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SOIL. AGRICULTURE. ENVIRONMENT.

# Soil and Agricultural Assessment for the UMK Mine EIA Amendment

**Submitted by TerraAfrica Consult cc**

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# 1. INTRODUCTION

TerraAfrica Consult cc was appointed by SLR Consulting (Africa) Pty Ltd to conduct the soil, land use and land capability study as part of an Environmental Authorisation process for new listed activities at the United Manganese of Kalahari (Pty) Ltd (from here onwards referred to as UMK). The UMK Mine is located approximately 13 km south of Hotazel and 80 km north west of Kuruman in the Joe Morolong Local Municipality within the John Taolo Gaetsewe District Municipality in the Northern Cape Province of South Africa (Figure 1). The proposed new listed activities will be located on the farm Botha 313, the RE of the farm Smartt 314, and portions 1, 2 and 3 (a portion of the RE) of the farm Rissik 330.

# 2. PROJECT DESCRIPTION

UMK is proposing to change the approved surface layout for the mine to optimize their mining operations. These changes include the addition of new infrastructure, upgrade and expansion of existing approved infrastructure and relocation of some infrastructure. The activities below will be included within the application for authorisation by the DMRE.

Proposed new surface infrastructure at the mine:

- New parking area (0.52 ha);
- Solar equipped boreholes and associated storage tanks;
- Tyre fitting bay, workshop/tyre centre and oil storage (7 ha)
- Waste rock and sand stockpiles:
    - Central West Waste Rock Dump (WRD) (84 ha)
    - Central West Sand Stockpile (40.9 ha)
    - J Block West WRD (133 ha)
    - J Block West Sand Stockpile (46.5 ha)
    - J Block East WRD (63.5)
    - J Block East Sand Stockpile (16.5 ha)
    - Powerline West WRD (196 ha)
    - Powerline West Sand Stockpile (35.9 ha)
    - A Block West WRD (145 ha)
- Product stockpile area within the approved sinter plant area (21.4 ha)
- TUP stockpile (12.4 Ha);
- Truck staging area (20.4 ha)
- Hard park areas (Phase 1 and 3) (14.3 ha)
- Barlow's Store (1 ha)
- Explosives depo and associated service road (13.1 ha); and
- Engineering salvage yard (temporal and permanent) (2.43 ha).

Upgrade of existing approved infrastructure:

- Prentec Sewage Plant; and
- Existing weigh bridge and associated access road.

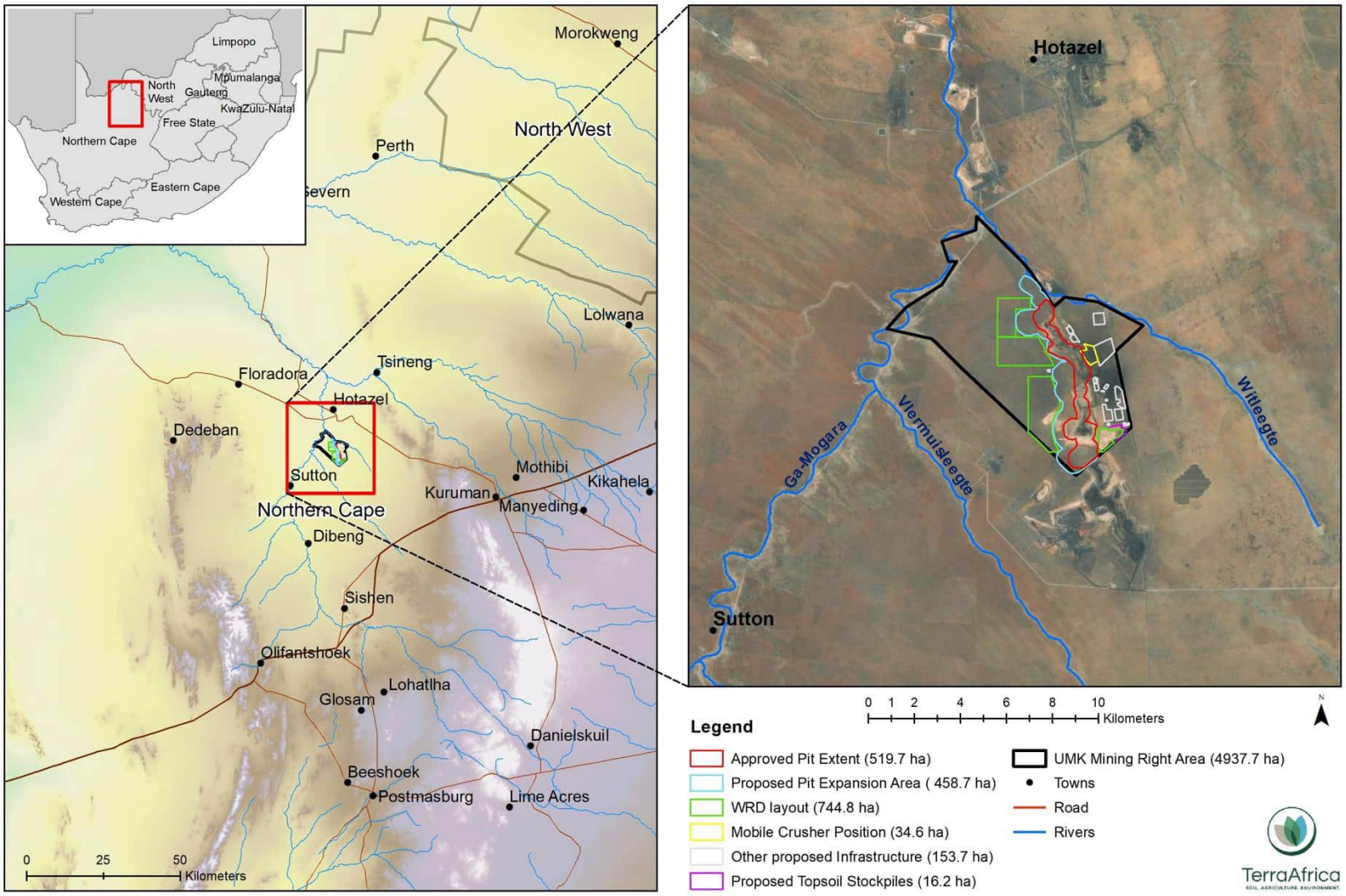


Figure 1 Locality of the proposed UMK Mining Right Area

Expansion of existing approved infrastructure:

- Expansion of the approved pit area (458.7 ha);
- Product stockpile (53.6 ha);
- Modular crushing plant (34.6 ha);
- Fuel storage farm (0.45 ha);
- EME workshop for major repair and maintenance (3.6 ha);
- Road truck staging area (1.6 ha); and
- Offices (19.1 ha).

Relocation of the following infrastructure at the mine:

- Prentec Sewage Plant; and
- Existing weigh bridge and associated access road.

## 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 infrastructure changes, is sufficiently considered. Also, that the information provided in this report, enables the Competent Authority (Northern Cape Department of Mineral Resources) to come to a sound conclusion on the impact of the proposed project on the agricultural production potential of the site for both livestock and crops.

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 UMK EIA Amendment 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.

# 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<br>Appendix 2 |
| 3.2. The compliance statement must:<br>3.2.1. be applicable to the preferred site and proposed development footprint; | Sections 2, 9 and 10 |
| 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:<br>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<br>Section 8 |
| 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 11 |
| 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 – the project infrastructure does not include linear activities |
| 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 in the proposed expansion areas at UMK, from low density livestock production to mining.

## 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 as well as a desktop assessment to verify the soil properties of the areas of footprint expansion as well as areas already affected by the mining activities.
- Update the existing UMK Soil, Land Use and Land Capability report submitted in 2017 to include the new areas.
- Identify and assess potential impacts on both agricultural potential as well as soil, resulting from the proposed amendments in the scope of UMK Mine's EMPr.
- 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.

The following knowledge gaps have been identified:

- There are no historical results on the soil pollution status of the land that was surveyed. As a result of the project area being part of a larger area of manganese mining activities, there may be elevated levels of possible pollutants as a result of polluted dust blowing into areas over a long period of time. Soil pollution assessment was outside of the scope of this study.

# 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 Department of Agriculture, Land Reform and Rural Development (DALRRD) to determine the land capability classes of the UMK Mining Right Area according to this system. The data was developed using a spatial evaluation modelling approach (DALRRD, 2017).
- The long-term grazing capacity for South Africa 2018 was analysed for the area and surrounding area of the UMK Mining Right 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 Boundaries (November 2019) was analysed to determine whether any crop production areas are present within the UMK Mining Right 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.

## 7.2. Site survey

Two site surveys were conducted during which the baseline soil classification observations were made. The first survey was on 15 and 16 March 2017 for the purpose of the EIA and EMPr amendment associated with the expansion of infrastructure at this time. The second survey was conducted on 24 June 2020 in the areas where the new WRDs and other surface

infrastructure expansion and / development are planned that are outside the footprint of the previous survey.

Prior to the final site visit, aerial photography was analysed to delineated areas where mining activities have already resulted in changes to the surface. The survey points observed were between 250 and 500m apart over study area. The soil profiles were examined to a maximum depth of 1.5m with an auger. 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 were initially described using the S.A. Soil Classification Taxonomic System (Soil Classification Working Group, 1991) published as memoirs in the Agricultural Natural Resources of South Africa No.15. However, for the updated report, the soil classification data points were revisited. The soil map units and descriptions are now based on 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.

## 7.3. Analysis of samples

During the 2017 site visit, six soil samples were collected at the study area (one topsoil and one subsoil sample at three different sampling locations). Due to the homogeneity of soil properties in the area of the UMK Mine, these analyses results were considered sufficient to provide an indication of the basic soil fertility and texture of soils in the areas where UMK Mine plans to expand their infrastructure into.

The soil samples were sealed in soil sampling plastic bags and sent to NviroTek Laboratories for analysis. Samples taken to determine baseline soil fertility were analysed for electrical conductivity (EC), pH (KCl and $H_2O$), phosphorus (Bray1), exchangeable cations (calcium, magnesium, potassium, sodium), organic carbon (Walkley-Black) and texture classes (relative fractions of sand, silt and clay).

## 7.4. 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 DALRRD 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,<br>➢ The soil is readily permeable to the roots of common cultivated plants to a depth of 750mm,<br>➢ The soil has a pH value of between 4,0 and 8.4,<br>➢ The soil has a low salinity and SAR,<br>➢ The soil has a permeability of at least 1,5-mm per hour in the upper 500-mm of soil<br>➢ The soil has less than 10 % (by volume) rocks or pedocrete fragments larger than 100-mm in diameter in the upper 750-mm,<br>➢ Has a slope (in %) and erodibility factor (K) such that their product is <2.0,<br>➢ 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,<br>➢ 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,<br>➢ 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. |

## 7.5. Impact assessment methodology

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

| **PART A: DEFINITIONS AND CRITERIA*** | | |
|---|---|---|
| **Definition of SIGNIFICANCE** | | **Significance = consequence x probability** |
| **Definition of CONSEQUENCE** | | **Consequence is a function of intensity, spatial extent and duration** |
| **Criteria for ranking of the INTENSITY of environmental impacts** | **VH** | Severe change, disturbance or degradation. Associated with severe consequences. May result in severe illness, injury or death. Targets, limits and thresholds of concern continually exceeded. Substantial intervention will be required. Vigorous/widespread community mobilization against project can be expected. May result in legal action if impact occurs. |
| | **H** | Prominent change, disturbance or degradation. Associated with real and substantial consequences. May result in illness or injury. Targets, limits and thresholds of concern regularly exceeded. Will definitely require intervention. Threats of community action. Regular complaints can be expected when the impact takes place. |
| | **M** | Moderate change, disturbance or discomfort. Associated with real but not substantial consequences. Targets, limits and thresholds of concern may occasionally be exceeded. Likely to require some intervention. Occasional complaints can be expected. |

| | | |
|---|---|---|
| | **L** | Minor (Slight) change, disturbance or nuisance. Associated with minor consequences or deterioration. Targets, limits and thresholds of concern rarely exceeded. Require only minor interventions or clean-up actions. Sporadic complaints could be expected. |
| | **VL** | Negligible change, disturbance or nuisance. Associated with very minor consequences or deterioration. Targets, limits and thresholds of concern never exceeded. No interventions or clean-up actions required. No complaints anticipated. |
| | **VL+** | Negligible change or improvement. Almost no benefits. Change not measurable/will remain in the current range. |
| | **L+** | Minor change or improvement. Minor benefits. Change not measurable/will remain in the current range. Few people will experience benefits. |
| | **M+** | Moderate change or improvement. Real but not substantial benefits. Will be within or marginally better than the current conditions. Small number of people will experience benefits. |
| | **H+** | Prominent change or improvement. Real and substantial benefits. Will be better than current conditions. Many people will experience benefits. General community support. |
| | **VH+** | Substantial, large-scale change or improvement. Considerable and widespread benefit. Will be much better than the current conditions. Favourable publicity and/or widespread support expected. |
| **Criteria for ranking the DURATION of impacts** | **VL** | Very short, always less than a year. Quickly reversible |
| | **L** | Short-term, occurs for more than 1 but less than 5 years. Reversible over time. |
| | **M** | Medium-term, 5 to 10 years. |
| | **H** | Long term, between 10 and 20 years. (Likely to cease at the end of the operational life of the activity) |
| | **VH** | Very long, permanent, +20 years (Irreversible. Beyond closure) |
| **Criteria for ranking the EXTENT of impacts** | **VL** | A part of the site/property. |
| | **L** | Whole site. |
| | **M** | Beyond the site boundary, affecting immediate neighbours |
| | **H** | Local area, extending far beyond site boundary. |
| | **VH** | Regional/National |

| **PART B: DETERMINING CONSEQUENCE** | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | **EXTENT** | | | | |
| | | | A part of the site/property | Whole site | Beyond the site, affecting neighbours | Local area, extending far beyond site. | Regional/ National |
| | | | **VL** | **L** | **M** | **H** | **VH** |
| **INTENSITY = VL** | | | | | | | |
| **DURATION** | Very long | **VH** | **Low** | **Low** | **Medium** | **Medium** | **High** |
| | Long term | **H** | **Low** | **Low** | **Low** | **Medium** | **Medium** |
| | Medium term | **M** | **Very Low** | **Low** | **Low** | **Low** | **Medium** |
| | Short term | **L** | **Very low** | **Very Low** | **Low** | **Low** | **Low** |
| | Very short | **VL** | **Very low** | **Very Low** | **Very Low** | **Low** | **Low** |
| **INTENSITY = L** | | | | | | | |
| **DURATION** | Very long | **VH** | **Medium** | **Medium** | **Medium** | **High** | **High** |
| | Long term | **H** | **Low** | **Medium** | **Medium** | **Medium** | **High** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | Medium term | M | Low | Low | Medium | Medium | Medium |
| | Short term | L | Low | Low | Low | Medium | Medium |
| | Very short | VL | Very low | Low | Low | Low | Medium |

**INTENSITY = M**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| DURATION | Very long | VH | Medium | High | High | High | Very High |
| | Long term | H | Medium | Medium | Medium | High | High |
| | Medium term | M | Medium | Medium | Medium | High | High |
| | Short term | L | Low | Medium | Medium | Medium | High |
| | Very short | VL | Low | Low | Low | Medium | Medium |

**INTENSITY = H**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| DURATION | Very long | VH | High | High | High | Very High | Very High |
| | Long term | H | Medium | High | High | High | Very High |
| | Medium term | M | Medium | Medium | High | High | High |
| | Short term | L | Medium | Medium | Medium | High | High |
| | Very short | VL | Low | Medium | Medium | Medium | High |

**INTENSITY = VH**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| DURATION | Very long | VH | High | High | Very High | Very High | Very High |
| | Long term | H | High | High | High | Very High | Very High |
| | Medium term | M | Medium | High | High | High | Very High |
| | Short term | L | Medium | Medium | High | High | High |
| | Very short | VL | Low | Medium | Medium | High | High |

| PART C: DETERMINING SIGNIFICANCE | | | | | | | |
|---|---|---|---|---|---|---|---|
| PROBABILITY (of exposure to impacts) | Definite/ Continuous | VH | Very Low | Low | Medium | High | Very High |
| | Probable | H | Very Low | Low | Medium | High | Very High |
| | Possible/ frequent | M | Very Low | Very Low | Low | Medium | High |
| | Conceivable | L | Insignificant | Very Low | Low | Medium | High |
| | Unlikely/ improbable | VL | Insignificant | Insignificant | Very Low | Low | Medium |
| | | | VL | L | M | H | VVH |
| | | | CONSEQUENCE | | | | |

| PART D: INTERPRETATION OF SIGNIFICANCE | |
|---|---|
| **Significance** | **Decision guideline** |
| Very High | Potential fatal flaw unless mitigated to lower significance. |
| High | It must have an influence on the decision. Substantial mitigation will be required. |
| Medium | It should have an influence on the decision. Mitigation will be required. |
| Low | Unlikely that it will have a real influence on the decision. Limited mitigation is likely to be required. |
| Very Low | It will not have an influence on the decision. Does not require any mitigation |
| Insignificant | Inconsequential, not requiring any consideration. |

# 8. RESULTS OF DESKTOP ANALYSIS

## 8.1. Land capability

The UMK Mining Right Area as well as the infrastructure expansion footprint was superimposed on the land capability raster data layer that DALRRD published in 2017 (Figure 2).

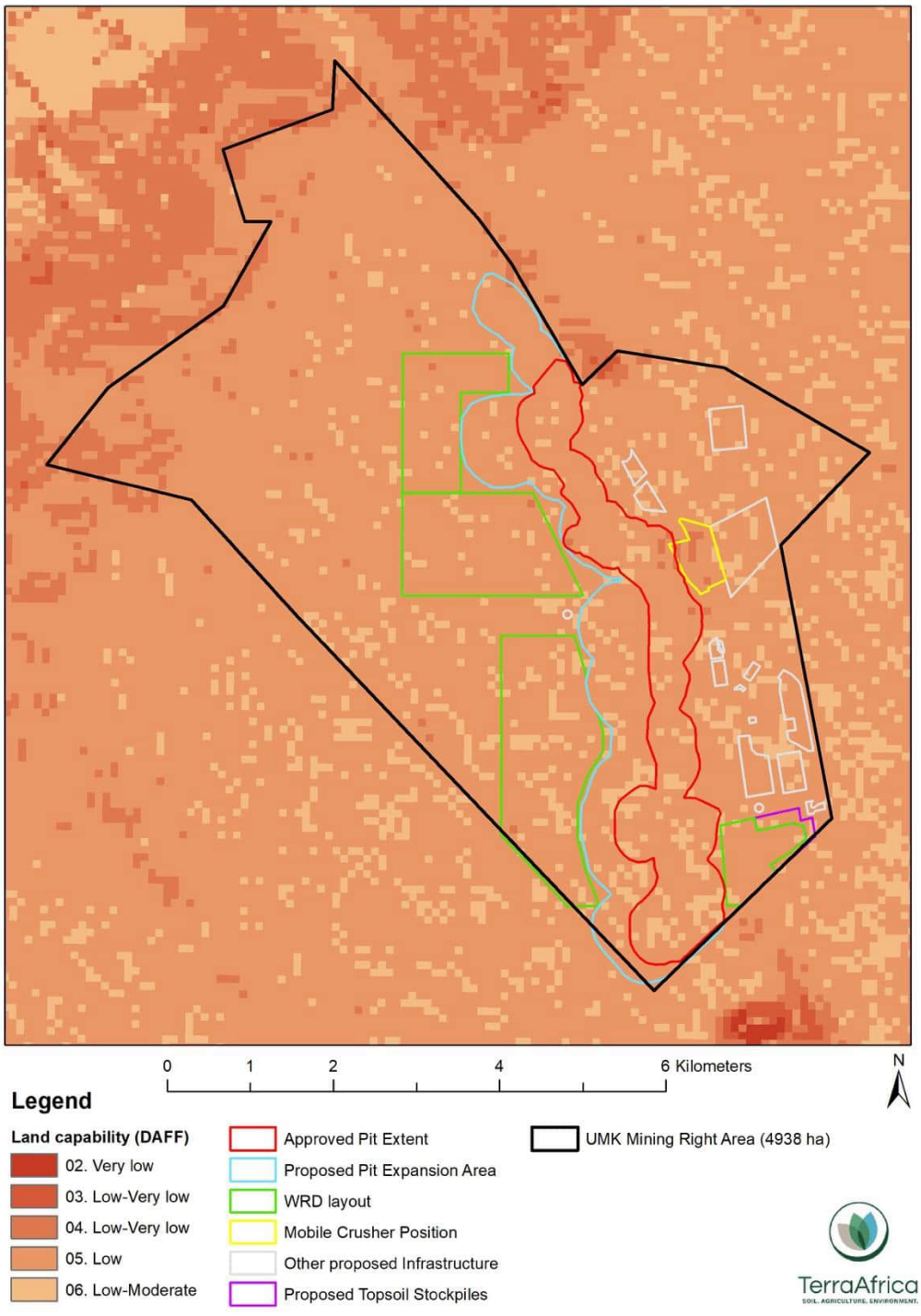


Figure 2 Land capability of the project site and the surrounding area (data source: DALRRD, 2017)

According to this data, the proposed surface infrastructure expansion areas (open pit and WRDs) consist largely of land with Low (Class 05) land capability. Smaller pockets distributed throughout the area consist of land with Low-Moderate (Class 06) land capability. Two areas with lower land capability are located north-east and south-east of the proposed final pit layout. These areas consist of Low-Very low (Classes 03 and 04) land capability.

## 8.2. Field crop boundaries

The field crop boundaries data layers of the Northern Cape Province (DALRRD,2019) were depicted within and around the boundaries of the UMK Mining Right Area (see Figure 3).

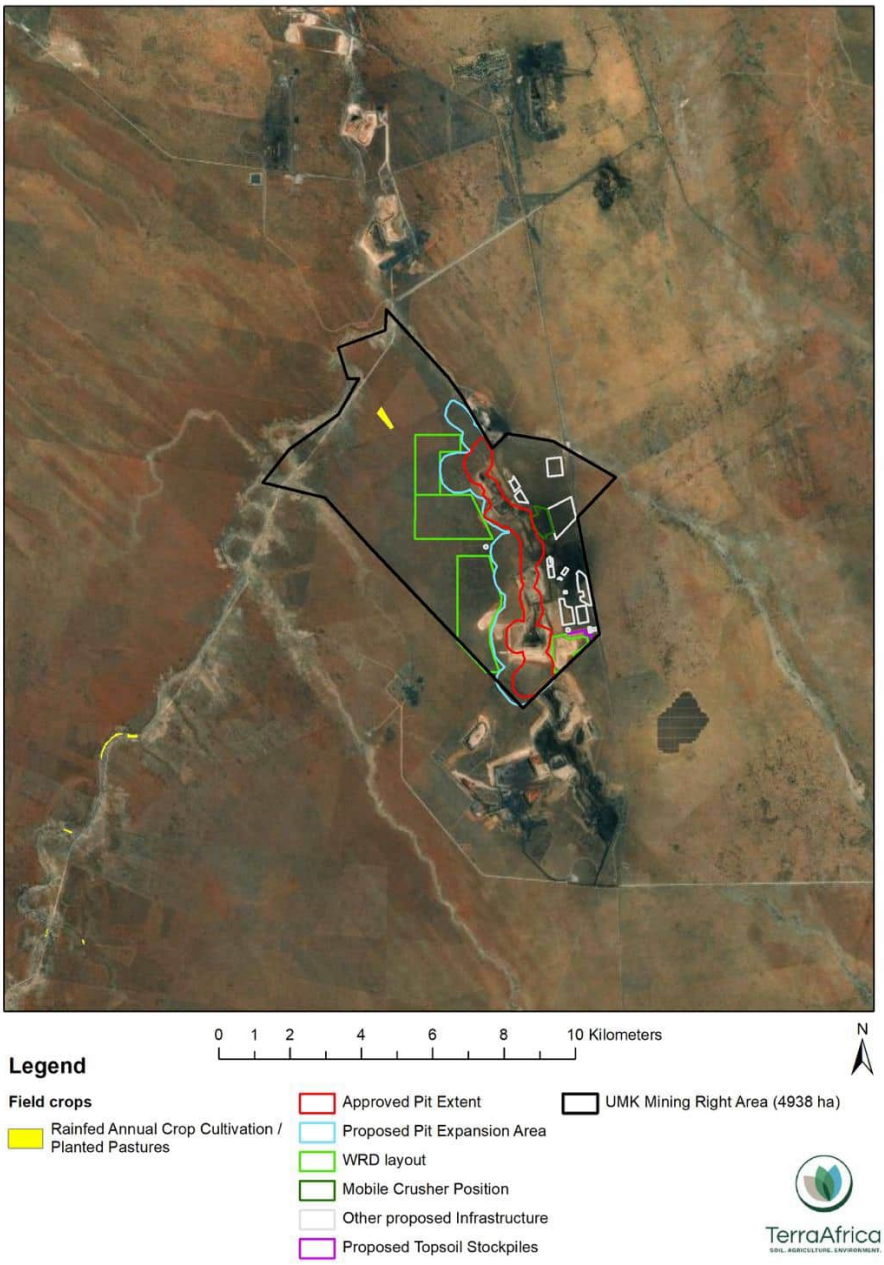


Figure 3 Field crop boundaries within study area as well as the surrounding area (data source: DALRRD, 2017)

The data indicate only one field that may either consist of rainfed agriculture or planted pasture within the Mining Right Area. However, this area is not affected by the proposed infrastructure layout of the UMK Mine. Outside of the UMK Mining Right Area, planted pastures (or rainfed crop fields) are located approximately 10km south-west of the UMK mining area.

# 9. RESULTS OF SITE ASSESSMENT

## 9.1. Soil classification

The total area of land where soil was classified, consists of three different soil forms (see Figure 4). Two of the three soil forms are natural soil forms with undisturbed soil horizon organisation and include soil of the Ermelo and Hutton forms. The third soil classification unit is Technosols and consist of soil that has undergone significant changes as a result of the mining activities in the area.

*Ermelo form*:

Approximately 987.4 ha of the areas where soil was classified, 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. This is the most dominant soil form within the UMK Mining Right Area. The soil form currently supports the natural vegetation of the area and will be affected by both the proposed new infrastructure within the Mining Rights Area.

*Hutton form:*

The Hutton soil forms 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. The clay content of Hutton soils identified is between 11%.

Soil depths of the Hutton profiles surveyed on site are all deeper than 1.5m and are without signs of wetness. In the Kalahari region where the UMK site is situated, the Hutton soil forms are preferred by *Vachellia erioloba* (camel thorn) as it allows the tap root of these trees to grow down to deeply in search of water stored below the surface. The Hutton soils will be affected by the north-western waste dump as well as the final pit and other proposed infrastructure.

*Technosols*:

The existing mining activities in UMK area that has already impacted on the in situ soil profiles include stripping and stockpiling of topsoil, compaction of haul road areas, erection of site offices and other buildings including a mechanical workshop. Following the new Soil Classification System of South Africa (Soil Classification Working Group, 2018), the entire area consists of possible four different type of Technosols. These are Transported Technosols (Witbank form), Chemically Polluted Technosols (Industria), Hydric Technosols (Stilfontein) and Anthropogenic Open Excavation Techonsols (Cullinan). The area of the final pit layout as

well as the areas of the proposed mobile crusher and offices, will be located in areas of Technosols.

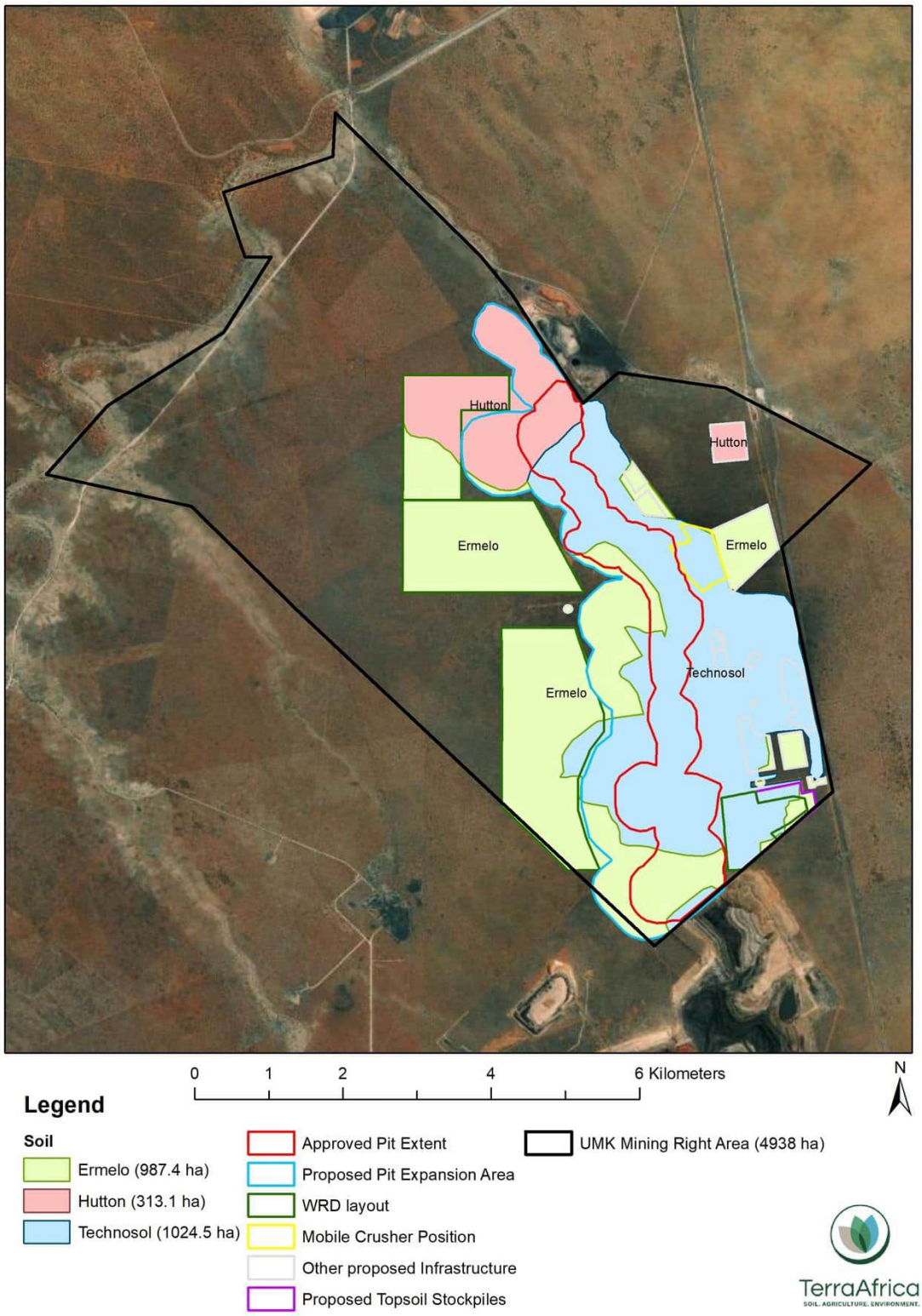


Figure 4 Soil classification map of the UMK Mine

## 9.2. Soil texture

The soil texture of the soil forms present within the proposed development area, was calculated by using the results of the particle size analysis for the soil texture triangle formulas as provided on the website of the United States Department of Agriculture's under Natural Resource Conservation Services (Soil) (www.nrcs.usda.gov). The results of the particle size analysis of the soil samples as well as the soil texture class into which results translate, are presented in Appendix 1. The entire area can be classified as having sandy loam texture with the sand fractions ranging between 85 and 88% while the clay fractions were all measured as 11%.

## 9.3. Soil fertility parameters

The pH levels of soil in the study area ranges between 4.74 (strongly acid) and 6.70 (very slightly acid). The soil pH levels do not pose a risk to plant growth and will not inhibit rehabilitation success. The phosphorus levels are as low as expected for natural veld conditions in South Africa. At lower pH levels, phosphor become unavailable for uptake by plant roots. The cation levels (calcium, magnesium and potassium) are well-balanced for plant growth. The cation complex is dominated by calcium, followed by potassium and then magnesium. Sodium levels are very low and do not pose a risk of causing sodic soils. The organic carbon content is very low and ranges between 0.02 and 0.68%.

## 9.4. 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. 1300.5 ha of grazing land capability and 1024.5 ha of wilderness land capability. The current position of these land capability classes is depicted in Figure 5.

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 nutritional quality of natural veld on Hutton and Ermelo soils can be expected to be good.

The wilderness land capability classification is used for everything that does not fall into the categories of arable, grazing and wetland land capability. Therefore, all areas of the Technosol soil group where the original soil profiles are currently compromised by either storage of topsoil and waste rock or alternatively mining infrastructure, falls into the category of wilderness land capability.

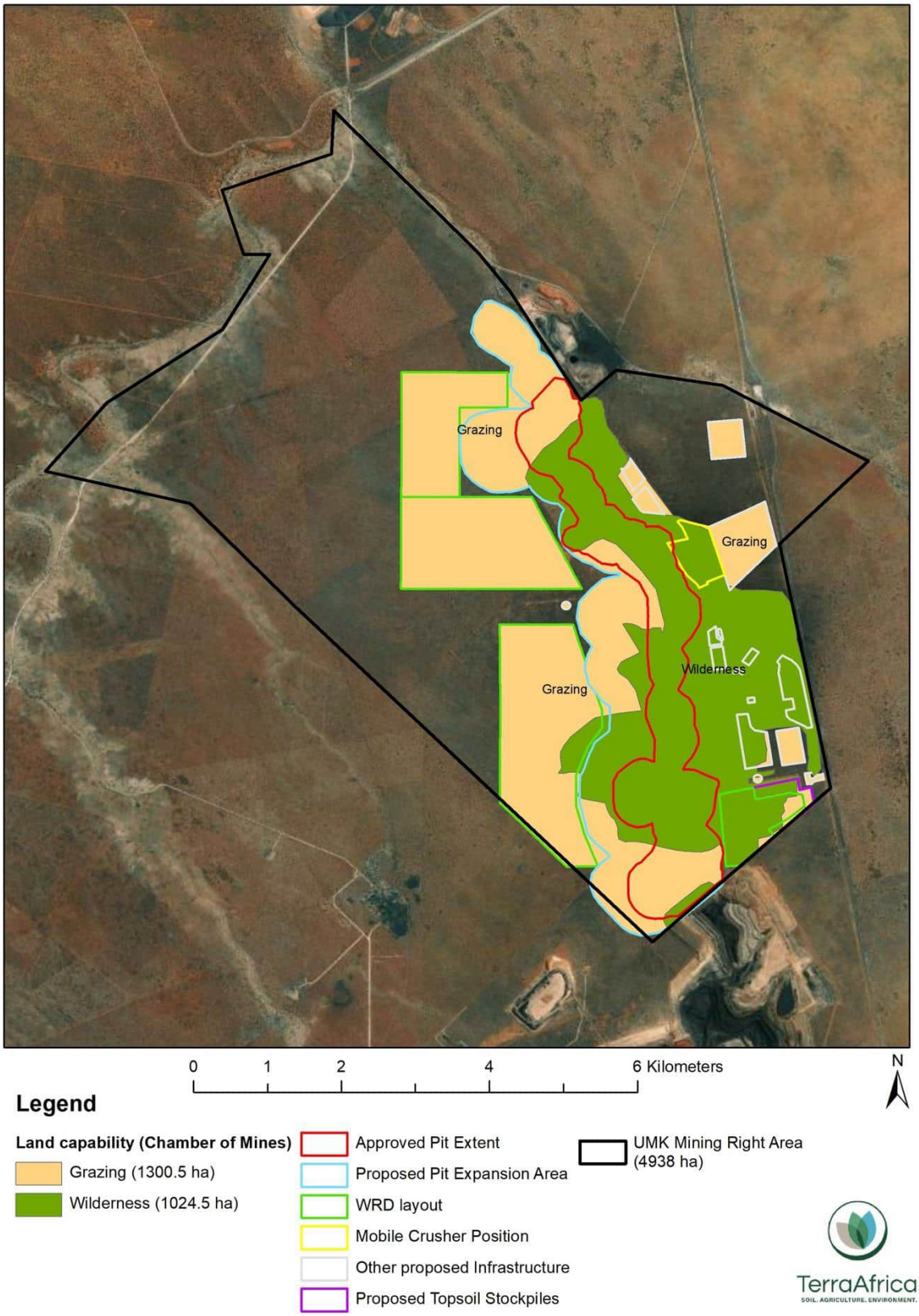


Figure 5 Land capability classification of the area assessed

## 9.5 Land use

The entire study area and its immediate surrounds can be broadly defined as Eastern Kalahari Bushveld and more specifically as Kathu Bushveld which is characterised by slightly to moderately undulating plains, including some low hills and preferential flow paths for water. The vegetation consists of a medium-tall tree layer with *Vachellia erioloba* and *Boscia albitrunca* in places, a shrub layer with *Senegalia mellifera* and *Diospyros lycioides* and variable cover by the grass layer (Mucina and Rutherford, 2011)

The land use on the study area can be defined as grazing for wildlife, and mining activities. 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). There was no evidence of cattle grazing on the study area during the site visit since it is already part of the mine's property and fenced off. 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.

## 9.6 Agricultural potential

The soil forms identified in the undisturbed parts of the study area, are the Hutton and Ermelo soil forms. 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 UMK Mine 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 soil form 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.

Although the UMK Mining Right Area is not currently used for commercial or community livestock farming, it is considered the most viable agricultural production option for the area. In order to calculate the livestock farming potential of the infrastructure areas to be affected, the long-term grazing capacity data for the area was used.

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. This definition includes the condition that this feed consumption should also prevent the degradation of the soil and the vegetation. The grazing capacity is therefore expressed in a number of hectares per LSU (ha/LSU) (South

Africa, 2018). Following the metadata layer obtained from DALRRD, the grazing capacity of the entire UMK Mining Right Area, is 11ha/LSU (Figure 6).

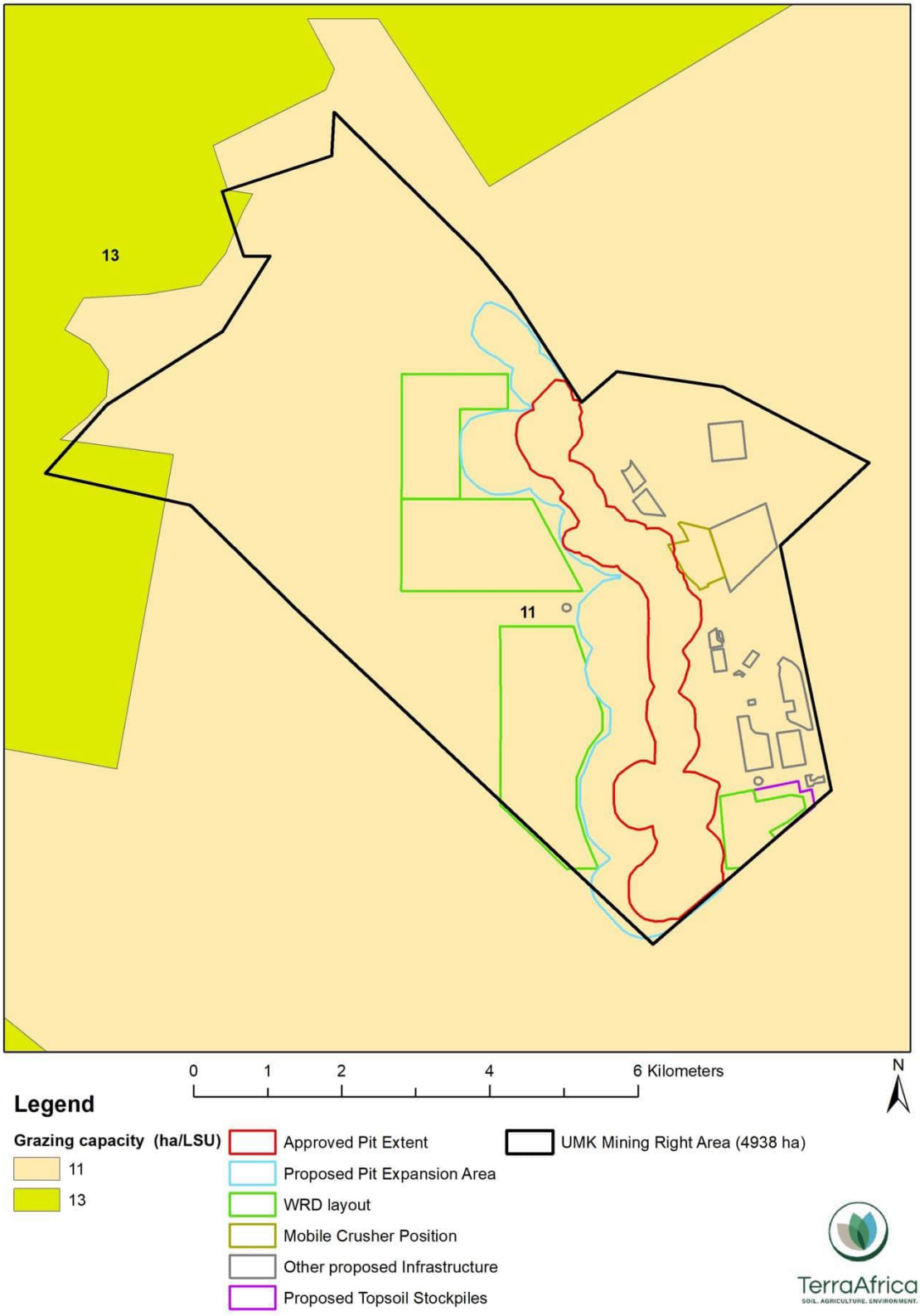


Figure 6 Long-term grazing capacity of the UMK Mining Right Area (data source: DALRRD, 2018)

When using this grazing capacity, the areas with grazing land capability, that will be affected by the proposed infrastructure changes, can provide feed for 118 head of cattle. The total area to be occupied by the proposed infrastructure expansion, will therefore result in the loss of this vegetation from future agricultural production.

## 10. SITE SENSITIVITY TO THE PROPOSED DEVELOPMENT

The combined Agricultural Sensitivity of the area considered for the UMK Expansion 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 the Department of Agriculture, Land Reform and Rural Development (DALRRD 2016, DALRRD 2019).

The screening report was generated by SLR on 23 April 2021. The requirements of GN320 stipulates that a 50m buffered area around the development footprint must be assessed with the screening tool. The area that was used include a larger block of land around the proposed infrastructure expansion that includes a buffered area of between 50 and 100m. The results provided by the screening tool indicated that the site mostly has Low sensitivity interspersed with smaller areas of Medium agricultural sensitivity (Figure 7). The entire area assessed is surrounded by land with Low agricultural sensitivity with larger areas of Medium sensitivity located to the areas west and north-west of the site.

From the results described in Section 9 above, it is confirmed by the specialist that the entire site has Medium to Low sensitivity to the proposed development.

## 11. MICRO-SITING AND CONSIDERATION OF ALTERNATIVE LAYOUTS

No alternative layouts were provided for the proposed infrastructure changes at the UMK Mine. The layout that was provided aims to optimise the mining of the available mineral resource from the pit and also keep supporting infrastructure as close as possible. By keeping the expansion of the development footprint as close as possible to the existing mining activities, the fragmentation of the agricultural grazing land of the area, is minimised.

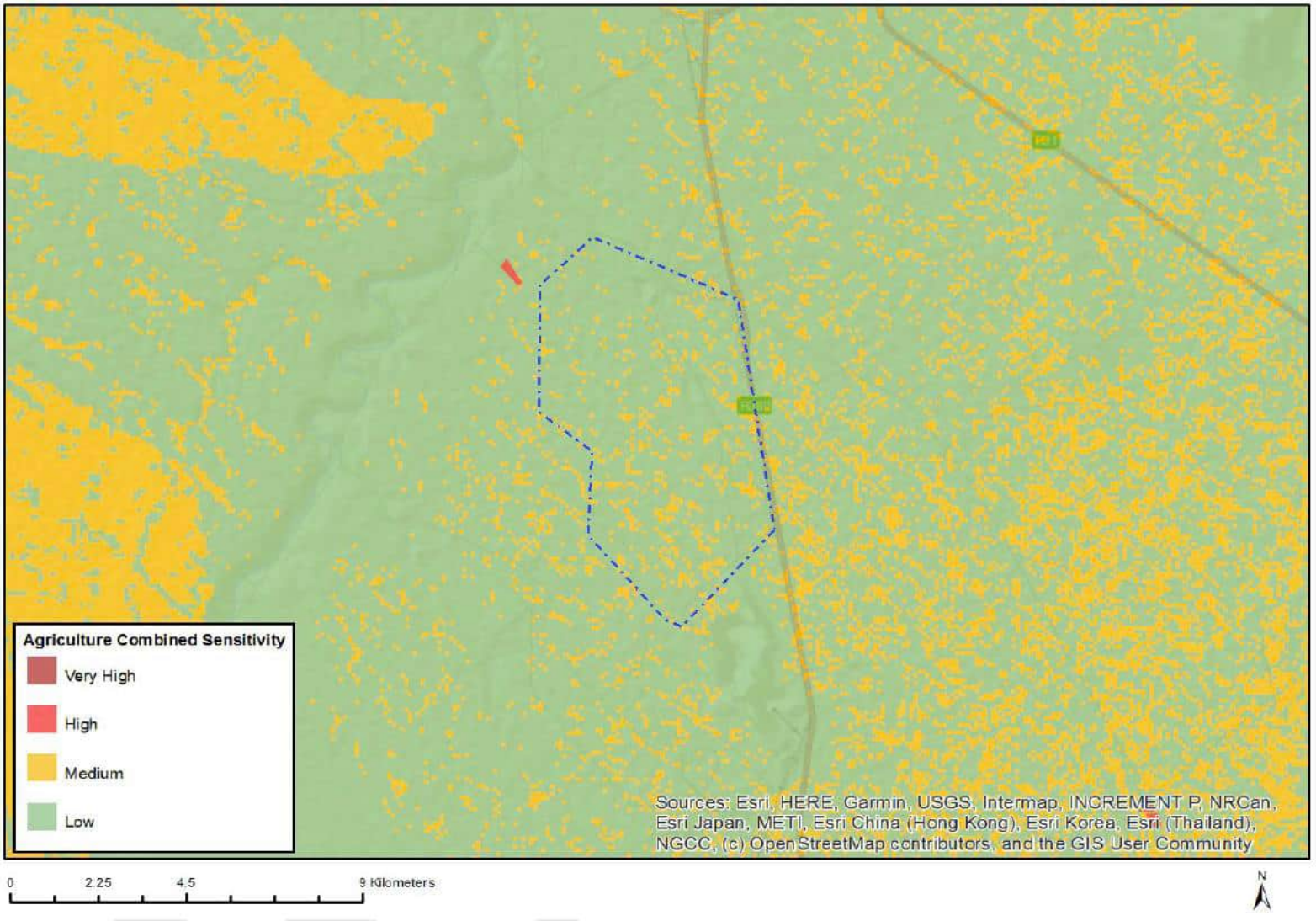


Figure 7 Agricultural combined sensitivity of the area considered for the UMK Expansion Project

# 12. IMPACT ASSESSMENT

The UMK mine is currently in the operational phase of its development and requires the construction and operation of additional infrastructure as well as expansion and upgrading of existing infrastructure. The new development footprint will include waste rock dumps and sand stockpiles as well as product and TUP stockpiles. Other components that will also be added include parking areas, truck staging areas, product storing areas and a salvage yard. Expansion of existing infrastructure include the expansion of the pit area, product stockpile, modular crushing plant, offices, workshop and truck staging area. The layout is presented in

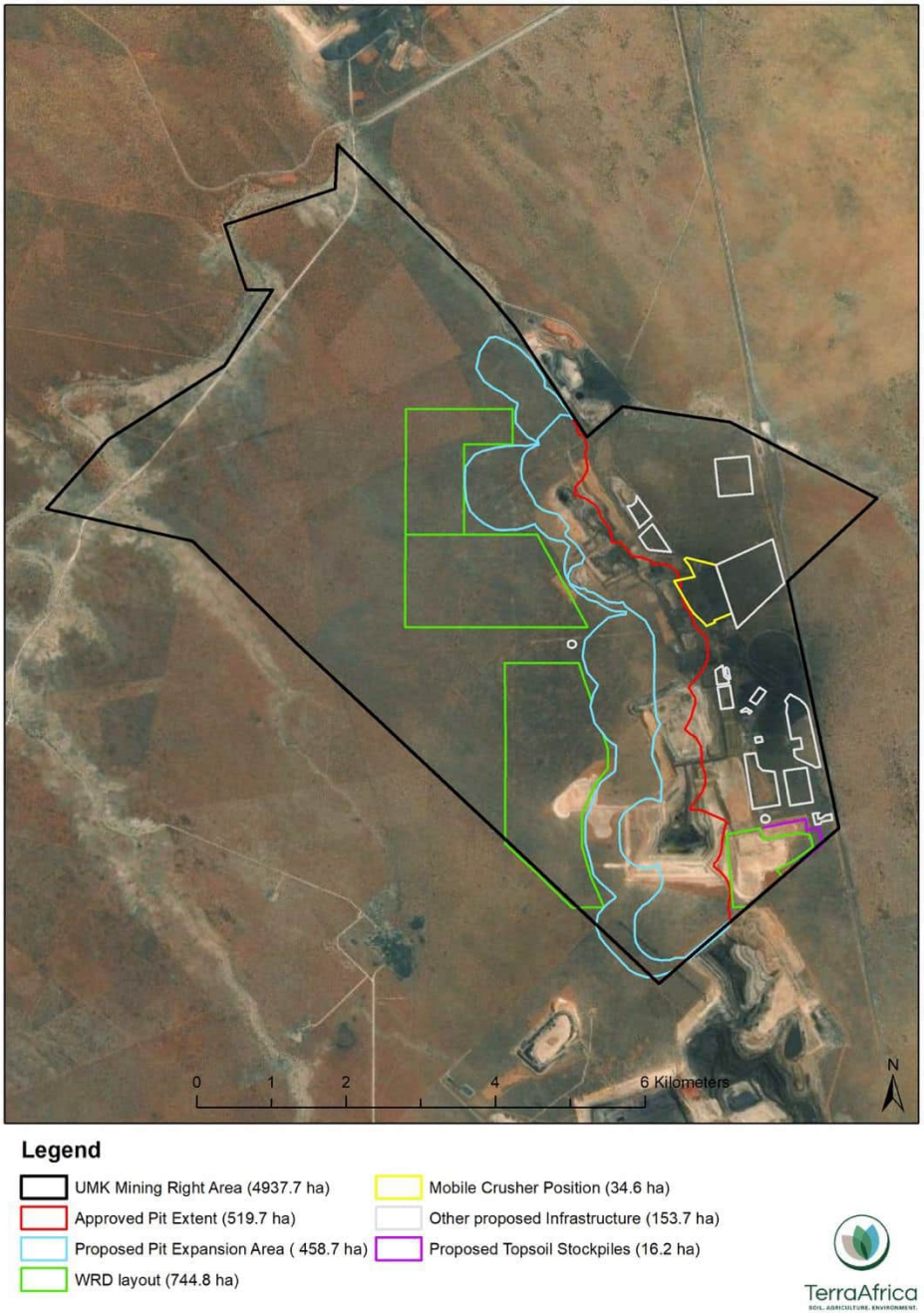


Figure 8 Layout of the proposed infrastructure expansion, addition and changes at UMK Mine

The following sub-sections will describe and rate the significance of impacts on soil and land capability as a result of the proposed infrastructure changes at the UMK Mine. The impacts of each project phase are described below together with mitigation measures that will reduce the significance of the impacts.

## 12.1 Construction phase

### 12.1.1 Soil erosion

Soil erosion is an impact with high intensity that definitely requires intervention. The loss of soil particles through erosion is irreversible and if left unmanaged, can affect areas outside of the project site. Through the implementation of mitigation measures, the risk of soil erosion can be limited to the development footprint area and largely be prevented. The rating of the unmitigated and mitigated impact significance is presented in Table 3.

The following mitigation measures must be implemented to reduce the impact of soil erosion:

- Limit vegetation clearance to only the areas where the surface infrastructure will be constructed.
- Avoid parking of vehicles and equipment outside of designated parking areas.
- Plan vegetation clearance activities for dry seasons (late autumn, winter and early spring).
- Design and implement a Stormwater Management System where run-off from surfaced areas is expected.
- Reduce the slope gradients along haul roads and other disturbed areas to gradients at or below the angle of repose.
- Re-establish vegetation along the newly constructed infrastructure to reduce the impact of run-off from bare soil surfaces.

Table 3 Significance rating of soil erosion before and after the implementation of mitigation measures

| Scenario | Intensity | Duration | Extent | Consequence | Probability | Significance |
|---|---|---|---|---|---|---|
| Unmitigated | H | VH | M | H | H | H |
| Mitigated | M | H | VL | M | M | L |

### 12.1.2 Disturbance of original soil profiles

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 mitigation measures are provided below, 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.

Implementation of the following mitigation measures will reduce the impact of soil disturbance:

- Land clearance must only be undertaken immediately prior to construction activities and only within the development footprint; and
- Unnecessary land clearance must be avoided.

Table 4 Significance rating of soil horizon disturbance before and after the implementation of mitigation measures

| Scenario | Intensity | Duration | Extent | Consequence | Probability | Significance |
|---|---|---|---|---|---|---|
| Unmitigated | H | VH | L | H | VH | H |
| Mitigated | H | H | VL | M | H | M |

### 12.1.3 Soil chemical pollution

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).

During the construction phase, soil chemical pollution must be minimised through implementation of the following mitigation measures:

- Losses of fuel and lubricants from the oil sumps and steering racks of vehicles and equipment should be contained using a drip tray with plastic sheeting filled with absorbent material;
- Using biodegradable hydraulic fluids, using lined sumps for collection of hydraulic fluids, recovering contaminated soils and treating them off-site, and securely storing dried waste mud by burying it in a purpose-built containment area;
- Avoiding waste disposal at the site wherever possible, by segregating, trucking out, and recycling waste;
- Containing potentially contaminating fluids and other wastes; and
- Cleaning up areas of spillage of potentially contaminating liquids and solids.

Table 5 Significance rating of soil chemical pollution before and after the implementation of mitigation measures

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

### 12.1.4 Soil compaction

Soil compaction will occur as a result of the heavy vehicles and equipment moving over the soil surface in areas where infrastructure will be constructed. In the areas where the hard parking area, the workshop and the offices will be constructed, soil will be deliberately compacted to stabilise the surface and to meet engineering requirements for compacted surfaces underneath structures. The weight of the sand stockpiles will also compact the surface underneath. Soil compaction will result in a moderate disturbance of the soil quality and without any mitigation measures, will remain permanent (Very High Duration). Without mitigation measures, the extent of the impact may affect the entire site (Low Extent). With the implementation of mitigation measures, the extent can be limited to only the development footprint. This impact will definitely occur, both in the mitigated and unmitigated scenarios.

The significance of soil compaction can be reduced through the implementation of the following mitigation measures:

- Minimise the areas of activity to that indicated in the infrastructure layout (refer to Figure *8*); and
- The activities of construction contractors or employees will be restricted to the planned areas.

Table 6 Significance rating of soil compaction before and after the implementation of mitigation measures

| Scenario | Intensity | Duration | Extent | Consequence | Probability | Significance |
|---|---|---|---|---|---|---|
| Unmitigated | M | VH | L | H | VH | H |
| Mitigated | M | H | VL | M | VH | M |

### 12.1.5 Loss of grazing land capability

The loss of the current grazing land capability of the areas to be affected by infrastructure expansion at the UMK Mine, will be a moderate change that will last for more than twenty years or perpetually (in the absence of land rehabilitation). The footprint of the unmitigated scenario can include the entire site but by implementation of the mitigation measures below, the extent can be kept within the development footprint (Very Low). This impact will definitely occur, both in the unmitigated and mitigated scenarios.

The significance of loss of grazing land capability can be reduced through the implementation of the following mitigation measures:

- Minimise the areas of activity to that indicated in the infrastructure layout (refer to Figure *8*);
- The activities of construction contractors or employees will be restricted to the planned areas;
- Implement a rehabilitation plan in all areas of temporary disturbance that restore the natural vegetation of the area; and

- Conserve topsoil volumes and quality for use during the final rehabilitation to ensure that natural vegetation can be re-established in order to return the land to grazing land capability.

Table 7 Significance rating of loss of grazing land capability before and after the implementation of mitigation measures

| Scenario | Intensity | Duration | Extent | Consequence | Probability | Significance |
|---|---|---|---|---|---|---|
| Unmitigated | M | VH | L | H | VH | H |
| Mitigated | M | VH | VL | M | VH | 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.

### 12.2.1 Soil erosion

Soil will be prone to erosion during the operational phase as sand stockpiles will be exposed to wind and rainfall, especially since the soil (sand) will be stockpiled at a pre-determined angle. It is assumed that the stockpiles will not actively be re-vegetated. Soil erosion is an impact with high intensity that definitely requires intervention. The loss of soil particles through erosion is irreversible and if left unmanaged, can affect areas outside of the project site. Through the implementation of mitigation measures, the risk of soil erosion can be limited to the development footprint area and largely be prevented.

The following mitigation measures must be implemented to reduce the impact of soil erosion:

- Regularly check all stockpiles and bare surfaces around infrastructure areas, for signs of soil erosion.
- In the case of any onset of soil erosion being detected, the surfaces must be rehabilitated through the use of geotextiles accompanied by seeding of indigenous vegetation.
- A Stormwater Management Plan that minimizes the impact of surface water run-off, must be adhered to.

Table 8 Significance rating of soil erosion before and after the implementation of mitigation measures

| Scenario | Intensity | Duration | Extent | Consequence | Probability | Significance |
|---|---|---|---|---|---|---|
| Unmitigated | H | VH | L | H | H | H |
| Mitigated | M | H | VL | M | M | L |

### 12.2.3 Soil chemical pollution

During the operational phase, vehicles and equipment will move over bare surfaces and materials, solvents, liquids and lubricants will be handled at the Barlow Store, salvage yard and the EME workshop. The upgraded Prentec Sewage Plant may be a source of soil pollution in the case of any incident that result in the spillage of untreated sewer. Without mitigation measures implemented, soil pollution is considered a severe degradation of soil quality that may result in environmental and human health impacts. Without deliberate rehabilitation, the impact may last for a long period of time and may affect the entire site. Also, without implementation of preventative mitigation measures, there is a high probability that the impact will occur.

- Losses of fuel and lubricants from the oil sumps and steering racks of vehicles and equipment should be contained using a drip tray with plastic sheeting filled with absorbent material;
- Using biodegradable hydraulic fluids, using lined sumps for collection of hydraulic fluids, recovering contaminated soils and treating them off-site, and securely storing dried waste mud by burying it in a purpose-built containment area;
- Avoiding waste disposal at the site wherever possible, by segregating, trucking out, and recycling waste; and
- Containing and cleaning up areas of spillage of potentially contaminating liquids, solids and other wastes.

Table 9 Significance rating of soil chemical pollution before and after the implementation of mitigation measures

| Scenario | Intensity | Duration | Extent | Consequence | Probability | Significance |
|---|---|---|---|---|---|---|
| Unmitigated | VH | H | L | H | H | H |
| Mitigated | L | H | VL | L | M | VL |

### 12.2.4 Soil compaction

Soil compaction will occur as a result of the heavy vehicles and equipment moving over the soil surface during the operational phase. Soil compaction will result in a moderate disturbance of the soil quality and without any mitigation measures, will remain permanent (Very High Duration). Without mitigation measures, the extent of the impact may affect the entire site (Low Extent). With the implementation of mitigation measures, the extent can be limited to only the

development footprint. This impact will definitely occur, both in the mitigated and unmitigated scenarios.

The significance of soil compaction can be reduced through the implementation of the following mitigation measures:

- Minimise the areas of activity to that indicated in the infrastructure layout (refer to Figure *8*).
- The activities of construction contractors or employees will be restricted to the planned areas.
- Roads that will carry heavy-duty traffic should be designed in areas previously disturbed rather than clearing new areas.

Table 10 Significance rating of soil compaction before and after the implementation of mitigation measures

| Scenario | Intensity | Duration | Extent | Consequence | Probability | Significance |
|---|---|---|---|---|---|---|
| Unmitigated | M | VH | L | H | VH | H |
| Mitigated | M | H | VL | M | VH | M |

### 12.3 Decommissioning phase

In areas where infrastructure is decommissioned, soil will be prone to soil compaction and soil chemical pollution.

#### 12.3.1 Soil compaction

Soil compaction during the decommissioning phase will occur as a result of the heavy vehicles and equipment moving over the soil surface. The shaping of the surfaces to be rehabilitated into the final landform, will further result in soil compaction. It is considered a moderate disturbance of the soil quality and without any mitigation measures, will remain permanent (Very High Duration). Without mitigation measures, the extent of the impact may affect the entire site (Low Extent). With the implementation of mitigation measures, the extent can be limited to only the development footprint. This impact will definitely occur, both in the mitigated and unmitigated scenarios.

The significance of soil compaction can be reduced through the implementation of the following mitigation measures:

- Minimise the areas of activity to that indicated in the infrastructure layout (refer to Figure *8*).
- The activities of construction contractors or employees will be restricted to the planned areas.
- Roads that will carry heavy-duty traffic should be designed in areas previously disturbed rather than clearing new areas.

Table 11 Significance rating of soil compaction before and after the implementation of mitigation measures

| Scenario | Intensity | Duration | Extent | Consequence | Probability | Significance |
|---|---|---|---|---|---|---|
| Unmitigated | M | VH | L | H | VH | H |
| Mitigated | M | H | VL | M | VH | M |

### 12.2.3 Soil chemical pollution

During the decommissioning phase, buildings will be dismantled and materials removed from their current position. Vehicles and equipment will move around in the area to decommission infrastructure and shape the surface into the final landforms. Without mitigation measures implemented, soil pollution is considered a severe degradation of soil quality that may result in environmental and human health impacts. Without deliberate rehabilitation, the impact may last for a long period of time and may affect the entire site. Also, without implementation of preventative mitigation measures, there is a high probability that the impact will occur.

- Losses of fuel and lubricants from the oil sumps and steering racks of vehicles and equipment should be contained using a drip tray with plastic sheeting filled with absorbent material;
- Using biodegradable hydraulic fluids, using lined sumps for collection of hydraulic fluids, recovering contaminated soils and treating them off-site, and securely storing dried waste mud by burying it in a purpose-built containment area;
- Avoiding waste disposal at the site wherever possible, by segregating, trucking out, and recycling waste; and
- Cleaning up areas of spillage of potentially contaminating liquids and solids.

Table 12 Significance rating of soil chemical pollution before and after the implementation of mitigation measures

| Scenario | Intensity | Duration | Extent | Consequence | Probability | Significance |
|---|---|---|---|---|---|---|
| Unmitigated | VH | H | L | H | H | H |
| Mitigated | L | H | VL | L | M | VL |

## 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.

## 12. ACCEPTABILITY STATEMENT

The proposed infrastructure expansion at UMK Mine falls within a larger area of mining projects intermixed with game and livestock farming and settlement (Hotazel, Black Rock, Kuruman and Kathu). The soil quality of undisturbed land affected by the surface footprint of the proposed project will include soil erosion, soil compaction and soil pollution as well as a loss of the grazing land capability. 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 best practice regarding soil management must be implemented.

## 13. 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.

Department of Agriculture, Forestry and Fisheries, 2017. *National land capability evaluation raster data: Land capability data layer*, 2017. Pretoria.

Soil Classification Working Group (2018). *Soil Classification: A Natural and Anthropogenic System for South Africa.* ARC-Institute for Soil, Climate and Water. Pretoria

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 – SOIL ANALYSIS RESULTS

| Lab No | Ref No | pH (KCl) | P (Bray1) | K | Na | Ca | Mg | %Ca | %Mg | %K | %Na | C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | mg/kg | mg/kg | mg/kg | mg/kg | mg/kg | % | % | % | % | % |
| 5092 | UMK 01 TOP | 6,70 | 1 | 56 | 8 | 266 | 29 | 76,25 | 13,52 | 8,27 | 1,96 | 0,68 |
| 5093 | UMK 02 SUB | 5,04 | 1 | 66 | 5 | 111 | 24 | 58,88 | 21,17 | 17,78 | 2,17 | 0,12 |
| 5094 | UMK 03 TOP | 5,33 | 1 | 31 | 4 | 193 | 23 | 77,02 | 15,08 | 6,40 | 1,50 | 0,02 |
| 5095 | UMK 04 SUB | 4,74 | 1 | 50 | 4 | 164 | 28 | 68,72 | 18,96 | 10,68 | 1,64 | 0,16 |
| 5096 | UMK 05 TOP | 6,61 | 1 | 43 | 5 | 328 | 46 | 76,50 | 17,46 | 5,10 | 0,95 | 0,07 |
| 5097 | UMK 06 SUB | 5,60 | 1 | 55 | 4 | 221 | 67 | 60,91 | 30,46 | 7,72 | 0,91 | 0,06 |

| Ca:Mg | (Ca+Mg)/K | Mg:K | S-Value | Na:K | T | Density | S AmAc | EC | Clay | Silt | Sand |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1.5-4.5 | 10.0-20.0 | 3.0-4.0 | cmol(+)/kg | | cmol(c)/kg | g/cm3 | mg/kg | mS/m | % | % | % |
| 5,64 | 10,86 | 1,63 | 1,74 | 0,24 | 1,74 | 1,60 | 2,62 | 35,6 | 11 | 4 | 85 |
| 2,78 | 4,50 | 1,19 | 0,95 | 0,12 | 0,95 | 1,50 | 2,88 | 20,89 | 11 | 1 | 88 |
| 5,11 | 14,39 | 2,36 | 1,25 | 0,23 | 1,25 | 1,61 | 2,54 | 15,99 | 11 | 2 | 87 |
| 3,63 | 8,21 | 1,77 | 1,19 | 0,15 | 1,19 | 1,55 | 2,55 | 21,3 | 11 | 1 | 88 |
| 4,38 | 18,44 | 3,43 | 2,14 | 0,19 | 2,14 | 1,58 | 1,75 | 27,7 | 11 | 1 | 88 |
| 2,00 | 11,83 | 3,94 | 1,82 | 0,12 | 1,82 | 1,48 | 0,97 | 23,1 | 11 | 4 | 85 |

# APPENDIX 2 – CURRICULUM VITAE OF SPECIALIST

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Wolmaransstad,
South Africa

## 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 101Training
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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