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Soil and Agricultural Assessment for the Mn48 Project

Submitted by TerraAfrica Consult cc

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12 September 2020

Declaration of the Specialist

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Declaration of Independence

I, Mariné Pienaar, hereby declare that TerraAfrica Consult, an independent consulting firm, has no interest or personal gains in this project whatsoever, except receiving fair payment for rendering an independent professional service.

I further declare that I was responsible for collecting data and compiling this report. All assumptions, assessments and recommendations are made in good faith and are considered to be correct to the best of my knowledge and the information available at this stage.

TerraAfrica Consult cc represented by M Pienaar
12 September 2020

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1. INTRODUCTION

TerraAfrica Consult cc was appointed by SLR Consulting (South Africa) Pty Ltd (SLR) to conduct the soil and agricultural assessment for the environmental authorisation processes required for the Mn48 project. The project area is located on a portion of Portion 1 of the farm Lehating 741. The property is approximately 9km north Black Rock in the Joe Morolong Local Municipality, located in the John Taolo Gaetsewe District Municipality of the Northern Cape Province (Figure 1).

The Environmental Impact Assessment (EIA) and Environmental Management Programme (EMPr) for the (then proposed) Lehating Mine was submitted by SLR in January 2014. This Environmental Authorisation (EA) process included a soil study report. There is currently an existing mining right for underground mining of high-grade manganese on properties directly south of the Mn48 project area that is hold by Khwara Manganese (Pty) Ltd (Khwara). This mining right area includes Portion 2 of the farm Wessels 227 and the Remaining Extent and Portions 3 and 4 of the farm Dibiaghomo 226. The EIA and EMPr for the Khwara Mine was submitted by SLR in 2017. This EA process did not include a dedicated soil study and reference was made to the soil study that was part of the Lehating Mine's EIA.

2. PROJECT DESCRIPTION

An agreement was made between Lehating and Khwara that will merge the two mining companies into one and the company is now known as Mn48 (Pty) Ltd (Mn48) and that is also the company who is applying for environmental authorisation. Neither the Lehating or Khwara Mines have been developed. The merging of these two entities includes the consolidation of the mining right areas of both Lehating and Kwara as well as the associated EMPRs. Following the recommendations of the Bankable Feasibility Study (BFS), the approved layout for the proposed surface infrastructure on the farm Lehating 741 needs to be amended.

In summary, the changes to the approved operations and surface infrastructure include the following:

- Relocation of the primary crushing facilities from underground to surface;
- Extension of the footprint and capacity of the approved WRD;
- Addition of a second PCD, and relocation of the already approved PCD (note that the previously proposed emergency control dam will no longer be required);
- General re-configuration of approved surface infrastructure;
- Revision of the stormwater management plan to accommodate the changes to the surface infrastructure layout; and
- Establishment of proposed new support infrastructure such as a helicopter pad and weighbridge.

In addition to the above, the approved EMPr for Mn48 specified the need for a TSF. This will no longer be required. The project has made a fundamental change to the mineral processing methodology whereby a dry screening process will be used, instead of a wet screening process which would produce tailings.

The initial authorised surface footprint is 36.9ha. However the planned infrastructure amendments will increase the surface areas to be affected to approximately 77ha (
Figure *2*).

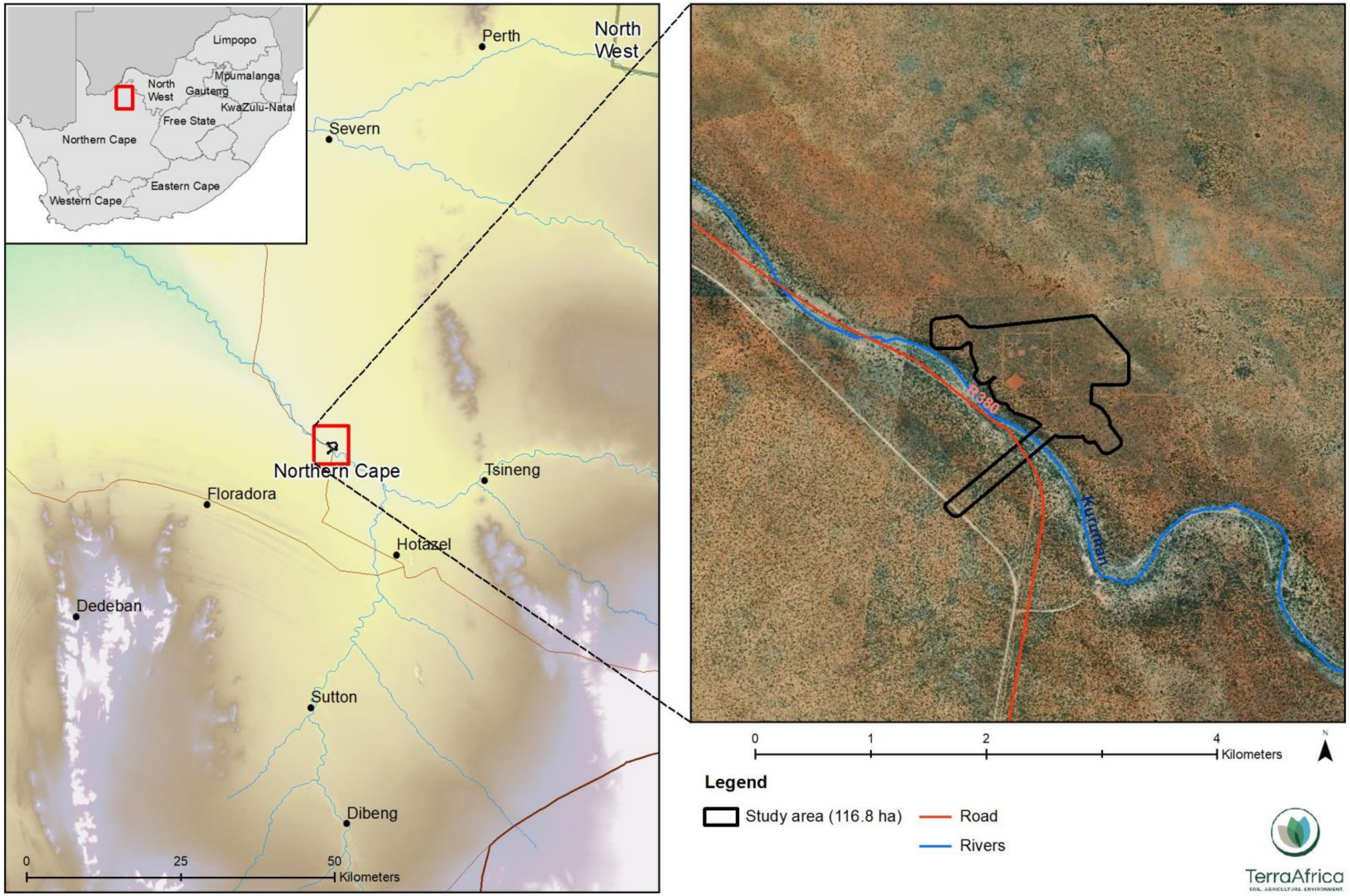

Figure 1 Locality of the study area of the proposed Mn48 mining project

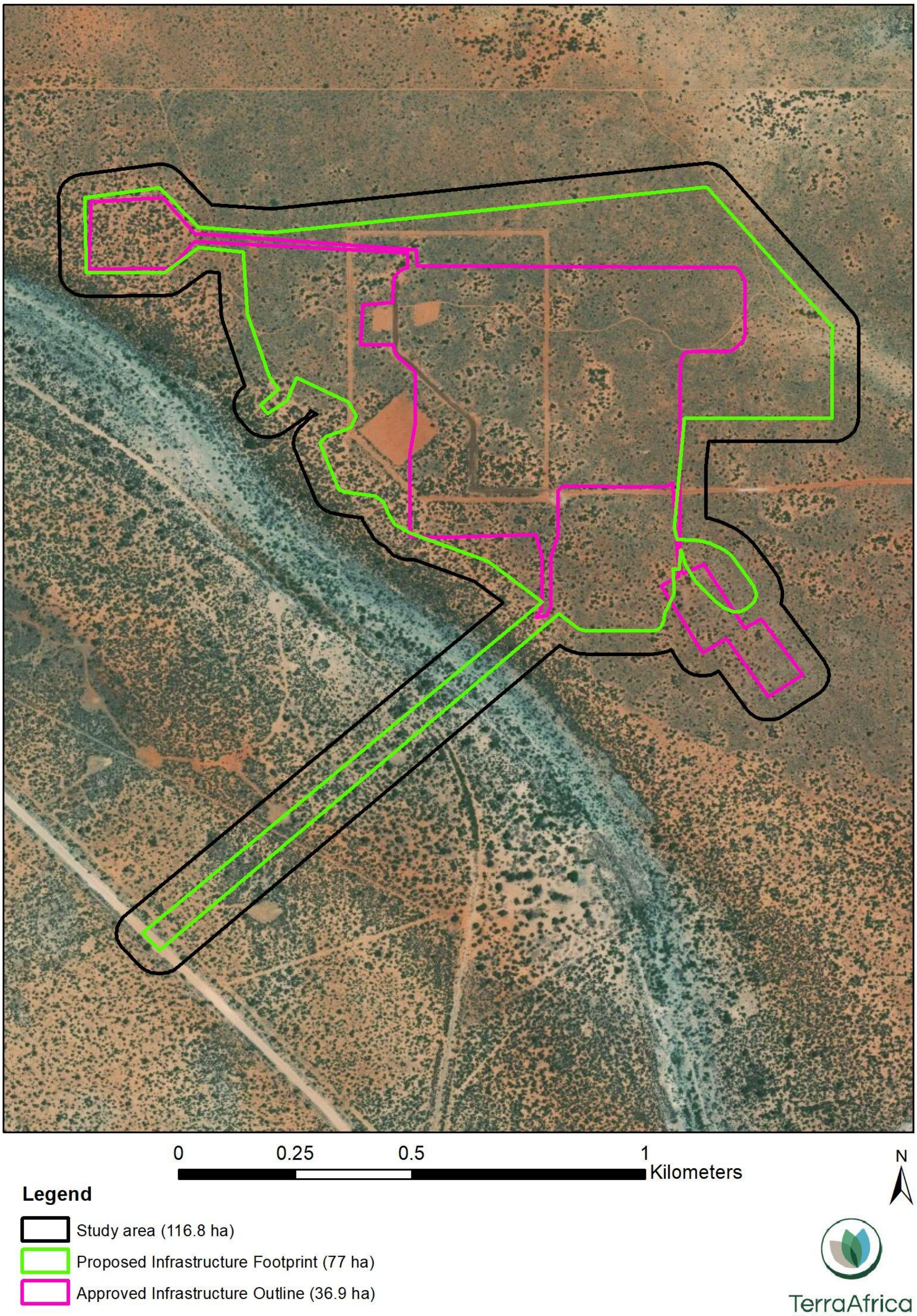

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Figure 2 Layout of the approved surface infrastructure footprint as well as the proposed new infrastructure footprint for the Mn48 project

3. PURPOSE AND OBJECTIVES OF THE ASSESSMENT

The overarching purpose of the Soil and Agricultural Compliance Specialist Assessment (from here onwards also referred to as the Soil and Agricultural Assessment) that will be included in the Environmental Impact Assessment Report, is to ensure that the sensitivity of the site to the proposed land use change (from agriculture to mining) is sufficiently considered. Also, that the information provided in this report, enables the Competent Authority to come to a sound conclusion on the impact of the proposed project on the food production potential of the site.

To meet this objective, site sensitivity verification must be conducted of which the results must meet the following objectives:

- It must confirm or dispute the current land use and the environmental sensitivity as was indicated by the National Environmental Screening Tool.
- It must contain proof in the form of photographs of the current land use and environmental sensitivity pertaining to the study field.
- All data and conclusions are submitted together with the Scoping and Environmental Impact Assessment Report (prepared in accordance with the NEMA regulations) for the proposed Mn48 Project.

According to GN320, the agricultural compliance statement that is submitted must meet the following requirements:

- It must be applicable to the preferred site and the proposed development footprint.
- It has to confirm that the site is of “low” or “medium” sensitivity for agriculture.
- It has to indicate whether or not the proposed development will have an unacceptable impact on the agricultural production capability of the site.

Secondly, the assessment will evaluate the impact that the amendments to the existing mining rights to include the additional surface infrastructure area, will have on the potential of the land affected, to be returned to productive agricultural land. For this, the following study objectives are met:

- Determine the impact of the proposed new project infrastructure layout on the productivity of the area.
- Ensure that the Soil and Agricultural assessment is aligned with the current legislative framework for specialist studies.

4. LEGISLATIVE FRAMEWORK FOR THE ASSESSMENT

The report follows the protocols as stipulated for the Agricultural Assessment in Government Notice 320 of 2020 (GN320). This Notice provides the procedures and minimum criteria for reporting in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act (No. 107 of 1998) (from here onwards referred to as NEMA). It replaces the previous requirements of Appendix 6 of the Environmental Impact Assessment Regulations of

NEMA. Table 1 details the relevant sections of the report where the GN320 requirements have been addressed.

Table 1 Summary of report references of the GN320 requirements

GNR 320 requirements of an Agricultural Compliance Statement (Low to Medium Sensitivity)	Reference in this report
3.1. The compliance statement must be prepared by a soil scientist or agricultural specialist registered with the SACNASP.	Page i
3.2. The compliance statement must: 3.2.1. be applicable to the preferred site and proposed development footprint;	Page 6
3.2.2. confirm that the site is of "low" or "medium" sensitivity for agriculture; and	Section 9.3
3.2.3. indicate whether or not the proposed development will have an unacceptable impact on the agricultural production capability of the site.	Section 12
3.3. The compliance statement must contain, as a minimum, the following information: 3.3.1. contact details and relevant experience as well as the SACNASP registration number of the soil scientist or agricultural specialist preparing the assessment including a curriculum vitae;	Page i and Appendix 2
3.3.2. a signed statement of independence;	Page i
3.3.3. a map showing the proposed development footprint (including supporting infrastructure) with a 50m buffered development envelope, overlaid on the agricultural sensitivity map generated by the screening tool;	Figure 3
3.3.4. confirmation from the specialist that all reasonable measures have been taken through micro- siting to avoid or minimise fragmentation and disturbance of agricultural activities;	Section 10.6
3.3.5. a substantiated statement from the soil scientist or agricultural specialist on the acceptability, or not, of the proposed development and a recommendation on the approval, or not, of the proposed development;	Section 12
3.3.6. any conditions to which the statement is subjected;	Section 13
3.3.7. in the case of a linear activity, confirmation from the agricultural specialist or soil scientist, that in their opinion, based on the mitigation and remedial measures proposed, the land can be returned to the current state within two years of completion of the construction phase;	N/A – not a linear activity
3.3.8. where required, proposed impact management outcomes or any monitoring requirements for inclusion in the EMPr; and	Section 12
3.3.9. a description of the assumptions made as well as any uncertainties or gaps in knowledge or data.	Section 6
3.4. A signed copy of the compliance statement must be appended to the Basic Assessment Report or Environmental Impact Assessment Report.	This report forms part of the BA process reports for authorisation

In addition to the specific requirements for this study, the following South African legislation is also considered applicable to the interpretation of the data and conclusions made with regards to environmental sensitivity:

- The Conservation of Agricultural Resources (Act 43 of 1983) states that the degradation of the agricultural potential of soil is illegal. This Act requires the protection of land against soil erosion and the prevention of water logging and salinisation of soils by means of suitable soil conservation works to be constructed and maintained. The utilisation of marshes, water sponges and watercourses are also addressed.
- Section 3(a) of the Subdivision of Agricultural Land Act 70 of 1970 states that agricultural land must not be subdivided. Although the purpose of EA process is not for the subdivision of agricultural land, it will change the current land use from extensive livestock production to mining for the duration of the Life of Mine.

5. TERMS OF REFERENCE

In addition to the requirements stipulated in GN320, the following Terms of Reference as stipulated by SRL Africa (Pty) Ltd applies to this report:

- Conduct a site visit to verify the soil properties of the areas of footprint expansion as well as areas included in the existing mining rights for which previously only desktop assessments were conducted.
- Identify and assess potential impacts on both agricultural potential as well as soil, resulting from the proposed amendments that is part of the Mn48 project.
- Identify and describe potential cumulative soil, agricultural potential and land capability impacts resulting from the proposed development in relation to proposed and existing developments in the surrounding area.
- Recommend mitigation and management measures to reduce the anticipated impacts on the soil and agricultural properties of the area.

6. ASSUMPTIONS, UNCERTAINTIES AND KNOWLEDGE GAPS

The following assumptions were made during the assessment and reporting phases:

- The assessment of the anticipated impacts assumes that the proposed surface footprint of the project will stay within the confines as depicted in the layout maps in this report.
- It was assumed that the layout will consist of the components stipulated in the final project layout and description that was provided by the applicant.
- Assumptions regarding the impacts of the proposed infrastructure were made and based on the author’s knowledge of the nature and extent of the planned infrastructure.

7. METHODOLOGY

7.1. Desktop analysis of satellite imagery and other spatial data

The most recent aerial photography of the area available from Google Earth was obtained. The satellite imagery was analysed to determine areas of existing impact and land uses within the study area as well as the larger landscape. Prior to the site visit, a number of geo-referenced data sets were analysed to understand what the likely baseline properties of the grid connection corridor and surrounding areas are. The data sets that were analysed are:

- The National Land Capability Evaluation Raster Data Layer was obtained from the DAFF to determine the land capability classes of the Mn48 project area according to this system. The data was developed using a spatial evaluation modelling approach (DAFF, 2017).
- The long-term grazing capacity for South Africa 2018 was analysed for the Mn48 project area and surrounding area. This data set includes incorporation of the RSA grazing capacity map of 1993, the Vegetation type of SA 2006 (as published by Mucina L. & Rutherford M.C.), the Land Types of South Africa data set as well as the KZN Bioresource classification data. The values indicated for the different areas represent long term grazing capacity with the understanding that the veld is in a relatively good condition.
- The Northern Cape Field Crop Boundaries (November 2019) was analysed to determine whether any crop production areas are present within the Mn48 project area. The crop production areas may include rainfed annual crops, non-pivot and pivot irrigated annual crops, horticulture, viticulture, old fields, small holdings and subsistence farming.
- Land type data for the project assessment zone was obtained from the Institute for Soil Climate and Water (ISCW) of the Agricultural Research Council (ARC) (Land Type Survey Staff, 1972 – 2006). The land type data is presented at a scale of 1:250 000 and entails the division of land into land types, typical terrain cross sections for the land type and the presentation of dominant soil types for each of the identified terrain units.

7.2. Site survey

The site survey was conducted on 24 July 2020. The area that was assessed includes the proposed new surface infrastructure layout as well as a 50m buffered area around the infrastructure. The total area assessed is 116.8ha, and are from here onwards referred to as the study area.

For the soil classification, a hand-held bucket soil auger was used to observe soil profiles to a depth of 1.5m or refuse, depending on the effective soil depth of the area. Observations were made regarding soil form, texture, structure, nature and depth of underlying material as well as any signs of existing soil degradation. Observations were made regarding soil texture, structure, colour and soil depth at each survey point. A cold 10% hydrochloric acid solution was used on site to test for the presence of carbonates in the soil. The soils are described according to the soil the Soil Classification Working Group of 2018's *Soil Classification: A Natural and Anthropogenic System for South Africa*. For soil mapping of the areas assessed in detail, the soils were grouped into classes with relatively similar soil characteristics.

Other observations included the agricultural activities in the area, the quality of the natural vegetation that support the livestock farming in the area and the presence of existing farming infrastructure that may be affected by the proposed project.

7.3. Land capability

Once the soil classification survey was completed, the different soil form units were grouped together as the different land capability classes that are present on site. The land capability classes were determined using the guidelines outlined in Section 7 of "The Chamber of Mines Handbook of Guidelines for Environmental Protection (Volume 3, 1981)". The Chamber of Mines pre-mining land capability system differs from the DAFF system (described in Section 7.1 above) in that it classifies the capability of land only into four major classes that includes wetland land capability but ignores different grades of suitability for agricultural production. Table 2 indicates the set of criteria as stipulated by the Chamber of Mines to group soil forms into different Land capability classes.

Table 2: Summary of land capability classification criteria as per the Chamber of Mines Guidelines

Criteria for Wetland	➢ Land with organic soils or ➢ A horizon that is gleyed throughout more than 50 % of its volume and is significantly thick, occurring within 750mm of the surface.
Criteria for Arable Land	➢ Land, which does not qualify as a wetland, ➢ The soil is readily permeable to the roots of common cultivated plants to a depth of 750mm, ➢ The soil has a pH value of between 4,0 and 8.4, ➢ The soil has a low salinity and SAR, ➢ The soil has a permeability of at least 1,5-mm per hour in the upper 500-mm of soil ➢ The soil has less than 10 % (by volume) rocks or pedocrete fragments larger than 100-mm in diameter in the upper 750-mm, ➢ Has a slope (in %) and erodibility factor (K) such that their product is <2.0, ➢ Occurs under a climatic regime, which facilitates crop yields that are at least equal to the current national average for these crops, or is currently being irrigated successfully.
Criteria for Grazing Land	➢ Land, which does not qualify as wetland or arable land, ➢ Has soil, or soil-like material, permeable to roots of native plants, that is more than 250-mm thick and contains less than 50 % by volume of rocks or pedocrete fragments larger than 100-mm, ➢ Supports, or is capable of supporting, a stand of native or introduced grass species, or other forage plants, utilizable by domesticated livestock or game animals on a commercial basis.
Criteria for Wilderness Land	➢ Land, which does not qualify as wetland, arable land or grazing land.

7.4. Impact assessment methodology

Below are the tables with the steps followed to do the impact rating according to the methodology prescribed by SLR (South Africa) (Pty) Ltd.

PART A: DEFINITION AND CRITERIA		
Definition of SIGNIFICANCE		**Significance = consequence x probability**
Definition of CONSEQUENCE		**Consequence is a function of severity / nature, spatial extent and duration**
Criteria for ranking of the SEVERITY/NATURE of environmental impacts	**H**	Substantial deterioration (death, illness or injury). Recommended level will often be violated. Vigorous community action. Irreplaceable loss of resources.
	M	Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints. Noticeable loss of resources.
	L	Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints. Limited loss of resources.
	L+	Minor improvement. Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	M+	Moderate improvement. Will be within or better than the recommended level. No observed reaction.
	H+	Substantial improvement. Will be within or better than the recommended level. Favourable publicity.
Criteria for ranking the DURATION of impacts	**L**	Quickly reversible. Less than the project life. Short term
	M	Reversible over time. Life of the project. Medium term
	H	Permanent. Beyond closure. Long term.
Criteria for ranking the SPATIAL SCALE/ EXTENT of impacts	**L**	Localised - Within the site boundary.
	M	Fairly widespread – Beyond the site boundary. Local
	H	Widespread – Far beyond site boundary. Regional/ national

PART : DETERMINING CONSEQUENCE

	SEVERITY / NATURE = L				
DURATION	Long term	**H**	**Medium**	**Medium**	**Medium**
	Medium term	**M**	**Low**	**Low**	**Medium**
	Short term	**L**	**Low**	**Low**	**Medium**
	SEVERITY / NATURE = M				
DURATION	Long term	**H**	**Medium**	**High**	**High**
	Medium term	**M**	**Medium**	**Medium**	**High**
	Short term	**L**	**Low**	**Medium**	**Medium**
	SEVERITY / NATURE = H				
DURATION	Long term	**H**	**High**	**High**	**High**
	Medium term	**M**	**Medium**	**Medium**	**High**
	Short term	**L**	**Medium**	**Medium**	**High**
			L	**M**	**H**
			SPATIAL SCALE / EXTENT		

PART C: DETERMINING SIGNIFICANCE					
PROBABILITY (of exposure to impacts)	Definite/ Continuous	**H**	**Medium**	**Medium**	**High**
	Possible/ frequent	**M**	**Medium**	**Medium**	**High**
	Unlikely/ seldom	**L**	**Low**	**Low**	**Medium**
			L	**M**	**H**
			CONSEQUENCE		

PART D: INTERPRETATION OF SIGNIFICANCE	
Significance	**Decision guideline**
High	It would influence the decision regardless of any possible mitigation.
Medium	It should have an influence on the decision unless it is mitigated.
Low	It will not have an influence on the decision.

***H = high, M= medium and L= low and + denotes a positive impact.**

8. RESULTS OF ENVIRONMENTAL SCREENING TOOL

The combined Agricultural Sensitivity of the proposed consolidated mining right area of the Mn48 project, was determined by using the National Environmental Screening Tool (www.screening.environment.gov.za). The Agricultural Theme of the screening tool considers a combination of the national land capability raster data as well as the field crop boundaries as compiled by Department of Agricultural, Forestry and Fisheries (DAFF) (DAFF 2017, DAFF 2019).

The screening report was generated by SLR on 2 July 2020. The requirements of GN320 stipulates that a 50m buffered development envelope must be assessed with the screening tool. The area that was used include all the land portions that will be part of the consolidated mining right area and therefore exceeds the requirement of a 50m buffer zone around the proposed areas of impact. The results provided by the screening tool indicated that the site has Medium to Low sensitivity to the proposed development (Figure 3).

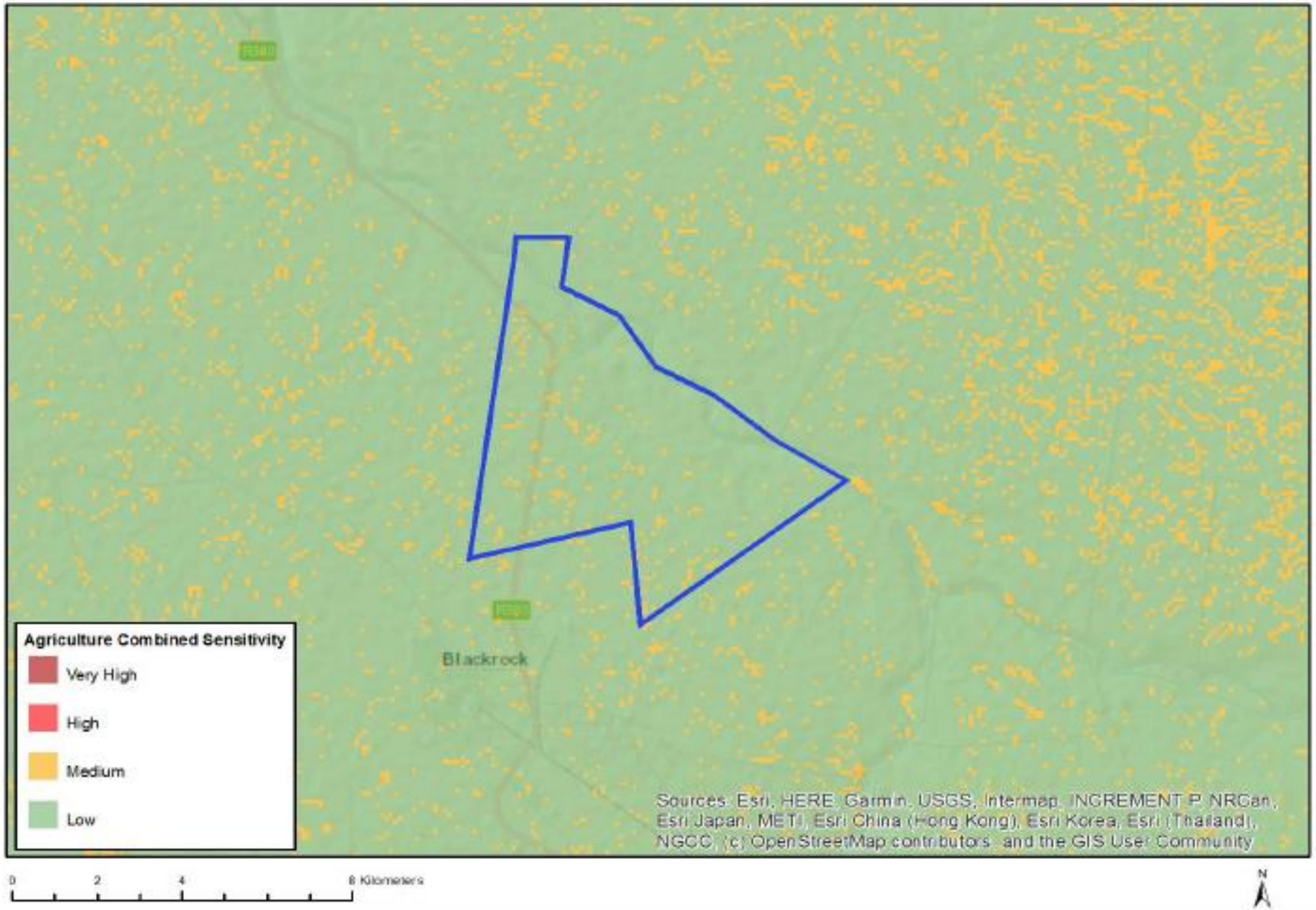

Figure 3 Illustration of the Agricultural Combined Sensitivity of the consolidated Mining Right areas (Environmental Screening Tool, DEA)

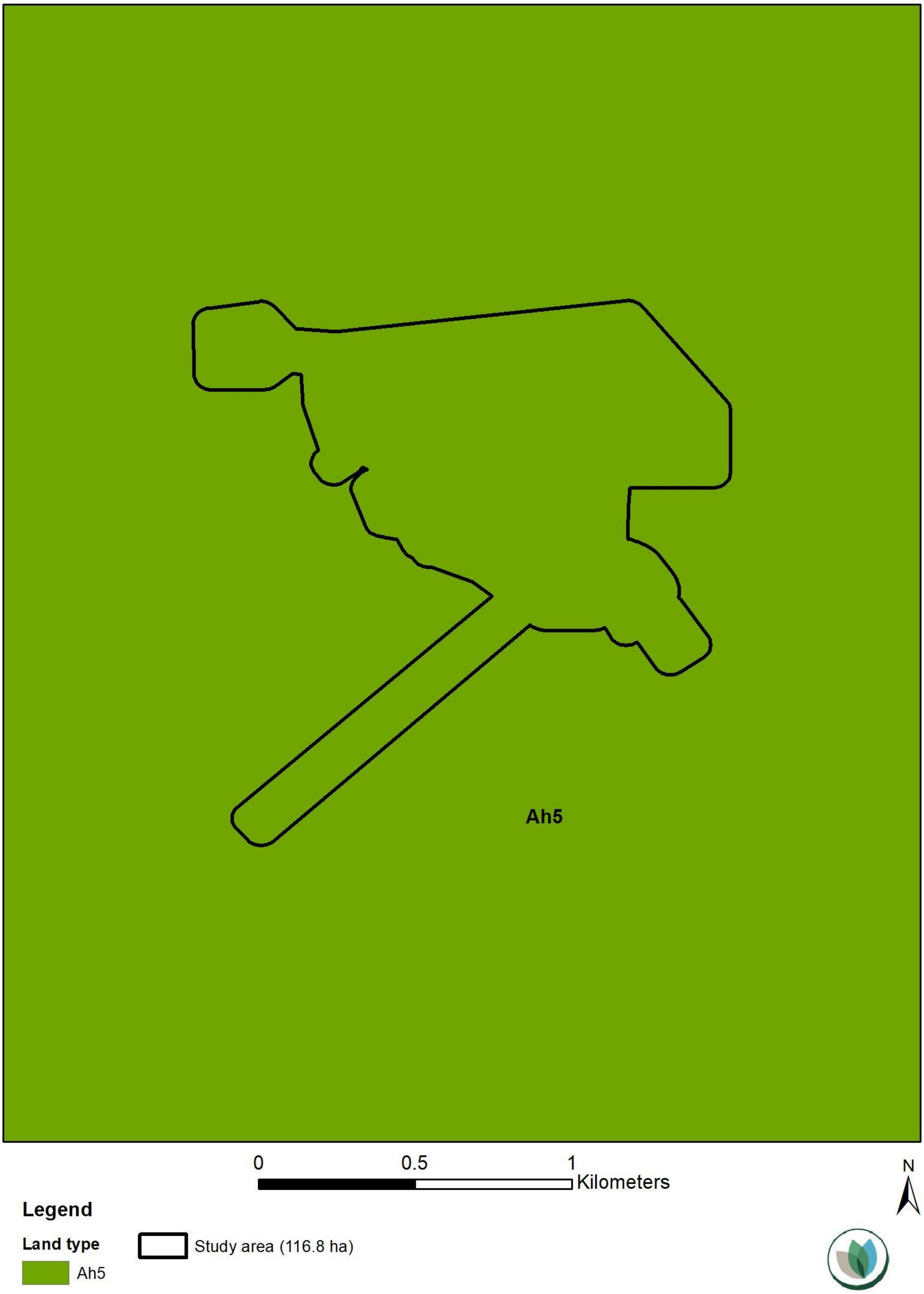

Figure 4 Land type map of the Mn48 study area and surrounding area

9. RESULTS OF DESKTOP ANALYSIS

9.1 Land type classification

The entire Mn48 project area as well as the surrounding area are classified as one land type i.e. Land Type Ah5 (Figure 4). The complete data sheet of this land type is attached as Appendix 1. According to the land type data sheet, the terrain of Land Type Ah5 consists of two landscape positions (Figure 5). The flat toe-slope positions (Terrain unit 4) have slope of 0 to 1% and is present in approximately 95% of the total surface area covered by this land type. The remaining 5% consist of valley bottom positions (Terrain unit 5) with slope that ranges between 1 and 3%. The toe-slopes consist of around 98% deep soil profiles of the Clovelly and Hutton forms and the remaining 2% of shallow profiles of the Mispah form as well as endorheic pans. The valley bottoms consist of a mixture of shallow profiles of the Mispah form as well as albic profiles of the Fernwood form and endorheic pans.

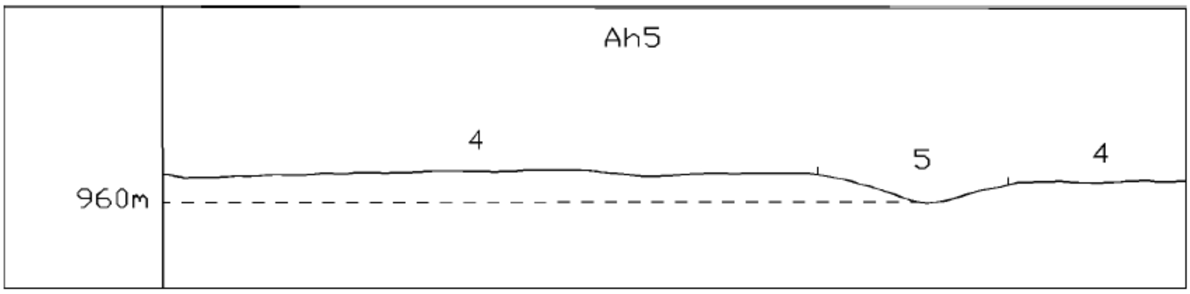

Figure 5 Terrain form sketch of Figure Ah5

9.2. Land capability

The boundary of the study area of the Mn48 project was superimposed on the land capability raster data layer that DAFF published in 2017 (Figure 5). The data set is used as one part of the criteria for determination of agricultural sensitivity by the Environmental Screening Tool.

According to this data, the proposed surface infrastructure layout consist mainly of land with Low (Class 05) land capability. Small areas scattered within the project area as well as around it consist of land with slightly higher land capability (Low-Moderate or Class 06) as well as lower land capability classes (Low-Very low or Classes 03 and 04). The areas along the Kuruman River are considered to generally of lower land capability classification. All the land capability classes identified within the project area indicate that from an agricultural perspective, the land is not considered suitable for arable agriculture but can be used for livestock grazing.

9.3. Field crop boundaries

The field crop boundaries data layers of the both Northern Cape province(DAFF,2019), were depicted within and around the Mn48 study area (Figure 7). The data indicate that no crop fields are present within this area. The nearest crop fields are between 25 and 30km north, south and southwest of the study area and consist of annual rainfed crop cultivation or planted pastures.

Figure 6 Land capability of the Mn48 study area and the surrounding area (data source: DAFF, 2017)

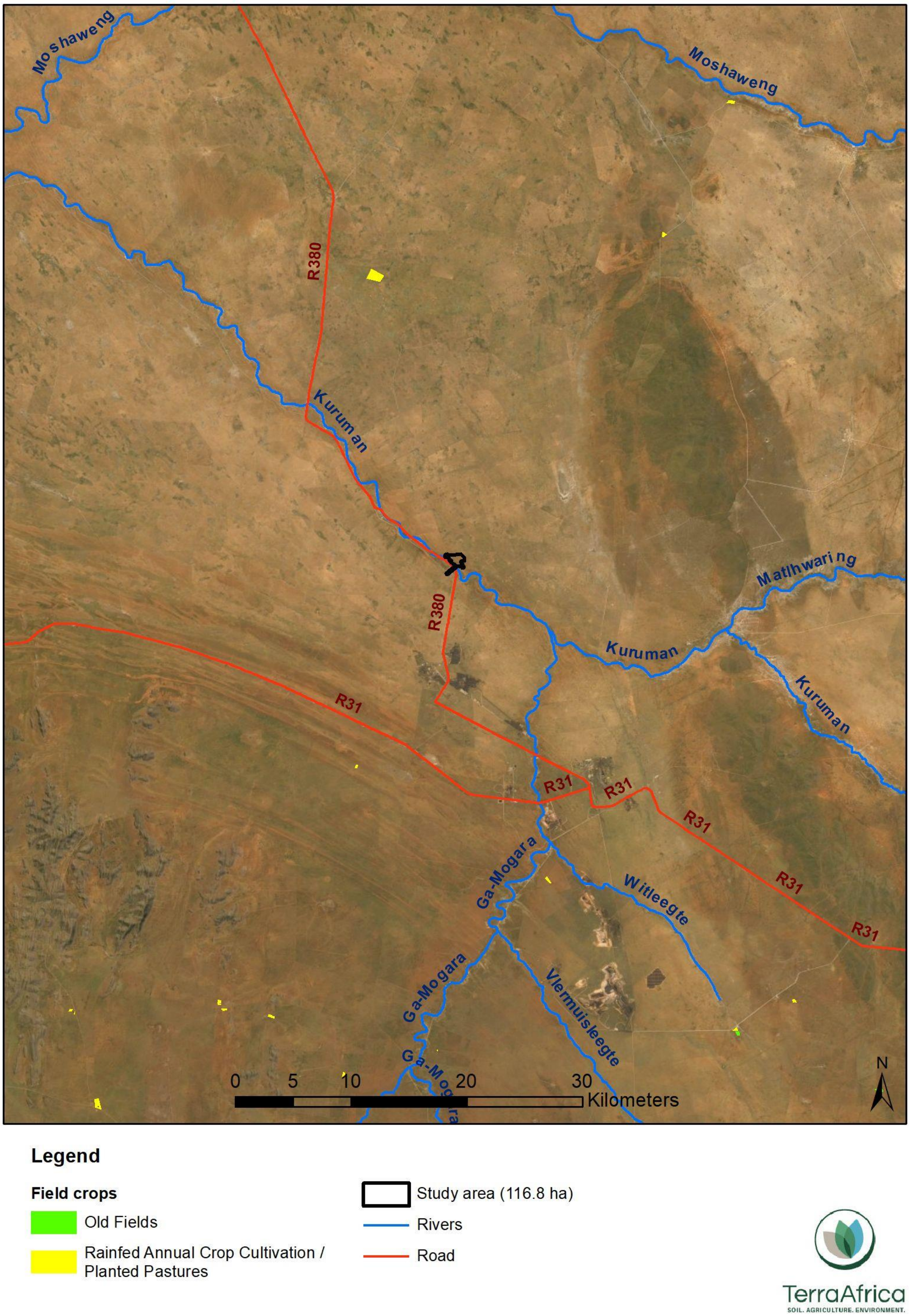

Figure 7 Field crop boundaries within study area as well as the surrounding area (data source: DAFF, 2019)

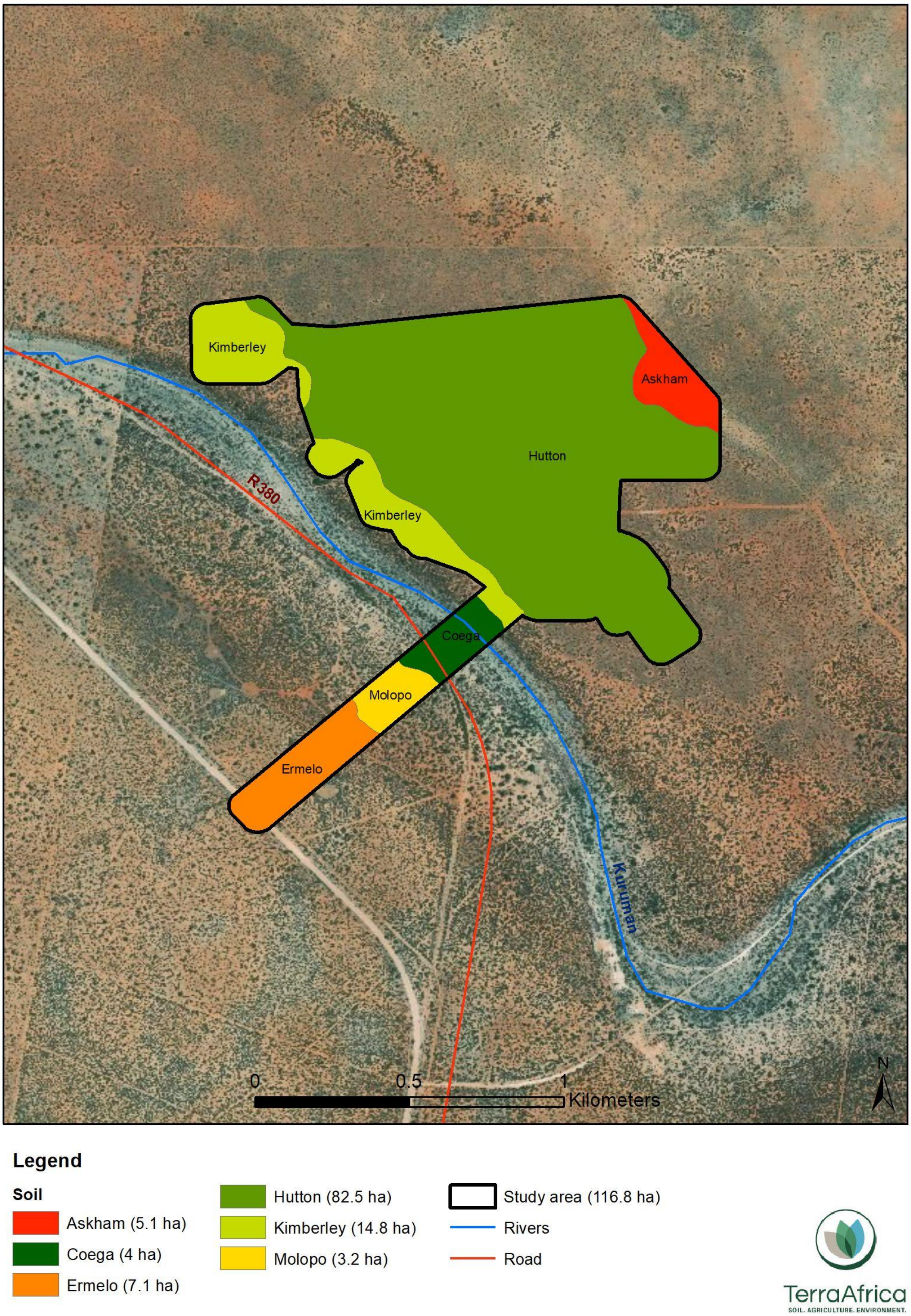

Figure 8 Soil classification map of the Mn48 project's study area

10. RESULTS OF SITE ASSESSMENT

10.1. Soil classification

The total area of land where soil was classified, consists of six different soil forms. The positions of these soil forms within the study area, are indicated in
Figure *8*. All of the soil forms are natural soil forms where the original soil horizon organisation is still present. Each of the soil forms and the approximate area covered by it, is discussed below.

Ermelo form:

Approximately 7.1ha of the study area consist of the Ermelo soil form. The Ermelo soil form consist of bleached to slightly chromic sandy topsoil that is underlain by yellow-brown apedal subsoil that is deeper than 1.5m. The soil is structureless (apedal) and well-drained. The soil form currently supports the natural vegetation of the area and has grazing land capability. According to the project infrastructure layout, the Ermelo form will be affected by the road to be constructed from the mining area to the main gravel road located west of the study area.

Figure 9 Example of an Ermelo soil profile present within the Mn48 study area

Hutton form:

The Hutton soil form is the most prevalent soil form within the study area (82.5 ha). It consist of an orthic A horizon on a red apedal B horizon overlying unspecified material. The range of red colours that is a key identification tool in differentiating between a red apedal and yellow-brown apedal is defined by the Soil Classification Working Group (2018). Most of the defining red soil colours identified on the sites are highly bleached (5YR 5/8), thus borderline red

(Figure 10). Soil depths of the Hutton profiles surveyed on site are all deeper than 1.5m and are without signs of wetness.

Figure 10 Photographic evidence of the red colour of the apedal subsoil of the Hutton form

Coega form:

The Coega form is found in the beds of the Kuruman River and consist of bleached, sandy orthic topsoil of between 0.15 and 0.35m thick that is underlain by hard carbonate. As the river bed area of the Kuruman River is a preferential flow path in the landscape, surface runoff after a rainfall event, will transport soil and sediment particles and deposit it in this area. However, the high evaporation rate in the area will result in the accumulation of free carbonates in the topsoil material.

Kimberley form:

The Kimberley form consist of similar topsoil and subsoil horizons as the Hutton form, except that the depth of these profiles are limited by the presence of soft carbonate at depths of 0.6 to 0.9m. This soil form is present directly north-east of the Kuruman River and area of around 14.8 ha within the study area.

Molopo form:

The Molopo form consist of orthic, structureless topsoil with sandy texture (approximately 0.25m thick) that overlies a yellow-brown apedal subsoil horizon. The subsoil horizon is limited in depth by the presence of soft carbonate. The soft carbonate material occur at depths of between 0.4 and 1.3 m.

Figure 11 The range of depths observed in the area with the Molopo form where the proposed road will be constructed

Askham form:

The Askham form has similar properties than the Molopo form, except that the yellow-brown apedal horizon is underlain by hard carbonate instead of soft carbonate.

10.2. Land capability classification

Following the results of the soil classification survey as well as other site assessment observations such as the terrain and climate, the entire study area can be divided into two land capability classes i.e. 112.8 ha of grazing land capability and 4 ha of wilderness land capability. The current position of these land capability classes are depicted in Figure 12. The deeper soils of the Hutton and Ermelo forms could have had arable land capability and could also be suitable for irrigated crop production. Due to unfavourable climatic conditions and lack of irrigation water the land capability of these parts of the study area is that of extensive grazing.

The wilderness land capability classification has been assigned to the area where the Kuruman River is present. Although this area is a preferential flow path in the landscape, the soil forms of this area is not indicative of typical wetland soils with hydric soils that exhibit mottles and gley horizons. The vegetation in this area is more sparse than that of the surrounding deeper soil profiles. This area has therefore been assigned “Wilderness land capability”.

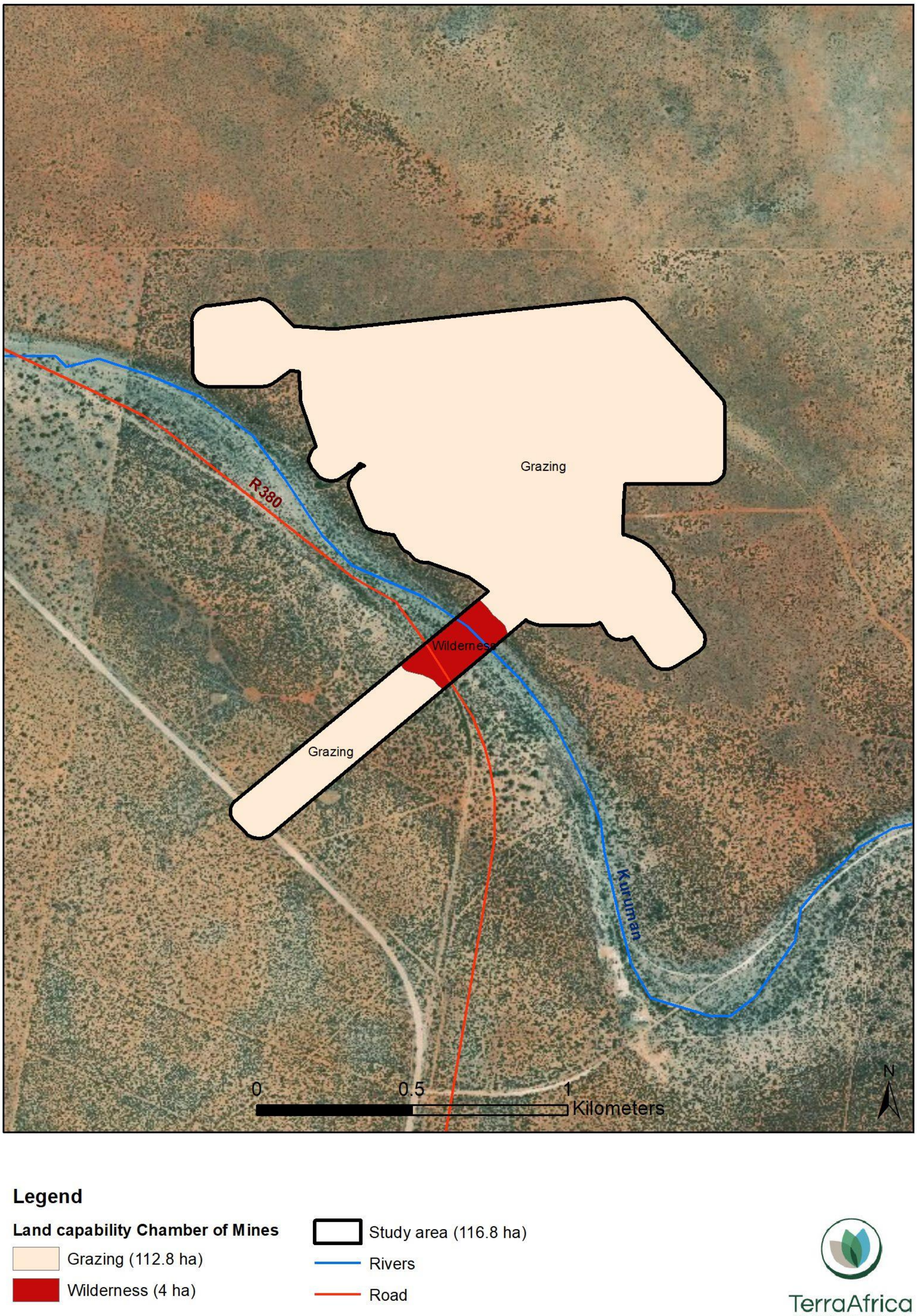

Figure 12 Land capability map of the study area according to the Chamber of Mines Classification System

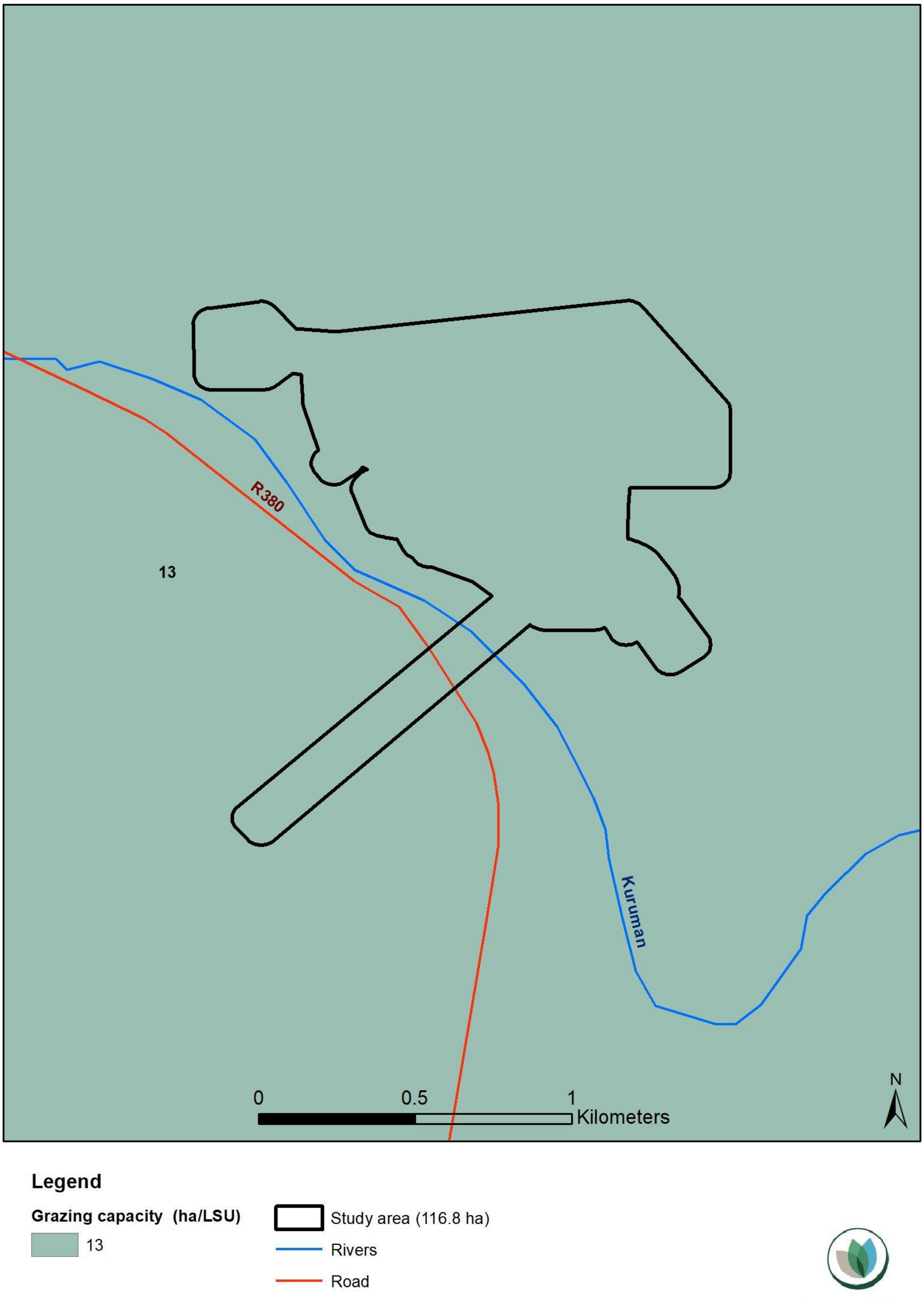

Figure 13 Long-term grazing capacity of the UMK Mining Right Area (data source: DAFF, 2018)

10.6 Agricultural potential

During the site visit as well as through analysis of desktop data for the infrastructure expansion areas, it was found that the areas to be directly affected by the project infrastructure, is suitable for extensive livestock farming. Although the Mn48 Area is not currently used for commercial or community livestock farming, it is considered the most viable agricultural production option for the area. Therefore, the spatial data layer of the long-term grazing capacity of the area (DAFF, 2018), was used to determine the number of cattle that feed in the study area. The ideal grazing capacity of a specified area is an indication of the long-term production potential of the vegetation layer growing there to maintain an animal with an average weight of 450 kg (defined as 1 Large Stock Unit (LSU)) with an average feed intake of 10 kg dry mass per day over the period of approximately a year.

Following the metadata layer obtained from DAFF, the grazing capacity of the entire Mn48 study area, is 13ha/LSU (Figure 13). When using this grazing capacity, the proposed infrastructure areas are theoretically able to provide feed to 9 head of cattle and this will be lost from the area if the Mn48 project goes ahead.

From a soil physical and chemical perspective, the Hutton and Ermelo soils on site may have been highly suitable for dryland crop production. However, the study area receives an average of 460mm of rain annually, the soils are very well drained and the evaporation rate is high because of high temperatures, commercial crop production would be at high risk of suffering losses as a result of droughts.

The Mn48 study area did not have any current irrigation infrastructure that was being used for irrigation purposes. No large dams with irrigation potential have been observed on the study area. The Hutton, Kimberley, Askham, Molopo and Ermelo soil forms identified on the study area is suitable for irrigated crop production if irrigation water is available. Although the establishment of irrigation infrastructure requires high initial capital investment, the site has potential for this production method should it ever become a future land use possibility.

10.5 Land use

The land use of the study area can be defined as grazing for wildlife. There was no evidence of cattle grazing on the study area. Unsurfaced farm roads is present on the property and connect areas where exploration for manganese was done, to the main access gate. One of these farm roads are covered by a gravel layer for stability (Figure 14). This material was transported onto site from somewhere else. There were tracks of wild animals observed during the site visit. Stock and/or game farming will be a viable post mining land use of the study area as long as the field quality is maintained by never exceeding the grazing capacity.


Figure 14 Farm road covered by imported gravel for stability

The land uses surrounding the proposed project is a combination of farming activities (livestock and game farming), mining activities (at Black Rock, Hotazel and Kathu), residential areas (Kuruman, Hotazel, Black Rock and Kathu as well as informal settlements and farmsteads), commercial and recreational activities in the above-mentioned towns and transport services (R380 provincial road and D3340 private gravel road).

10.6 Consideration of site sensitivities and micro-siting

Several options for the surface infrastructure layout were considered prior to deciding on the final layout that was provided for the purpose of this assessment. The positioning of the infrastructure was determined by underground mining layout as well as the mining method. Once the mining method was determined , the associated infrastructure and shaft positions were identified to ensure that the extraction of ore is maximised with the least amount of waste development. All surface infrastructure was then oriented around the shafts to ensure unhindered flow of men, material and ore. Only one site was selected as a possible Waste Rock Dump area and the decision was made through consideration of the available space on site and proximity to areas from where waste material will be transported.

Although agricultural and soil sensitivities were not used as criteria for decisions on the proposed infrastructure layout, the area's land capabilities and agricultural potential is almost homogeneous and the infrastructure is positioned on land with low agricultural combined sensitivity.

12. IMPACT ASSESSMENT

Although both Lehating and Khwara Mines have existing mining rights that are now consolidated, the mining activities that were authorised, have not commenced before. It is therefore anticipated that the activities of the consolidated area will include all the typical construction and operational activities associated with a typical open-cast manganese mining project.

12.1 Construction phase

The disturbance of original soil profiles and horizon sequences of these profiles during earthworks (stripping of topsoil) is a measurable deterioration. This impact is permanent but will be localised within the site boundary. This impact is possible and will have medium significance. Even though topsoil management is described in the Soil Management Plan (SMP), the impact will still have medium significance with mitigation measures implemented as it is impossible to re-create the original soil profile distribution. Once rehabilitation of the pit area has commenced, the rehabilitated soil profiles will be a new soil with properties that may resemble some of the original soil properties but that may also be altered because of the mixing of soil horizons. The “new” soil can still be used for re-vegetation and successful rehabilitation practices will be able to restore the grazing capacity of the land over a period of time.

Soil chemical pollution because of potential oil and fuel spillages from vehicles, is considered to be a moderate deterioration of the soil resource. This impact will be localised within the site boundary and will have medium significance on the soil resource when not managed. However, with proper waste management and immediate clean-up as mitigation measures, the significance of this impact can be reduced to very low (post-mitigation) (Soil Management Plan).

Soil compaction will be a measurable deterioration that will occur as a result of the heavy vehicles commuting on the existing roads as well as any new access and maintenance roads constructed for this project. Loading, hauling and transportation of the waste rock involve the use of heavy vehicles and will cause serious compaction of the soil resource. This is a permanent impact that will be localised within the site boundary with medium consequence and significance as subsurface soil compaction is difficult to alleviate.

The only areas where permanent change to land capability will occur is the areas where waste rock dumps are likely to remain on the soil surface post closure of the mine. In these areas the grazing land capability is permanently lost. This is considered a minor loss, permitting that all the other areas around it is sufficiently rehabilitated back to grazing land.

Soil erosion

Scenario	Intensity	Duration	Extent	Consequence	Significance
Unmitigated	H	H	L	H	H
Mitigated	M	H	L	M	M

Disturbance of original soil profiles

Scenario	Intensity	Duration	Extent	Consequence	Significance
Unmitigated	H	H	L	H	H
Mitigated	H	H	L	H	H

Soil chemical pollution

Scenario	Intensity	Duration	Extent	Consequence	Significance
Unmitigated	L	H	L	M	M
Mitigated	L	H	L	M	M

Soil compaction

Scenario	Intensity	Duration	Extent	Consequence	Significance
Unmitigated	M	H	L	M	M
Mitigated	M	H	L	M	M

Loss of grazing land capability

Scenario	Intensity	Duration	Extent	Consequence	Significance
Unmitigated	H	H	L	H	H
Mitigated	M	H	L	M	M

Loss of current land use

Scenario	Intensity	Duration	Extent	Consequence	Significance
Unmitigated	H	H	L	H	H
Mitigated	M	H	L	M	M

12.2 Operational phase

The operational phase includes all the processes associated with the daily management of the open pit mining and related activities. The main envisaged operational activities that will impact on soil, land use and land capability in the study area include the following:

- Surface infrastructure namely the waste rock dumps are disruptive to current land uses, land capability as well as agricultural potential of the soil.
- Other general activities include transport and loading and hauling of the waste rock on roads that will result in soil compaction while waste generation (non-mineral waste) and accidental spills and leaks may result in soil chemical pollution when unmanaged.

The continued disturbance of original soil profiles and horizon sequences of these profiles is considered to be a measurable deterioration. This impact is considered to be permanent but will be localised within the site boundary. This impact is possible and will have medium significance when unmanaged.

Soil chemical pollution as a result of pollutants leaching into subsurface soil horizons where waste rock is stockpiled, is considered to be a moderate deterioration of the soil resource.

This impact will be localised within the site boundary and have medium significance on the soil resource.

Soil compaction will be a measurable deterioration that will occur as a result of the weight of the movement of vehicles on the soil surfaces and the weight of topsoil stored on the soil surface. This is a permanent impact that will be localised within the site boundary with medium consequence and significance. Hauling of rock and where topsoil will be stockpiled

The current land capability and land use of areas where permanent waste rock dumps are created will be lost permanently. However, the land capability and land use of areas where infrastructure will be decommissioned (topsoil stockpiles), can be restored through proper land rehabilitation techniques.

Soil erosion

Scenario	Intensity	Duration	Extent	Consequence	Significance
Unmitigated	H	H	L	H	H
Mitigated	M	H	L	M	M

Disturbance of original soil profiles

Scenario	Intensity	Duration	Extent	Consequence	Significance
Unmitigated	H	H	L	H	H
Mitigated	H	H	L	H	H

Soil chemical pollution

Scenario	Intensity	Duration	Extent	Consequence	Significance
Unmitigated	M	H	L	M	M
Mitigated	L	H	L	M	L

Soil compaction

Scenario	Intensity	Duration	Extent	Consequence	Significance
Unmitigated	H	H	L	H	H
Mitigated	M	H	L	M	M

Loss of grazing land capability

Scenario	Intensity	Duration	Extent	Consequence	Significance
Unmitigated	H	H	L	H	H
Mitigated	M	H	L	M	M

Loss of current land use

Scenario	Intensity	Duration	Extent	Consequence	Significance
Unmitigated	H	H	L	H	H
Mitigated	M	H	L	M	M

12.3 Decommissioning phase

Decommissioning will only apply to the topsoil stockpiles since the WRDs may remain on surface after closure. The topsoil will be used for the final rehabilitation of reclaimed areas as well as the WRDs.

- Transport of stockpiled topsoil to rehabilitation sites. This will compact the soil of the existing roads and fuel and oil spills from vehicles may result in soil chemical pollution.
- Earthworks will include redistribution topsoil to rehabilitated areas and to be added to the soil surface. These activities will not result in further impacts on land use and land capability but may increase soil compaction.

Soil chemical pollution

Scenario	Intensity	Duration	Extent	Consequence	Significance
Unmitigated	M	M	L	M	M
Mitigated	L	L	VL	L	VL

Soil compaction

Scenario	Intensity	Duration	Extent	Consequence	Significance
Unmitigated	H	H	L	H	H
Mitigated	M	M	VL	M	L

Soil chemical pollution as a result of potential oil and fuel spillages from vehicles, is considered to be a moderate deterioration of the soil resource. This impact will be localised within the site boundary and have medium significance on the soil resource when not managed. However, with proper waste management and immediate clean-up, the significance of this impact can be reduced to very low .

Soil compaction will be a measurable deterioration that will occur as a result of the heavy vehicles. This is a long-term impact because soil ripping will only alleviate compaction in surface soil layers and have little to no effect on deeper soil compaction. Soil compaction will be localised within the site boundary with medium consequence and low significance.

12.4 Closure phase

The closure phase occurs after the cessation of all decommissioning activities. Relevant closure activities are those related to the after care and maintenance of remaining structures. It is assumed that any permanent waste rock dumps will be stable and will have no further impacts on soil during the closure phase.

13. ACCEPTABILITY STATEMENT

The proposed development of mining infrastructure for the Mn48 mining project falls within a larger area of mining projects intermixed with game and livestock farming and settlement (Hotazel, Black Rock, Kuruman and Kathu). The land capability and soil quality of land affected by the surface footprint of mining activities will be compromised and the anticipated impacts include soil erosion, soil compaction, soil pollution as well as a loss of the grazing land capability.

Furthermore, if soil management measures are followed as outlined in this report and the land be rehabilitated to the highest standard possible, livestock and game farming will be possible on rehabilitated land, except for the area covered by waste rock dumps that may remain in perpetuity.

It is therefore of my opinion that the activity may be an acceptable change to the current land use of the property, should the project be authorised. It follows that the recommendations and monitoring requirements as set out in this report should form part of the conditions of the environmental authorisation for the project.

14. REFERENCE LIST

Brady, N.C. and Weil, R.P. 2008. The Nature and Properties of Soils. Revised fourteenth edition., Upper Saddle River, New Jersey: Prentice Hall.

Crop Estimates Consortium, 2019. *Field crop boundary data layer (NC province)*, 2019. Pretoria. Department of Agriculture, Forestry and Fisheries.

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South Africa (Republic) 2018. *Long-term grazing capacity for South Africa*: Data layer. Government Gazette Vol. 638, No. 41870. 31 August 2018. Regulation 10 of the Conservation of Agricultural Resources Act (CARA): Act 43 of 1983. Pretoria. Government Printing Works.

APPENDIX 1 – DATA SHEET OF LAND TYPE AH5

LAND TYPE / *LANDTIPE*...................... : Ah5

CLIMATE ZONE / *KLIMAATSONE* .... : 1S

Area / *Oppervlakte* .... : 364310 ha

Estimated area unavailable for agriculture

Beraamde oppervlakte onbeskikbaar vir landbou : 6000 ha

Occurrence (maps) and areas / *Voorkoms (kaarte) en oppervlakte :*

2622 Morokweng (305260 ha) 2722 Kuruman (59050 ha)

Inventory by / *Inventaris deur :*

J F Eloff & A T P Bennie

Modal Profiles / *Modale profiele :*

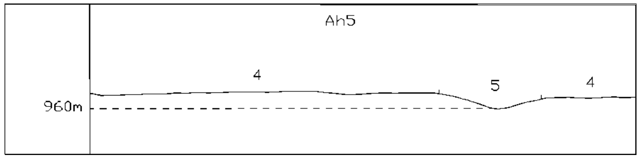
None / Geen

Terrain unit / *Terreineenheid*	:	4	5
% of land type / *% van landtipe*	:	95	5
Area / *Oppervlakte (ha)*	:	346094	18216
Slope / *Helling (%)*	:	0 - 1	1 - 3
Slope length / *Hellingslengte (m)*	:	1000 - 10000	200 - 1200
Slope shape / *Hellingsvorm*	:	Z	Z
MB0, MB1 (ha)	:	342634	7286
MB2 - MB4 (ha)	:	3461	10929

Soil series or land classes / ***Grondseries of landklasse***	**Depth** / ***Diepte*** **(mm)**	**MB**		**ha**	**%**	**ha**	**%**	**Total** / ***Totaal*** **ha**	**%**	**Clay content %** / ***Klei-inhoud %*** **A**	**E**	**B21**	**Hor**	**Texture** / ***Tekstuur*** **Class / *Klas***	**Depth limiting material** / ***Diepte-beperkende materiaal***
Sunbury Cv30	>1200	0	:	145359	42			145360	39.9	2-4		3-6	B	fiSa	
Mangano Hu33	>1200	0	:	62297	18			62297	17.1	3-6		6-10	B	fiSa	
Annandale Cv33	>1200	0	:	62297	18			62297	17.1	3-6		6-10	B	fiSa	
Roodepoort Hu30, Gaudam Hu31	>1200	0	:	41531	12			41531	11.4	2-4		3-6	B	fi/meSa	
Sandspruit Cv31	>1200	0	:	27688	8			27688	7.6	2-4		3-6	B	meSa	
Mispah Ms10, Kalkbank Ms22	100-250	3	:	3461	1	9108	50	12569	3.5	6-10			A	fiSa	R,ka
Maputa Fw10, Motopi Fw20,			:												
Fernwood Fw11, Langebaan Fw21	>1200	0	:	3461	1	5465	30	8926	2.5	3-6		4-8	B	fi/meSa	
Shorrocks Hu36	>1200	0	:			1822	10	1822	0.5	7-10		15-18	B	fiSaLm	
Pans/Panne		4	:			1822	10	1822	0.5						

Terrain type / *Terreintipe :* A1

Terrain form sketch / *Terreinvormskets*



For an explanation of this table consult LAND TYPE INVENTORY (table of contents)

Ter verduideliking van hierdie tabel kyk LANDTIPE - INVENTARIS (inhoudsopgawe)

Geology: Aeolian sand of Recent age with occasional outcrops of Tertiary Kalahari beds (surface limestone, silcrete and sandstone) in the riverbeds.

Geologie: Eoliese sand van Resente ouderdom met enkele dagsome van Tersiere Kalaharilae (oppervlakkalksteen, silkreet en sandsteen) in die rivierlope.

APPENDIX 2 – CURRICULUM VITAE OF SPECIALIST

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Wolmaransstad,
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EXPERTISE

Soil Quality Assessment

Soil Policy and Guidelines

Agricultural Agro-Ecosystem Assessment

Sustainable Agriculture

Data Consolidation

Land Use Planning

Soil Pollution

Hydropedology

EDUCATION

MASTER'S DEGREE
Environmental Science
University of Witwatersrand
2010 – 2018

BACHELOR'S DEGREE
Agricultural Science
University of Pretoria
2001 – 2004

PROFESSIONAL PROFILE

I contribute specialist knowledge on agriculture and soil management to ensure long-term sustainability of projects in Africa. For the past thirteen years, it has been my calling and I have consulted on more than 200 projects. My clients include environmental and engineering companies, mining houses, and project developers. I enjoy the multi-disciplinary nature of the projects that I work on and I am fascinated by the evolving nature of my field of practice. The next section provide examples of the range of projects completed. A comprehensive project list is available on request.

PROJECT EXPERIENCE

Global Assessment on Soil Pollution

Food and Agricultural Organisation (FAO) of the United Nations (UN)

Author of the regional assessment of Soil in Sub-Saharan Africa. The report is due for release in February 2021. The different sections included:

- Analysis of soil and soil-related policies and guidelines for each of the 48 regional countries
- Description of the major sources of soil pollution in the region
- The extent of soil pollution in the region and as well as the nature and extent of soil monitoring
- Case study discussions of the impacts of soil pollution on human and environmental health in the region
- Recommendations and guidelines for policy development and capacitation to address soil pollution in Sub-Saharan Africa

Data Consolidation and Amendment

Range of projects: Mining Projects, Renewal Energy

These projects included developments where previous agricultural and soil studies are available that are not aligned with the current legal and international best practice requirements such as the IFC Principles. Other projects are expansion projects or changes in the project infrastructure layout. Tasks on such projects include the incorporation of all relevant data, site verification, updated baseline reporting and alignment of management and monitoring measures.

Project examples:

- Northam Platinum's Booysendal Mine, South Africa
- Musonoi Mine, Kolwezi District, Democratic Republic of Congo
- Polihali Reservoir and Associated Infrastructure, Lesotho
- Kaiha 2 Hydropower Project, Liberia
- Aquarius Platinum's Kroondal and Marikana Mines

PROFESSIONAL MEMBERSHIP

South African Council for Natural Scientific Professions (SACNASP)

Soil Science Society of South Africa (SSSSA)

Soil Science Society of America (SSSA)

Network for Industrially Contaminated Land in Africa (NICOLA)

LANGUAGES

English (Fluent)

Afrikaans (Native)

French (Basic)

PRESENTATIONS

There is spinach in my fish pond
TEDx Talk
Available on YouTube

♦

Soil and the Extractive Industries
Session organiser and presenter
Global Soil Week, Berlin (2015)

♦

How to dismantle an atomic bomb
Conference presentation (2014)
Environmental Law Association (SA)

PROJECT EXPERIENCE (Continued)

Agricultural Agro-Ecosystem Assessments

Range of projects: Renewable Energy, Industrial and Residential Developments, Mining, Linear Developments (railways and power lines)

The assessments were conducted as part of the Environmental and Social Impact Assessment processes. The assessment process includes the assessment of soil physical and chemical properties as well as other natural resources that contributes to the land capability of the area.

Project examples:

- Mocuba Solar PV Development, Mozambique
- Italthai Railway between Tete and Quelimane, Mozambique
- Lichtenburg PV Solar Developments, South Africa
- Manica Gold Mine Project, Mozambique
- Khunab Solar PV Developments near Upington, South Africa
- Bomi Hills and Mano River Mines, Liberia
- King City near Sekondi-Takoradi and Appolonia City near Accra, Ghana
- Limpopo-Lipadi Game Reserve, Botswana
- Namoya Gold Mine, Democratic Republic of Congo

Sustainable Agriculture

Range of projects: Policy Development for Financial Institutions, Mine Closure Planning, Agricultural Project and Business Development Planning

Each of the projects completed had a unique scope of works and the methodology was designed to answer the questions. While global indicators of sustainable agriculture are considered, the unique challenges to viable food production in Africa, especially climate change and a lack of infrastructure, in these analyses.

Project examples:

- Measurement of sustainability of agricultural practices of South African farmers – survey design and pilot testing for the LandBank of South Africa
- Analysis of the viability of avocado and mango large-scale farming developments in Angola for McKinsey & Company
- Closure options analysis for the Tshipi Borwa Mine to increase agricultural productivity in the area, consultation to SLR Consulting
- Analysis of risks and opportunities for farm feeds and supplement suppliers of the Southern African livestock and dairy farming industries
- Sustainable agricultural options development for mine closure planning of the Camutue Diamond Mine, Angola

PROFESSIONAL DEVELOPMENT

Contaminated Land Management 101 Training
Network for Industrially Contaminated Land in Africa
2020

Intensive Agriculture in Arid & Semi-Arid Environments
CINADCO/MASHAV R&D Course, Israel
2015

World Soils and their Assessment Course
ISRIC – World Soil Information Centre, Netherlands
2015

Wetland Rehabilitation Course
University of Pretoria
2010

Course in Advanced Modelling of Water Flow and Solute Transport in the Vadose Zone with Hydrus
University of Kwazulu-Natal
2010

Environmental Law for Environmental Managers
North-West University Centre for Environmental Management
2009

PROJECT EXPERIENCE (Continued)

Soil Quality Assessments

Range of projects: Rehabilitated Land Audits, Mine Closure Applications, Mineral and Ore Processing Facilities, Human Resettlement Plans

The soil quality assessments included physical and chemical analysis of soil quality parameters to determine the success of land rehabilitation towards productive landscapes. The assessments are also used to understand the suitability for areas for Human Resettlement Plans

Project examples:

- Closure Planning for Yoctolux Colliery
- Soil and vegetation monitoring at Kingston Vale Waste Facility
- Exxaro Belfast Resettlement Action Plan Soil Assessment
- Soil Quality Monitoring of Wastewater Irrigated Areas around Matimba Power Station
- Keaton Vanggatfontein Colliery Bi-Annual Soil Quality Monitoring

REFERENCES

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