SOIL, LAND USE AND LAND CAPABILITY REPORT FOR THE PROPOSED BAUBA A HLABIRWA MOEIJELIK MINING PROJECT

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1. Introduction

M2 Environmental Connections appointed TerraAfrica Consult to conduct the soil, land use and land capability study as part of the Environmental Impact Assessment (EIA) process for a mining right application on the farm Moeijelyk 142 KS. Bauba A Hlabirwa Mining Investments (Pty) Ltd already obtained a Mining Permit (No. 64/2014) for small-scale opencast mining operations in 2014. The new application is for the expansion of current opencast section of the mine as well as the utilisation of the underground section below the mine pit (hereafter referred to as the Bauba A Hlabirwa Moeijelik Project).

The proposed Bauba A Hlabirwa Moeijelyk chrome mine is situated on the farm Moeijelyk 412 KS. The operation falls in the Limpopo Province under the jurisdiction of the Fetakgomo Local Municipality situated within the Sekhukhune District Municipality.

The mining area is situated just off the R37 road and in close proximity to the administrative border between Greater Tubatse and Fetakgomo Local Municipalities. It is located approximately 85 km south-east from Polokwane, 56 km south, south-east from Tzaneen, 42 km south of Misty Crown (Haenertsburg), 25 km north-east of Ga-Nkoana and 50 km north west of Burgersfort (Figure 1).

2. Environmental legislation applicable to study

The most recent South African Environmental Legislation that needs to be considered for any new or expanding development with reference to management of soil and land use includes:

- Soils and land capability are protected under the National Environmental Management Act 107 of 1998, the Minerals Act 28 of 2002 and the Conservation of Agricultural Resources Act 43 of 1983.
- The National Environmental Management Act 107 of 1998 requires that pollution and degradation of the environment be avoided, or, where it cannot be avoided be minimised and remedied.
- The Conservation of Agricultural Resources (Act 43 of 1983) states that the degradation of the agricultural potential of soil is illegal.

- The Conservation of Agriculture Resources Act 43 of 1983 requires the protection of land against soil erosion and the prevention of water logging and salinization 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.
- Government Notice R983 of 4 December 2014, Activity 21. The purpose of the Notice is to identify activities that would require environmental authorisation prior to commencement of that activity.

3. Terms of reference

The terms of reference applicable to the Soils, Land Capability and Land Use Study include the following:

- A review of available desktop information about the project site;
- Design and execution of a soils field survey covering the surface footprints of the proposed new developments such as the two adits, topsoil stockpiles, waste rock dumps and office facilities;
- A soil, land use and land capability baseline for the project affected area;
- Identification and assessment of potential impacts on baseline soil, land use and land capability properties as a result of the proposed project;
- Development of mitigation and management measures for the identified impacts.

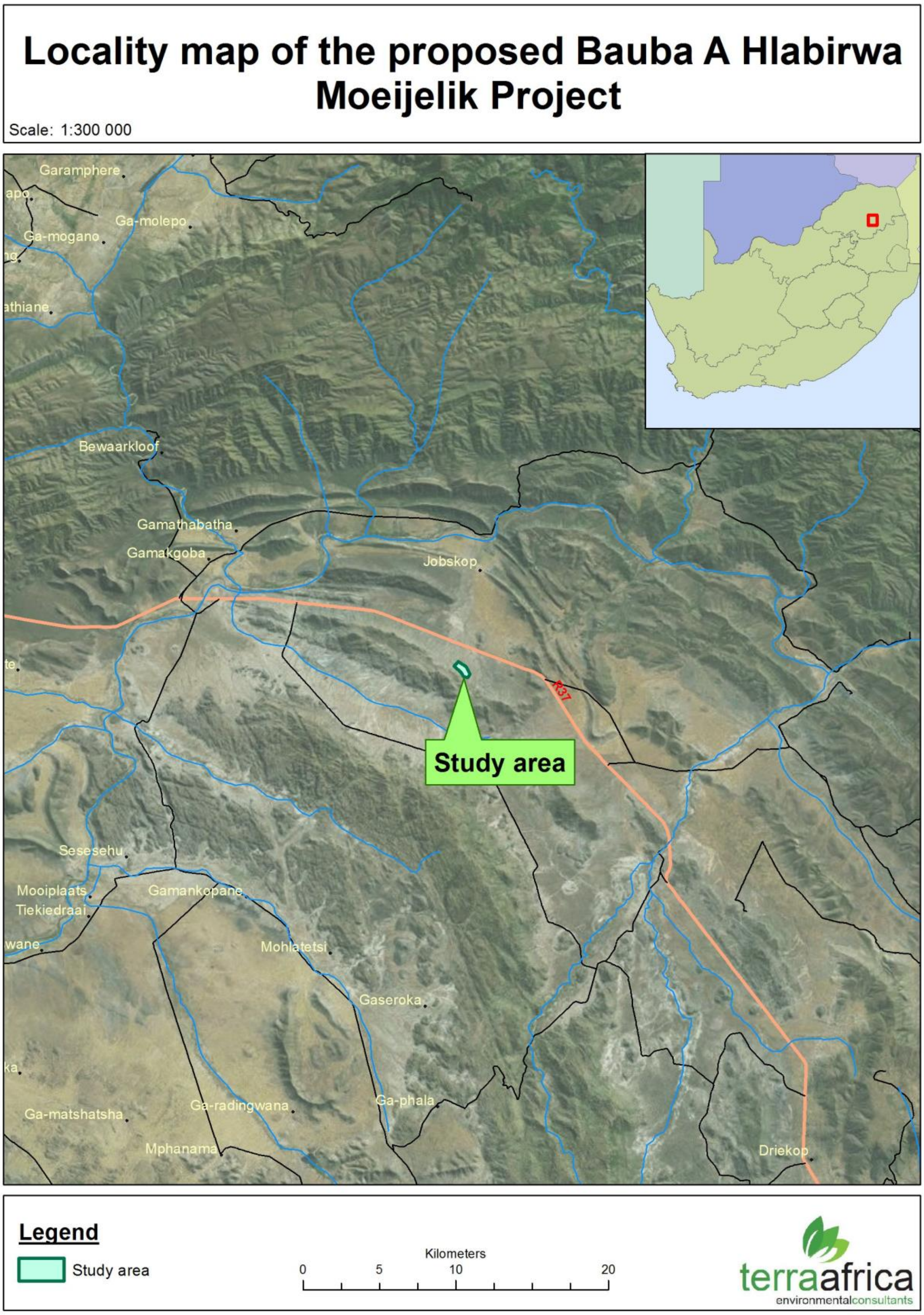

Figure 1: Locality map of the proposed Bauba A Hlabirwa Moeijelik Project

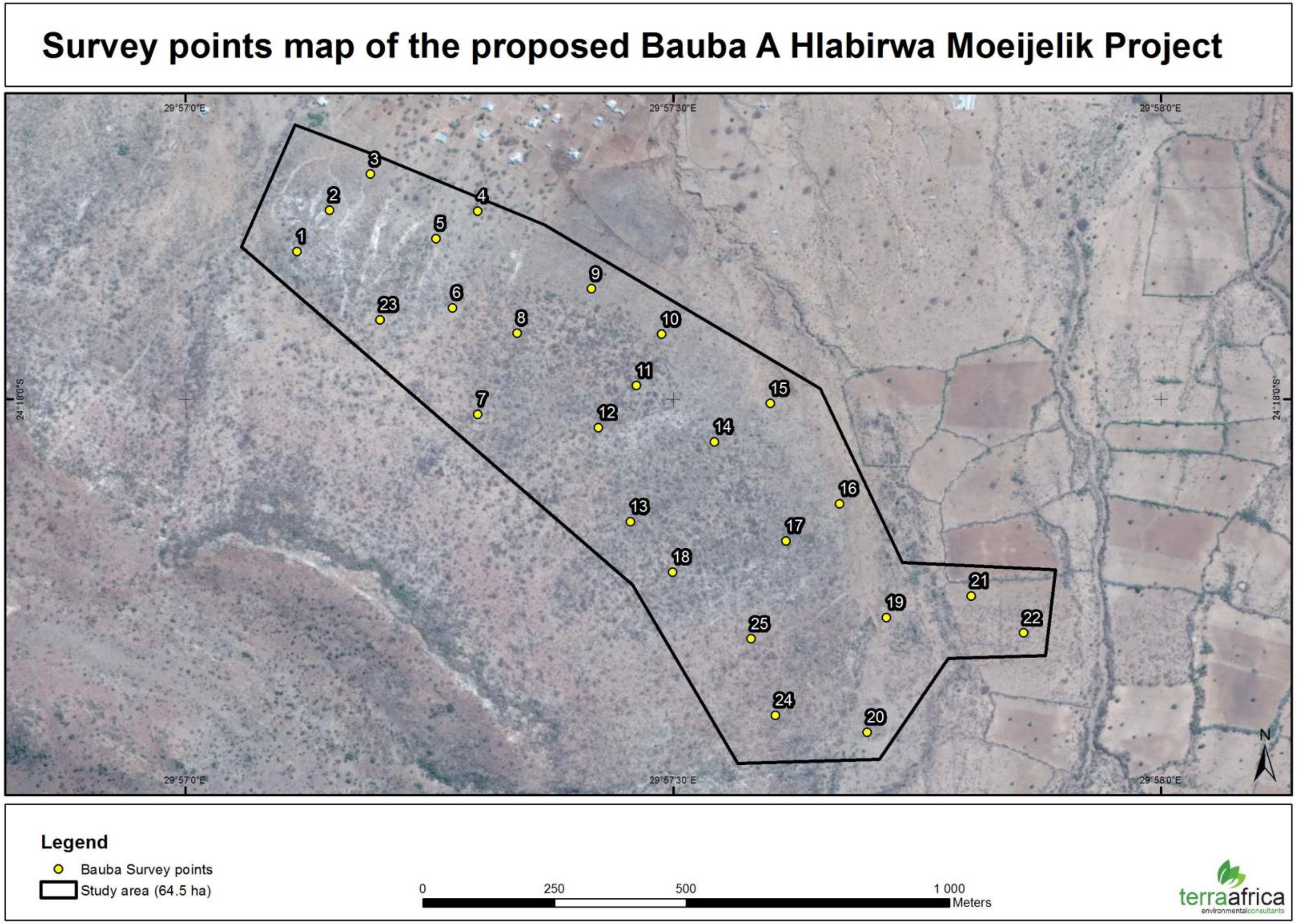

Figure 2: Survey points map of the proposed Bauba A Hlabirwa Moeijelik Project

4. Methodology

4.1 Desktop study and literature review

The following data was obtained and studied for the desktop study and literature review:

- Bauba A Hlabirwa Moeijelyk Scoping Report, SAMRAD Ref No: LP 30/5/1/2/2/10096 MR, submitted 11 May 2015.
- Broad geological, soil depth and soil description classes were obtained from the Department of Environmental Affairs and studied. This data forms part of the Environmental Potential Atlas (ENPAT) of South Africa;
- The most recent aerial photography of the area available from Google Earth was obtained.

4.2 Site survey

A systematic soil survey was undertaken with sampling points between 50 and 150m apart in the study area (Figure 2). The soil profiles were examined to a maximum depth of 1.5m using an auger, unless restricted by an impenetrable layer such as hard rock (Figure 2). 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 using the S.A. Soil Classification Taxonomic System (Soil Classification Working Group, 1991) published as memoirs on the Agricultural Natural Resources of South Africa No.15. For soil mapping, the soils were grouped into classes with relatively similar soil characteristics.

4.3 Analysis of samples at soil laboratory

Five representative soil samples were collected (3 top- and 2 subsoil samples). Soil samples were sealed in soil sampling plastic bags and sent to Nvirotek Labs, Brits for analyses. Samples were analysed for pH (KCl), phosphorus (Bray1), exchangeable cations (calcium, magnesium, potassium, sodium), organic carbon (Walkley-Black) and texture classes (relative fractions of sand, silt and clay).

4.4 Land capability classification

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 was utilised, given that this is the dominant capability classification system used for the mining industry. **Table 1** indicates the set of criteria as stipulated by the Chamber of Mines to group soil forms into different land capability classes.

Table 1: Pre-Mining Land Capability Requirements

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.

5. Baseline conditions

5.1 *Climate data*

The study area falls within a larger region with hot summers during which drought spells may often occur and cold, dry winters. Average daily maximum temperatures range from 21.7℃ in June to 30.1℃ in January. The region is the coldest during June when the temperature drops to 3.9℃ on average during the night. The average rainfall is 559 mm per year. The lowest rainfall per month is in June (4 mm) and the highest in November namely 102 mm while the potential evapotranspiration will be between 102 mm to 259 mm per month. Rainfall during winter months is erratic (between 4 mm and 8 mm monthly) while evapotranspiration is never less than 102 mm per month

5.2 *Soil forms in the study area*

Seven different soil units were identified in the Bauba A Hlabirwa Moeijelik Project area. The area is dominated by shallow to medium deep soils where crumbly, dark-brown to black melanic A-horizons are overlying a variety of B1-horizons. B1-horizons range from soft carbonate, pedocutanic to lithocutanic or unspecified material. Other soil forms found in different positions along the study area includes soil forms are a medium-deep to deep Oakleaf form and areas of existing mining disturbance of the Witbank form.

Bonheim

The Bonheim soil profiles identified in this area are shallow to medium-deep and occurs along the northern and north-eastern boundary of the property (19ha of the study site). This soil form consists of a melanic A horizons overlying a pedocutanic B1 horizon which overlies unspecified materials. The Bonheim soil form has been identified on hill slopes and lower-lying positions of the landscape and has grazing land capability due to the shallow soil depth.

Oakleaf

Only one area with Oakleaf soils has been identified on site. The Oakleaf profiles consist of an orthic A horizon (25 cm), overlying a neocutanic B horizon (120cm) on unspecified material. The neocutanic horizons observed have non-uniform colouring and cutans and channel infillings are visible. Oakleaf soils have high agricultural production potential and are rather well-drained permitting that the rainfall allows crop production.

Inhoek

The Inhoek form occurs in one area in the middle of the project site (Figure 3). The Inhoek soils consist of a melanic A horizon with dark colours overlying unspecified material resembling weathering parent material. The melanic A horizon has a clay-loam texture and high organic carbon content. The profiles observed are not deeper than 25cm.

Valsrivier

The Valsrivier soil form consists of a shallow sandy-loam orthic A-horizon overlying a pedocutanic B1 horizon with sub-angular medium strong structure overlying unconsolidated material without signs of wetness. This soil form occurs in one area in the most northern part of the proposed Bauba A Hlabirwa Project site. This soil form can support sufficient vegetation for grazing purposes.

Mayo

The Mayo soil form identified consists of a melanic A horizon (20 cm to 80 cm deep), overlying a lithocutanic B horizon (Figure 4A). More than 70% by volume of the hard lithocutanic B horizon consists of parent bedrock, fresh or partly weathered, with a hard consistence in the dry, moist and wet states. The melanic A horizon lacks slickensides that are diagnostic of vertic horizons but has structure that is strong enough so that the mayor part of the horizon is not both massive and hard or very hard when dry. Absence of vertic properties is usually because of either a lower clay content or a predominance of other clay minerals than the high expansive smectitic clay minerals which are predominant in vertic soils. The most conspicuous feature of this soil is its relatively shallow depth above weathered parent material. Land use is normally confined to livestock grazing or wildlife conservation.

Steendal

The Steendal soil form consists of a melanic A-horizon overlying a soft carbonate horizon (Figure 4B). Soil depth of these profiles ranged between 20 cm to 60 cm. The A-horizon is well-structured but do not become massive and hard when dry. This horizon has dark-brown to black colours. The soft carbonate horizon has morphology, which is that of calcium carbonates present, whether in powder, nodular, honeycomb, or boulder form. The Willowbrook soil form has grazing land capability and is not suitable for crop production.

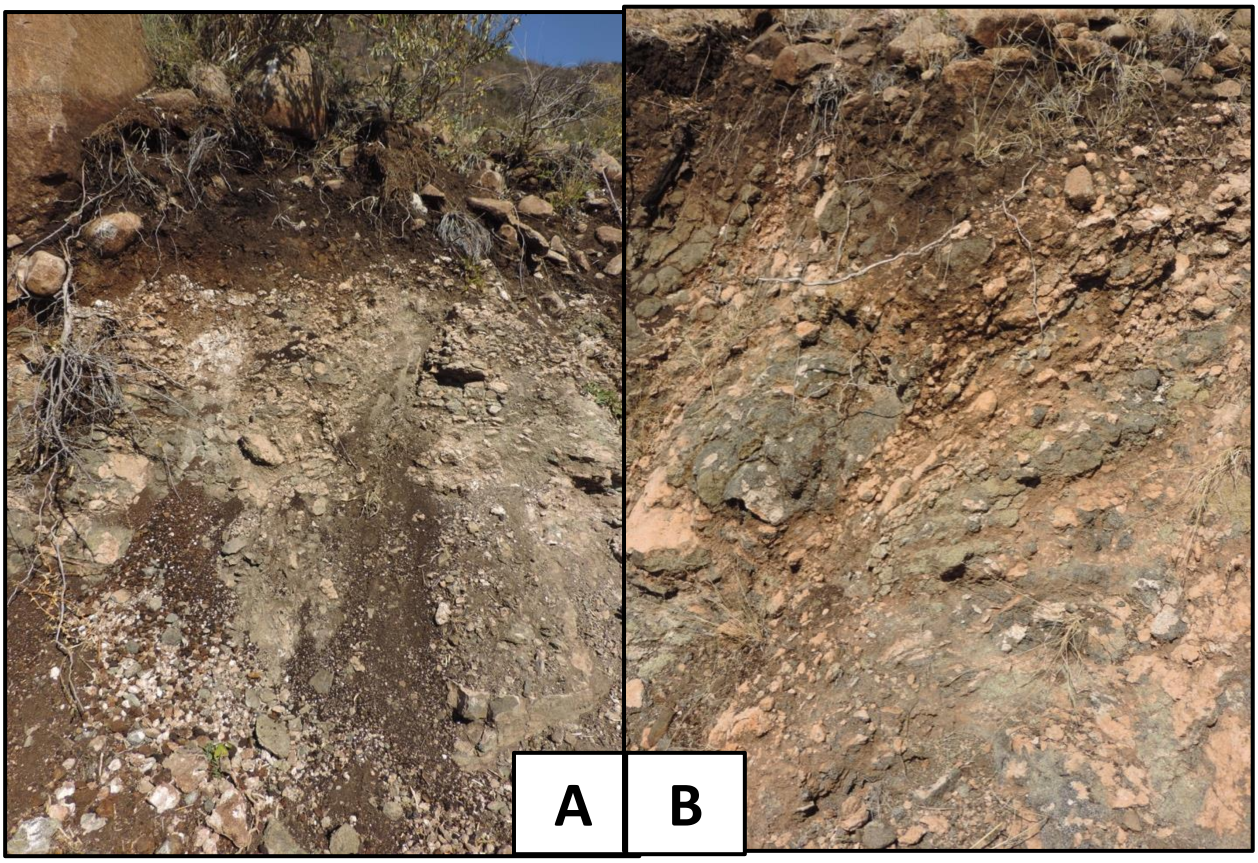

Figure 3: Photographic examples of the Steendal soil form (A) and the Mayo soil form (B) identified on site

Witbank

In South Africa there is currently only one soil form that caters for the anthropic group according to the Soil Classification Working Group (1991), namely Witbank soil form. Anthropic soils are those soils that have been so profoundly affected by human disturbance that their natural genetic character (i.e. their link to the natural factors of soil formation) has largely been destroyed or has had insufficient time to express itself. In South Africa the most extensive areas of anthropic soils belong to the technic Witbank form, created as a result of the rehabilitation of mined land. The thickness of the orthic A horizon plus man-made soil deposit must be more than 500 mm if these overlie a classifiable buried soil. In other instances, the total thickness can be less than 500 mm.

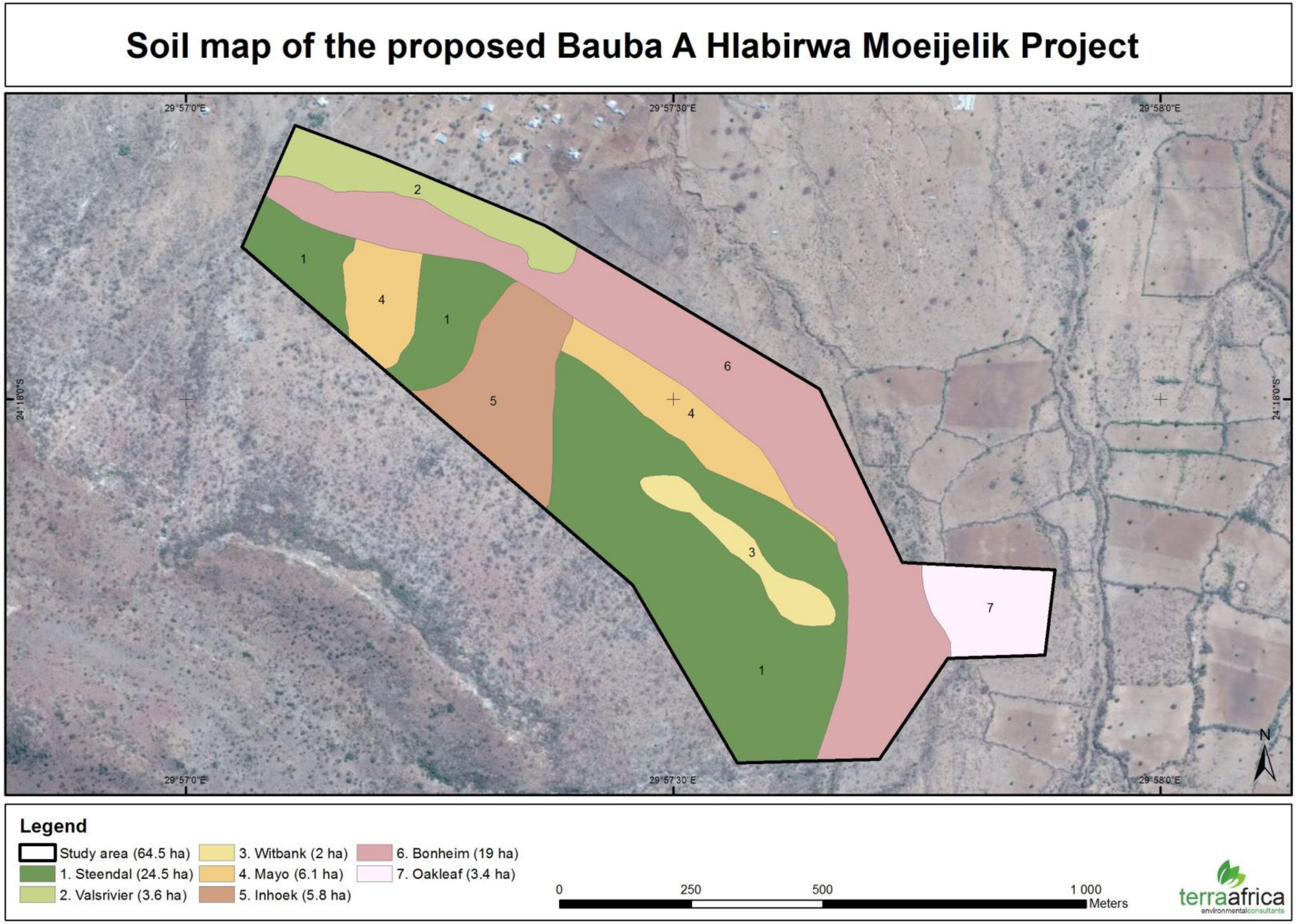

Figure 4: Locality of soil forms present in the Bauba A Hlabirwa Project area

5.3 Soil chemical characteristics and soil fertility

The purpose of establishing baseline chemical composition of soil on a site before development commences, is to determine whether there is any deterioration in soil fertility and what the nutrient status of the soil is associated with the natural vegetation. Should the chemical content of the soil be drastically different once rehabilitation commences, the chemical composition might have to be amended by the addition of fertilizers or organic matter.

5.1.1 pH levels

For successful crop production, a pH of between 5.8 and 7.5 is optimum and crops will do well in these soils permitting that other essential plant nutrients are also available for uptake by plant roots. The pH of the baseline soil samples range between 6.37 and 7.68 that is neutral to slightly alkaline.

5.1.2 Phosphorus

Phosphorus is essential for plant growth and functioning as it enhances the fundamental processes of photosynthesis, nitrogen fixation, flowering, fruiting and seed production. It is needed in large quantities in meristematic tissue and enhances root growth. Soil phosphorus levels for the study site was analysed with a Bray 1 extraction that measures phosphorus available to the plant. The optimum level will vary with type of crop and soil conditions, but for most field crops, 20 to 30 mg/kg is adequate.

Phosphorus levels of baseline samples analysed range between 1 and 3 mg/kg that is deficient for crop production purposes and phosphorus-containing fertilizer will be required for crop production. As uncultivated soil in South Africa is naturally low in phosphorus, there is no need for phosphorus fertilization should the land remain under natural vegetation or pasture.

5.4 Agricultural potential

A large portion of the site consists of shallow rocky soil on steep slopes which has no potential for arable agriculture and is suitable for grazing and has habitat to indigenous ecosystems. The deeper, more fertile Oakleaf soil on the eastern portion of the site where the planned office blocks will be, has arable land capability and medium agricultural potential. or shallow swith a medium to high arable agricultural potential. This area has the potential for crop production of maize, sunflowers and soy beans as well as for forestry purposes.

5.5 Land use

The site can currently be divided into two different main land uses. The southeastern portion of the proposed project site already contains a section of existing land disturbance where exploration and fencing activities have resulted in a haul road cutting into the mountain. The rest of site has fairly undisturbed indigenous vegetation that stabilises the soil present on the hill slopes and prevent erosion.

Surrounding land use includes a community living rural houses with associated infrastructure such as water tanks and animal camps. Small maize fields are dotted between grazing fields. The fields are used for grazing by cattle, goats, donkeys and horses. A portion of land neighbouring the study area has already been converted to mining activities.

Figure 5: Local village neighbouring the project site

5.6 Land capability

Two land capability classes have been identified for the Bauba A Hlabirwa Project area. The study area is dominated by land with grazing land capability. These areas are mainly associated with soil forms with steeper slopes, rocky areas and duplex soils. The Oakleaf soil form in the area where the planned office blocks will be, has arable land capability. This is because the soil is deeper, slightly structured and is suitable for crop cultivation. Oakleaf soils in the larger area surrounding the project site are currently supporting patches of maize under rainfed cropping system.

Table 2: Soil chemistry results

Lab No	Reference no	pH (KCl)	PBray1	K	Na	Ca	Mg	Exch Acid	%Ca	%Mg	%K	%Na
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	cmol(+)/kg	%	%	%	%
77039	M01 A Horizon	6,37	3	85	14	3485	927	0,00	68,87	30,03	0,86	0,24
77040	M02 B1 Horizon	6,93	1	35	151	2036	2310	0,00	34,09	63,42	0,30	2,19
77041	M03 B2 Horizon	7,48	1	46	900	2371	1881	0,00	37,87	49,26	0,38	12,50
77042	M04 A Horizon	6,24	1	40	28	2240	1326	0,00	50,25	48,75	0,46	0,55
77043	M05 B Horizon	7,68	1	28	35	2749	926	0,00	63,74	35,22	0,33	0,72

Lab No	Reference no	Ca:Mg	(Ca+Mg)/K	Mg:K	S Value	Na:K	T	Density	S AmAc	SAmAc	C	EC
		1.5-4.5	10.0-20.0	3.0-4.0	cmol(+)/kg		cmol(+)/kg	g/cm3	mg/kg	mg/kg	%	µS/cm
77039	M01 A Horizon	2,29	115,05	34,93	25,30	0,27	25,30	1,20	9,90	9,47	3,78	182,6
77040	M02 B1 Horizon	0,54	321,51	209,11	29,86	7,23	29,86	1,13	21,41	8,72	1,16	412
77041	M03 B2 Horizon	0,77	231,36	130,80	31,30	33,19	31,30	1,05	2,25	17,85		543
77042	M04 A Horizon	1,03	215,52	106,13	22,29	1,19	22,29	1,19	6,27	17,63	2,47	166,6
77043	M05 B Horizon	1,81	301,23	107,21	21,56	2,18	21,56	1,34	5,33	2,88		257

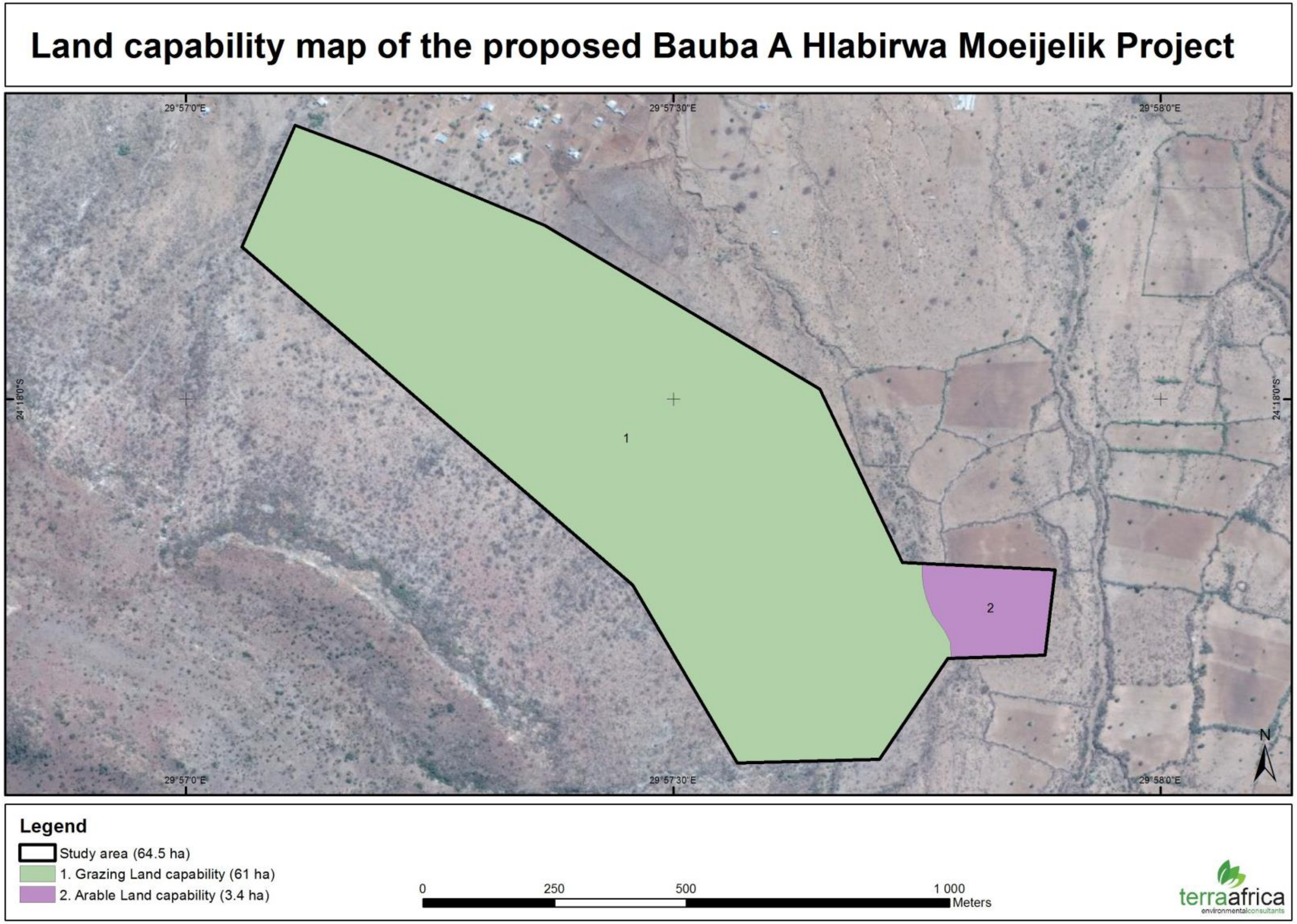

Figure 6: Land capability classification for the proposed Bauba A Hlabirwa Moeijelik Project

6 Potential impacts as a result of the proposed Bauba A Hlabirwa Moeijelik Project

6.1 *Anticipated impacts per phase*

6.1.1 Construction phase

The main impacts associated with the construction phase of the proposed Bauba a Hlabirwa Moeijelik Platinum Project are:

- Soil compaction and topsoil loss leading to reduced fertility (especially due to the presence of duplex soils);
- Soil loss as a result of wind and water erosion and sediment release to land and water (by removing vegetation);
- Alteration of natural drainage lines; and
- The change of land use from natural vegetation and agriculture (livestock grazing) to industrial within the planned development areas of the proposed project.

Limited impacts are expected outside of the proposed project area, with the exception along unpaved roads within the region, where erosion can impact on adjacent areas. Much of the impacts to soil and land capability cannot be mitigated further because they derive from the land-take footprint from the physical presence of the development, however measures can be implemented to help minimise impacts.
Impacts will definitely occur. They will be permanent in duration, but significance of the impact will decrease when disturbed areas are rehabilitated and re-vegetated during decommissioning of the mining infrastructure. Intensity will range from low to high as natural functions of the soil will be altered. Impact magnitude will be medium to high given the extent of the area affected. Impact significance to soil resources and land capability before mitigation is expected to be high.

6.1.2 Operational phase

The main impacts associated with the operational phase of the proposed Bauba a Hlabirwa Moeijelik Platinum Project are:

- The sterilisation of the soil resource under which the platinum is mined and where the support facilities will be constructed. This will be an on-going loss for the duration of the operation;
- The creation of dust and the possible loss (erosion) of utilisable soil down-wind and/or downstream, and the siltation of the local streams and waterways;
- The compaction of the in-situ and stored soils and the potential loss of utilisable materials from the system;
- The contamination of the in-situ and stored soils by dirty water run-off and or spillage of hydrocarbons from vehicles and machinery or from dust and emissions from the process of mining (blasting dust etc.) and hauling of platinum ore;
- The contamination and impact of sensitive materials located on or in close proximity (bordering) to the mining venture and their loss from the system;
- Contamination of soils by use of dirty water for road wetting (dust suppression) and irrigation of the stockpile vegetation;
- Contamination of soil resource by emission fallout; and
- Sterilisation and the loss of the soil nutrient pool, organic carbon stores and fertility of stored soils.

6.1.3 Decommissioning phase

The decommissioning of the Bauba a Hlabirwa Moeijelik Platinum Project infrastructure will entail the demolition of buildings and removal of infrastructure. During the decommissioning activities, impacts to soil resources may include compaction and contamination and impacts may be significant in the short term.

Stockpiled topsoil will be replaced and subsequent rehabilitation and re-vegetation of the disturbed areas will allow a return to pre-impact land capability for agricultural land use namely grazing. Overall rehabilitation of the site will have a positive, permanent direct impact on the land capability within the Bauba a Hlabirwa Moeijelik Platinum Project area.

The intensity and magnitude is likely to be high as the land capability will be compromised from industrial to a combination of wilderness and grazing land capability.

6.2 Impact rating

6.2.1 Soil compaction

Project phases where impact will occur:

- Construction phase
- Operational phase
- Decommissioning phase

Environmental significance:

Soil compaction will take place due to unnatural load and increased traffic by heavy construction vehicles in the area and will change the soil structure. Soil compaction generally reduces the amount of water that plants can take up. This is because compaction crushes many of the macro-pores and large micro-pores into smaller pores, and the bulk density increases. As the clay particles are forced closer together, soil strength may increase beyond about 2000 kPa, the level considered to limit root penetration. Compaction also results in aggravation of run-off erosion as compaction reduces the water infiltration rate.

Soil compaction will be an impact in all the proposed footprint areas – waste dumps, stockpiles and haul roads. The effect of this will largely be within the site boundary and is highly likely to occur frequently due to the permanent nature of the waste dumps as well as the haul roads being used almost exclusively to transport heavy loads. If probable mitigating measures are not implemented the effect of the compaction will affect soil structure of soils on the site permanently. The significance of this potential impact is considered to be high.

Possible mitigation measures:

- When stripping machinery is used for stripping, stockpiling and 'topsoiling' operations, it should operate when the soil moisture content is below approximately 8 % (during the dry winter months) in order to limit soil compaction and machinery getting stuck.
- For use on site, tracked vehicles are more desirable than wheeled vehicles due to their lower point loading and slip, while vehicle speed should be maintained in order to reduce the duration of applied pressure, thereby minimizing compaction.
- The width of the levelled or disturbed area for haul roads must be minimized as much as possible. Unnecessary dirt tracks (outside of the area to be disturbed) should not be formed during the construction of the haul road.
- Using existing roads and reducing new roads to a minimum can reduce impact beyond the site boundary.

Significance of implementation of mitigation measures:

The significance of suggested mitigation measures will only be moderate due to the nature and long-term duration of the project. The most effective mitigation will be the minimization of the construction footprint and by preventing unnecessary traffic on the haul roads. Therefore the effect of compaction mitigation will be localised within the area. The significance of this potential impact, after mitigation, is considered to be medium-high.

Construction Phase (Pre-mitigation)						
Potential Impact	**Activities**	**M**	**E**	**D**	**P**	**SR**
Soil compaction	Dust suppression	8	6	5	5	95
	Admin & office buildings					
	Hauling and vehicles					
	Topsoil Stockpile					

Construction Phase (Post-mitigation)						
Potential Impact	**Activities**	**M**	**E**	**D**	**P**	**SR**
Soil Compaction	Dust supression	6	2	5	5	65
	Admin & office buildings					
	Hauling and vehicles					
	Topsoil stockpile					

Operational Phase (Pre-mitigation)						
Potential Impact	**Activities**	**M**	**E**	**D**	**P**	**SR**
Soil compaction	Dust suppression Admin & office buildings Loading and hauling Topsoil Stockpile Waste Rock Stockpile Overburden Stockpile Product Stockpile	8	6	5	5	95

Operational Phase (Post-mitigation)						
Potential Impact	**Activities**	**M**	**E**	**D**	**P**	**SR**
Soil Compaction	Dust supression Admin & office buildings Loading and hauling Topsoil stockpile Waste rock Stockpile Overburden Stockpile Product Stockpile	6	2	5	5	65

Decommissioning and Closure Phase (Pre-mitigation)						
Potential Impact	**Activities**	**M**	**E**	**D**	**P**	**SR**
Soil compaction	Dust suppression Removing infrastructure Topsoiling rehabilitated areas Removal of waste rock	6	6	2	5	70

Decommissioning and Closure Phase (Post-mitigation)						
Potential Impact	**Activities**	**M**	**E**	**D**	**P**	**SR**
Soil Compaction	Dust suppression Removing infrastructure Topsoiling rehabilitated areas Removal of waste rock	6	2	2	4	40

6.2.2 Soil erosion

Project phases where impact will occur:

- Construction phase
- Operational phase

- Decommissioning phase

Environmental significance:

Soil will be prone to erosion where vegetation has been removed. The current vegetation layer protects the duplex soils on the site, and once removed, will result in wind erosion and erosion by the impact of water flow, especially during the rainy season. Erosion will be localised within the site boundary but will have a permanent effect that would stretch into the operational phase of the project. This will ultimately lead to the irretrievable commitment of this resource. The measurable effect of reducing erosion by utilising mitigation measures may reduce possible erosion significantly. The significance of this potential impact is considered to be high.

Significance of implementation of mitigation measures:

The application of the suggested mitigation measures to prevent erosion effectively will cause the effect of soil erosion to be localised but it will still occur regularly for the entire life of the operation as new areas gets cleared when the waste dumps expand. Any soils left exposed throughout the construction and operational phases could lead to significant erosion of the soils in the vicinity of the development. The impact after mitigation is considered medium-low.

Possible mitigation measures:

- Stripping of topsoil should not be conducted earlier than required (maintain grass cover for as long as possible) in order to prevent the erosion by wind and water of organic matter, clay and silt.
- Stripped soils should be stockpiled as a berm upslope (the majority) and surrounding the disturbed area.
- Soil stockpiles must be sampled, ameliorated (fertilized) and re-vegetated as soon after construction as possible. This is in order to limit raindrop and wind energy, as well as to slow and trap runoff, thereby reducing soil erosion. Grassland and shrub species indigenous to the area are preferred, given both their hardy nature as well as their lower maintenance requirements.

- The soils stripped for leveling purposes must be stockpiled as a berm along the entire length of haul roads (upslope).
- Erosion control measures such as intercept drains and toe berms must be constructed where necessary.
- Gravel roads must be well drained in order to limit soil erosion.
- The vegetative (grass) cover on the soil stockpiles (berms) must be continually monitored in order to maintain a high basal cover. Such maintenance will limit soil erosion by both the mediums of water (runoff) and wind (dust).
- The gravel haul road drainage system and surface must be well maintained in order to limit soil erosion

Construction Phase (Pre-mitigation)						
Potential Impact	**Activities**	**M**	**E**	**D**	**P**	**SR**
Soil Erosion	Removal of vegetation Hauling and vehicles Topsoil stockpiling	8	3	5	5	80

Construction Phase (Post-mitigation)						
Potential Impact	**Activities**	**M**	**E**	**D**	**P**	**SR**
Soil Erosion	Removal of vegetation Hauling and vehicles Topsoil stockpiling	6	2	4	4	48

Operational Phase (Pre-mitigation)						
Potential Impact	**Activities**	**M**	**E**	**D**	**P**	**SR**
Soil Erosion	Removal of vegetation Loading and hauling Topsoil stockpiling	8	3	5	5	80

Operational Phase (Post-mitigation)						
Potential Impact	**Activities**	**M**	**E**	**D**	**P**	**SR**
Soil Erosion	Removal of vegetation Loading and hauling Topsoil stockpiling	6	2	4	4	48

Decommissioning and Closure Phase (Pre-mitigation)						
Potential Impact	**Activities**	**M**	**E**	**D**	**P**	**SR**
Soil Erosion	Replacing topsoil	8	3	3	5	70
	Ripping Haulroads					
	Revegetation					

Decommissioning and Closure Phase (Post-mitigation)						
Potential Impact	**Activities**	**M**	**E**	**D**	**P**	**SR**
Soil Erosion	Replacing topsoil	6	2	3	4	44
	Ripping Haulroads					
	Revegetation					

6.2.3 Sterilization of topsoil layer

Project phases where impact will occur:

- Construction phase
- Operational phase

Environmental significance:

The soil is generally low in organic matter content and most of the composted organic matter that originates from leaf litter and old grass roots which decayed, remains in the top 5-20 cm of the profile. The topsoil also contains the seed bank for the natural vegetation. Stripping of topsoil during construction will remove this fertile layer. This will result in the loss of the soil carbon content as well as soil micro-organisms that support the soil nutrient cycles.

The effect of this will be localised within the site boundary but will have a long term effect that would stretch into the operational phase of the project and will ultimately lead to the irretrievable commitment of this resource. The significance of this potential impact is considered to be high.

Where buildings are erected and material like waste rock are stockpiled on top of topsoil, compaction and the creation of anaerobic conditions also result in the loss of viable seed and soil micro-organisms and lead to the sterilization of the topsoil.

The measurable effect of the construction and operational phase on this resource and the likeliness of preventing or reducing the effect by utilizing mitigation measures are negligible. The reason for this is that most of the organic carbon as well as the soil microbial life, are contained in the topsoil horizon. These components are crucial for the maintenance of the vegetation layer. Once the surface horizon is removed during construction and stockpiled, the nutrient cycles such as the carbon and nitrogen cycles are disturbed and the organic matter breaks down very quickly. Although the topsoil may later be replaced in more or less the original position in the landscape, the soil fertility will have been compromised. Therefore the significance of the potential impact after mitigation is still considered to be high.

Construction Phase (Pre-mitigation)						
Potential Impact	**Activities**	**M**	**E**	**D**	**P**	**SR**
Sterilisation of Topsoil	Administration Buildings	10	2	5	5	85
	Offices and other buildings					
	Topsoil stockpiling					
	Waste rock stockpiles					

Construction Phase (Post-mitigation)						
Potential Impact	**Activities**	**M**	**E**	**D**	**P**	**SR**
Sterilisation of Topsoil	Administration Buildings	10	2	5	5	85
	Offices and other buildings					
	Topsoil stockpiling					
	Waste rock stockpiles					

Operational Phase (Pre-mitigation)						
Potential Impact	**Activities**	**M**	**E**	**D**	**P**	**SR**
Sterilisation of Topsoil	Administration Buildings	10	2	5	5	85
	Offices and other buildings					
	Topsoil stockpiling					
	Waste rock stockpiles					
	Overburden stockpiles					
	Product stockpiles					

Operational Phase (Post-mitigation)						
Potential Impact	**Activities**	**M**	**E**	**D**	**P**	**SR**
Sterilisation of Topsoil	Administration Buildings	10	2	5	5	85
	Offices and other buildings					
	Topsoil stockpiling					
	Waste rock stockpiles					
	Overburden stockpiles					
	Product stockpiles					

10.2.4 Chemical soil pollution

Project phases where impact will occur:

- Construction phase
- Operational phase
- Decommissioning phase

Environmental significance:

The use of vehicles that can result in oil and fuel spills on site as well as waste generation by mine workers can result in possible chemical soil pollution. Chemical soil pollution can also be caused by leakage from waste storage facilities. The effect can stretch beyond the site boundaries and the significance of this potential impact is considered to be high.

Soil pollution within and outside the site boundary can be prevented through mitigation and the anticipated impact can be reduced from medium to low. The significance of this potential impact, after mitigation, is considered to be low.

Possible mitigation measures:

- An intercept drain should be constructed upslope of construction and operational areas, in order to re-direct clean water away to avoid soil chemical pollution to clean groundwater resources.
- An intercept drain should possibly be constructed downslope of polluted areas, in order to drain potentially polluted water into a pollution control dam.
- Drains and intercept drains should be maintained to ensure that it continue to redirect clean water away from the polluted areas.

- Conduct proper chemical waste management to avoid spillage of chemicals during all the phases of the project cycle.

Construction Phase (Pre-mitigation)						
Potential Impact	**Activities**	**M**	**E**	**D**	**P**	**SR**
Chemical soil Pollution	On-site sanitation Oil and fuel spills Leakage from waste storage Waste generation by workers Pollution with building material	10	2	4	5	80

Construction Phase (Post-mitigation)						
Potential Impact	**Activities**	**M**	**E**	**D**	**P**	**SR**
Chemical soil Pollution	On-site sanitation Oil and fuel spills Leakage from waste storage Waste generation by workers Pollution with building material	2	2	4	2	16

Operational Phase (Pre-mitigation)						
Potential Impact	**Activities**	**M**	**E**	**D**	**P**	**SR**
Chemical soil Pollution	On-site sanitation Oil and fuel spills Leakage from waste storage Waste generation by workers Pollution with building material	10	2	4	5	80

Operational Phase (Post-mitigation)						
Potential Impact	**Activities**	**M**	**E**	**D**	**P**	**SR**
Chemical soil Pollution	On-site sanitation Oil and fuel spills Leakage from waste storage Waste generation by workers Pollution with building material	2	2	4	2	16

Decommissioning and Closure Phase (Pre-mitigation)						
Potential Impact	**Activities**	**M**	**E**	**D**	**P**	**SR**
Chemical soil Pollution	On-site sanitation Oil and fuel spills Leakage from waste storage Waste generation by workers Pollution with building rubble	10	2	4	5	80

Decommissioning and Closure Phase (Post-mitigation)						
Potential Impact	**Activities**	**M**	**E**	**D**	**P**	**SR**
Chemical soil Pollution	On-site sanitation Oil and fuel spills Leakage from waste storage Waste generation by workers Pollution with building rubble	2	2	4	2	16

6.2.5 Loss of current land capability

Project phases where impact will occur:

- Construction phase
- Operational phase

<u>Environmental significance:</u>

The proposed sites largely consist of land with grazing land capability and areas with arable land capability. During the construction and operational phases of the project, large areas of land will be cleared of the original vegetation. This will result in a total loss of the land capability as it currently is and will change the current land use from grazing and arable to industrial land-use. The significance of this potential impact is considered to be high.

<u>Possible mitigation measures:</u>

Although the stockpiles will be revegated, it is not anticipated that areas where grazing land capability was lost will be remediated to such an extent that the land capability will return. At most, the site will be rehabilitated to wilderness land capability. However, it is still recommended that the natural vegetation be re-established once the mining operations have ceased and that the grazing capacity is restored as good as possible. Should the land capability be re-established, the impact after mitigation is considered to be medium-low.

Construction Phase (Pre-mitigation)						
Potential Impact	**Activities**	**M**	**E**	**D**	**P**	**SR**
Loss of land capability	Removal of vegetation	10	2	5	5	85
	Hauling and vehicles					
	Mining activities					

Construction Phase (Post-mitigation)						
Potential Impact	**Activities**	**M**	**E**	**D**	**P**	**SR**
Loss of land capability	Removal of vegetation	8	2	5	5	75
	Hauling and vehicles					
	Mining activities					

Operational Phase (Pre-mitigation)						
Potential Impact	**Activities**	**M**	**E**	**D**	**P**	**SR**
Loss of land capability	Removal of vegetation	10	2	5	5	85
	Hauling and vehicles					
	Mining activities					

Operational Phase (Post-mitigation)						
Potential Impact	**Activities**	**M**	**E**	**D**	**P**	**SR**
Loss of land capability	Removal of vegetation	8	2	5	5	75
	Hauling and vehicles					
	Mining activities					

7. Reference list

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