Environmental Impact Assessment for the Proposed Elandsfontein Coal Mining Project

Mpumalanga Province, South Africa

Pedology Assessment

July 2020 (Updated November 2020)

CLIENT

Prepared by:

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Report Name	**Environmental Impact Assessment for the Proposed Elandsfontein Coal Mining Project**
Submitted to	EIMS ENVIRONMENTAL IMPACT MANAGEMENT SERVICES
Report Reviewer	**Wayne Jackson** Wayne Jackson is a Soils Scientist & Hydrologist and has 11 years' experience in the classification of soils, and the delineation and assessment of wetlands. Wayne completed a B.Sc. degree (Soil Science and Hydrology) from the University of Kwa-Zulu Natal and has 11 years of consulting experience. Wayne Jackson is Pr Sci Nat registered (119037).
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 Writer and Fieldwork	**Ivan Baker** Ivan Baker is Cand. Sci Nat registered (119315) in environmental science and geological science. Ivan is a wetland and ecosystem service specialist, a hydropedologist and pedologist that has completed numerous specialist studies ranging from basic assessments to EIAs. Ivan has carried out various international studies following FC standards. Ivan completed training in Tools for Wetland Assessments with a certificate of competence and completed his MSc in environmental science and hydropedology at the North-West University of Potchefstroom.
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.

EXECUTIVE SUMMARY

GNR 326	Appendix 6 (n): Specialist Opinion

The planning, construction, operational, decommissioning and rehabilitation/closure phases have all been assessed during the impact assessment. For these phases, open cast and underground mining was considered respectively. The results from the impact assessment suggest that no final significance ratings higher than “Low” are expected during the planning, construction, decommissioning and rehabilitation/closure phases. As for the operational phase, the open cast mining activities and underground mining activities have been scored “High” and “Medium” final significance ratings respectively.

It is the specialist’s opinion that all proposed activities should proceed as have been planned given the adherence to all recommendations and prescribed mitigation measures.

The Elandsfontein Colliery comprises of two mining rights (MR63 and MR314). The applicant plans to combine these two MRAs into one single MRA with associated consolidated Environmental Management Programme (EMPR). In addition, the applicant plans to expand current mining areas and include new open cast and underground mining areas.

The purpose of the specialist study is to provide relevant input into the EIA process and to provide a report for the proposed activities associated with open cast and underground mining. This report, after taking into consideration the findings and recommendations provided by the specialist herein, should inform and guide the Environmental Assessment Practitioner (EAP) and regulatory authorities, enabling informed decision making, as to the ecological viability of the proposed project.

Various soil forms were identified during the site assessment, of which four soil forms were classed as having a land capability class II, three being classified as class III and one soil form regarded as class IV. Additionally, all wetland areas have been grouped together as a land capability class V given wetland properties with all disturbed/mining areas disregarded given the lack of natural soil properties.

The latter mentioned land capability classes were then classified into three different land potential categories. Land capability class II and III is classified as a land potential level II with the land capability class IV being scored a land potential level III. All wetland areas (class V) have been classified as a “vlei” land potential. These land potential levels have been determined by means of a combination of land capability (i.e. depths, clay percentage etc.) and climatic conditions. Of all three land potential levels, the level 2 land potential is most sensitive with the land potential “vlei” being the least sensitive.

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

July 2020

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Figures

1. Introduction & Background

The Elandsfontein Colliery comprises of two mining rights (MR63 and MR314). The applicant plans to combine these two MRAs into one single MRA with associated consolidated Environmental Management Programme (EMPR). In addition, the applicant plans to expand current mining areas and include new open cast and underground mining areas.

One site assessment was carried out in March 2020 which has also been supplemented by a hydropedological assessment carried out in August 2019.

The purpose of the specialist study is to provide relevant input into the EIA process and to provide a report for the proposed activities associated with open cast and underground mining. This report, after taking into consideration the findings and recommendations provided by the specialist herein, should inform and guide the Environmental Assessment Practitioner (EAP) and regulatory authorities, enabling informed decision making, as to the ecological viability of the proposed project.

2. Document Structure

The table below provides the NEMA (2014) Requirements for Ecological Assessments, and also the relevant sections in the reports where these requirements are addressed:

GNR 326	Description	Section in the Report
Specialist Report		
Appendix 6 (a)	A specialist report prepared in terms of these Regulations must contain— details of— i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Page 3
Appendix 6 (b)	A declaration that the specialist is independent in a form as may be specified by the competent authority;	Appendix iv
Appendix 6 (c)	An indication of the scope of, and the purpose for which, the report was prepared;	Section 1
Appendix 6 (cA)	An indication of the quality and age of base data used for the specialist report;	Section 1
Appendix 6 (cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 10
Appendix 6 (d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 1
Appendix 6 (e)	A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 7
Appendix 6 (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 9
Appendix 6 (g)	An identification of any areas to be avoided, including buffers;	Section 9 and 10
Appendix 6 (h)	A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 10
Appendix 6 (i)	A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 13
Appendix 6 (j)	A description of the findings and potential implications of such findings on the impact of the proposed activity [including identified alternatives on the environment] or activities;	Section 10
Appendix 6 (k)	Any mitigation measures for inclusion in the EMPr;	Section 11
Appendix 6 (l)	Any conditions for inclusion in the environmental authorisation;	Section 12.2 and 12.3
Appendix 6 (m)	Any monitoring requirements for inclusion in the EMPr or environmental authorisation;	11
Appendix 6 (n)	A reasoned opinion— i. [as to] whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and 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 12.2 and 12.3
Appendix 6 (o)	A description of any consultation process that was undertaken during the course of preparing the specialist report;	None
Appendix 6 (p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	None
Appendix 6 (q)	Any other information requested by the competent authority.	None

3. Specialist Details

3.1 Report Writer and Fieldwork

Ivan Baker

Ivan Baker is Cand. Sci Nat registered (119315) in environmental science and geological science. Ivan is a wetland and ecosystem service specialist, a hydropedologist and pedologist that has completed numerous specialist studies ranging from basic assessments to EIAs. Ivan has carried out various international studies following FC standards. Ivan completed training in Tools for Wetland Assessments with a certificate of competence and completed his MSc in environmental science and hydropedology at the North-West University of Potchefstroom.

3.2 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.

Wayne Jackson

Wayne Jackson is a Soils Scientist & Hydrologist and has 11 years' experience in the classification of soils, and the delineation and assessment of wetlands. Wayne completed a B.Sc. degree (Soil Science and Hydrology) from the University of Kwa-Zulu Natal and has 11 years of consulting experience. Wayne Jackson is Pr Sci Nat registered (119037).

4. Terms of Reference

The Terms of Reference (ToR) for this study include the following:

- Conducting a pedology 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;
- The findings from the study were used to determine the existing land capability and current land use of the entire surface area of the relevant portions of the project area;
- For the underground mining areas, identification of soils was done in random patterns with 100 m grids being assessed for the open cast sections. 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.

- Soils samples were taken from the top-and subsoils relevant to the proposed open cast mining areas and sent of to Nvirotek labs for a standard and textural analysis.

5. Project Description

5.1 Project area

The Elandsfontein Colliery is located in the Witbank Coal Field on the farm Elandsfontein 309 JS. The property is approximately 16 km west of the town of Witbank in the Mpumalanga Province, South Africa. The centre point of the site is 25°53'05.01"S and 29°05'36.57"E. The Elandsfontein Colliery comprises 2 distinct mining rights (MR314 and MR63). The applicant plans to consolidate the two mining right areas into a single mining right with associated consolidated EMPR. In addition, the applicant wishes to expand their existing mining operations to include additional mineral resource areas (i.e.: new open cast & underground areas within the consolidated mining right boundary) (GSW, 2019). The dominant land uses surrounding the project area includes watercourses, cultivation, urban sprawls and mining. A locality map of the project area is shown in Figure 5-1.

5.2 Background

Elandsfontein Colliery is an existing mine with opencast and underground sections. Elandsfontein Colliery holds two mining rights, namely MP 314 MR (~593 ha) and MP 63 MR (~237 ha). It produces coal for the local and the export market, at a rate of ~500 000 tons/annum. Coal has been produced historically from the No. 1 Seam (underground bord and pillar operation) and an opencast operation on the No. 4 Seam and on the No. 2 Seam.

The roll over strip mining method is utilised to extract coal from the shallower No.2 coal seam. The existing opencast operations have an approximate extent of 257 ha (some of this area has already been mined and other areas are currently being mined in accordance with the previous approved mine plan) while the applicant wishes to authorise an additional 69.47 ha of opencast mining. Deeper coal will be extracted by underground bord and pillar mining using decline shafts to access the No. 1 coal seam. The historical underground footprint covers an approximate area of 182 ha, while Elandsfontein Colliery wishes to authorise an additional 485 ha of underground mining and 249 ha of opencast mining. Associated infrastructure consists of a discard dump, coal RoM stockpiles, overburden stockpiles, pollution control dams (PCD) and slurry dam.

Elandsfontein Colliery is planning to add additional opencast and underground mining areas within the existing mining right areas to extend the life-of-mine (LoM). As such a MPRDA S102 amendment process is being undertaken by the mine, supported by the integrated EIA/WML and WULA applications. The EIA process will result in a consolidation of the numerous

authorisation processes that have been undertaken to date to produce a single overarching EMPr for holistic management of the Colliery going forward. Elandsfontein Colliery will be applying for the relevant approvals to cover their extended LoM which will include future opencast and underground mining operations and associated infrastructure. Various amendments to the existing EA/EMP as well as IWUL will also be applied for to align the specific conditions with the current status of the mine as well as to provide more clarity on certain conditions.

The following rights, authorisations and approvals are currently in place and have been considered in the compilation of the report:

- Mining Right 63 MR renewal, granted to Elandsfontein Colliery (Pty) Ltd, in terms of Section 24 (3) of the MPRDA on 6 August 2019 which covers the following portions of the farm Elandsfontein 309 JS: Portion of the RE of Portion 6, Portion of the RE of Portion 8 and RE of Portion 1.
- Mining Right 314 MR renewal, granted to Elandsfontein Colliery (Pty) Ltd, in terms of Section 24 (3) of the MPRDA on 6 August 2019 which covering the following portions of the farm Elandsfontein 309 JS: RE of Portion 7, Portion of the RE of Portion 8, Portion 44 and Portion 14;
- An amended EMPr dated August 2017;
- Approved IWUL, File No. 16/2/7/B100/C11 granted on 20 October 2015 for various S21 (g), (c) and (i) which covers Portions 1, 7, 8 and 14 of Elandsfontein 309 JS (amended 23 July 2019).

The existing approved surface infrastructure at Elandsfontein Colliery consists of the following:

- Opencast pit;
- Underground mining areas;
- Stockpiles;
- Offices;
- Beneficiation Plant area (crushing and screening);
- Contractors yard;
- Weighbridge;
- Access and haul roads;
- Security point and fencing;
- Pumps and sumps;
- Clean water trenches;
- Dirty water trenches;
- 3 PCD’s; and

- Storm water control trenches.

5.3 Description of Activities to Be Undertaken

This section describes the current authorization process activities as provided. The proposed project includes inter alia the following application processes with associated activities:

- New Integrated Environmental Authorisation (Scoping and Environmental Impact Report (S&EIR)) for:
    - New opencast and underground mining areas;
    - New PCDs and stormwater management infrastructure;
    - New residue deposits and/or residue stockpiles (requiring Waste Management Licence); and
    - Various activities including the primary processing of a mineral resource related to the extended LoM.
- Renewal of Integrated Water Use Licence (IWUL) and application for new water uses for:
    - Residue stockpiles/deposits;
    - Dewatering of pits and underground areas;
    - New PCD's and stormwater management infrastructure; and
    - GN704 exemptions.
- MPRDA Section 102 Amendment:
    - Revised Mine Works Programme;
    - Revised Social and Labour Plan;
    - Revised Regulation 2.2 Plan; and
    - Revised consolidated EMPr.

The proposed mining can be seen in Figure 5-2 whereas the proposed surface infrastructure, stockpiles and the related activities can be seen in Figure 5-3

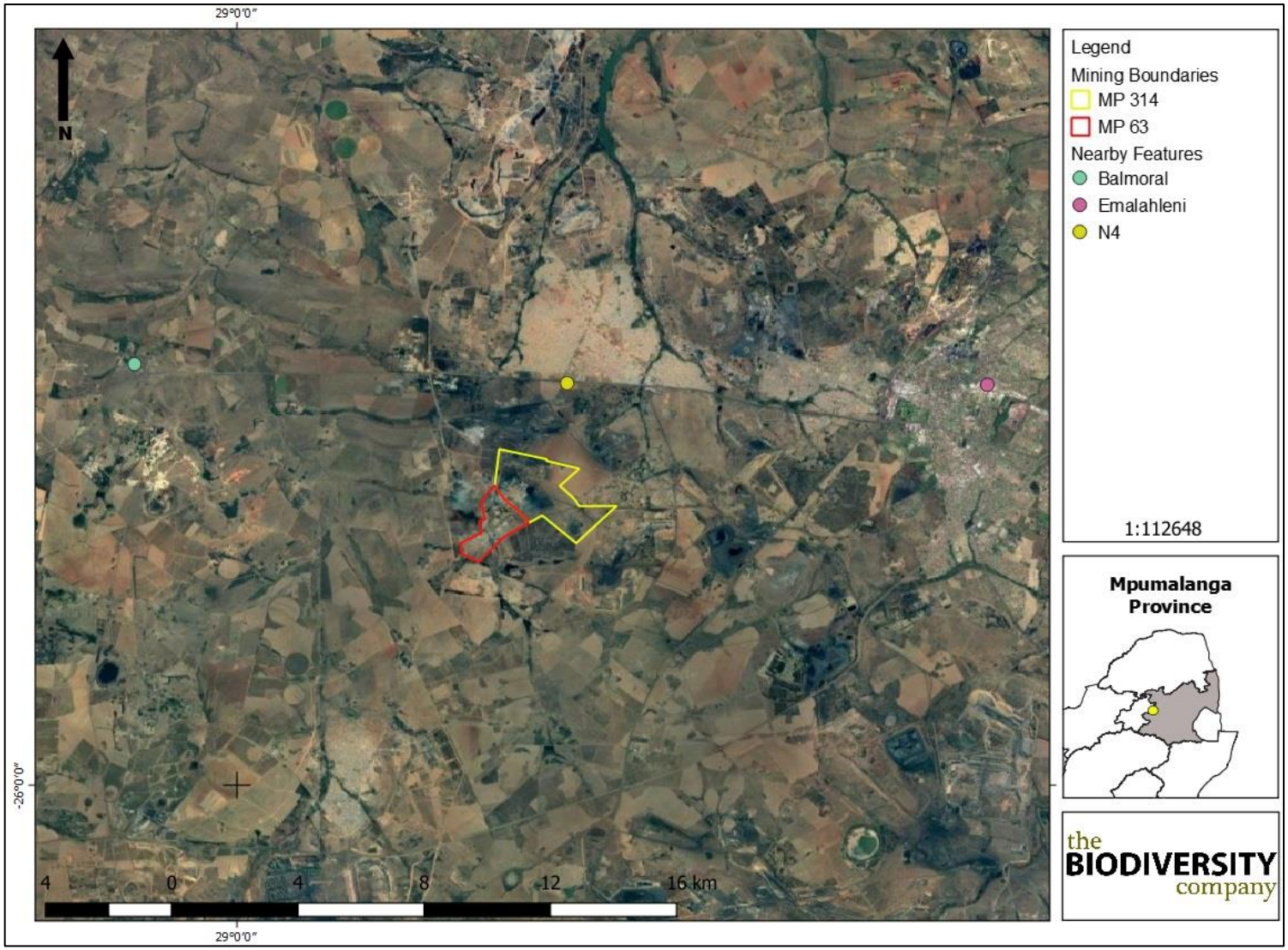

Figure 5-1 Locality map of the project area

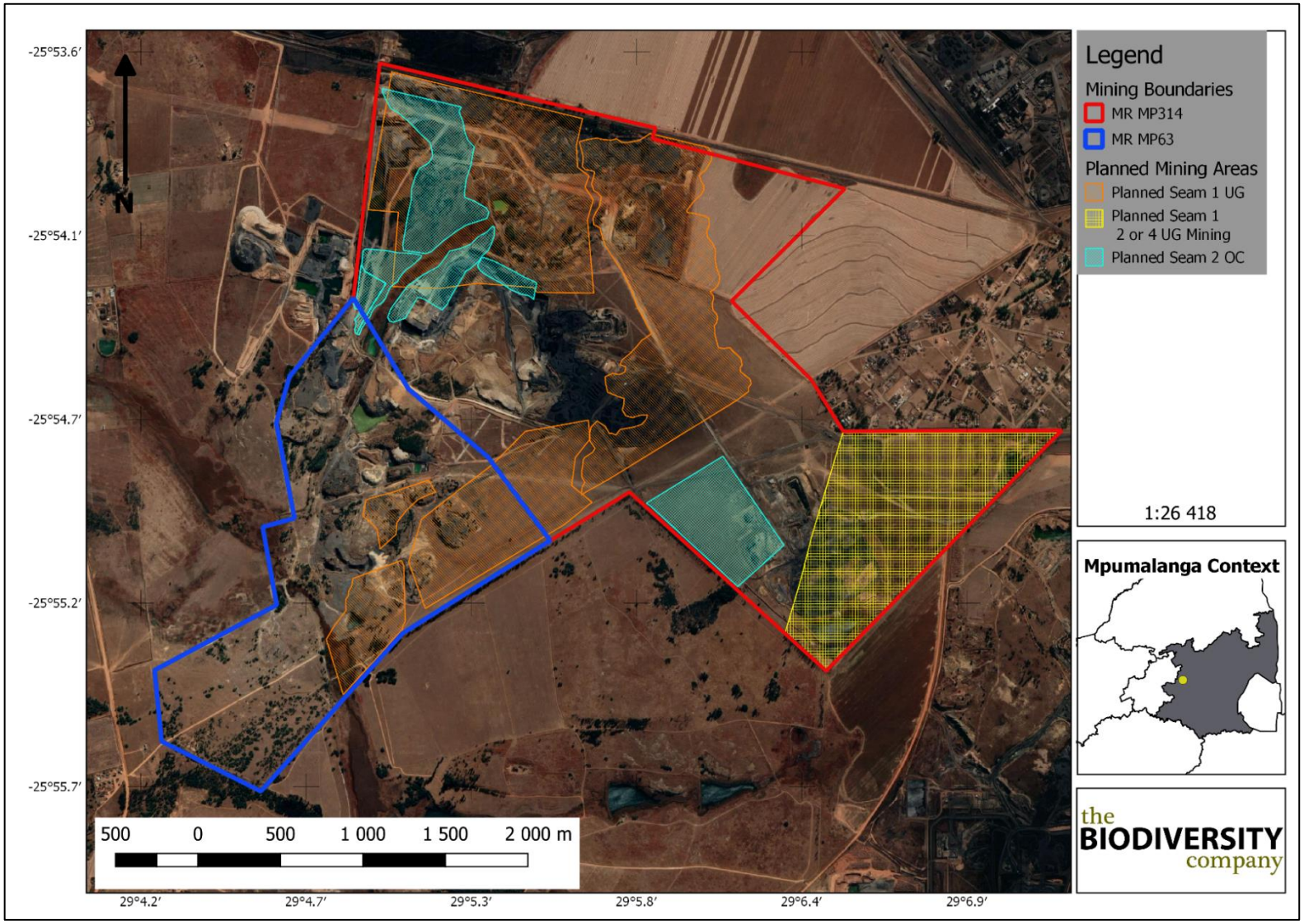

Figure 5-2 Extent of proposed open cast and underground mining areas

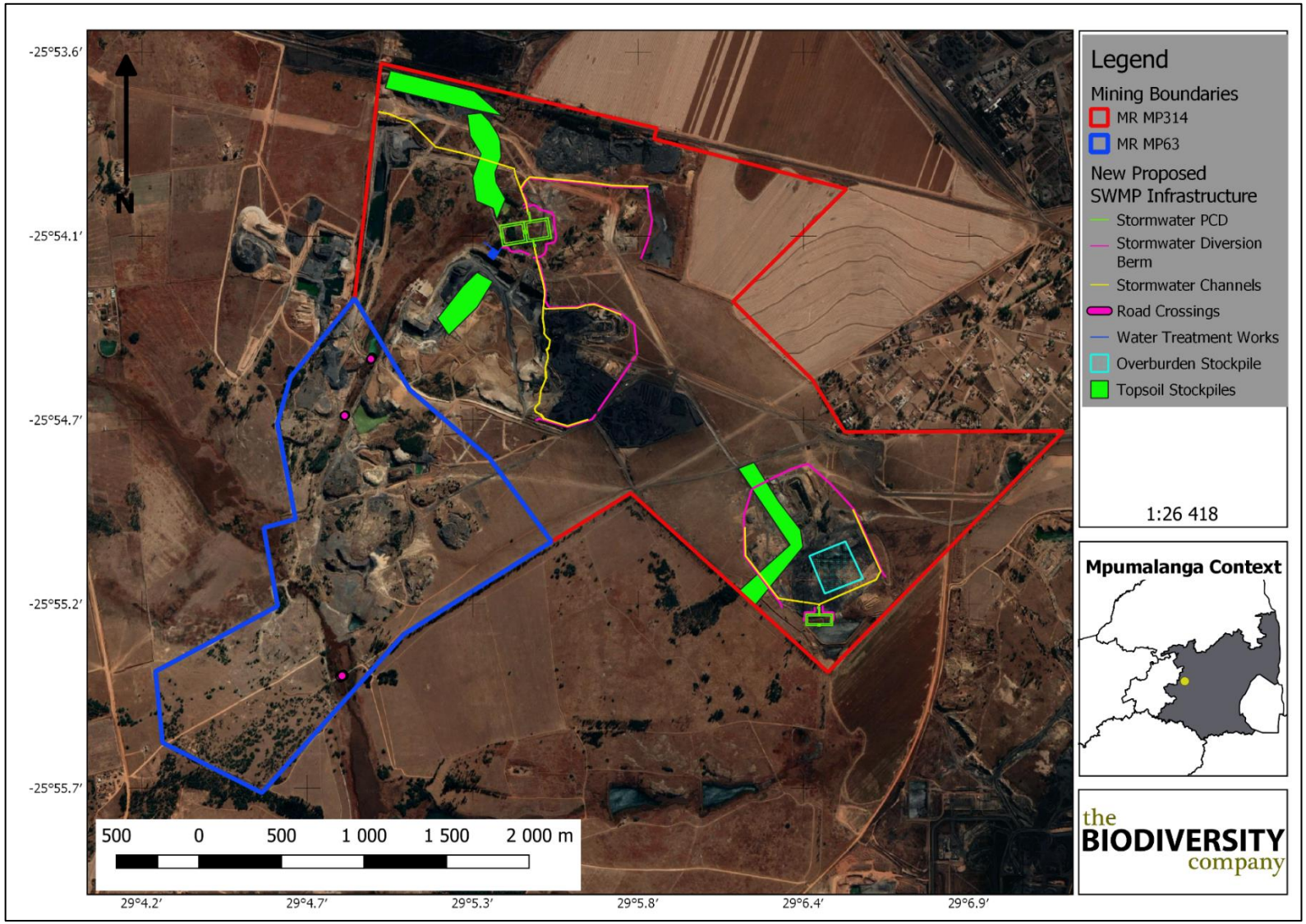

Figure 5-3 Layout map indicating new stormwater management infrastructure

6. Legislative and Policy Framework

Currently, various pieces of legislation and related policies exist that guide and direct the land user in terms of land use planning both on a national and provincial level. This legislation includes, but is not limited to:

- The Constitution of the Republic of South Africa (Act 108 of 1996);
- Sub-division of Agricultural Land Act (Act 70 of 1970);
- Municipal Structures Act (Act 117 of 1998);
- Municipal Systems Act (Act 32 of 2000); and
- Spatial Planning and Land Use Management Act, 16 of 2013 (not yet implemented).

The above mentioned are supported by additional legislation that aims to manage the impact of development on the environment and the natural resource base of the country. Related legislation to this effect includes:

- Conservation of Agricultural Resources Act (Act 43 of 1983);
- Environment Conservation Act (Act 73 of 1989);
- National Environmental Management Act (Act 107 of 1998); and
- National Water Act (Act 36 of 1998).

6.1 National Environmental Management Act (Act No. 107 of 1998)

The National Environmental Management Act (NEMA) (Act 107 of 1998) and the associated Regulations as amended in April 2017, states that prior to any development taking place within a wetland or riparian area, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment Report (BAR) process or the Environmental Impact Assessment (EIA) process depending on the scale of the impact.

7. Methodologies

7.1 Desktop Assessment

The elevation and slope percentage of the project area will be determined by means of SAGA software, which will be used to determine the agricultural potential of the site.

7.2 Field Survey

The site will be traversed by vehicle and on foot. A soil auger will be used to determine the soil form/family and depth. The soil will be 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.

7.3 Agricultural Potential Assessment

Land capability and agricultural potential will be 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 **Invalid source specified.**

Land capability is divided into eight classes and these may be divided into three capability groups. Table 7-1 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 7-1 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 7-2. The final land potential results are then described in Table 7-2.

Table 7-2 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 7-3 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

7.4 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.

7.5 Soil Sampling

The topsoil and subsoil of ten soil profiles in selected undisturbed areas (especially focussing on proposed open cast areas) (see Figure 7-1) were sampled and sent off to the Nvirotek Lab for fertility testing. The results from these tests are attached as an appendix.

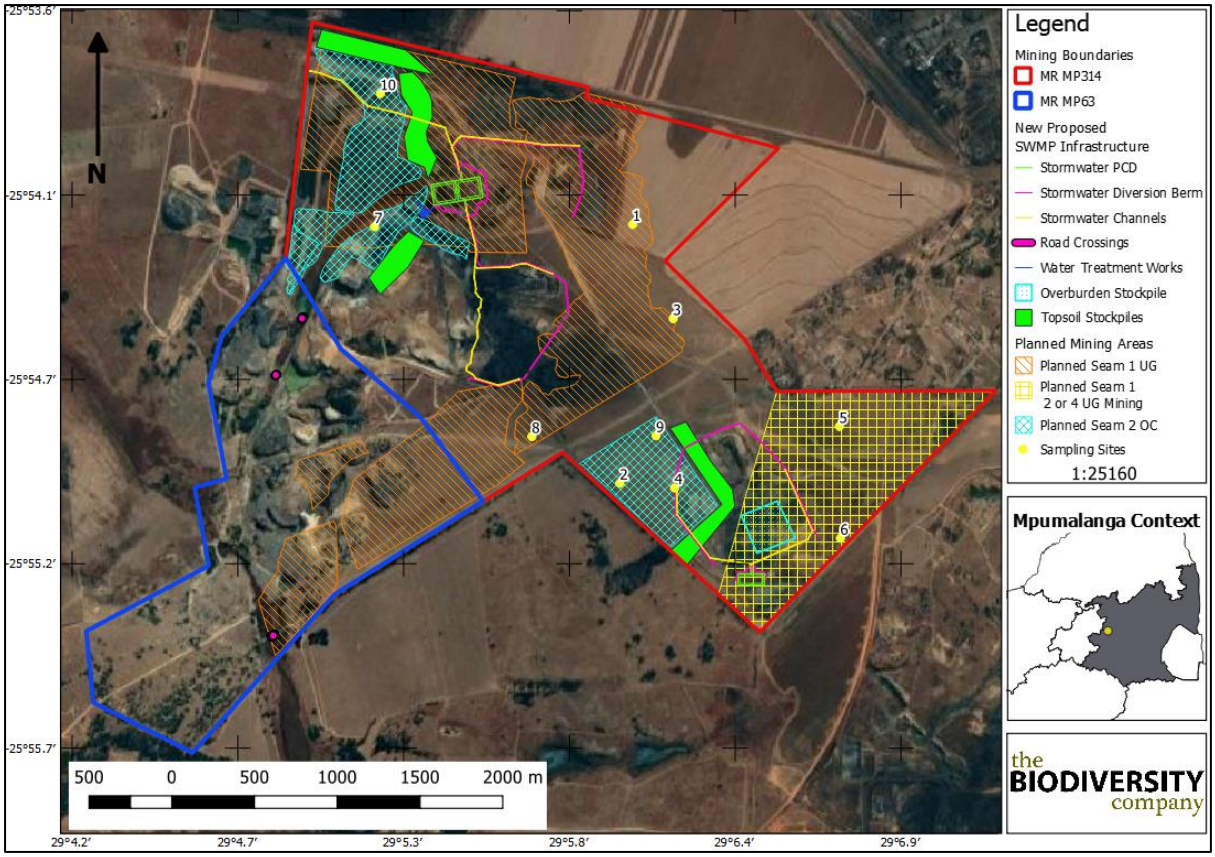

Figure 7-1 Sampling sites relevant to the MRA

8. Receiving Environment

8.1 Desktop Assessment

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

8.1.1 Soils and Geology

According to the land type database (Land Type Survey Staff, 1972 - 2006), the project area is characterised by the Bb 13 and the Ba 5 land types. Figure 8-1 illustrates the respective terrain units relevant to the Bb 13 land type with the expected soils illustrated in Table 8-1. Figure 8-2 illustrates the respective terrain units relevant to the Ba 5 land type with the expected soils illustrated in Table 8-2.

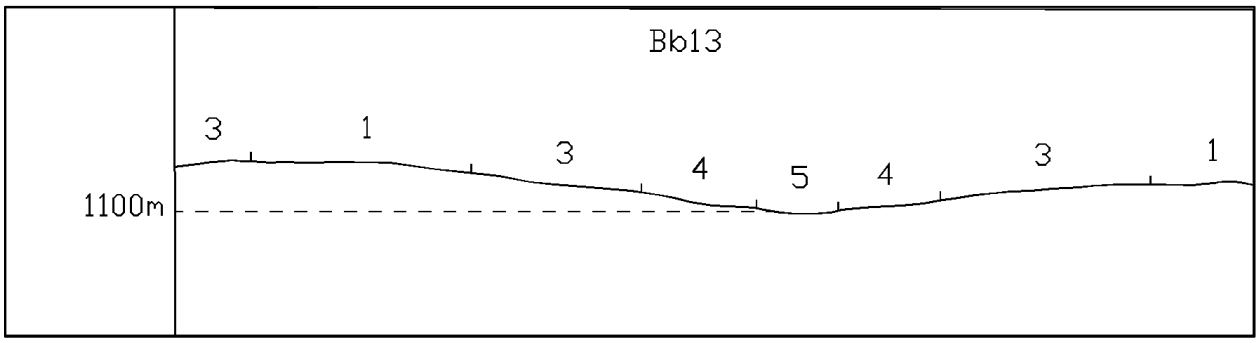

Figure 8-1 Illustration of land type Bb 13 terrain units (Land Type Survey Staff, 1972 - 2006)

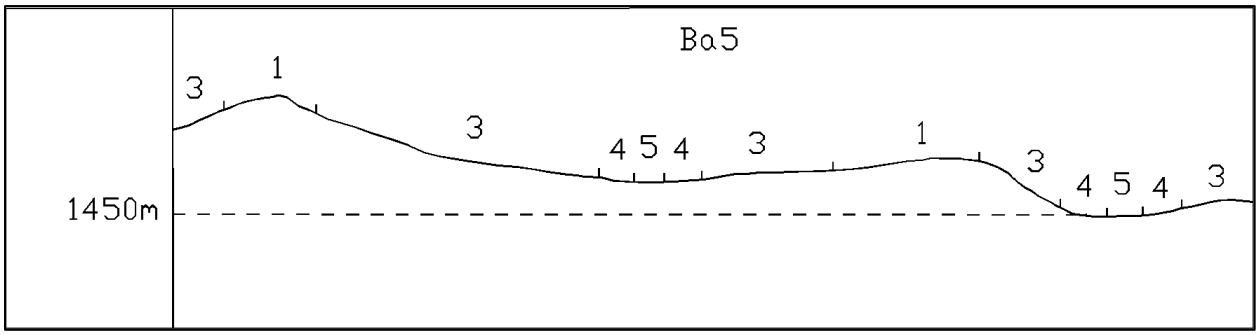

Figure 8-2 Illustration of land type Ba 5 terrain units (Land Type Survey Staff, 1972 - 2006)

Table 8-1 Soils expected at the respective terrain units within the Bb 13 land type (Land Type Survey Staff, 1972 - 2006)

Terrain units							
1 (40%)		**3 (45%)**		**4 (10%)**		**5 (5%)**	
Clovelly	45	Avalon	35	Avalon	30	Karspruit	40
Glencoe	25	Clovelly	35	Longlands	25	Kroonsdad	30

Hutton	15	Hutton	10	Kroonstad	15	Furnwood	20
Avalon	15	Glencoe	10	Glencoe	10	Longlands	10
		Longlands	5	Wasbank	10		
		Kroonstad	5	Fernwood	10		

Table 8-2 Soils expected at the respective terrain units within the Ba 5 land type (Land Type Survey Staff, 1972 - 2006)

Terrain units							
1 (20%)		**3 (60%)**		**4 (15%)**		**5 (5%)**	
Hutton	60	Hutton	40	Hutton	25	Rensburg	50
Glenrosa	20	Avalon	15	Avalon	15	Katspruit	30
Clovelly	10	Glencoe	10	Longlands	15	Swartland	20
		Glenrosa	10	Kroonstad	10		
		Clovelly	5	Bonheim	10		
		Longlands	5	Clovelly	10		
		Swartland	5	Swartland	5		
		Wasbank	5	Glencoe	5		
		Mispha	5	Wasbank	5		

The geology of this region is characterised by the Pretoria group and the Witwatersrand Subgroup's quartzite ridges as well as the Rooiberg Group's Selons River Formation which is from the Transvaal Supergroup. The parent geology from this vegetation type supports shallow soils like Glenrosa and Mispah which typically forms on slopes and ridges where topsoil is likely to wash off (Mucina & Rutherford, 2006).

8.1.2 Climate

The climate for the Rand Highveld Grassland is characterised by a summer rainfall with a mean annual precipitation of 654mm which is slightly lower in the western parts of this vegetation type see (Figure 8-3). These areas are known to have warm-temperate conditions with dry winters. The likelihood of frost however is greater in the western parts with the incidence of frost ranging from 30 to 40 days compared to the east which has a frost incidence of 10 to 35 days (Mucina & Rutherford, 2006). This vegetation type is also classified as endangered even though very little conservation has been done for this vegetation type.

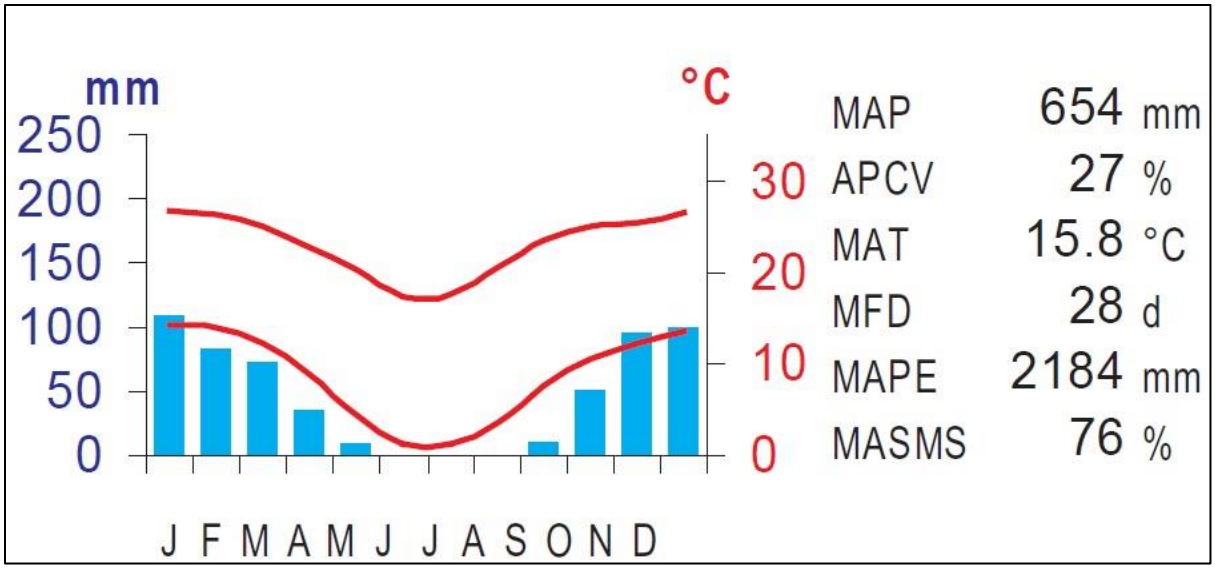

Figure 8-3 Climate for the Rand Highveld Grassland (Mucina & Rutherford, 2006)

8.1.3 Terrain

The Digital Elevation Model (DEM) indicates a range in elevation of 1 477 Metres Above Sea Level (MASL) to 1 571 MASL (see Figure 8-4).

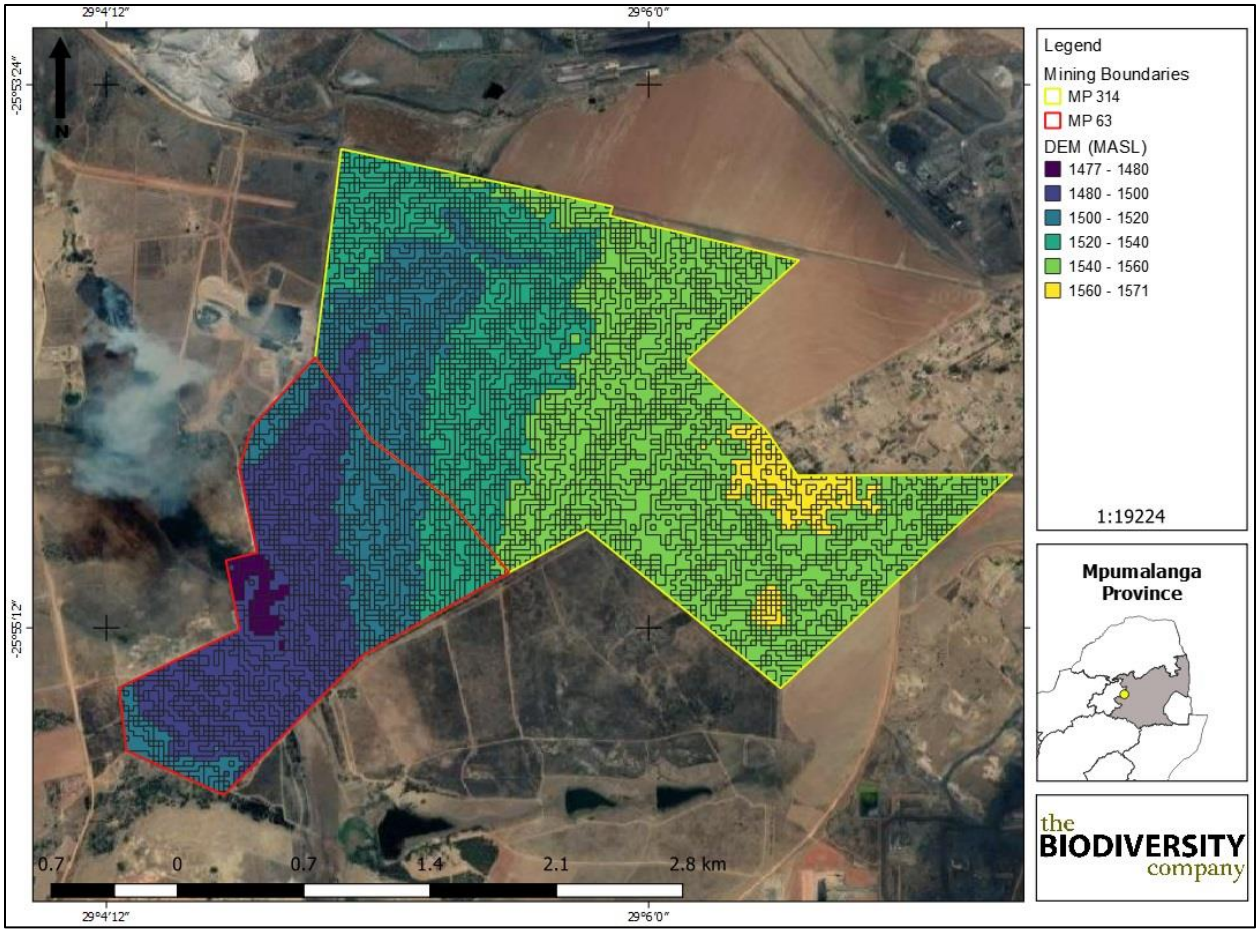

Figure 8-4 Digital elevation model (MASL)

The MRA is predominantly characterised by a slope percentage of between 0 and 1%, with some areas being characterised by steeper slopes of up to 2.9% (see Figure 8-5). This phenomenon indicates a gentle slope with a steep slope in areas disturbed by mining activities (i.e. waste impoundments).

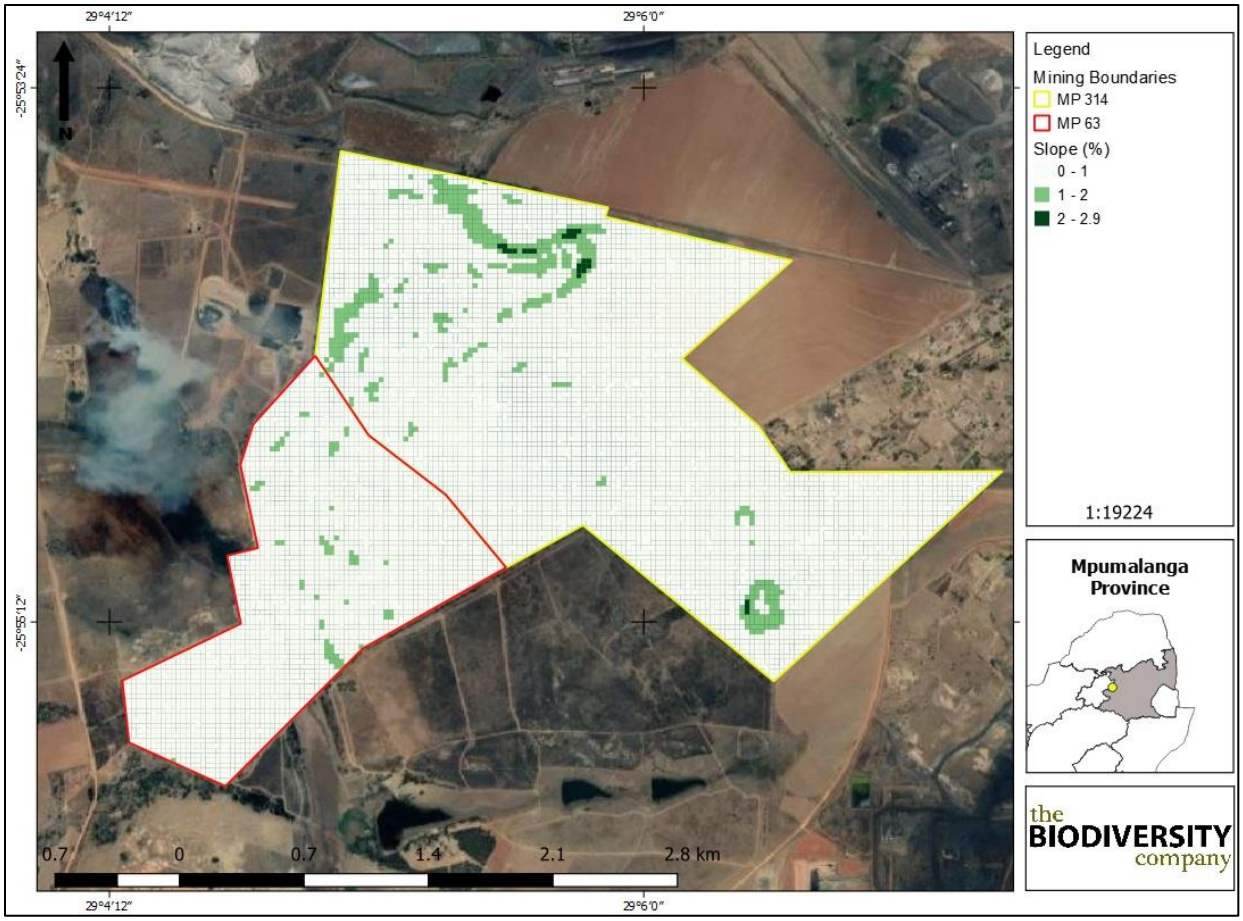

Figure 8-5 Slope percentage

8.2 Field Survey

8.2.1 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. During the site assessment, various soil forms were identified. These soil forms have been delineated and illustrated in Figure 8-6and described in according to depth, clay percentage, indications of surface crusting, signs of wetness and percentage rock.

All of the hydromorphic soils identified have similar properties and depths and has therefore been labelled as “hydromorphic soils” rather than individual soil forms. More information about the hydromorphic soils and their properties are discussed in a recent wetland assessment for the site (TBC, 2020).

Nine soil forms were identified within the MRA (see Figure 8-6) with some areas classified as “Not Assessed” and others classified as “Disturbed” (see Section 14.4 for justification of this limitation). Some of these notable soil forms identified within the MRA are illustrated in Figure 8-7, Figure 8-8 and Figure 8-9.

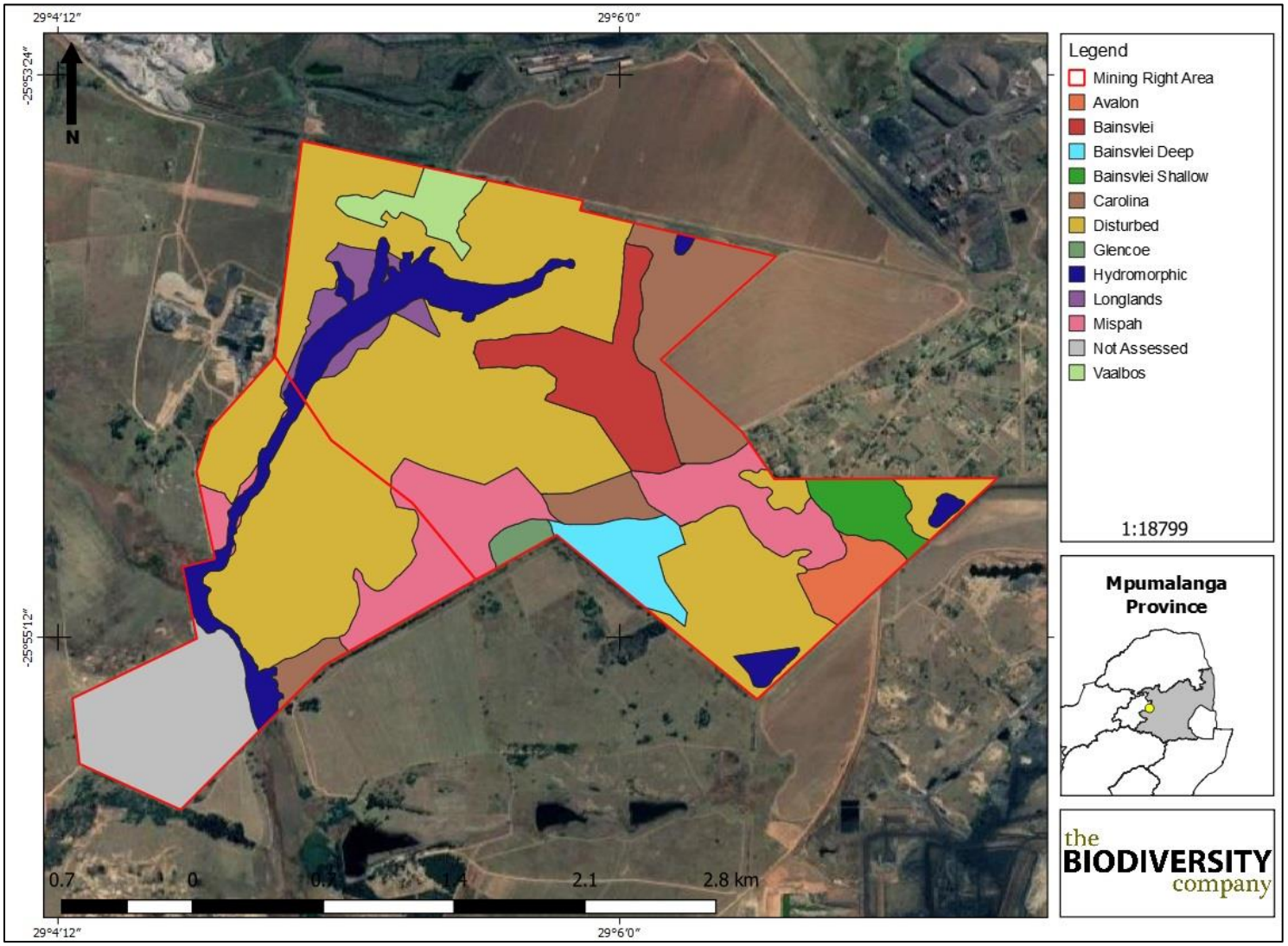

Figure 8-6 Soil delineations within the project area

Table 8-3 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	300	0-15	None	0	None	N/A				N/A			
Glencoe	300	0-15	None	0	None	300 – 1 200	0 - 15	None	0	N/A			
Vaalbos	300	0-15	None	R3	None	300 - 900	0-15	None	0	N/A			
Carolina	300	0-15	None	0	None	300 – 1 200	0-15	None	0	N/A			
Longlands	300	15-35	W3	0	None	300 – 1 100	0-15	W3	0	> 1 100	15-35	W3	0
Hydromorphic soils	300	15-35	W3	0	None	300 – 600	> 35	W3	0	> 600	>35	W3	0
Avalon	300	0-15	0	0	None	300 - 600	0-15	None	0	> 600	15-35	W1	R1
Bainsvlei (Shallow)	300	0-15	0	R2	None	300 – 1 000	0-15	None	R2	> 1 000	0-15	W1	R1
Bainsvlei (Deep)	300	0-15	0	0	None	300 – 2 400	0-15	None	R1	>2 400	15-35	W1	0

R1) 2-10% Rockiness

R2) 10-20% Rockiness

R3) 20-30% Rockiness

W3) Periodically wet, mottling occurs within top 200 mm.

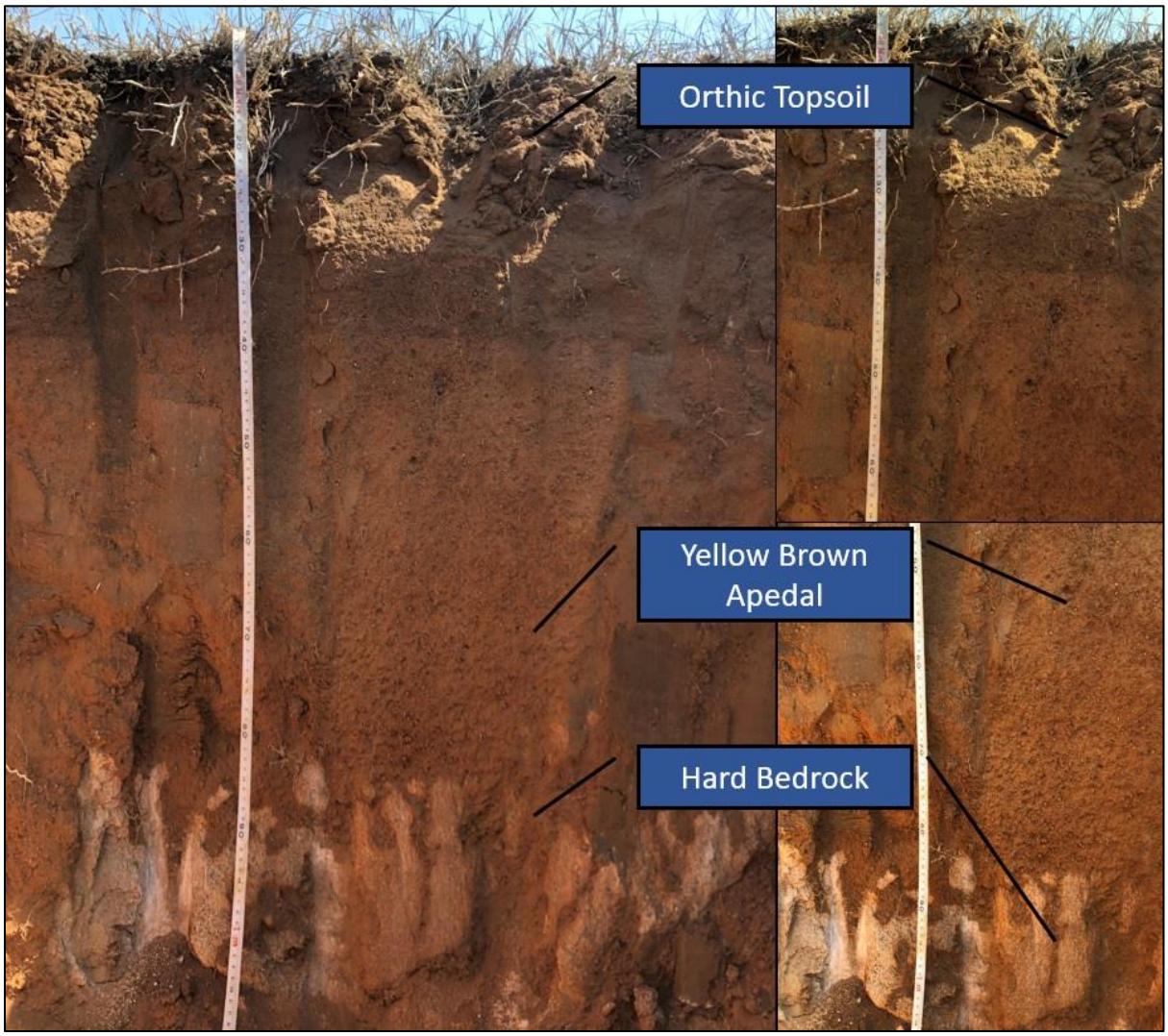

Figure 8-7 Carolina soil form

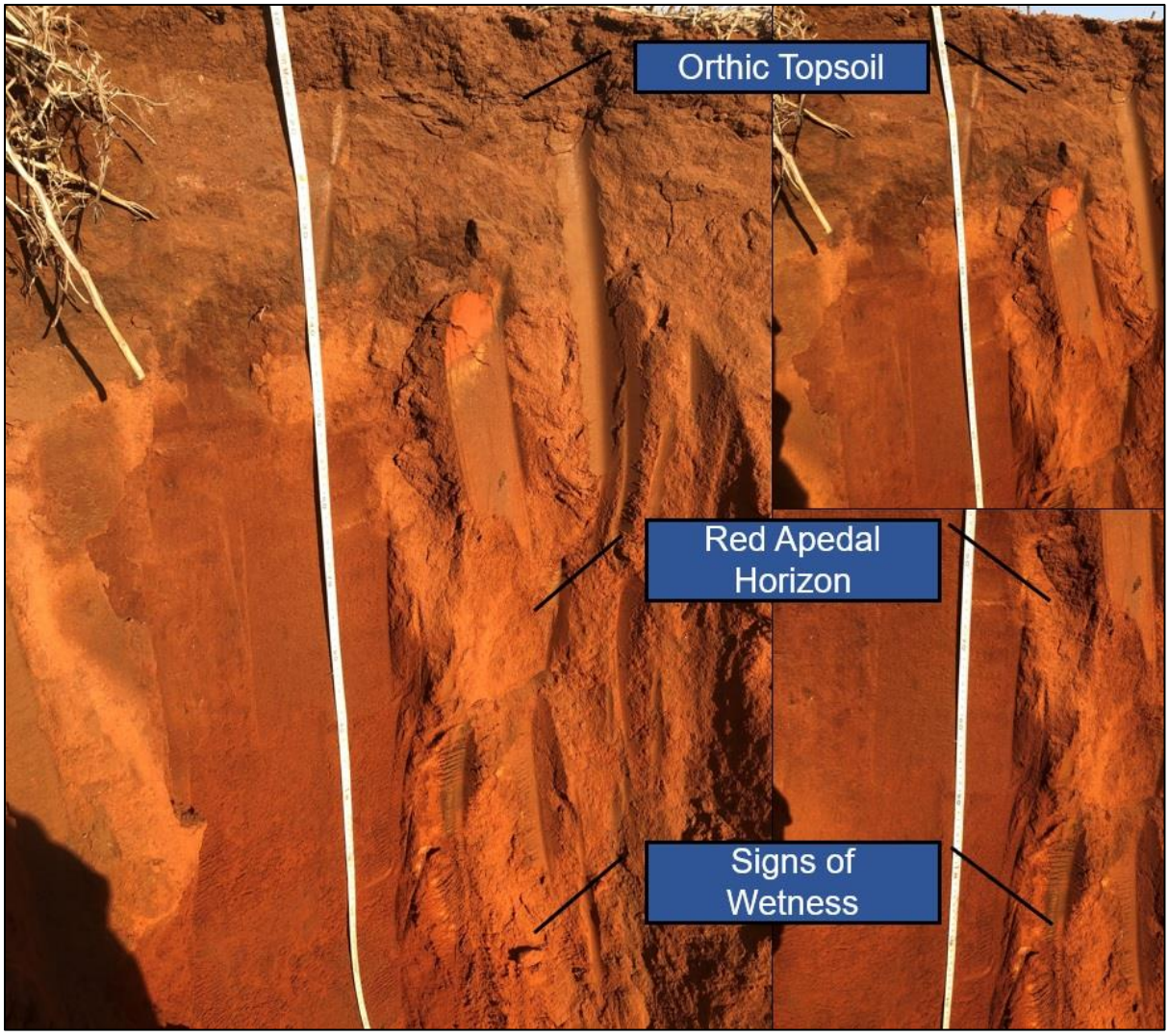

Figure 8-8 Bainsvlei Soil Form

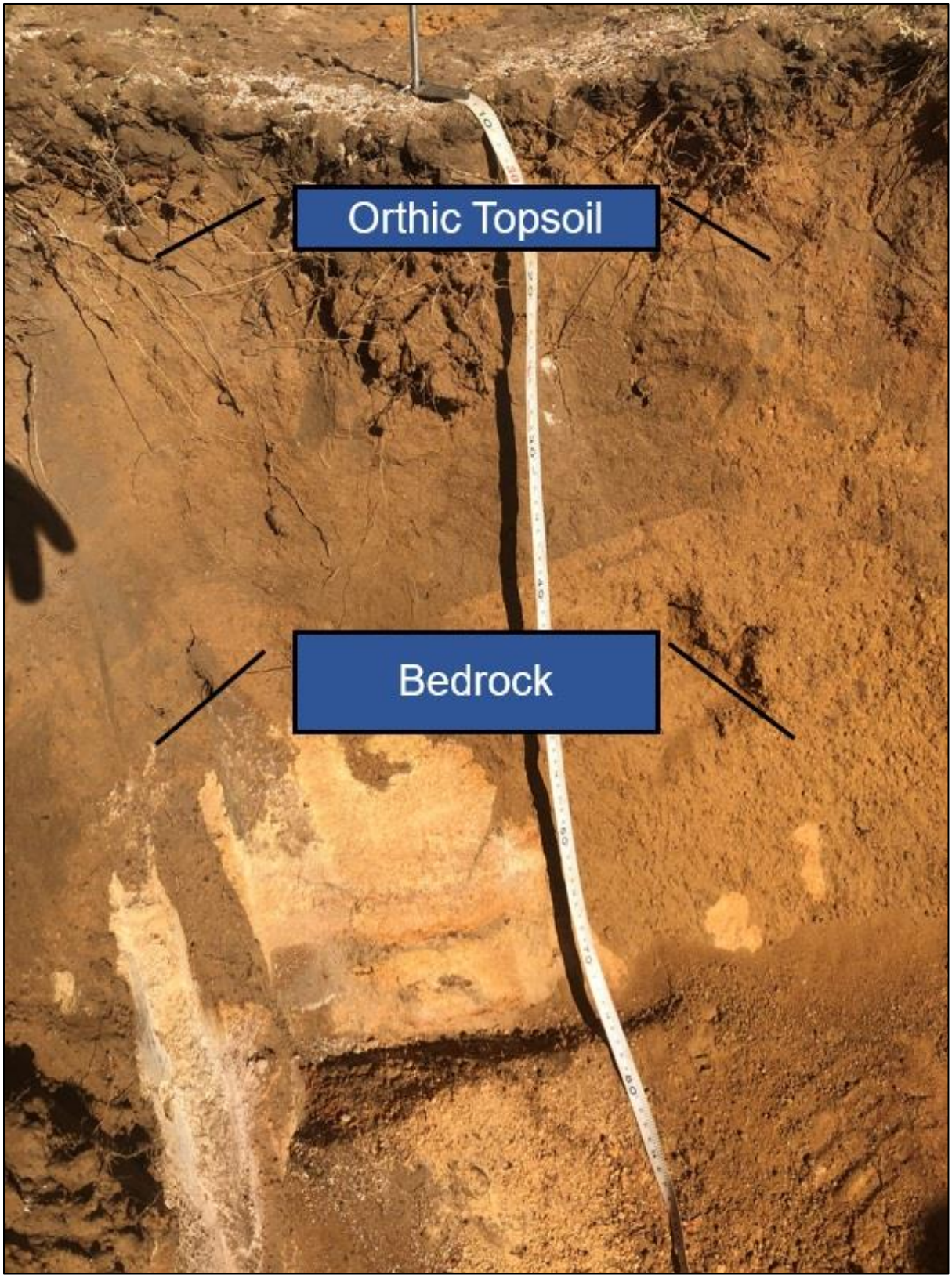

Figure 8-9 Mispah Soil Form

8.2.2 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.

8.2.1.1 Climate Capability

The climate capability for this region was determined to be C2 classification. The C2 climate capability class is characterised by a local climate which is favourable for a wide range of adapted crops and year-round growing season. Moisture stress and lower temperatures increase risk and decrease yields relative to C1 (Smith, 2006).

8.2.1.2 Land Capability (Smith, 2006)

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 7-1. The land capability for the project area is illustrated in Figure -8-10 and described in Table 8-4. It is worth noting that the hydromorphic soils have been degraded to a Class V due to wetland indicators within 200 mm from the surface.

Table 8-4 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
Glencoe	Class II	Slight limitations, high arable potential and low erosion hazard	Adequate run-off control	Annual cropping with special tillage or ley (25%)	14.7	Arable Land
Bainsvlei (Deep)						
Bainsvlei (Shallow)						
Vaalbos						
Carolina	Class III	Moderate limitations with some erosion hazard	Special conservation practice and tillage methods	Rotation of crops and ley (50%).	12.8	
Longlands						
Avalon						
Mispah	Class IV	Severe limitations, low arable potential and high erosion hazards.	Intensive conservation practice.	Long-term leys (75%).	11	
Hydromorphic	Class V	Watercourse and land with wetness indicators.	Protection and control of water table.	Improved pastures, suitable for wildlife.	7.5	Grazing

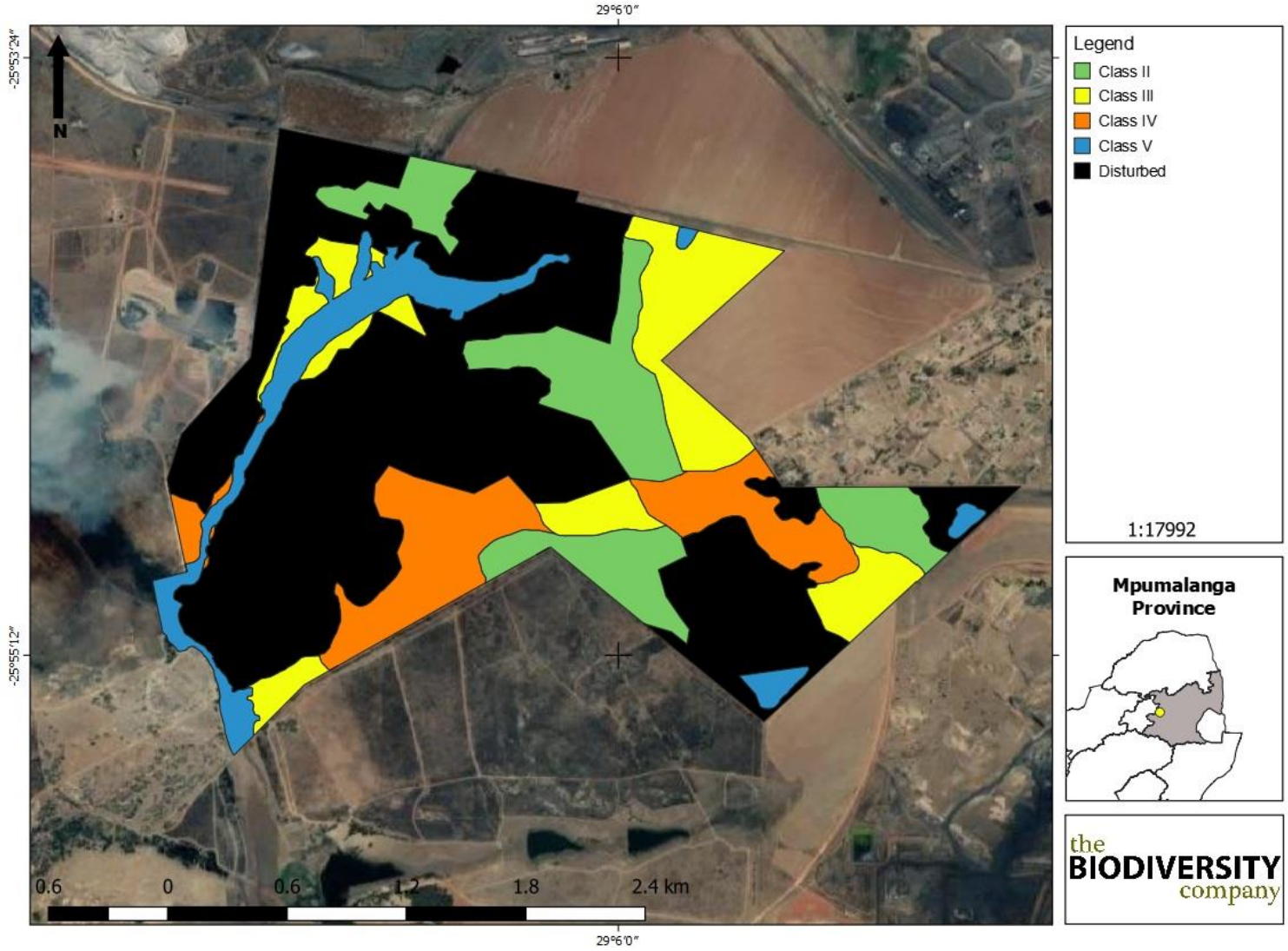

Figure -8-10 Land capability classes for the project area

8.2.1.3 Land Capability (LaRSSA)

The Coaltech/LaRSSA methodology was used in addition to the more detailed Smith (2006) methodology to determine the pre-mining land capability for the area. This has been carried out for post-mining land capability comparisons. The land capability classes as per this methodology are described in Table 8-5 and illustrated in Figure 8-11.

Table 8-5 Land capability for the soils within the project area

Soil Forms	Land Capability Class	Classification Criteria (Pre-Mining)	Classification Criteria (Post-Mining)
Glencoe **Bainsvlei (Deep)** **Bainsvlei (Shallow)** **Vaalbos** **Carolina** **Longlands**	Arable	• Does not qualify as a wetland; • Has soil that is readily permeable to the roots of common cultivated plants throughout a depth of 750 mm from the surface; • Soil pH value between 4.0 and 8.4; • EC of the saturated extract must be less than 400 mS/m; • The soil depth must be greater than 750 mm; • The permeability of the soil must be at least 1.5 mm per hour; • Less than 10% of the soil volume must consist of rock; and • The product of the slope and erodibility factor must be less than 2.0.	• Soil depth >600 mm; • Soil material must not be saline or sodic; • Slope percentage will be such that when multiplied by the soil erodibility factor, the product will not be more than 2.0; and • For typical coal fields, slopes must be flatter than 1:14 and free draining.
Avalon	Grazing	• Does not qualify as a wetland or arable land; • Has soil or soil-like material, permeable to the roots of native plants, that is kore than 250 mm thick and contains less than 50% volume of rocks; and • Supports or is capable of supporting a stand of native or introduced grass species or other forage plants utilisable by domesticated livestock or game animals on a commercial basis.	• Soil depth must exceed 250 mm; and • Slopes must be between 1:7 and 1:14.
Mispah	Wilderness	• Land that has little or no agricultural capability by virtue of being too arid, too saline, too steep or too stony to support plants of economic value; • Its uses lie I the fields of recreation and wildlife conservation. It does however also include watercourses, submerged land, built-up land and excavations; and • Defined by exclusion, namely land that does not qualify as wetland, arable or grazing.	• Soil depth between 150 and 250 mm.

Hydromorphic	Wetland	• Usually a water table present at shallow depth in soil (swamps, marches etc.); • A diagnostic organic horizon at the surface; and • A horizon that is gleyed throughout more than 50% of its volume and is significantly thick, occurring within 750 mm of the surface.	• Soil depth must exceed 250 mm; and • Specific wetland soil used, as stockpiled from pre-mining delineated wetland areas.

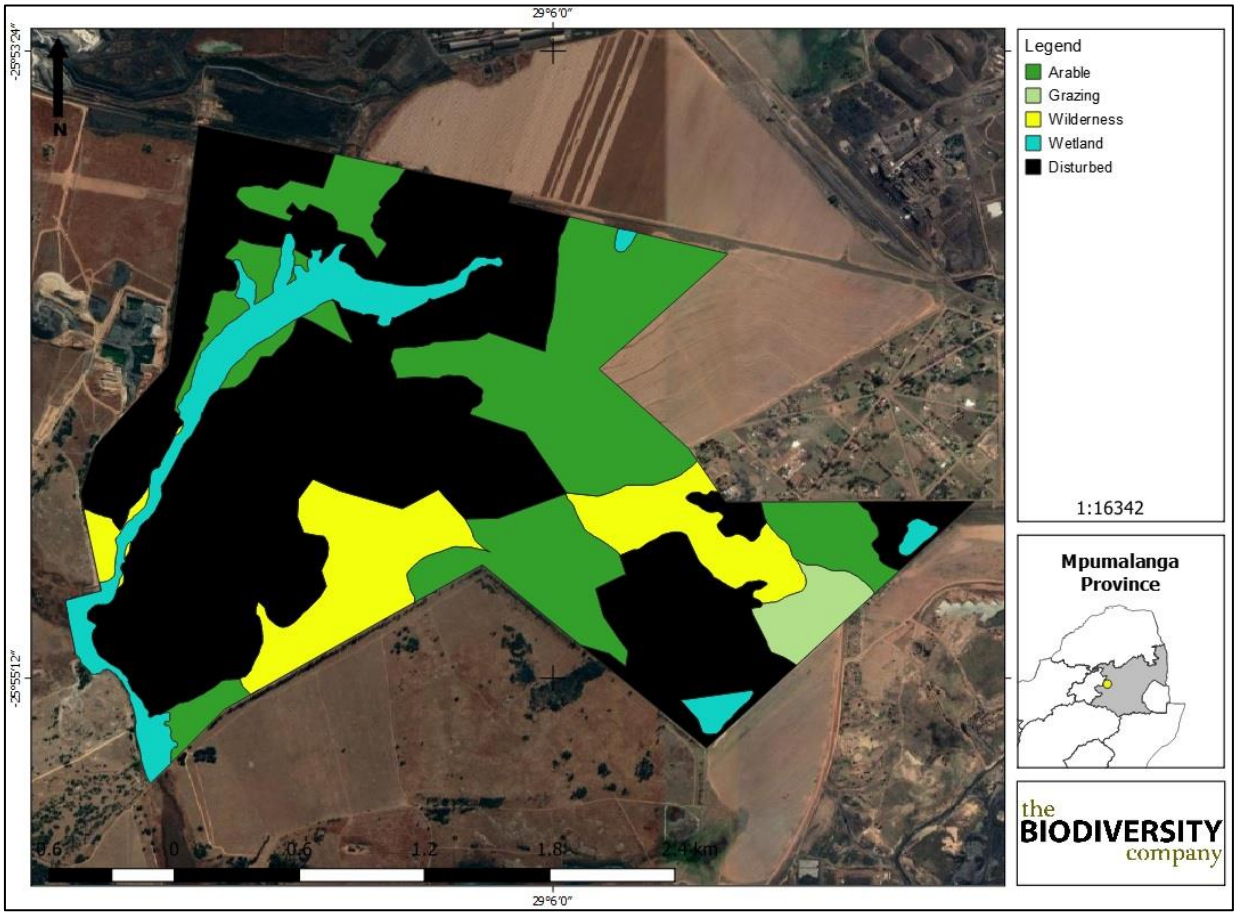

Figure 8-11 Land capability classes (LaRSSA methodology)

8.2.1.4 Land Potential

The land potential of the project area is illustrated in Figure 8-12 and described in Table 8-6. Classes II and III have been merged into a land potential of “L2” whereas class IV has been determined to have a land potential of “L3”. Lastly, the wetland areas classified as class V have been classified as having a land potential of “Vlei”.

Table 8-6 Land potential for the soils within the project area

Soil Forms	Land Capability Class	Land Potential	Size (ha)	Percentage	Description of Land Potential Class
Glencoe **Bainsvlei (Deep** **Bainsvlei (Shallow**	**Class II**	**L2**	**209**	**22%**	**High potential: Infrequent and/or moderate limitations due to the soil, slope, rainfall or temperatures. Appropriate contour protection must be implemented and inspected.**

Vaalbos					
Carolina	**Class III**				
Longlands					
Avalon					
Mispah	**Class IV**	**L3**	**89**	**11%**	**Good potential: Infrequent and/or moderate limitations due to soil, slope, temperature or rainfall. Appropriate contour protection must be implemented and inspected.**
Hydromorphic	**Class V**	**Vlei**	**56**	**7%**	**N/A**

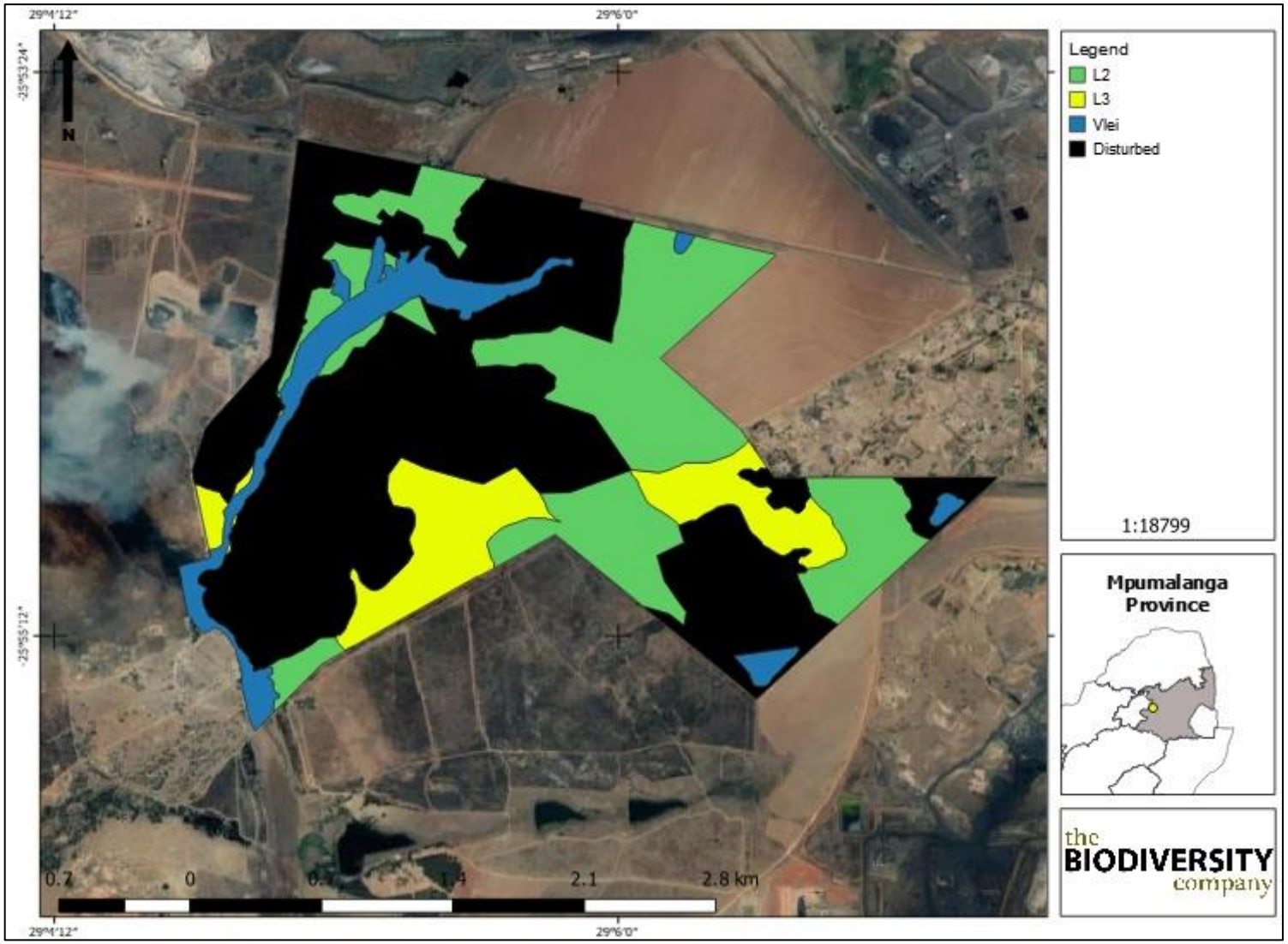

Figure 8-12 Land potential determined for the project area

9. Current Land Use

The project area is approximately 840 ha in size with disturbed areas (mining) taking up approximately 48% of the space, wetlands taking up approximately 7%, crop fields taking up roughly 4% and degraded grassland areas taking up approximately 41% of the project area, see Figure 9-1 to Figure 9-2.

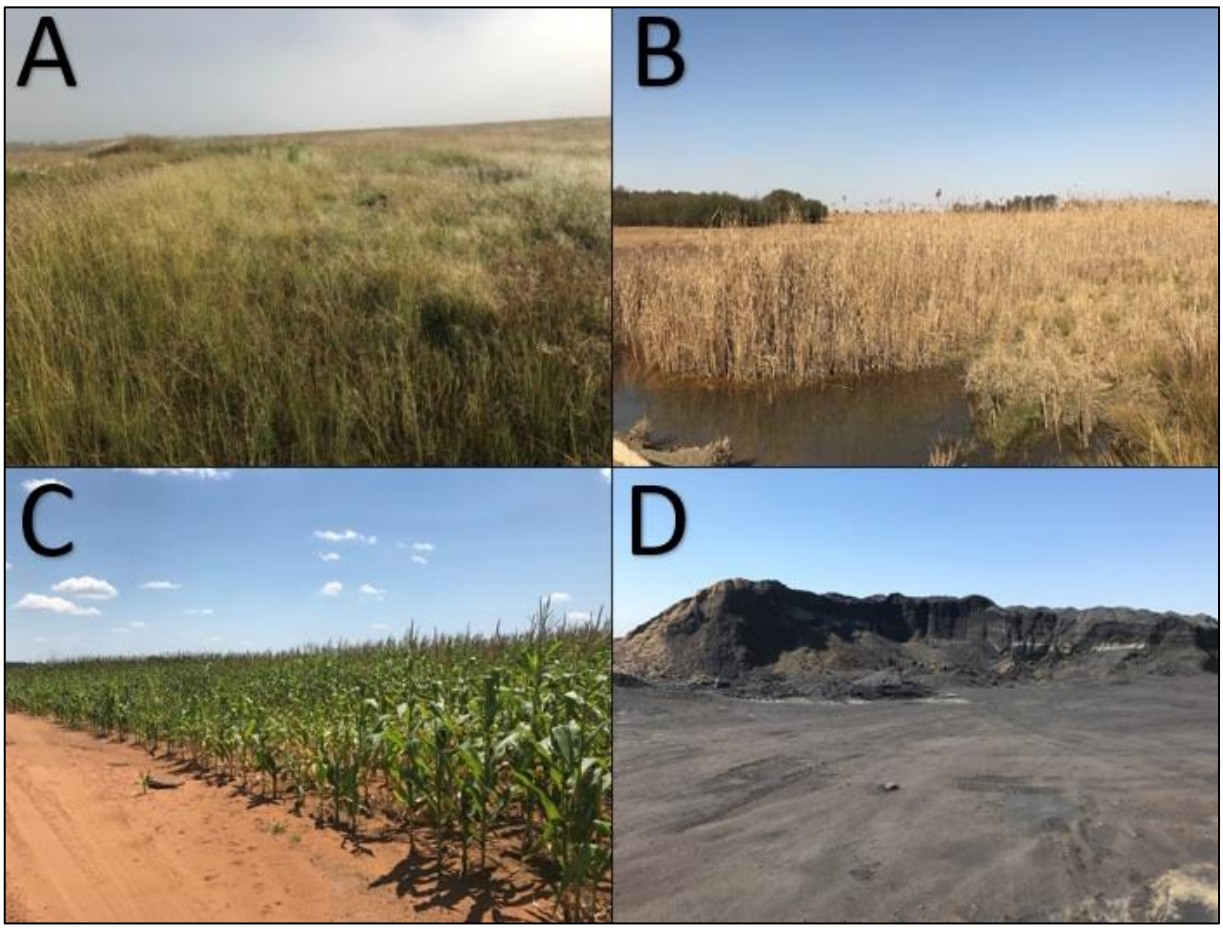

Figure 9-1Land use identified within the project area. A) Degraded grassland. B) Wetland. C) Agriculture. D) Mining/Disturbed

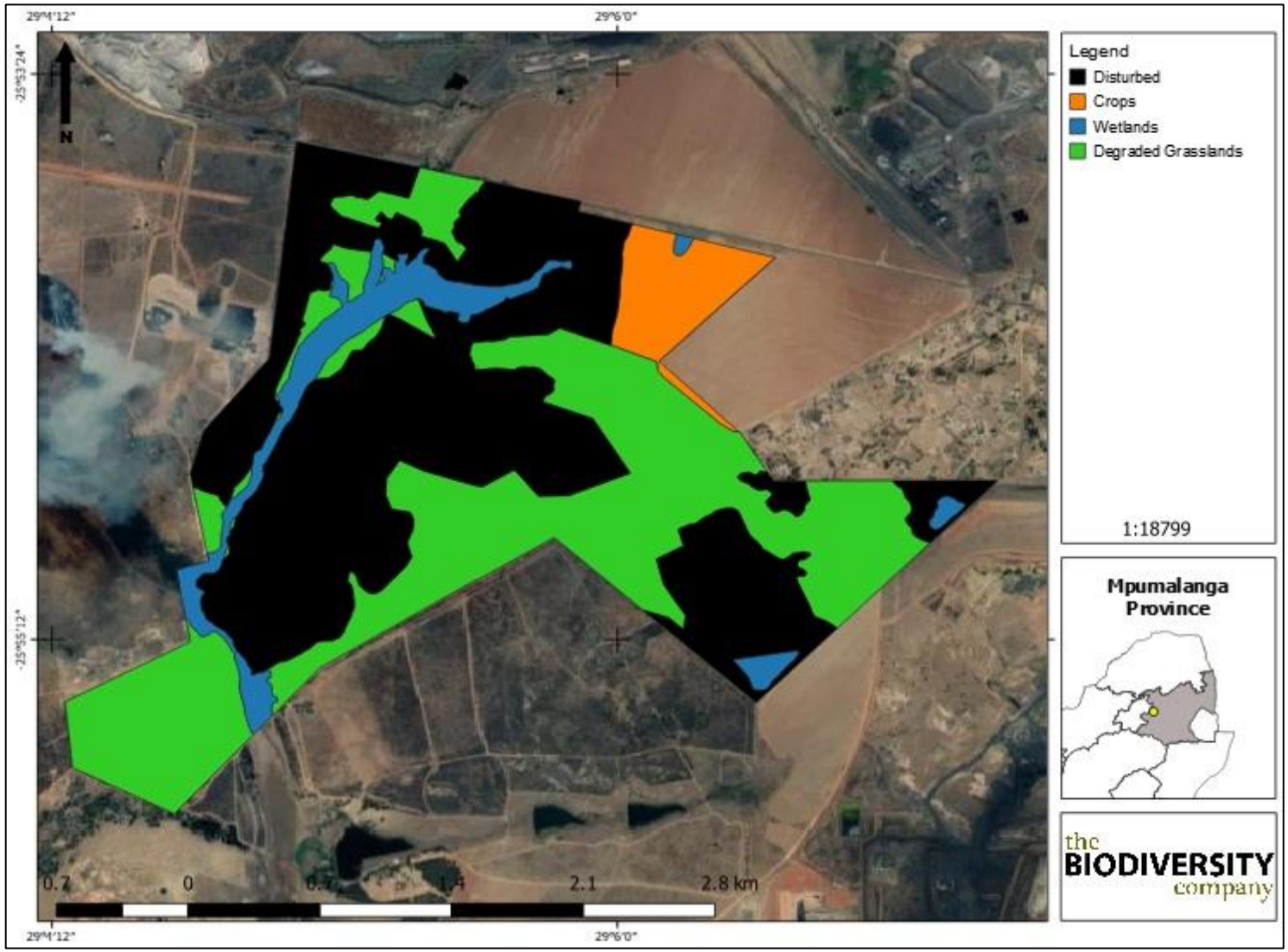

Figure 9-2Land use for the project area

10. Soil Chemical and Physical Properties

According to the Chamber of Mines South Africa/Coaltech (2007), one of the main objectives for rehabilitation is to restore the disturbed area back to the land capability conditions prior to mining activities. The land capability of the surrounding area has therefore been determined as the reference land capability. Additionally, samples were taken from the surrounding areas to be sent away for fertility tests. These results will also be used as reference for post-rehabilitation targets. These reference conditions will assist the responsible party in the rehabilitation process. The reference conditions should be achieved during rehabilitation to ensure that the conditions prior to development be restored.

10.1 Soil Physical Properties

Physical properties are defined by particle size distribution (soil textural classes) which refers to the percentage clay, silt and sand. All of the samples taken were sent for analysis. The average soil texture for all the soil samples are illustrated in Table 10-1.

Table 10-1 Results for physical properties for the surrounding land uses

Sample Site	Horizon	Clay %	Silt %	Sand %
1	Topsoil	16	2	82
	Subsoil	18	3	79
2	Topsoil	12	2	86
	Subsoil	14	3	83
3	Topsoil	16	2	82
	Subsoil	16	2	82
4	Topsoil	12	1	87
	Subsoil	12	1	87
5	Topsoil	12	2	86
	Subsoil	18	4	78
6	Topsoil	12	2	86
7	Topsoil	30	7	63
	Subsoil	38	9	53
8	Topsoil	14	11	75
	Subsoil	16	2	82
9	Topsoil	14	1	85
	Subsoil	16	4	80
10	Topsoil	14	4	82
	Subsoil	18	4	78

10.2 Soil Chemical Properties

Guidelines for relevant chemical properties are illustrated in Table 10-2, (Fertilizer Society of South Africa, 2007). The results from the chemical analysis are illustrated in

Table 10-3. It is vital that the disturbed area be rehabilitated in such a way that not only the reference conditions be reached but that the recommended values described below be reached. This will ensure that vegetation be established with greater ease flourish.

Table 10-2 Guidelines for soil chemical properties

Guidelines (mg/kg)					
	Low Values	**Recommended Values**	**High Values**		
Calcium (Ca)	<200		>3000		
Magnesium (Mg)	<50		>300		
Potassium (K)	<40		>250		
Phosphorus (Ph)	<5		>35		
Sodium (Na)	<50		>200		
pH (KCl)					
Very Acidic	Acidic	Slightly Acidic	Neutral	Slightly Alkaline	Alkaline
<4	4.0-5.9	6-6.7	6.8-7.2	7.3-8	>8
Phosphate (P) Pbray 1 (mg/kg)					
Very Low	Low	Moderate	High	Very High	
<5	5-10	10-17	17-25	>25	
Na:K ratio					
0.001-0.9	**>0.99**				

Table 10-3 Chemical property results from the surrounding land uses

Site	Horizon	Phosphorus (Bray 1) (mg/kg)	pH (KCl)	Exchangeable Cations				Na:K
				Na (mg/kg)	**K (mg/kg)**	**Ca (mg/kg)**	**Mg (mg/kg)**	
1	A	3	3,99	26	121	395	144	0,21
	B	12	3,34	12	4	85	13	3,00
2	A	4	4,04	10	38	200	38	0,26
	B	2	3,47	12	12	86	13	1,00
3	A	2	3,83	11	27	113	21	0,41
	B	2	3,78	10	19	83	9	0,53
4	A	5	4,9	12	61	387	56	0,20
	B	2	5,79	11	10	190	48	1,10

5	A	1	4,82	9	25	212	40	0,36
	B	2	4,21	10	16	83	25	0,63
6	A	5	4,66	10	27	305	38	0,37
7	A	2	5,59	12	91	632	104	0,13
	B	2	4,39	15	38	319	65	0,39
8	A	2	5,44	13	93	752	116	0,14
	B	2	4,56	11	38	189	41	0,29
9	A	3	5,06	9	32	292	39	0,28
	B	2	4,47	11	10	155	35	1,10
10	A	31	5,43	10	45	316	75	0,22
	B	4	3,99	11	15	165	25	0,73

Phosphorus (Bray 1)

According to the Fertilizer Handbook (Fertilizer Society of South Africa, 2007), the recommended phosphorus value will be between 10 mg/kg and 17 mg/kg, which is classified as moderate. Anything higher or lower than that will be defined as low or high. The majority of sampling sites within the project area is characterised by very low (<5) phosphorus levels. Most samples tend to show “Low” phosphorus values with “Very Low” values being recorded for the A-horizons of sample site 1 and 2. Plants use phosphorus as a source of energy used to assist the process of photosynthesis as well as respiration, (Hazelton & Murphy, 2007.) therefore, by increasing the phosphate levels by means of ameliorants and/or fertiliser, an increase in plant growth could be expected which will add significance to the rehabilitation process.

The following samples are characterised by suitable phosphorus values;

- Sample site 1 (subsoil).

pH (KCl)

The recommended pH level will be between 6.8 and 7.2, (Fertilizer Society of South Africa, 2007). Reaching this value will be very difficult and, in some cases, impractical, therefore, it is recommended that a pH of at least 5.5 be reached seeing that this level of pH will decrease most of the risks involved with an acidic soil. Figure 10-1 indicates the pH level where nutrients become available. Acidic soils are characterised by nutrient deficiency and lacks organic matter which is vital to healthy soil, (Fertilizer Society of South Africa, 2007). The pH of the project site could and should be increased by applying relevant amounts of dolomitic lime to aim for a neutral level. A soil pH lower than 5 potentially could cause aluminium and manganese toxicity as well as calcium deficiency.

None of the sampled soils are characterised by suitable pH levels.

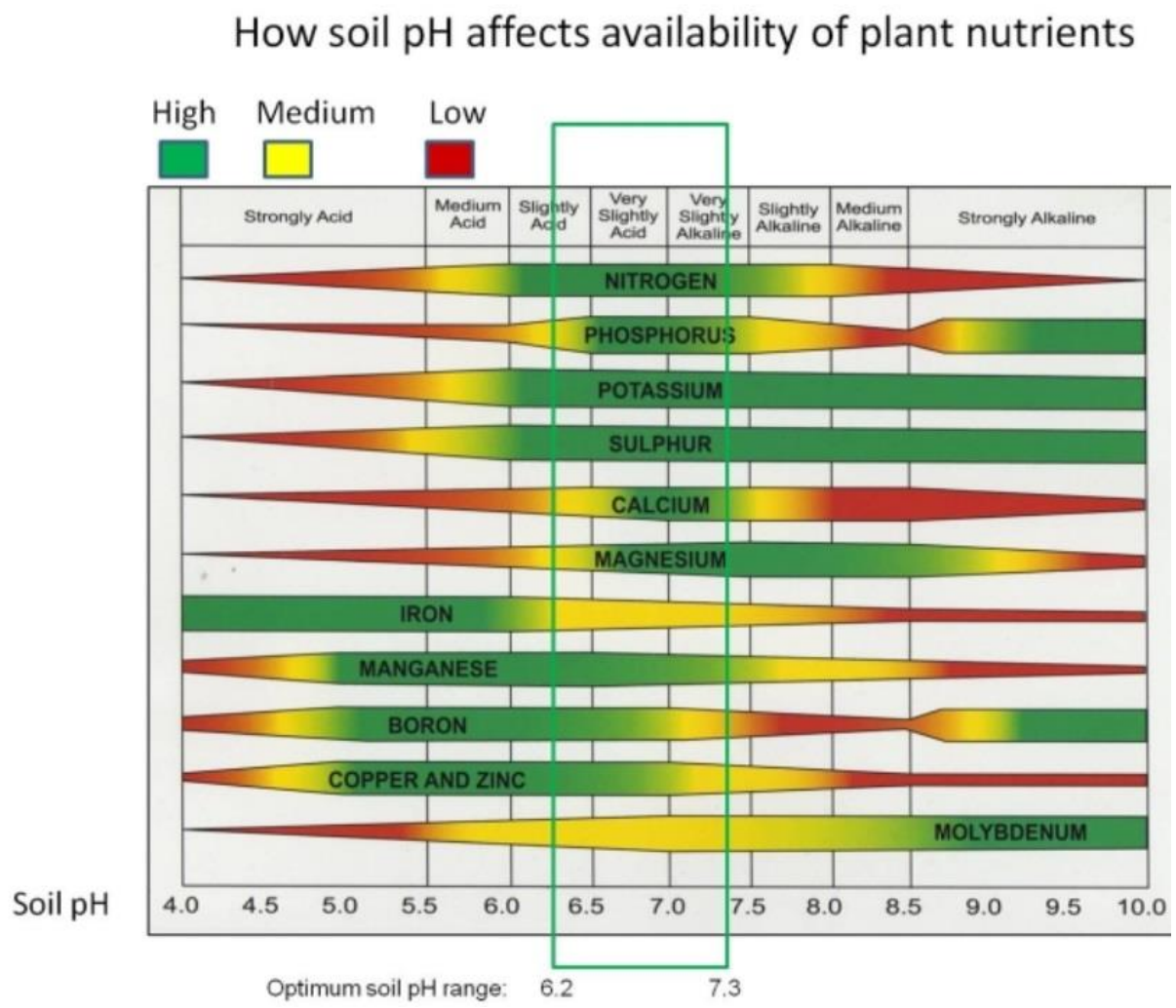

Figure 10-1 Indication of the nutrient availability at certain pH levels

Sodium (Na)

All of the sample sites show low sodium concentrations. The recommended sodium concentration lies between 50 mg/kg and 200 mg/kg. It is however important to notice that the Na:K relationships for the following sites do not have suitable relationships;

- Site 1 (subsoil);
- Site 2 (subsoil);
- Site 4 (subsoil); and
- Site 9 (subsoil).

The sodium concentrations within soil should always be lower than potassium. If sodium levels exceed that of potassium, the sodium cations will replace that of potassium on a Cation Exchange Capacity point of view seeing that plants require large amounts of potassium compared to other elements, (Fertilizer Society of South Africa, 2007).

Potassium (K)

The recommended potassium levels are between 40 mg/kg and 250 mg/kg, (Fertilizer Society of South Africa, 2007). Potassium is vital for healthy plant growth due to the integral role this

element plays in the size, shape, strength and colour of plants, (Fertilizer Society of South Africa, 2007).

The following sites are characterised by suitable potassium levels;

- Site 1 (topsoil);
- Site 4 (topsoil);
- Site 7 (topsoil);
- Site 8 (topsoil); and
- Site 10 (topsoil).

Calcium (Ca)

According to (Fertilizer Society of South Africa, 2007) the recommended calcium levels range between 200 mg/kg and 3000 mg/kg. Calcium plays an integral part in rectifying acidity and is vital for plants as a basic need. Calcium should be present within the root zone for easy abstraction by roots and pods, (Fertilizer Society of South Africa, 2007).

The following sites are characterised by suitable calcium levels;

- Site 1 (topsoil);
- Site 2 (topsoil);
- Site 4 (topsoil);
- Site 5 (topsoil);
- Site 6 (topsoil and subsoil);
- Site 7 (topsoil and subsoil);
- Site 9 (topsoil); and
- Site 10 (topsoil).

Magnesium (Mg)

According to (Fertilizer Society of South Africa, 2007), the recommended magnesium concentrations range between 50 mg/kg and 300 mg/kg. The following sites are characterised by suitable magnesium levels;

- Site 1 (topsoil);
- Site 4 (topsoil);
- Site 7 (topsoil and subsoil);
- Site 8 (topsoil); and
- Site 10 (topsoil).

11. Spatially Sensitive Mapping

11.1 Methodology

As part of the EIMS environmental mapping methodology, specialists are required to identify all features in terms of the specific field of expertise within the study area. This methodology includes the compilation of detailed shapefiles with specific attributes. Three main components form part of this methodology, namely;

- Feature layer;
- Overall sensitivity layer; and
- Legislative constraint layer.

All identified features will be rated according to the sensitivity of the feature as well as threats posed by proposed activities. These sensitivity rankings are described and illustrated in

Table 11-1 Sensitivities relevant to the EIMS methodology

	Sensitivities				
	Least Concern	Low	Medium	High	No-Go
Broad Class Description	The inherent feature status and sensitivity is already degraded. The proposed development will not affect the current status and/or may result in a positive impact. These features would be the preferred alternative for the project or infrastructure placement.	The proposed development will have not had a significant effect on the inherent feature status and sensitivity.	The proposed development will negatively influence the current status of the feature.	The proposed development will negatively significantly influence the current status of the feature.	The proposed development cannot legally or practically take place.
Scoring	0	1	2	3	+99

11.2 Feature Layer

Various soils forms have been identified within the mining boundaries, which all have been grouped into three main land potential levels, namely Land Potential level 2, 3 and “Vlei” (see Figure 11-1). These features were used to determine the sensitivity of resources relevant to this assessment.

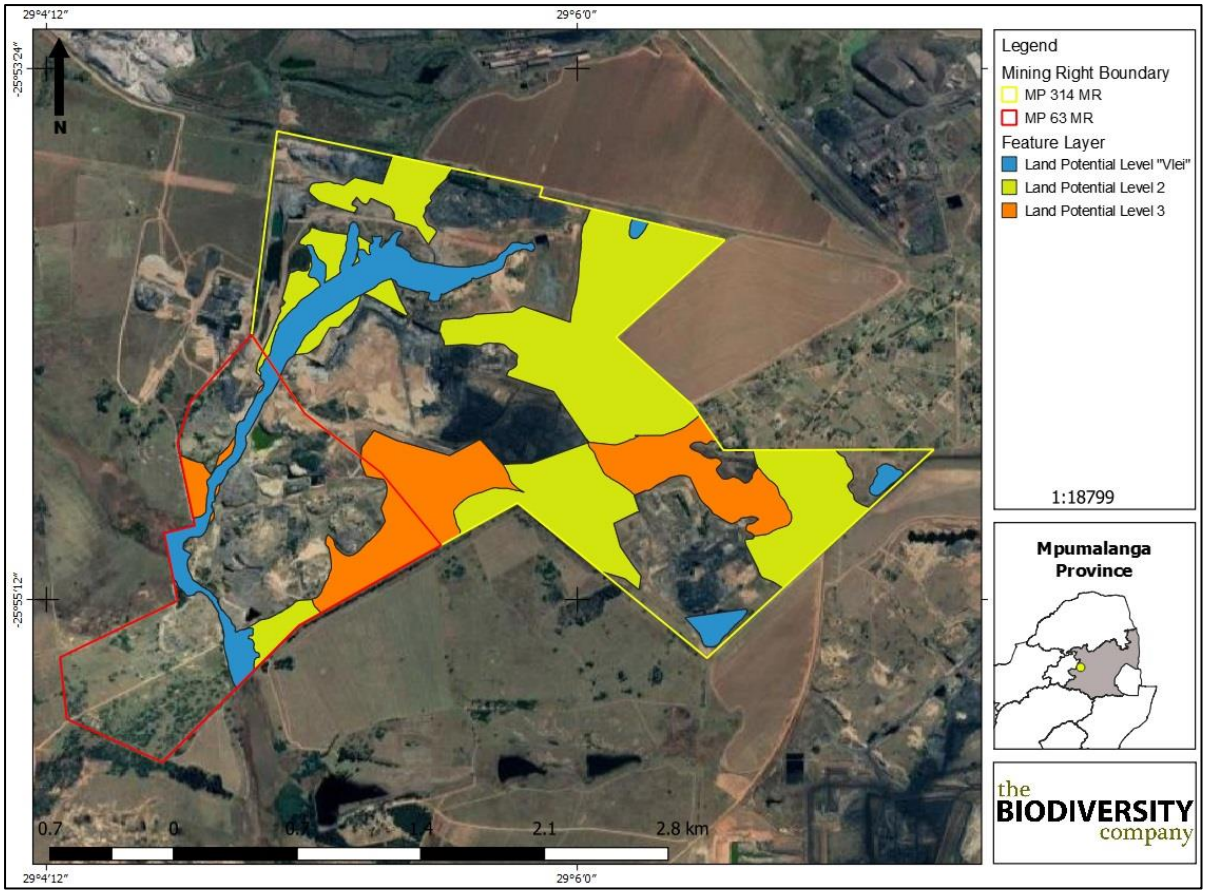

Figure 11-1 Feature layers within the mining boundaries

11.3 Overall Sensitivity

All features mentioned in Section 11.2- “Feature Layer” have been scored a sensitivity rating as per the EIMS methodology. All land potential categories will be impeded upon to some extent by the proposed open cast mining activities. The land potential level 2 and 3 features have been scored a “High” sensitivity rating given the fact the proposed open cast mining activities will impede into this soil form as well as the fact that this land potential has a high agricultural potential (see Figure 11-2).

The “Vlei” land potential level has been scored a “Low” sensitivity given the fact that this land potential is not arable but rather more suited for grazing. It is worth noting that all areas not delineated as part of the features identified by the specialist also are of “Least Concern”.

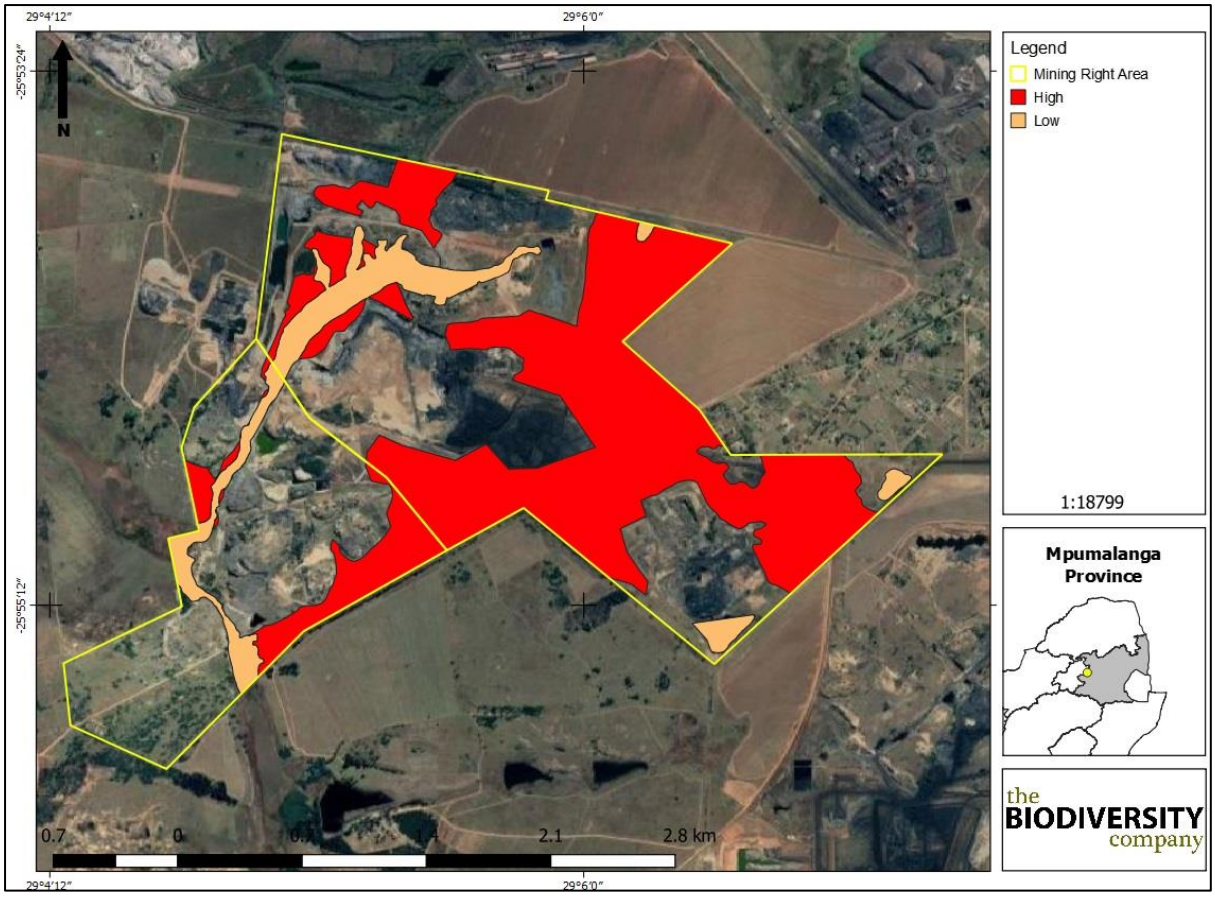

Figure 11-2 Overall sensitivity of identified features

11.4 Legislative Constraints

Legislation does not differ from one land potential level to another, but rather are all subject to the National Environmental Management Act (NEMA) (Act 107 of 1998) and the associated Regulations as amended in April 2017.

12. Impact Assessment

12.1 Current Impacts

Mining activities contribute mainly to the degradation of soil resources within the MRA. Open cast mining, mining related infrastructure, stockpiling and haul roads have all contributed to the degradation of natural soil resources (see Figure 12-1).

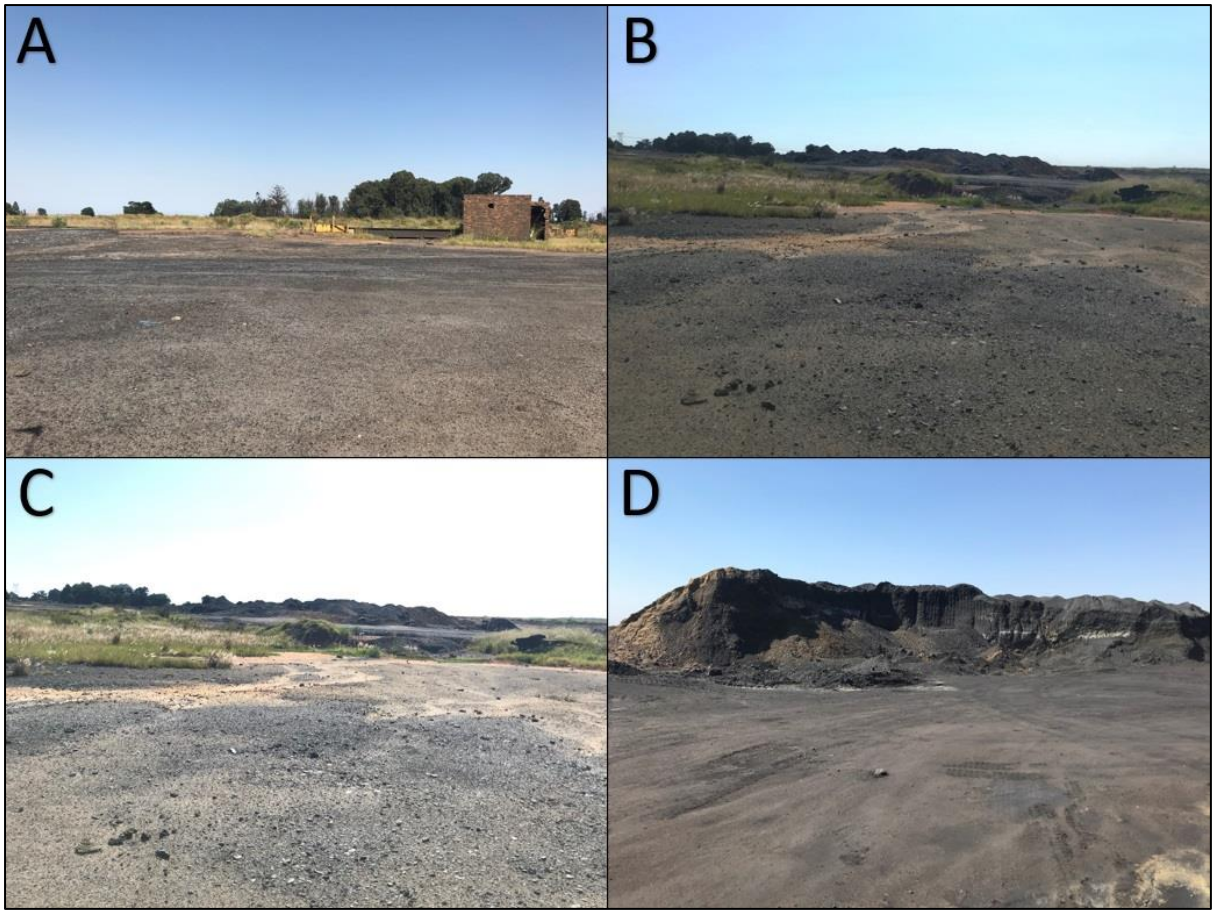

Figure 12-1 A) Haul roads. B) Disturbed mining area. C & D) Stockpiles.

12.2 Impact Assessment Methodology

An impact assessment methodology was provided by EIMS to determine the environmental risk associated with various aspects related to the proposed activities (open cast and underground mining with ancillary infrastructure). This impact assessment takes the following components into consideration;

- The nature of the associated impact (positive or negative);
- The extent of the proposed activities;
- The duration of the proposed activities;
- The magnitude of the effects caused by the proposed activities;
- The reversibility of associated impacts; and
- The probability of relevant aspects affecting sensitive receptors.

12.3 Anticipated Impacts

The broad aspect assessed during the impact assessment is that of “the loss of land capability”. It is worth noting that various activities and impacts are associated with such an aspect (seeTable 12-1).

Table 12-1 Various activities and impacts associated with the loss of land capability

Activities	Impacts
• Construction, operation and decommissioning of roads • Construction, operation and decommissioning of mining associated infrastructure • Construction, operation and decommissioning of shafts • Construction, operation and decommissioning of stockpiles • Construction and backfilling of open cast pits • Soil Stripping • Excavation of soil and mining resources • Water treatment • Processing activities • Mixing of soil	• Erosion; • Dust pollution; • Acid mine drainage; • Compaction; • Land contamination; • Degradation of stockpiles soil;

12.4 No-Go Option (Activity Alternative A2)

The land potential levels discussed during the sensitivity assessment currently is in a moderate condition. The proposed open cast mining activities will completely degrade and remove soil resources where the proposed mining boundaries impede into the respective features.

By considering the no-go option, these soil resources will remain in a moderate condition, and with the addition of rehabilitation, will improve to a greater quality. Therefore, the no-go option will be most favourable considering the conservation of soil resources.

12.5 Dust Suppression

This impact includes the potential land contamination from dust suppression taking into consideration the use of water from dirty water containment facilities.

12.5.1 Dust Suppression from Dirty Water (Processing Alternative P2a)

Dust suppression will have the same effect on sensitive receptors during all three the phases it would be applicable.

The final significance rating has been determined to be “Moderate” given the effect that contaminated water used for dust suppression will have on soil resources.

12.5.1.1 Mitigation Measures

See Section 13 for detailed mitigation measures.

12.5.1.2 Cumulative Impacts

The cumulative impact rating has been scored “High” given the already degraded state of soil resources in the surrounding area due to current and historic mining activities.

12.5.1.3 Irreplaceable loss of Resources

The proposed dust suppression using contaminated water could result in an irreplaceable loss of resources.

12.5.1.4 Impact on Alternatives Considered

Using cleaner water will be a better alternative than to use contaminated water for dust suppression.

12.5.2 Dust Suppression from Surface Water (Processing Alternative P2b)

Dust suppression will have the same effect on sensitive receptors during all three the phases it would be applicable.

The final significance rating has been determined to be “Low” given the fact that clean water will be used for dust suppression.

12.5.2.1 Mitigation Measures

See Section 13 for detailed mitigation measures.

12.5.2.2 Cumulative Impacts

The cumulative impact rating has been scored “High” given the already degraded state of soil resources in the surrounding area due to current and historic mining activities.

12.5.2.3 Irreplaceable loss of Resources

The proposed dust suppression using surface water will not result in an irreplaceable loss of resources.

12.5.2.4 Impact on Alternatives Considered

This alternative should rather be considered rather than using contaminated water given the lower environmental risk.

12.6 Planning Phase

12.6.1 Open Cast Mining

The final significance rating has been determined to be “Low” given the duration of planning activities, the lower magnitude of impacts and the fact that roads already are in existence throughout the project area, which will be utilised during the planning phase. This section is relevant to all open cast mining activities given the fact that all of the proposed open cast mining areas impede into valuable soil resources and that the significance of all potential open cast areas will be similar regardless of the locality of the open cast pit.

12.6.1.1 Mitigation Measures

See Section 13 for detailed mitigation measures.

12.6.1.2 Cumulative Impacts

The cumulative impact rating has been scored “Medium” given the extent of existing mining activities as well as the expected degradation of soil resources as a result of mining activities.

12.6.1.3 Irreplaceable loss of Resources

The planning phase of the relevant activities are not expected to result in irreplaceable loss of soil resources.

12.6.1.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed mining activities for Seam 2 due to the fact that only open cast mining has been proposed.

12.6.2 Underground Mining

The final significance rating has been determined to be “Low” given the duration of planning activities, the lower magnitude of impacts and the fact that roads already are in existence throughout the project area, which will be utilised during the planning phase. This section is relevant to all underground mining activities given the fact that all underground mining activities (regardless of the locality) will result in the same effects on natural soil resources.

12.6.2.1 Mitigation Measures

See Section 13 for detailed mitigation measures.

12.6.2.2 Cumulative Impacts

The cumulative impact rating has been scored “Medium” given the extent of existing mining activities as well as the expected degradation of the soil resources as a result of mining activities.

12.6.2.3 Irreplaceable loss of Resources

The planning phase of the relevant activities are not expected to result in irreplaceable loss of soil resources.

12.6.2.4 Impact on Alternatives Considered

Underground mining will always be a better alternative as opposed to open cast mining due to the significance of degradation of the soil profile during the latter.

12.6.3 Surface infrastructure, stockpiles and their respective associated activities

The final significance rating has been determined to be “Low” given the duration of planning activities, the lower magnitude of impacts and the fact that some infrastructure is already are in existence throughout the project area, which will be utilised during the planning phase.

12.6.3.1 Mitigation Measures

See Section 13 for detailed mitigation measures.

12.6.3.2 Cumulative Impacts

The cumulative impact rating has been scored “Low” given the extent of existing mining activities as well as the expected degradation of soil resources as a result of mining activities.

12.6.3.3 Irreplaceable loss of Resources

The planning phase of the relevant activities are not expected to result in irreplaceable loss of soil resources.

12.6.3.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed infrastructure.

12.7 Construction Phase Impacts

12.7.1 Open Cast Mining

The final significance rating has been determined to be “Low” given the duration of construction activities, the lower magnitude of impacts and the fact that much of the area already has been transformed and disturbed. Additionally, various roads already are in existence which can be used during the proposed activities. Recommended mitigation measures are expected to ensure a decrease in final significance ratings from “Moderate” to “Low. This section is relevant to all open cast mining activities given the fact that all of the proposed open cast mining areas impede into valuable soil resources and that the significance of all potential open cast areas will be similar regardless of the locality of the open cast pit.

12.7.1.1 Mitigation Measures

See Section 13 for detailed mitigation measures.

12.7.1.2 Cumulative Impacts

The cumulative impact rating has been scored “Medium” given the extent of existing mining activities as well as the expected degradation of the soil resources as a result of mining activities.

12.7.1.3 Irreplaceable loss of Resources

The construction phase of the relevant activities could result in a loss of natural resources. It is however worth noting that the relevant resources have limited value.

12.7.1.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed mining activities for Seam 2 due to the fact that only open cast mining has been proposed.

12.7.2 Underground Mining

The final significance rating has been determined to be “Low” given the duration of construction activities, the lower magnitude of impacts and the fact that much of the area already has been transformed and disturbed. Additionally, various roads already are in existence which can be used during the proposed activities. Recommended mitigation measures are expected to ensure a decrease in final significance ratings from “Moderate” to “Low”. This section is relevant to all underground mining activities given the fact that all underground mining activities (regardless of the locality) will result in the same effects on natural soil resources.

12.7.2.1 Mitigation Measures

See Section 13 for detailed mitigation measures pertaining to all alternatives and aspects.

12.7.2.2 Cumulative Impacts

The cumulative impact rating has been scored “Medium” given the extent of existing mining activities as well as the expected degradation of the soil resources as a result of mining activities.

12.7.2.3 Irreplaceable loss of Resources

The construction phase of the relevant activities could result in a loss of natural resources. It is however worth noting that the relevant resources have limited value.

12.7.2.4 Impact on Alternatives Considered

Underground mining will always be a better alternative as opposed to open cast mining due to the significance of degradation of the soil profile during the latter.

12.7.3 Surface infrastructure, stockpiles and their respective associated activities

The final significance rating has been determined to be “Low” given the duration of construction activities, the lower magnitude of impacts and the fact that much of the area already has been transformed and disturbed. Recommended mitigation measures are expected to ensure a further decrease in final significance ratings.

12.7.3.1 Mitigation Measures

See Section 13 for detailed mitigation measures.

12.7.3.2 Cumulative Impacts

The cumulative impact rating has been scored “Low” given the extent of existing mining activities as well as the expected degradation of the soil resources as a result of mining activities.

12.7.3.3 Irreplaceable loss of Resources

The construction phase of the relevant activities could result in a loss of natural resources. It is however worth noting that the relevant resources have limited value.

12.7.3.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed infrastructure.

12.8 Operational Phase Impacts

12.8.1 Open Cast Mining

The final significance rating has been determined to be “High” given the duration of operational activities, the higher magnitude of impacts and the fact that soil resources with land capabilities of 2 and 3 are expected to completely be lost in some areas. No mitigation is expected to decrease the final significance ratings for this phase due to the direct loss of land capability in some areas. This section is relevant to all open cast mining activities given the fact that all of the proposed open cast mining areas impede into valuable soil resources and that the

significance of all potential open cast areas will be similar regardless of the locality of the open cast pit.

12.8.1.1 Mitigation Measures

See Section 13 for detailed mitigation measures.

12.8.1.2 Cumulative Impacts

The cumulative impact rating has been scored “High” given the extent of existing mining activities as well as the expected degradation of the soil resources as a result of mining activities.

12.8.1.3 Irreplaceable loss of Resources

The operational phase of the relevant activities could result in a loss of natural resources. It is however worth noting that the relevant resources are considered to be of high value.

12.8.1.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed mining activities for Seam 2 due to the fact that only open cast mining has been proposed.

12.8.2 Underground Mining

The final significance rating has been determined to be “Medium” given the duration of operational activities, the higher magnitude of impacts and the fact that soil resources are expected to be undermined during this phase which could result in degradation by means of subsidence. Mitigation in the form of subsidence investigation will result in a decrease in significance rating. This section is relevant to all underground mining activities given the fact that all underground mining activities (regardless of the locality) will result in the same effects on natural soil resources.

12.8.2.1 Mitigation Measures

See Section 13 for detailed mitigation measures.

12.8.2.2 Cumulative Impacts

The cumulative impact rating has been scored “High” given the extent of existing mining activities as well as the expected degradation of the soil resources as a result of mining activities.

12.8.2.3 Irreplaceable loss of Resources

The operational phase of the relevant activities could result in a loss of natural resources. It is however worth noting that the relevant resources are not considered to be of high value.

12.8.2.4 Impact on Alternatives Considered

Underground mining will always be a better alternative as opposed to open cast mining due to the significance of degradation of the soil profile during the latter.

12.8.3 Surface infrastructure, stockpiles and their respective associated activities

The final significance rating has been determined to be “Low” given the duration of construction activities, the lower magnitude of impacts and the fact that much of the area already has been transformed and disturbed. Recommended mitigation measures are expected to ensure a further decrease in final significance ratings.

12.8.3.1 Mitigation Measures

See Section 13 for detailed mitigation measures.

12.8.3.2 Cumulative Impacts

The cumulative impact rating has been scored “Low” given the extent of existing mining activities as well as the expected degradation of the soil resources as a result of mining activities.

12.8.3.3 Irreplaceable loss of Resources

The construction phase of the relevant activities could result in a loss of natural resources. It is however worth noting that the relevant resources have limited value.

12.8.3.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed infrastructure.

12.9 Decommissioning Phase Impacts

12.9.1 Open Cast Mining

The final significance rating has been determined to be “Low” given the duration of decommissioning activities, the lower magnitude of impacts and the fact that roads already are in existence throughout the project area. This section is relevant to all open cast mining activities given the fact that all of the proposed open cast mining areas impede into valuable soil resources and that the significance of all potential open cast areas will be similar regardless of the locality of the open cast pit.

12.9.1.1 Mitigation Measures

See Section 13 for detailed mitigation measures pertaining.

12.9.1.2 Cumulative Impacts

The cumulative impact rating has been scored “Medium” given the extent of existing mining activities as well as the expected degradation of the wetlands as a result of mining activities.

12.9.1.3 Irreplaceable loss of Resources

The decommissioning phase of the relevant activities could result in a loss of natural resources. It is however worth noting that the relevant resources have limited value.

12.9.1.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed mining activities for Seam 2 due to the fact that only open cast mining has been proposed.

12.9.2 Underground Mining

The final significance rating has been determined to be “Low” given the duration of decommissioning activities, the lower magnitude of impacts and the fact that roads already are in existence throughout the project area. This section is relevant to all underground mining activities given the fact that all underground mining activities (regardless of the locality) will result in the same effects on natural soil resources.

12.9.2.1 Mitigation Measures

See Section 13 for detailed mitigation measures pertaining to all alternatives and aspects.

12.9.2.2 Cumulative Impacts

The cumulative impact rating has been scored “Medium” given the extent of existing mining activities as well as the expected degradation of soil resources as a result of mining activities.

12.9.2.3 Irreplaceable loss of Resources

The decommissioning phase of the relevant activities could result in a loss of natural resources. It is however worth noting that the relevant resources have limited value.

12.9.2.4 Impact on Alternatives Considered

Underground mining will always be a better alternative as opposed to open cast mining due to the significance of degradation of the soil profile during the latter.

12.9.3 Surface infrastructure, stockpiles and their respective associated activities

The final significance rating has been determined to be “Low” given the duration of decommissioning activities, the lower magnitude of impacts and the fact that roads already are in existence throughout the project area.

12.9.3.1 Mitigation Measures

See Section 13 for detailed mitigation measures pertaining.

12.9.3.2 Cumulative Impacts

The cumulative impact rating has been scored “Medium” given the extent of existing mining activities as well as the expected degradation of the wetlands as a result of mining activities.

12.9.3.3 Irreplaceable loss of Resources

The decommissioning phase of the relevant activities could result in a loss of natural resources. It is however worth noting that the relevant resources have limited value.

12.9.3.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed infrastructure.

12.10 Rehabilitation Phase Impacts

12.10.1 Open Cast Mining

The final significance rating has been determined to be “Low” given the fact that rehabilitation will take place which includes very little degradation to the environment. This section is relevant to all open cast mining activities given the fact that all of the proposed open cast mining areas impede into valuable soil resources and that the significance of all potential open cast areas will be similar regardless of the locality of the open cast pit.

12.10.1.1 Mitigation Measures

See Section 13 for detailed mitigation measures.

12.10.1.2 Cumulative Impacts

The cumulative impact rating has been scored “Medium” given the extent of existing mining activities as well as the expected degradation of the wetlands as a result of mining activities.

12.10.1.3 Irreplaceable loss of Resources

The rehabilitation phase of the relevant activities is not expected to result in a loss of natural resources.

12.10.1.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed mining activities for Seam 2 due to the fact that only open cast mining has been proposed.

12.10.2 Underground Mining

The final significance rating has been determined to be “Low” given the fact that rehabilitation will take place which includes very little degradation to the environment. This section is relevant to all underground mining activities given the fact that all underground mining activities (regardless of the locality) will result in the same effects on natural soil resources.

12.10.2.1 Mitigation Measures

See Section 13 for detailed mitigation measures.

12.10.2.2 Cumulative Impacts

The cumulative impact rating has been scored “Medium” given the extent of existing mining activities as well as the expected degradation of soil resources as a result of mining activities.

12.10.2.3 Irreplaceable loss of Resources

The rehabilitation phase of the relevant activities is not expected to result in a loss of natural resources.

12.10.2.4 Impact on Alternatives Considered

Underground mining will always be a better alternative as opposed to open cast mining due to the significance of degradation of the soil profile during the latter.

12.10.3 Surface infrastructure, stockpiles and their respective associated activities

The final significance rating has been determined to be “Low” given the fact that rehabilitation will take place which includes very little degradation to the environment. There remains the potential to rehabilitate areas with stockpiled soil to achieve closure objectives.

12.10.3.1 Mitigation Measures

See Section 13 for detailed mitigation measures.

12.10.3.2 Cumulative Impacts

The cumulative impact rating has been scored “Medium” given the extent of existing mining activities as well as the expected degradation of the wetlands as a result of mining activities.

12.10.3.3 Irreplaceable loss of Resources

The rehabilitation phase of the relevant activities is not expected to result in a loss of natural resources.

12.10.3.4 Impact on Alternatives Considered

No alternatives have been considered for the impacts related to the proposed mining activities for Seam 2 due to the fact that only open cast mining has been proposed

13. Specialist Management Plan

Table 13-2 presents the recommended mitigation measures and the respective timeframes, targets and performance indicators. The mitigations within this section has been taken into consideration during the impact assessment in cases where the post-mitigation environmental risk is lower than that of the pre-mitigation environmental risk.

The following recommendations have been made for the construction, operational, decommissioning and rehabilitation phase to ultimately ensure that closure is obtained within reasonable time after the LOM.

13.1 Monitoring During the Construction Phase

The entire project area should be monitored every three months for compaction, erosion and subsidence. In cases where compaction, subsidence and/or erosion does occur, action plans should be implemented to apply mitigation.

13.2 Monitoring During the Operational Phase

Soil samples should be taken on site by a soil scientist and sent away for fertility tests within the first month of the operational phase. By comparing the fertility results after the construction phase to the fertility of the topsoil prior to construction, conclusions can be made regarding the degradation of the soil’s chemical properties. Mitigation measures should be suggested by a soil scientist thereafter to rectify any degradation.

Compaction and erosion monitoring should take place every six months up until the start of the decommissioning phase. Refer to the mitigation measures to attend to any degradation.

13.3 Monitoring During the Decommissioning Phase

The entire project area should be monitored every month for compaction and erosion. In cases where compaction and/or erosion does occur, action plans should be implemented to apply mitigation and to avoid these areas as much as possible in the near future.

13.4 Monitoring During the Rehabilitation and Closure phase

Soil samples should be taken on site by a soil scientist and sent away for fertility tests within the first month of rehabilitation. The results thereof should be compared to the results obtained prior to construction and after construction to conclude the findings of the change in the top soil's chemical properties. Mitigation measures can be suggested by the relevant soil scientist thereafter to rectify any degradation. Thereafter, similar sampling should be carried out every year within the same season that the previous sampling has been done until closure is obtained.

Compaction and erosion should be monitored within the first month to gain knowledge of areas impacted upon during the decommissioning phase. Rehabilitation of these sites should take place by means of the rehabilitation guidelines provided. Thereafter, similar monitoring and the accompanied mitigation measures should be applied every six months until closure is obtained.

A post-mining land capability assessment should form part of a yearly monitoring program to assess the rehabilitated areas against the land capability targets set.

Table 13-1 Mitigation measures including requirements for timeframes, roles and responsibilities

Action plan				
Phase	**Management action**	**Timeframe for implementation**	**Responsible party for implementation**	**Responsible party for monitoring/audit/review**
Planning phase	Proper planning of mining sequences	At least 6 months prior to the implementation of soil stripping	Applicant	Applicant
	Determine			
	Acquire stripping and stockpiling guideline	At least 2 months prior to the implementation of soil stripping	Applicant	Applicant
	Acquire rehabilitation and monitoring plans	At least 2 months prior to the implementation of soil stripping	Applicant	Applicant
	Proper investigation into ideal locations for the construction of all the infrastructure on site	At least 5 months prior to the implementation of soil stripping	Applicant	Applicant
Construction	Bush clearing of all bushes and trees taller than one meter	This activity should be finished at least a week prior to any stripping of topsoil, excavations of underground mining areas, the construction of stockpiles/discard dump and the construction of the wash plant.	Applicant Contractor	Applicant Eco Environmental authority
	Assign all access routes	This activity should be finished at least two weeks prior to any stripping of topsoil, excavations of underground mining areas, the construction of stockpiles/discard dump and the construction of the wash plant.	Applicant ECO	Applicant Eco Environmental authority
	Stripping of topsoil	During the first month	Applicant ECO Contractor	Applicant Eco Environmental authority
	Stockpile the stripped soils in designated stockpile areas	During and after the soil stripping process.	Applicant ECO Contractor	Applicant Eco Environmental authority
	Continuously monitor subsidence on site	During the timeframe assigned for the Life of Mine (LOM).	Applicant	Applicant Eco Environmental authority
	Vegetate these stockpiles according to the rehabilitation plan	During and after the completion of the stockpiles.	Applicant Contractor	Applicant Eco Environmental authority
Operation	Continuously monitor erosion on site	During the timeframe assigned for the Life of Mine (LOM).	Applicant	Applicant Eco Environmental authority
	Monitor compaction on site	During the timeframe assigned for the Life of Mine (LOM).	Applicant	Applicant Eco

				Environmental authority
	Continuously monitor subsidence on site	During the timeframe assigned for the Life of Mine (LOM).	Applicant	Applicant Eco Environmental authority
Decommissioning	Assign proper storm water management plans	This activity would be part of the architectural layout during the construction phase. A site-based assessment should be carried out two months prior to the decommissioning phase to ensure that all storm water management plans are adequate.	Applicant ECO	Applicant Eco Environmental authority
	After the completion of the project the area is to be cleared of all infrastructure;	Within the first two months after the completion of the project.	Applicant ECO Contractor	Applicant Eco Environmental authority
	The foundations to be removed;	Directly after the completion of the area clearance.	Applicant ECO Contractor	Applicant Eco Environmental authority
	Continuously monitor subsidence on site	During the timeframe assigned for the Life of Mine (LOM).	Applicant	Applicant Eco Environmental authority
	Topsoil to be replaced for rehabilitation purposes;	After the completion of the foundation removal.	Applicant ECO Contractor	Applicant Eco Environmental authority
Rehabilitation and closure	All rehabilitated areas should be assessed for signs of compaction, fertility and erosion.	Within the first month after the successful decommissioning of the area.	Applicant	Applicant Eco Environmental authority
	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;	Within the first month after successful rehabilitation as well as yearly for the next 5 years to ensure that a sustainable soil resource is established.	Applicant	Applicant Eco Environmental authority
	Compacted areas are to be ripped to loosen the soil structure and vegetation cover re-instated;	Monitoring compaction should take place every six months. In cases where compaction is identified, ripping should take place within the next month after detection.	Applicant	Applicant Eco Environmental authority
	If erosion occurs, corrective actions (erosion berms) must be taken to minimize any further erosion from taking place;	Monitoring erosion should take place every six months whilst monitoring for compaction. In cases where erosion is identified, relevant mitigation measures should take place within the next month after detection.	Applicant	Applicant Eco Environmental authority
	Continuously monitor subsidence on site	During the timeframe assigned for the duration of the closure plan	Applicant	Applicant Eco Environmental authority

Table 13-2 Mitigation measures including requirements for timeframes, roles and responsibilities

Mitigation Measures	Phase	Timeframe	Responsible Party for Implementation	Monitoring Party (Frequency)	Target	Performance Indicators (Monitoring Tool)
• Underground workings must adhere to a safety factor that will minimise the risk of subsidence; • Any loss/alteration of flow dynamics must be quantified, and mitigation options to re-introduce water in a safe and environmentally friendly way must be assessed; • Monitoring of adjacent watercourses must be undertaken to assess the impact of AMD to these systems; and • Cut-off trenches must be incorporated into the open cast mining areas' design to decrease contamination of watercourses via AMD.	Operation & Closure	Permanent	Applicant / Contractor	Monthly surface and groundwater quantity and quality	Avoid or minimise the loss of water input, and impaired water quality	Water quality guidelines (DWS,1996)
• Separate clean and dirty water; • Construct diversion berms and drains around working areas; • Incorporate green /soft engineering storm water measures. Avoid unnecessary vegetation clearing and avoid preferential surface flow paths; • No cleaning of vehicles, machines and equipment in water resources; • No servicing of machines, vehicles and equipment on site; • Storage of potential contaminants in bunded areas; • All contractors must have spill kits available and be trained in the correct use thereof; • All released water must be within DWAF (1996) water quality standards for aquatic ecosystems,	Construction & Operation	Ongoing	Applicant / Contractor	Biomonitoring (bi-annual) Water quality monitoring, frequency to be advised by hydrology specialist	Maintain drinking water quality standards	Water quality guidelines (DWS,1996)

and discharge must be managed to avoid scouring and erosion of the receiving systems; • Contain wastewater in a PCD. Contaminated water must not be discharged into the watercourses; • Clean and dirty water must be separated. This water should be looked at for treatment and then re-introduced to mitigate losses to the catchment water hydro-dynamics; • All contractors and employees should undergo induction which is to include a component of environmental awareness. The induction is to include aspects such as the need to avoid littering, the reporting and cleaning of spills and leaks and general good "housekeeping"; • Adequate sanitary facilities and ablutions must be provided for all personnel throughout the project area. • Have action plans on site, and training for contractors and employees in the event of spills, leaks and other impacts to the aquatic systems; • All waste generated on-site must be adequately managed; and • Separation and recycling of different waste materials should be supported.						
• Compile a suitable stormwater management plan; • Construct cut-off berms downslope of working areas; • Demarcate footprint areas to be cleared to avoid unnecessary clearing; • Exposed areas must be ripped and vegetated to increase surface roughness; • Create energy dissipation at discharge areas to prevent scouring; and	Construction & Operation	Ongoing	Applicant / Contractor	Biomonitoring (bi-annual) Water quality monitoring, frequency to be advised by hydrology specialist	Maintain drinking water quality standards	Water quality guidelines (DWS,1996)

• Temporary and permanent erosion control methods may include silt fences, retention basins, detention ponds, interceptor ditches, seeding and sodding, riprap of exposed areas, erosion mats, and mulching.						
• Separate clean and dirty water continue with surface water and biomonitoring programmes; • All chemicals and toxicants during construction must be stored in bunded areas; • All machinery and equipment should be inspected regularly for faults and possible leaks, these should be serviced off-site; • All contractors and employees should undergo induction which is to include a component of environmental awareness; • The induction is to include aspects such as the need to avoid littering, the reporting and cleaning of spills and leaks and general good "housekeeping"; • Adequate sanitary facilities and ablutions must be provided for all personnel throughout the project area; • Have action plans on site, and training for contractors and employees in the event of spills, leaks and other impacts to the aquatic systems; and • All waste generated on-site must be adequately managed. Separation and recycling of different waste materials should be supported.	Construction Operation	Ongoing	Applicant / Contractor	Biomonitoring (bi-annual) Water quality monitoring, frequency to be advised by hydrology specialist	Maintain drinking water quality standards	Water quality guidelines (DWS,1996)
• Clean vehicles on-site, and prioritise vehicles gaining access from surround areas.	Construction, Operation & Closure	Ongoing	Applicant / Contractor	Monthly inspections, with removal to be determined on a needs basis	Maintain drinking water quality standards	National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEM:BA): Category 1a/b: Invasive species requiring compulsory

						control. Remove and destroy.
• All surface infrastructure must be removed from the site; • Compacted areas must be ripped (perpendicularly) to a depth of 300 mm; • A seed mix must be applied to rehabilitated and bare areas; • Any gullies or dongas must also be backfilled; • The area must be shaped to a natural topography; • Indigenous trees (or vegetation stands) removed must be replaced; • No grazing must be permitted to allow for the recovery of the area; and • Attenuation ponds may be created in channels to retain water in the catchment.	Closure	Ongoing	Applicant	Biomonitoring (bi-annual) Wetland monitoring (bi-annual) Water quality monitoring, frequency to be advised by hydrology specialist	Maintain drinking water quality standards	Water quality guidelines (DWS,1996)
• Rehabilitation of the area and shaping of the topography must minimise the ingress of water into the mining area; • Additionally, measures must also be considered to implement constructed wetlands at likely decant areas, and the planting of tree reduce groundwater recharge; • Decommission cut-off berms and drains last.; • Debris must be placed in preferential flow paths; • Compacted areas must be ripped (perpendicularly) to a depth of 300 mm; • A seed mix must be applied to rehabilitated and bare areas; • Any gullies or dongas must also be backfilled; and	Closure	Ongoing	Applicant	Water quality monitoring, frequency to be advised by hydrology specialist	Maintain drinking water quality standards	Water quality guidelines (DWS,1996)

• The area must be shaped to a natural topography.						

13.5 General Stripping and Stockpiling Methodology

The following sections are based on the basic methodologies of soil stripping and stockpiling, it is worth noting that a thorough soil stripping guideline still must be compiled.

13.5.1 Soil Stripping

According to Chamber of Mines of South Africa (2007), soil stripping is deemed to be a key rehabilitation activity given the slow regeneration rate of soil. Successful soil stripping will ensure sufficient soil to use for backfilling and topsoil purposes, which is vital to rehabilitation. According to Chamber of Mines of South Africa (2007), it is vital to strip and stockpile the topsoil separately from that of the subsoil given the importance of topsoil in regard to fertility and seed bank.

Soils with a substantial difference in physical properties also should be stockpiles separately, with the most common separations being based on topsoil, subsoil and clay content (Chamber of Mines of South Africa, 2007). The following is noteworthy for the soil stripping process;

- A detailed soil plan must be set-up for the soil to be stripped;
- Soil stripping must take place a considerable distance from mining activities before the extension of mining boundaries to avoid degradation;
- Delineated soil boundaries must be demarcated;
- Cut-off horizons must be defined in simple terms in order for all stripping operators to understand;
- Soil stripping activities must be supervised to ensure that soils aren't mixed;
- Soil stripping must take place when moisture content minimises compaction;
- Strip and replace in one action where possible; and
- Shovel and truck must rather be used than bowlscrapers.

13.5.2 Soil Stockpiling

According to Chamber of Mines of South Africa (2007), stockpiling must be minimised with direct soil replacements being the preferred alternative (if possible). Wherever stockpiling is the only feasible alternative, it is of the utmost importance that proper stockpile configuration and locations be focussed on.

Soils stockpiles for up to 20 years provide a reasonable growth medium in cases where remediation is successfully carried out. Such remediation includes amelioration, irrigation, reseeding, tillage etc. (depending on the nature and properties of post-mining land capability and fertility). Regardless, it is essential that stockpiles be kept to a minimum, that stockpiling periods be kept short and that stockpiles be remanded as little as possible. The following is noteworthy for the soil stockpiling process (Chamber of Mines of South Africa, 2007);

- Stockpiles soil should not be rehandled after the initial stripping and stockpiling process;

- Locations with free drainage must be preferred for stockpiles to minimise erosion and waterlogging;
- Compaction must be minimised during stockpiling. End-tipping should be used to keep soils loose with stockpile height to be limited. The maximum safe height for stockpiles is regarded as between 4 and 5 metres (maximum);
- Stockpiles must be revegetated to ensure aeration and erosion loss; and
- Stockpiled soil must only be used for its initially purpose (i.e. backfilling, topsoil coverage etc.)

14. Conclusion

14.1 Baseline

Various soil forms were identified during the site assessment, of which four soil forms were classed as having a land capability class II, three being classified as class III and one soil form regarded as class IV. Additionally, all wetland areas have been grouped together as a land capability class V given wetland properties with all disturbed/mining areas disregarded given the lack of natural soil properties.

The latter mentioned land capability classes were then classified into three different land potential categories. Land capability class II and III is classified as a land potential level II with the land capability class IV being scored a land potential level III. All wetland areas (class V) have been classified as a "vlei" land potential. These land potential levels have been determined by means of a combination of land capability (i.e. depths, clay percentage etc.) and climatic conditions. Of all three land potential levels, the level 2 land potential is most sensitive with the land potential "vlei" being the least sensitive.

14.2 Impact Assessment

The planning, construction, operational, decommissioning and rehabilitation/closure phases have all been assessed during the impact assessment. For these phases, open cast and underground mining was considered respectively. The results from the impact assessment suggest that no final significance ratings higher than "Low" are expected during the planning, construction, decommissioning and rehabilitation/closure phases. As for the operational phase, the open cast mining activities and underground mining activities have been scored "High" and "Medium" final significance ratings respectively.

14.3 Specialist Recommendation

It is the specialist's opinion that all proposed activities may proceed as have been planned given the adherence to all recommendations and prescribed mitigation measures.

14.4 Potential Rehabilitation Targets

It is recommended that all areas except for the disturbed areas and the land capability V areas be rehabilitated to an "Arable" post-mining land capability. This includes (Chamber of Mines of South Africa, 2007);

- Rehabilitated areas exceeding a depth of 0,6 m;
- The soil resources forming part of rehabilitated areas cannot be saline or sodic;
- The slope percentage must have a lower value than 2.0 after multiplying the slope percentage with the erodibility factor; and
- In using a nomograph, a nominal value of 1% organic matter should be used.

All land capability V areas must be rehabilitated back to grazing, which include the following (Chamber of Mines of South Africa, 2007);

- Soil depth must be greater than 0,25 m.

Furthermore, it is recommended that the remediation take place aimed at reaching the current fertility of soils as much as possible.

15. Assumptions, Uncertainties and Gaps in Knowledge

The following aspects were considered as limitations:

- The MRA consists of approximately 50% disturbed areas, ultimately limiting soil classification;
- Shapefiles of the subsidence risk areas have not been provided;
- A soil stripping guideline is not part of this assessment;
- The property across the river to the west has not been assessed given the irrelevance of this property to the proposed development as well as the fact that this area has been disturbed by historic mining activities; and
- The GPS used for water resource delineations is accurate to within five meters. Therefore, the wetland delineation plotted digitally may be offset by at least five meters to either side.

16. References

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The Biodiversity Company. 2020. Environmental Impact Assessment -for the Proposed Elandsfontein Coal Mining Project

17. Appendices

17.1 Specialist CV

Masters in Environmental Science and Hydropedology

Cell: +27 79 898 4056

Email: ivan@thebiodiversitycompany.com

Identity Number: 9401105251087

Date of birth: 10 January 1994

Profile Summary

Working experience throughout Southern Africa

Working experience in West-Africa

Specialist experience with mining, construction and agriculture.

Specialist expertise include hydropedology, pedology, land contamination, agricultural potential, land rehabilitation, rehabilitation management and wetlands resources.

Experience hydropedological modelling (HYDRUS model)

Areas of Interest

Mining, Oil & Gas, Renewable Energy & Bulk Services Infrastructure Development, Farming, Land contamination, Sustainability and Conservation.

Key Experience

- Environmental Impact Assessments (EIA)
- Environmental Management Programmes (EMP)
- Wetland delineations and ecological assessments
- Rehabilitation Plans and Monitoring
- Soil-and rock classification
- Level 1, 2 and 3 hydropedology assessments
- Agriculture potential assessments
- Land contamination assessments
- Modulation of surface- and subsurface flows (HYDRUS model)

Countries worked in

South Africa, Mozambique, Swaziland, Zimbabwe, Guinea

Nationality

South African

Languages

English – Proficient

Afrikaans – Proficient

Qualifications

- MSc (North-West University of Potchefstroom) – Hydropedology
- BSc Honours (North-West University of Potchefstroom) – Environmental geology-Pedology and rehabilitation
- BSc Environmental sciences
- Pr Sci Nat candidateship

SELECTED PROJECT EXPERIENCE

Project Name: Environmental impact assessment for the construction of Road DR08606 leading to Mlamli Hospital, Sterkspruit

Personal position / role on project: Wetland ecologist

Location: Sterkspruit, Eastern Cape Province, South Africa

Main project features: To conduct a wetland assessment, as a component of the environmental authorisation process and Water Use Licence Application (WULA) for the construction of Road DR08606 leading to Mlamli Hospital

Project Name: Biodiversity Baseline & Impact Assessment Report for the proposed Nondvo Dam Project

Personal position / role on project: Wetland ecologist

Location: Mbabane, Swaziland

Main project features: To conduct various assessments according to IFC standards in regard to delineation of wetlands and assessing ecosystem services.

Project Name: Agricultural Potential Assessment - Proposed Kalabasfontein Coal Mining Project Extension

Personal position / role on project: Project Manager and Soil Specialist.

Location: Bethal, Mpumalanga, South Africa

Main project features: To conduct a soil assessment to identify any sensitive resources that might be affected by the proposed mining activities and associated infrastructure as part of an environmental impact assessment.

Project Name: Soil assessment for the closure of the St Helena Shaft, Harmony

Personal position / role on project: Soil specialist

Location: Welkom, Free State, South Africa

Main project features: To conduct a thorough soil and fertility assessment to recommend relevant mitigation and rehabilitation measures to finalise closure at the relevant mine

Project Name: Wetland Functionality Assessment for the Environmental, Health and Socio-Economic Baseline Studies for Block 2 at Siguiri Gold Mine

Personal position / role on project: Wetland ecologist

Location: Siguiri, Guinea, West-Africa

Main project features: To conduct various assessments according to IUCN standards in regard to delineation of wetlands and assessing ecosystem services.

Project Name: Level 3 Hydropedological Assessment for the Sara Buffels Mining Project

Personal position / role on project: Hydropedologist

Location: Ermelo, Mpumalanga, South-Africa

Main project features: To conduct various assessments to determine the hillslope hydrology and to acquire information relevant to the vadose zone's hydraulic properties to quantify sub-surface flows by means of modelling.

Project Name: Level 3 Hydropedological Assessment for the Buffalo Coal Mining Project

Personal position / role on project: Hydropedologist

Location: Dundee, KwaZulu-Natal, South-Africa

Main project features: To conduct various assessments to determine the hillslope hydrology and to acquire information relevant to the vadose zone's hydraulic properties to quantify sub-surface flows by means of modelling

Project Name: Biodiversity Baseline & Impact Assessment for the proposed Tetereane 15MW Solar PV Plant

Personal position / role on project: Ecosystem Services Specialist

Location: Cuamba, Mozambique, Southern-Africa

Main project features: To conduct various assessments according to IUCN standards in regard to ecosystem services

Project Name: Land contamination assessment for the proposed Fleurhof Development

Personal position / role on project: Soil Specialist

Location: Fleurhof, South Africa

Main project features: To conduct assessments relevant to the determination of land contamination, including recommendations, mitigations and risk assessments.

OVERVIEW

An overview of the specialist technical expertise include the following:

- Ecological wetland assessment studies, including the integrity (health) and functioning of the wetland systems.
- Wetland offset strategy designs.
- Wetland rehabilitation plans.
- Monitoring plans for wetland systems.
- Soil classification and agricultural assessments.
- Stripping and stockpiling guidelines.
- Soil rehabilitation plans.
- Soil and stockpile monitoring plans.
- Hydropedological assessments.

TRAINING

Some of the more pertinent training undergone includes the following:

- Tools for a Wetland Assessment (Certificate of Competence) – Rhodes University 2018; and
- Workshop on digital soil mapping.

EMPLOYMENT EXPERIENCE

Internship at SRK consulting (January 2017-August 2017)

- **Field assistant** for SRK consulting during 2017 included the sampling of surface and groundwater as well as on site tests, the accumulation of various different data sets from field loggers, presenting and arranging the relevant data and ultimately using it for my own personal post-graduate studies.

Internship at The Biodiversity Company (August 2017-December 2017)

Employed as an intern (wetland and soil scientist) during the last few months of 2017. During this period, I was part of a variety of soil- and wetland projects, both as report writer and/or field assistant.

CURRENT EMPLOYMENT: The Biodiversity Company (January 2018 – Present)

- **Scientific report writing** to ensure that the relevant standards and requirements have been attained, namely local country legislation, as well as WB, EP and IFC requirements.

ACADEMIC QUALIFICATIONS

North-West University of Potchefstroom: MAGISTER SCIENTIAE (MSc) - Hydropedology:

Title: *Characterisation of vadose zone processes in a tailings facility*

North-West University of Potchefstroom (2016): BACCALAUREUS SCIENTIAE HONORIBUS (Hons) – Environmental Geology- Pedology and rehabilitation

North-West University of Potchefstroom (2015): BACCALAUREUS SCIENTIAE IN NATURAL AND ENVIRONMENTAL SCIENCES. Majors: Geology and Geography

17.2 Laboratory Results

Table 17-1 Laboratory results

Sample Number	pH KCl	P Bray1	K AmAc	Na AmAc	Ca AmAc	Mg AmAc	EXCH ACID KCl	Ca% AmAc	Mg% AmAc	K% AmAc	Na% AmAc	ACID SAT. AmAc
	-	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	cmol(+)/kg	%	%	%	%	%
1 (Topsoil)	3,99	3	121	26	395	144	0,45	49,04	29,26	7,66	2,85	11,19
1 (Subsoil)	3,34	12	4	12	85	13	1,18	23,93	5,85	0,65	2,88	66,68
2 (Topsoil)	4,04	4	38	10	200	38	0,33	55,83	17,61	5,37	2,54	18,64
2 (Subsoil)	3,47	2	12	12	86	13	0,72	32,04	8,24	2,2	3,97	53,55
3 (Topsoil)	3,83	2	27	11	113	21	0,51	41,52	12,54	5,01	3,48	37,44
3 (Subsoil)	3,78	2	19	10	83	9	0,81	29,65	5,55	3,44	3,14	58,21
4 (Topsoil)	4,9	5	61	12	387	56	0	74,36	17,66	6,02	1,96	0
4 (Subsoil)	5,79	2	10	11	190	48	0	67,17	27,68	1,88	3,27	0
5 (Topsoil)	4,82	1	25	9	212	40	0	71,16	21,92	4,27	2,66	0
5 (Subsoil)	4,21	2	16	10	83	25	0,35	39,25	19,49	4	4,28	32,97
6 (Topsoil)	4,66	5	27	10	305	38	0	78,15	15,99	3,59	2,28	0
7 (Topsoil)	5,59	2	91	12	632	104	0	73,57	19,78	5,44	1,21	0
7 (Subsoil)	4,39	2	38	15	319	65	0,07	67,65	22,54	4,17	2,82	2,83
8 (Topsoil)	5,44	2	93	13	752	116	0	75,08	19,05	4,75	1,12	0
8 (Subsoil)	4,56	2	38	11	189	41	0	66,09	23,83	6,78	3,31	0
9 (Topsoil)	5,06	3	32	9	292	39	0	76,7	16,93	4,28	2,1	0
9 (Subsoil)	4,47	2	10	11	155	35	0,04	65,73	24,29	2,14	4,11	3,74
10 (Topsoil)	5,43	31	45	10	316	75	0	67,13	26,11	4,88	1,88	0
10 (Subsoil)	3,99	4	15	11	165	25	0,52	50,49	12,35	2,29	2,99	31,88

Table 17-2 Laboratory results

Sample Number	Ca:Mg AmAc	(Ca+Mg)/K AmAc	Mg:K AmAc	S-VALUE AmAc	Na:K AmAc	T-VALUE AmAc	Dens.	S AmAc	CLAY	SILT	SAND
	1.5-4.5	10.0-20.0	3.0-4.0	cmol(+)/kg	cmol(+)/kg	cmol(+)/kg	g/ml	mg/kg	%	%	%
1 (Topsoil)	1,68	10,22	3,82	3,57	0,37	4,02	1,44	11,57	16	2	82
1 (Subsoil)	4,09	45,94	9,02	0,59	4,45	1,77	1,23	437,27	18	3	79
2 (Topsoil)	3,17	13,67	3,28	1,46	0,47	1,79	1,44	25,05	12	2	86
2 (Subsoil)	3,89	18,34	3,75	0,62	1,81	1,34	1,31	138,85	14	3	83
3 (Topsoil)	3,31	10,78	2,5	0,85	0,69	1,36	1,37	17,08	16	2	82
3 (Subsoil)	5,34	10,23	1,61	0,58	0,91	1,4	1,31	18,92	16	2	82
4 (Topsoil)	4,21	15,3	2,94	2,6	0,33	2,6	1,4	3,52	12	1	87
4 (Subsoil)	2,43	50,48	14,73	1,42	1,74	1,42	1,29	6,2	12	1	87
5 (Topsoil)	3,25	21,8	5,13	1,49	0,62	1,49	1,43	6,07	12	2	86
5 (Subsoil)	2,01	14,68	4,87	0,71	1,07	1,05	1,29	66,24	18	4	78
6 (Topsoil)	4,89	26,25	4,46	1,95	0,63	1,95	1,44	6,87	12	2	86
7 (Topsoil)	3,72	17,16	3,64	4,29	0,22	4,29	1,2	11,62	30	7	63
7 (Subsoil)	3	21,64	5,41	2,29	0,68	2,36	1,05	214,05	38	9	53
8 (Topsoil)	3,94	19,84	4,02	5	0,24	5	1,16	20,09	14	11	75
8 (Subsoil)	2,77	13,27	3,52	1,43	0,49	1,43	1,28	11,4	16	2	82
9 (Topsoil)	4,53	21,87	3,95	1,91	0,49	1,91	1,44	4,71	14	1	85
9 (Subsoil)	2,71	42,1	11,36	1,14	1,92	1,18	1,27	29,49	16	4	80
10 (Topsoil)	2,57	19,12	5,35	2,36	0,39	2,36	1,32	8,15	14	4	82
10 (Subsoil)	4,09	27,44	5,39	1,11	1,31	1,63	1,22	29,41	18	4	78