation/construction of open cast pits” and “the construction of stockpiles”. One impact has been scored a final significance rating of “Medium” during the construction phase, namely the construction of the proposed infrastructure components. During the operational phase, two impacts have been scored “High Negative” final significance ratings, namely “the operation of the open cast mining areas” and “the continues construction and operation of stockpiles”. During the decommissioning phase, one “High Negative” final significance rating and one “Medium Negative” final significance rating has been scored for “the backfilling of open cast pits” and “the removal of stockpiles” respectively. As for the rehabilitation and closure phase, all of the relevant impacts have been scored “Low Negative” final significance ratings.

Table 7: Priority factor and final significance of all expected impacts

Phase	Impact Name	Alternative	Priority Factor	Final Significance
Planning	Planning for Open Cast Mining	Open Cast Mining	High	Low Negative
	Planning for Infrastructure	Infrastruture	Medium	Low Negative
Construction	Excavation of Open Cast Pits	Open Cast Mining	High	High Negative
	Construction of Stockpiles	Open Cast Mining and Infrastructure (Alternative 1)	High	High Negative
	Construction of Access Roads	Open Cast Mining and Infrastructure	Medium	Low Negative
	Construction of Infrastructure	Infrastruture	Medium	Medium Negative
	Traffic During Constrction	Open Cast Mining and Infrastructure	Medium	Low Negative
Operational	Operation of Open Cast Mine	Open Cast Mining	High	High Negative
	Continues Construction and Operatin of Stockiles	Open Cast Mining	High	High Negative
	Operation of Access Roads	Open Cast Mining and Infrastructure	Medium	Low Negative
	Operation of the Infrastructure	Infrastruture	Medium	Low Negative
Decommissioning	Backfilling of Open Cast Pits	Open Cast Mining	High	High Negative
	Removal of Stockpiles	Open Cast Mining	High	Medium Negative
	Decommissioning of Access Roads	Open Cast Mining and Infrastructure	Medium	Low Negative
	Decommissioning of Water Supply	Infrastruture	Medium	Low Negative

	Pipeline			
	Traffic During Decommissioning	Open Cast Mining and Infrastructure	Medium	Low Negative
Rehabilitation and Closure	Rehabilitation of all Degraded Areas	Open Cast Mining and Infrastructure	Medium	Low Negative
	Annual Monitoring	Open Cast Mining and Infrastructure	Medium	Low Negative

9.3.1 Planning Phase

The planning phase is an integral part of a mining operation given the fact that poor planning could result in the degradation of soil resources. This includes the planning of the construction, operational, decommissioning and rehabilitation and closure phases relevant to open cast mining and the associated infrastructure.

The final significance rating for the planning phase of the proposed open cast mining activities has been scored -5.5 ("Low Negative") with a prioritisation factor of 2 ("High") given the public response, the cumulative impact and the irreplaceable loss of soil resources.

Planning for the proposed open cast mining operations- Open Cast Mining					
Impact Name	**Planning for the proposed open cast mining operations**				
Alternative	**Open Cast Mining**				
Phase	**Planning**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	4	2
Extent of Impact	4	3	Reversibility of Impact	4	2
Duration of Impact	3	2	Probability	3	1
Environmental Risk (Pre-mitigation)					-3,25
Mitigation Measures					
***See Section** 10- "Mitigation Measures"*					
Environmental Risk (Post-mitigation)					-2,25
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					3
Issue has received an intense meaningful and justifiable public response					
Cumulative Impacts					3
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					3
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).					
Prioritisation Factor					2,00
Final Significance					-4,50

The post-mitigation significance rating for the planning phase of the proposed infrastructure layout has been scored -3 ("Low Negative") with a prioritisation factor of 1.5 ("Medium") given the public response, the cumulative impact and the irreplaceable loss of soil resources.

Planning for the proposed infrastructure areas- Infrastructure					
Impact Name	**Planning for the proposed infrastructure areas.**				
Alternative	**Infrastructure**				
Phase	**Planning**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	3	2
Extent of Impact	3	2	Reversibility of Impact	3	2
Duration of Impact	3	2	Probability	1	1
Environmental Risk (Pre-mitigation)					-3,00
Mitigation Measures					
***See Section** 10- "Mitigation Measures"*					
Environmental Risk (Post-mitigation)					-2,00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					2
Issue has received a meaningful and justifiable public response					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					2
The impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.					
Prioritisation Factor					1,50
Final Significance					-3,00

9.3.2 Construction Phase

The construction phase for open cast mining includes extensive excavations, stockpiling, the construction of infrastructure and associated traffic.

The final significance rating for the construction phase of the proposed open cast mining activities has been scored -37.5 ("High Negative") with a prioritisation factor of 2 ("High") given the public response, the cumulative impact and the irreplaceable loss of soil resources.

The construction of the open cast pits- Open Cast Mining	
Impact Name	**The construction of the open cast pits**
Alternative	**Open Cast Mining**
Phase	**Construction**

Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	5	5
Extent of Impact	3	3	Reversibility of Impact	5	3
Duration of Impact	3	4	Probability	5	5
Environmental Risk (Pre-mitigation)					-20,00
Mitigation Measures					
See Section 10- "Mitigation Measures"					
Environmental Risk (Post-mitigation)					-18.75
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					3
Issue has received an intense meaningful and justifiable public response					
Cumulative Impacts					3
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					3
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).					
Prioritisation Factor					2,00
Final Significance					-37,50

The final significance rating for the construction phase relevant to stockpiling activities has been scored -24 ("High Negative") with a prioritisation factor of 2 ("High") given the public response, the cumulative impact and the irreplaceable loss of soil resources.

Stockpiling- Open Cast Mining					
Impact Name	**Stockpiling**				
Alternative	**Open Cast Mining**				
Phase	**Construction**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	4	3
Extent of Impact	3	3	Reversibility of Impact	4	2
Duration of Impact	3	4	Probability	4	4
Environmental Risk (Pre-mitigation)					-14,00
Mitigation Measures					
See Section 10- "Mitigation Measures"					
Environmental Risk (Post-mitigation)					-12,00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					3
Issue has received an intense meaningful and justifiable public response					
Cumulative Impacts					3

Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.	
Degree of potential irreplaceable loss of resources	3
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).	
Prioritisation Factor	2,00
Final Significance	-24,00

The final significance rating for the construction phase relevant to access roads has been scored -8.25 ("Low Negative") with a prioritisation factor of 1.5 ("Medium") given the public response, the cumulative impact and the irreplaceable loss of soil resources.

The construction of access roads- Open Cast Mining and Infrastructure					
Impact Name	**The construction of access roads**				
Alternative	**Open Cast Mining and Infrastructure**				
Phase	**Construction**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	4	2
Extent of Impact	2	3	Reversibility of Impact	3	2
Duration of Impact	3	4	Probability	4	2
Environmental Risk (Pre-mitigation)					-12,00
Mitigation Measures					
See Section 10- "Mitigation Measures"					
Environmental Risk (Post-mitigation)					-5,50
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					2
Issue has received a meaningful and justifiable public response					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					2
The impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.					
Prioritisation Factor					1,50
Final Significance					-8,25

The final significance rating for the construction phase relevant to the infrastructure has been scored -8.25 ("Low Negative") with a prioritisation factor of 1.5 ("Medium") given the public response, the cumulative impact and the irreplaceable loss of soil resources.

The construction of infrastructure- Infrastructure	
Impact Name	**The construction of infrastructure**

Alternative	Infrastructure				
Phase	**Construction**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	4	2
Extent of Impact	2	3	Reversibility of Impact	3	2
Duration of Impact	3	4	Probability	4	2
Environmental Risk (Pre-mitigation)					-12,00
Mitigation Measures					
See Section 10- "Mitigation Measures"					
Environmental Risk (Post-mitigation)					-5,50
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					2
Issue has received a meaningful and justifiable public response					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					2
The impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.					
Prioritisation Factor					1,50
Final Significance					-8,25

The final significance rating for construction related traffic has been scored -8.25 ("Low Negative") with a prioritisation factor of 1.5 ("Medium") given the public response, the cumulative impact and the irreplaceable loss of soil resources.

Traffic- Open Cast Mining and Infrastructure (Alternative 1)					
Impact Name	**Traffic**				
Alternative	**Open Cast Mining and Infrastructure (Alternative 1)**				
Phase	**Construction**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	4	2
Extent of Impact	2	3	Reversibility of Impact	3	2
Duration of Impact	3	4	Probability	4	2
Environmental Risk (Pre-mitigation)					-12,00
Mitigation Measures					
See Section 10- "Mitigation Measures"					
Environmental Risk (Post-mitigation)					-5,50
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					2

Issue has received a meaningful and justifiable public response	
Cumulative Impacts	2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.	
Degree of potential irreplaceable loss of resources	2
The impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.	
Prioritisation Factor	1,50
Final Significance	-8,25

9.3.3 Operational Phase

The operational phase for open cast mining includes extensive excavations, stockpiling, the operation of the proposed infrastructure components and the operation of access roads.

The final significance rating for the operation phase relevant to open cast mining has been scored -32.00 ("High Negative") with a prioritisation factor of 2 ("High") given the public response, the cumulative impact and the irreplaceable loss of soil resources.

The operation of the open cast pits- Open Cast Mining					
Impact Name	**The operation of the open cast pits**				
Alternative	**Open Cast Mining**				
Phase	**Operation**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	5	4
Extent of Impact	3	3	Reversibility of Impact	4	3
Duration of Impact	4	4	Probability	5	4
Environmental Risk (Pre-mitigation)					-20.00
Mitigation Measures					
See Section 10- "Mitigation Measures"					
Environmental Risk (Post-mitigation)					-16.00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					3
Issue has received an intense meaningful and justifiable public response					
Cumulative Impacts					3
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					3
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).					
Prioritisation Factor					2,00
Final Significance					-32,00

The final significance rating for the operation phase relevant to stockpiling has been scored -28 ("High Negative") with a prioritisation factor of 2 ("High") given the public response, the cumulative impact and the irreplaceable loss of soil resources.

Stockpiling - Open Cast Mining					
Impact Name	**Stockpiling**				
Alternative	**Open Cast Mining**				
Phase	**Operation**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	5	4
Extent of Impact	3	3	Reversibility of Impact	5	3
Duration of Impact	4	4	Probability	5	4
Environmental Risk (Pre-mitigation)					-21,25
Mitigation Measures					
See Section 10- "Mitigation Measures"					
Environmental Risk (Post-mitigation)					-14,00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					3
Issue has received an intense meaningful and justifiable public response					
Cumulative Impacts					3
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					3
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).					
Prioritisation Factor					2,00
Final Significance					-28,00

The final significance rating for the operation phase relevant to access roads has been scored -6.75 ("Low Negative") with a prioritisation factor of 1.5 ("Medium") given the public response, the cumulative impact and the irreplaceable loss of soil resources.

The operation of access roads- Open Cast Mining and Infrastructure					
Impact Name	**The operation of access roads**				
Alternative	**Open Cast Mining and Infrastructure**				
Phase	**Operation**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	3	2
Extent of Impact	2	2	Reversibility of Impact	3	2

Duration of Impact	4	3	Probability	3	2
Environmental Risk (Pre-mitigation)					-9,00
Mitigation Measures					
See Section 10- "Mitigation Measures"					
Environmental Risk (Post-mitigation)					-4,50
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					2
Issue has received a meaningful and justifiable public response					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					2
The impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.					
Prioritisation Factor					1,50
Final Significance					-6,75

The final significance rating for the operation phase relevant to water supply pipeline has been scored -19,50 ("Medium Negative") with a prioritisation factor of 1.5 ("Medium") given the public response, the cumulative impact and the irreplaceable loss of soil resources.

The operation of the water supply pipeline- Infrastructure					
Impact Name	**The operation of the water supply pipeline**				
Alternative	**Infrastructure**				
Phase	**Operation**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	4	3
Extent of Impact	3	3	Reversibility of Impact	3	3
Duration of Impact	4	4	Probability	4	4
Environmental Risk (Pre-mitigation)					-14,00
Mitigation Measures					
See Section 10- "Mitigation Measures"					
Environmental Risk (Post-mitigation)					-13,00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					2
Issue has received a meaningful and justifiable public response					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					2
The impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.					
Prioritisation Factor					1,50

Final Significance	-19,50

9.3.4 Decommissioning Phase

The decommissioning phase for open cast mining includes backfilling of open cast pits, the removal of stockpiles as well as the decommissioning of access roads and the constructed infrastructure.

The final significance rating for the backfilling of open cast pits has been scored -20 ("High Negative") with a prioritisation factor of 2 ("High") given the public response, the cumulative impact and the irreplaceable loss of soil resources.

Backfilling of the open cast pits- Open Cast Mining					
Impact Name	**Backfilling of the open cast pits**				
Alternative	**Open Cast Mining**				
Phase	**Decommissioning**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	4	3
Extent of Impact	3	2	Reversibility of Impact	4	3
Duration of Impact	3	2	Probability	4	4
Environmental Risk (Pre-mitigation)					-14,00
Mitigation Measures					
See Section 10- "Mitigation Measures"					
Environmental Risk (Post-mitigation)					-10,00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					3
Issue has received an intense meaningful and justifiable public response					
Cumulative Impacts					3
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					3
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).					
Prioritisation Factor					2,00
Final Significance					-20,00

The final significance rating for the decommissioning of stockpiles has been scored -15 ("Medium Negative") with a prioritisation factor of 2 ("High") given the public response, the cumulative impact and the irreplaceable loss of soil resources.

Removal of stockpiles - Open Cast Mining	
Impact Name	**Removal of stockpiles**

Alternative	Open Cast Mining				
Phase	**Decommissioning**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	3	3
Extent of Impact	3	2	Reversibility of Impact	3	3
Duration of Impact	3	2	Probability	3	3
Environmental Risk (Pre-mitigation)					-9,00
Mitigation Measures					
See Section 10- "Mitigation Measures"					
Environmental Risk (Post-mitigation)					-7,50
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					3
Issue has received an intense meaningful and justifiable public response					
Cumulative Impacts					3
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					3
The impact may result in the irreplaceable loss of resources of high value (services and/or functions).					
Prioritisation Factor					2,00
Final Significance					-15,00

The final significance rating for the decommissioning of access roads has been scored -6 ("Low Negative") with a prioritisation factor of 1.5 ("Medium") given the public response, the cumulative impact and the irreplaceable loss of soil resources.

The decommissioning of access roads- Open Cast Mining and Infrastructure					
Impact Name	**The decommissioning of access roads;**				
Alternative	**Open Cast Mining and Infrastructure**				
Phase	**Decommissioning**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	3	2
Extent of Impact	2	2	Reversibility of Impact	3	2
Duration of Impact	3	2	Probability	3	2
Environmental Risk (Pre-mitigation)					-8,25
Mitigation Measures					
See Section 10- "Mitigation Measures"					
Environmental Risk (Post-mitigation)					-4,00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					2

Issue has received a meaningful and justifiable public response	
Cumulative Impacts	2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.	
Degree of potential irreplaceable loss of resources	2
The impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.	
Prioritisation Factor	1,50
Final Significance	-6,00

The final significance rating for the decommissioning of the water supply pipelines has been scored -6 ("Low Negative") with a prioritisation factor of 1.5 ("Medium") given the public response, the cumulative impact and the irreplaceable loss of soil resources.

The decommissioning of infrastructure- Infrastructure					
Impact Name	**The decommissioning of infrastructure**				
Alternative	**Infrastructure**				
Phase	**Decommissioning**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	3	2
Extent of Impact	2	2	Reversibility of Impact	3	2
Duration of Impact	3	2	Probability	3	2
Environmental Risk (Pre-mitigation)					-8,25
Mitigation Measures					
See Section 10- "Mitigation Measures"					
Environmental Risk (Post-mitigation)					-4,00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					2
Issue has received a meaningful and justifiable public response					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					2
The impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.					
Prioritisation Factor					1,50
Final Significance					-6,00

9.3.5 Rehabilitation and Closure Phase

The rehabilitation and closure phase for open cast mining and the decommissioned infrastructure includes rehabilitation of all degraded areas as well as annual monitoring.

The final significance rating for the rehabilitation of degraded areas during the rehabilitation and closure phase relevant to open cast mining has been scored -6 ("Low Negative") with a prioritisation factor of 1.5 ("Medium") given the public response, the cumulative impact and the irreplaceable loss of soil resources.

Rehabilitation of all degraded areas- Open Cast Mining and Infrastructure					
Impact Name	**Rehabilitation of all degraded areas**				
Alternative	**Open Cast Mining and Infrastructure**				
Phase	**Rehab and closure**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	3	2
Extent of Impact	4	2	Reversibility of Impact	3	2
Duration of Impact	3	2	Probability	3	2
Environmental Risk (Pre-mitigation)					-9,75
Mitigation Measures					
See Section 10- "Mitigation Measures"					
Environmental Risk (Post-mitigation)					-4,00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					2
Issue has received a meaningful and justifiable public response					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					2
The impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.					
Prioritisation Factor					1,50
Final Significance					-6,00

The final significance rating for annual monitoring during the rehabilitation and closure phase relevant to open cast mining has been scored -6 ("Low Negative") with a prioritisation factor of 1.5 ("Medium") given the public response, the cumulative impact and the irreplaceable loss of soil resources.

Open Cast Mining and Infrastructure					
Impact Name	**Annual Monitoring**				
Alternative	**Open Cast Mining and Infrastructure**				
Phase	**Rehab and closure**				
Environmental Risk					
Attribute	**Pre-mitigation**	**Post-mitigation**	**Attribute**	**Pre-mitigation**	**Post-mitigation**
Nature of Impact	-1	-1	Magnitude of Impact	2	2
Extent of Impact	2	2	Reversibility of	2	2

			Impact		
Duration of Impact	3	2	Probability	2	2
Environmental Risk (Pre-mitigation)					-4,50
Mitigation Measures					
See Section 10- "Mitigation Measures"					
Environmental Risk (Post-mitigation)					-4,00
Degree of confidence in impact prediction:					High
Impact Prioritisation					
Public Response					2
Issue has received a meaningful and justifiable public response					
Cumulative Impacts					2
Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.					
Degree of potential irreplaceable loss of resources					2
The impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.					
Prioritisation Factor					1,50
Final Significance					-6,00

10 Mitigation Measures

The following sections describe relevant mitigation measures recommended for the conservation of soil resources. It is worth noting that all of the expected impacts rated a final significance rating of “High Negative” are not included in this section given the fact that no mitigation measures are expected to decrease these scores.

The first step according to the mitigation hierarchy (DEA, 2013) is to avoid impacts towards sensitive areas. None of the proposed activities are expected to pose “no risks” towards the soil resources. Therefore, the next step will be to decrease impacts. The only impacts expected to be decreased in significance given that relevant mitigation measures are implemented is that of “planning for the proposed open cast mining activities”, “the construction of access roads” and “traffic during the construction phase”.

The construction and operation of infrastructure has been determined to have a “Medium” final significance rating, which emphasises the fact that this impact cannot be minimised by means of mitigation. The next step according to the mitigation hierarchy is therefore to rehabilitate this area.

Even though the “removal of stockpiles” has been scored a “Medium” final significance rating, no mitigation has been prescribed given the fact that a “Low” significance rating has been determined to be applicable to the construction and operational phase. The only aspect contributing to the “Medium” final significance rating is that of public response.

Mitigation towards open cast mining activities and stockpiling has been recommended to ensure that even though “High” final significance ratings are expected, that the conservation of soil resources be focussed on during the proposed activities.

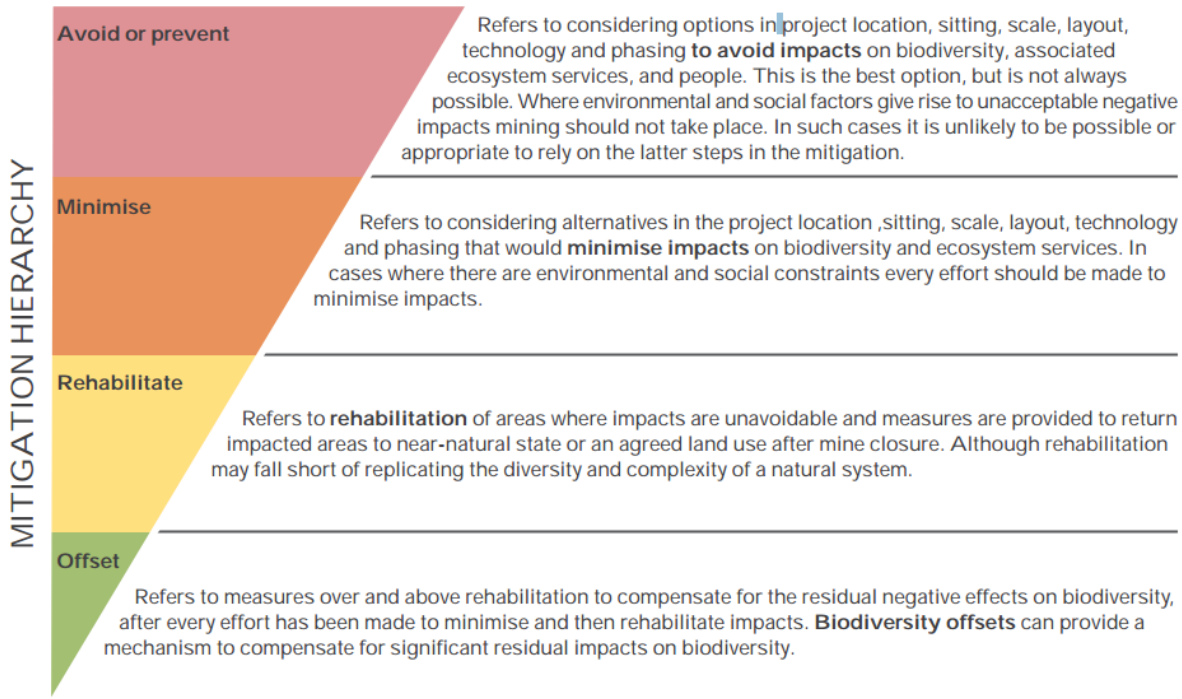

Figure 28: The mitigation hierarchy as described by the DEA (2013)

10.1 General Mitigation Measures

- It is preferable that construction takes place during the dry season (as much as possible) to reduce the erosion potential of the exposed surfaces;
- Prevent uncontrolled access of vehicles to reduce compaction;
- Prevent any spills from occurring. Machines must be parked within hard park areas and must be checked daily for fluid leaks;
- If a spill occurs, it is to be cleaned up immediately and reported to the appropriate authorities;
- Any exposed earth should be rehabilitated promptly by planting suitable vegetation (vigorous indigenous grasses) to protect the exposed soil; and
- No dumping of construction material on-site may take place.

10.2 Open Cast Mining

- The topsoil should be stripped by means of an excavator bucket, and loaded onto dump trucks;
- A soil fertility and post-mining land capability assessment must be done to address any compaction or fertility issues that may arise from the open cast mining activities (post-rehabilitation).
- Topsoil is to be stripped when the soil is dry, as to reduce compaction;
- Bush clearing contractors will only clear bushes and trees larger than 1m the remaining vegetation will be stripped with the top 0.3 m of topsoil to conserve as much of the nutrient cycle, organic matter and seed bank as possible;
- The subsoil will then be stripped and stockpiled separately;
- The handling of the stripped topsoil must be minimized to ensure the soil's structure does not deteriorate significantly;
- The rehabilitated area must be assessed once a year for compaction, fertility, and erosion;
- The soils fertility must be assessed by a soil specialist yearly (during the dry season so that recommendations can be implemented before the start of the wet season) as to correct any nutrient deficiencies;
- Compacted areas are to be ripped to loosen the soil structure and vegetation cover re-instated;

10.3 Stockpiling

- If any erosion occurs, corrective actions (erosion berms) must be taken to minimize any further erosion from taking place;

- If erosion has occurred, topsoil should be sourced and replaced and shaped to reduce the recurrence of erosion;
- A stripping and stockpiling guideline must be compiled for the proposed open cast mining activities;
- Compacted areas are to be ripped to loosen the soil structure;
- Stockpiles must be kept to a maximum height of 4m if space allows. Soil can be stockpiled to a height of 10m where it is absolutely necessary, keeping the 10m footprint as small as possible.
- A soil fertility and post-mining land capability assessment must be done to address any compaction or fertility issues that may arise from the stockpiling (post-rehabilitation).
- Compaction of the removed topsoil must be avoided by prohibiting traffic on stockpiles;
- The stockpiles must be vegetated in order to reduce the risk of erosion, prevent weed growth and to reinstitute the ecological processes within the soil.
- Ensure proper storm water management designs are in place; and
- During the backfill process, topsoil is to be moved when the soil is dry, as to reduce compaction;

11 Recommendations

The following recommendations have been made to ensure that all soil resources are conserved;

- The fertility of the areas designated to be mined and built on must be assessed for fertility before the construction phase. These results (together with the land capability results within this report) must be compared to that of the mined areas after the rehabilitation phase to identify any potential shortcomings in the rehabilitation phase;
- A soil stripping guideline must be completed before the construction phase to ensure the conservation of the soil resources;
- A rehabilitation plan must be set up to accommodate “roll-over mining” (which has been proposed for this mining project). This rehabilitation plan must include rehabilitation during the construction, operational, decommissioning and rehabilitation phase; and
- All of the recommended mitigation measures must be adhered to;

12 Conclusions

12.1 Pedology

The findings from this assessment has indicated the presence of nine identified soils forms, which has been divided into four different land capability classes given the depth, permeability, clay percentage and slope percentage of these soils. These four land capability classes have been divided into three different land potential classes, which takes into consideration any climatic restrictions of the area.

The proposed infrastructure “Alternative 3” is located within the “Vlei” land potential class with Alternative 1 and 2 being located within a “Moderate” sensitivity area in regard to land potential sensitivity. The proposed open cast mining areas cover most of the project area, including the “Low” sensitivity land potential classes, the “Moderate” sensitivity land potential classes and the “Vlei” land potential class.

12.2 Impact Statement

All of the final significance ratings scored “High” is related to open cast mining and associated stockpiling. The impacts associated with the construction and operation of the proposed infrastructure components has been rated “Moderate”.

Mitigation measures have been recommended by the specialist herein to ensure that impacts are minimised. It however is the specialist’s opinion that these mitigation measures will not be sufficient. It therefore has been recommended that a suitable rehabilitation plan be set up to decrease the degradation of soil resources.

13 References

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