

# Ecological Management Services Ecological Management Services

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## BIODIVERSITY AND FRESHWATER ASSESSMENT REPORT FOR UMK MINE, IN SUPPORT OF THE EMP AMENDMENT PROCESS, HOTAZEL NORTHERN CAPE

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For  
SLR Consulting (Africa) (Pty) Ltd (Pty)

August 2021

## **DECLARATION OF CONSULTANT**

I Natalie Birch declare that I –

- act as the independent specialist in this study;
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2017;
- do not have and will not have any vested interest in the activity proceeding;
- have no, and will not engage in, conflicting interests in the undertaking of the activity;
- undertake to disclose, to the competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the Environmental Impact Assessment Regulations, 2017;
- will provide the competent authority with access to all information at my disposal regarding the study.

A handwritten signature in black ink, appearing to read 'NB' followed by a stylized flourish.

Natalie Birch Pr. Sci. Nat 400117/05

August 2021

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**ABBREVIATIONS**

ADE	Aquifer Dependent Ecosystems
BGIS	Biodiversity Geographical Information System
CBA	Critical Biodiversity Area
CITES	Convention on International Trade in Endangered Species
DAERL	Department of Agriculture, Environmental Affairs, Rural Development and Land Reform
EIA	Environmental Impact Assessment
ESA	Ecological Support Area
EWT	Endangered Wildlife Trust
FEPA	Freshwater Ecosystem Priority Areas
GPS	Global Positioning System
GWC	Griqualand West Centre of Endemism
IUCN	International Union for Conservation of Nature
NCNCA	Northern Cape Nature Conservation Act
NEM:BA	National Environmental Management: Biodiversity Act
NEMA	National Environmental Management Act
NFEPA	National Freshwater Ecosystem Priority Areas assessment
NPAES	National Protected Areas Expansion Strategy
PESEIS	Present Ecological State, Ecological Importance & Ecological Sensitivity
QDS	Quarter Degree Squares
SABAP	South African Bird Atlas Project
SABIF	South African Biodiversity Information Facility
SANBI	South African National Biodiversity Institute
SARCA	Southern African Reptile Conservation Assessment
SIBIS	SANBI's Integrated Biodiversity Information System
TOPS	Threatened or Protected Species

## 1.1. INTRODUCTION

SLR has been appointed by the United Manganese of Kalahari (Pty) Ltd (UMK) Mine to conduct a full Scoping and Environmental Impact Assessment (EIA) process in support of an Environmental Management Programme (EMPr) amendment application for the following scope of work:

UMK is proposing to change the approved surface layout for the mine to optimize their mining operations as follows;

### ***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)(84Ha)
  - Central West Sand Stockpile (40.9 Ha)
  - J Block West WRD(133Ha)
  - J Block West Sand Stockpile(46.5Ha)
  - J Block East WRD(63.5Ha)
  - J Block East Sand Stockpile(16.5Ha)
  - Powerline West WRD(196ha)
  - Powerline West Sand Stockpile(35,9Ha)
  - A Block West WRD (145 Ha)
- Product stockpile area within the approved sinter plant area (21.4 Ha);
- TUP stockpile area (12.4 Ha);
- Truck staging area (20.4 ha);
- Hard park areas (Phase 1 and 3) (14.3 Ha);
- Barlow's Store (1 Ha);
- Explosive 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.

### ***Expansion of existing approved infrastructure***

- 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).
- Expansion of the pit (458.54 Ha)

***Relocation of the following surface infrastructure at the mine:***

- Approved dirty water dams/pollution control ponds; and
- 132 KV powerline from current location to its old location.

SLR appointed Ecological Management Services to undertake the Biodiversity & Freshwater specialist study required as part of the impact assessment process for the Environmental Management Programme (EMPr) amendment application. A biodiversity report was completed as part of the original EIA in 2007, this report was updated in 2017. The 2007 report and the updated version was compiled by Dr N.V. Birch *Pr. Sci Nat.* (reg no 400117/05). Details of the specialist for this report are attached in Appendix 3

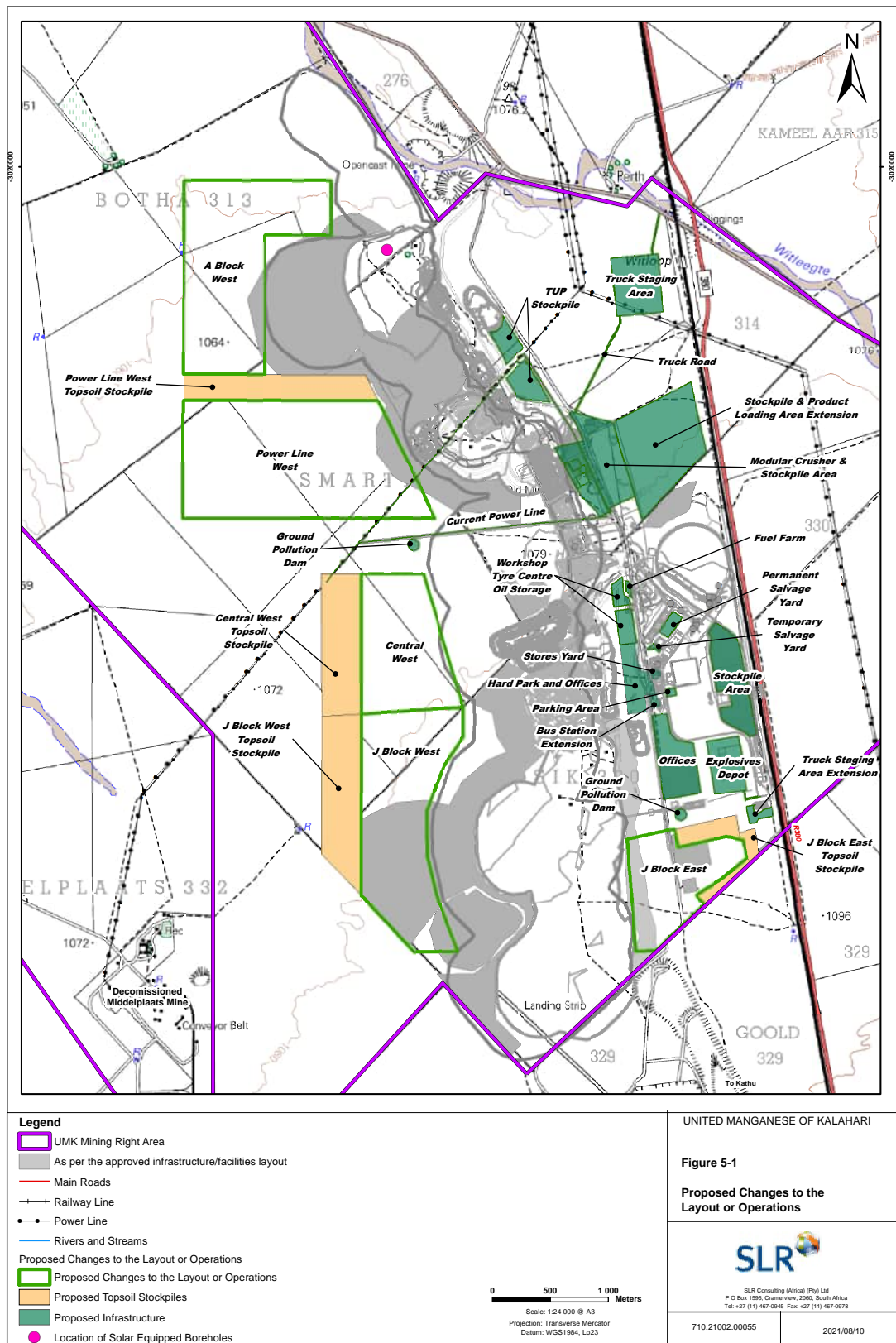
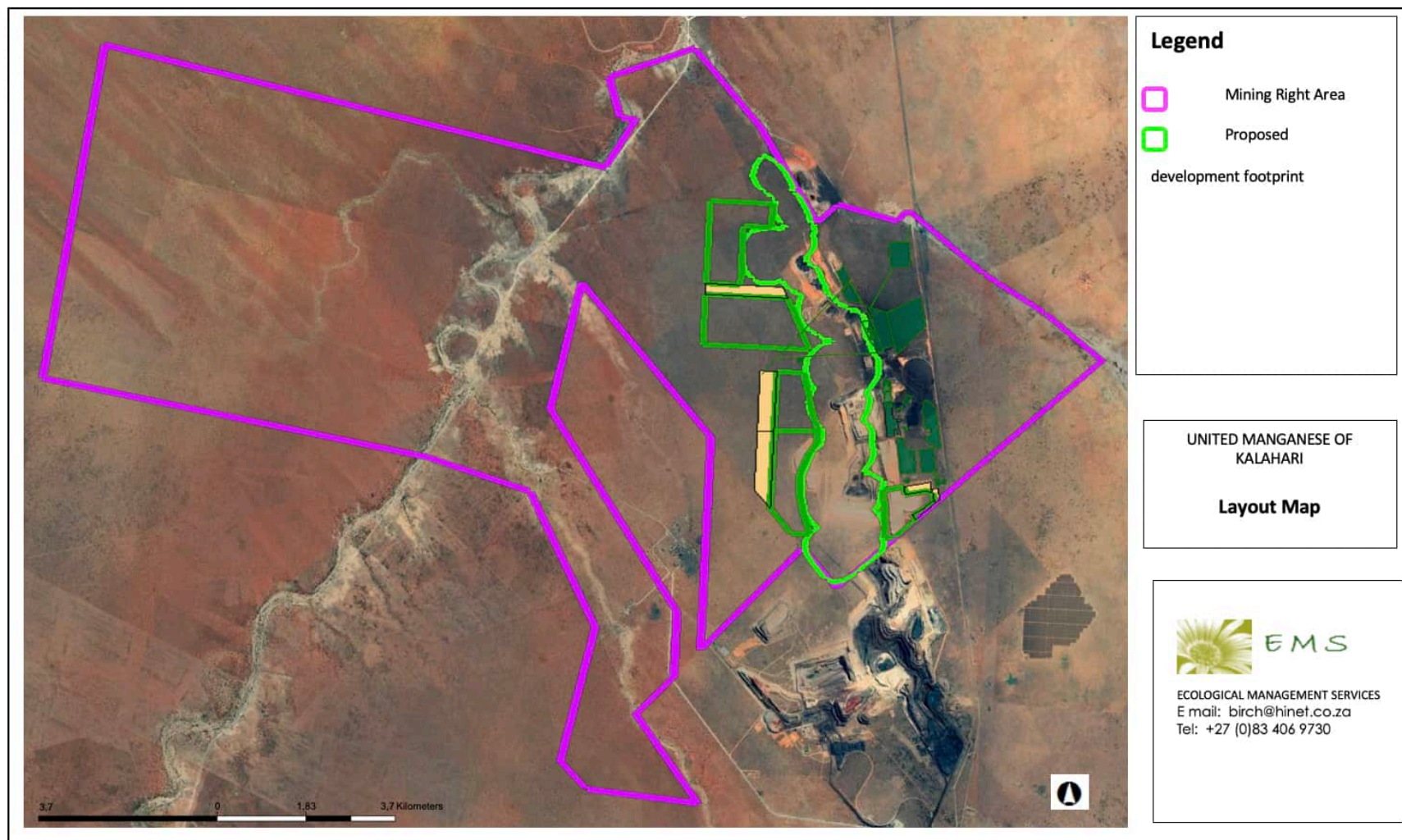


Figure 1.1: Proposed Changes to the layout or operations



**Figure 1.2:** Proposed development footprint and mining right area



### 1.1. TERMS OF REFERENCE & SCOPE OF WORK

The scope of work for this study includes

#### *Biodiversity assessment*

- Review available information and documentation relating to the proposed development;
- A comprehensive investigation to identify potential floral species of special concern, this includes all IUCN listed species, TOPS listed species and species listed in schedule 1 and 2 of the NCNCA. These will be identified through the SANBI POSA database as well as other available literature and confirmed on site.
- A single field survey and literature review of the property to determine vegetation type and distribution. The survey will be undertaken to identify potential floral species of special concern.
- A single field survey and literature review to determine what red data faunal species could potentially occur within the study site. The habitat requirements of each red data species that could potentially occur on-site will be compared with the vegetation description. No onsite trapping of faunal species will be undertaken.
- Once the overall potential for occurrence of each red data species has been identified, each habitat type (based on the vegetation description and any factors identified as relevant to fauna) will be ranked in terms of conservation importance, as well as ecological sensitivity.
- The sites importance in terms of regional sensitivity will also be assessed
- The report and survey will comply with the NEMA Appendix 6 requirements.

#### *Freshwater Assessment*

- Review available information and documentation relating to the proposed development;
- A site visit and assessment of the site;
- Determine the Present Ecological State (PES) & Ecological Importance and Sensitivity (EIS) of the Witleegte watercourse
- Determine the impacts in terms of the characteristics of the Witleegte ecosystem affected and associated with the proposed development;
- Describe and assess the significance of the proposed development on the ecosystem;
- Recommend mitigation measures to minimize the potential negative impacts on freshwater ecosystems;
- Provide comment on the impacts to the biodiversity and freshwater ecosystem as a consequence of the proposed amendments.

## 1.2. DATA SOURCING AND REVIEW

The data sources consulted and used where necessary in the study includes the following;

### Vegetation:

- Vegetation types and their conservation status were extracted from the South African National Vegetation Map (South African National Biodiversity Institute, 2006-2018)).
- Information on plant species recorded for the Quarter Degree Squares (QDS), was extracted from the POSA database hosted by SANBI. This is a much larger extent than the study area, but the data was extracted from a larger area to account for the fact that the area has probably not been well sampled in the past.
- The IUCN conservation status of the species in the list (Table 1.1) was also extracted from the database and is based on the Threatened Species Programme, Red List of South African Plants (2020).
- Threatened Ecosystem data was extracted from the NBA Threat Status and Protection Level list (SANBI 2018).
- Freshwater and wetland information was extracted from the National Freshwater Ecosystem Priority Areas assessment, NFEPA (Nel et al. 2011).
- Important catchments and protected areas expansion areas were extracted from the National Protected Areas Expansion Strategy 2016 (NPAES).

### Fauna

- Lists of mammals, reptiles and amphibians which are likely to occur at the site were derived based on distribution records from the literature and various spatial databases (ADU Atlas, and BGIS databases).
- Literature consulted includes Branch (1988) and Alexander and Marais (2007) *Bates et al.* (2014) for reptiles, Du Preez and Carruthers (2009) for amphibians, Friedmann and Daly (2004) and Skinner and Chimimba (2005) for mammals.
- Bird species lists for the area were extracted from the SABAP 1 and SABAP 2 databases and Birdlife South Africa's Important Bird Areas was also consulted to ascertain if the site falls within the range of any range-restricted or globally threatened species.
- The faunal species lists provided are based on species which are known to occur in the broad geographical area, as well as a preliminary assessment of the availability and quality of suitable habitat at the site. For each species, the likelihood that it occurs at the site was rated according to the following scale:
  - **Low:** The available habitat does not appear to be suitable for the species and it is unlikely that the species occurs at the site.

- **Medium:** The habitat is broadly suitable or marginal and the species may occur at the site.
- **High:** There is an abundance of suitable habitat at the site and it is highly probable that the species occurs there.
- **Definite:** Species that were directly or indirectly (scat, characteristic diggings, burrows etc.) observed at the site.
- The conservation status of each species is also listed, based on the IUCN Red List Categories and Criteria version 3.1 (2021-1) (See Table 1.1) and where species have not been assessed under these criteria, the CITES status is reported where possible. These lists are adequate for mammals and amphibians, the majority of which have been assessed, however the majority of reptiles have not been assessed and therefore, it is not adequate to assess the potential impact of the development on reptiles, based on those with a listed conservation status alone. In order to address this shortcoming, the distribution of reptiles was also taken into account such that any narrow endemics or species with highly specialized habitat requirements occurring at the site were noted.

**Table 1. 1**The IUCN Red List Categories for fauna and flora. Species that fall within the categories in red and orange below are of conservation concern.

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**IUCN Red List Category**

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Critically Endangered (CR)

Endangered (EN)

Vulnerable (VU)

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Near Threatened (NT)

Critically Rare

Rare

Declining

Data Deficient - Insufficient Information (DDD)

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Data Deficient - Taxonomically Problematic (DDT)

Least Concern

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The following is provided in Accordance with NEMA Appendix 6, and the protocol for specialist assessment and minimum report content requirements for environmental impacts on terrestrial biodiversity (Government Gazette 43110, 20 March 2020)

Section	NEMA 2014 Regs – Appendix 6 (1) Requirement	Position in Report
1	A specialist report prepared in terms of these Regulations must contain—	
(a)	Details of -	
	(i) the specialist who prepared the report; and	Cover page
	(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	Appendix 3
(b)	a declaration that the person is independent in a form as may be specified by the competent authority;	Page 2
(c)	an indication of the scope of, and the purpose for which, the report was prepared;	Section 1.1
(d)	the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 3
(e)	a description of the methodology adopted in preparing the report or carrying out the specialised process;	Section 3
(f)	the specific identified sensitivities of the site related to the activity and its associated structures and infrastructure;	Section 4.3, 4.7 and Section 5
(g)	an identification of any areas to be avoided, including buffers;	Section 5
(h)	a map superimposing the activity including the associated structures and infrastructure on the environmental sensitive of the site including areas to be avoided, including buffers;	Section 5
(i)	a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 1.3
(j)	a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment;	Section 6 and 7
(k)	any mitigation measures for inclusion in the EMPr;	Section 6 & 7
(l)	any conditions for inclusion in the environmental authorization;	Section 7
(m)	any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 6 & 7

(n)	a reasoned opinion- (i) as to whether the proposed activity or portions thereof should be authorized and (ii) if the opinion is that the proposed activity of portion thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 7
(o)	a description of any consultation process that was undertaken during the course of preparing the specialist report;	N/A
(p)	a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A at this stage,
(q)	any other information requested by the competent authority.	N/A at this stage

### 1.3. LIMITATIONS AND ASSUMPTIONS

The major potential limitation associated with the sampling approach is the narrow temporal window of sampling. Ideally, a site should be visited several times during different seasons to ensure that the full complement of plant and animal species present are captured. However, this is rarely possible due to time and cost constraints. This survey has been conducted during July and represents the winter/dry season survey. This does limit the potential to encounter all the species that may be present and hinders the identification of some species. However a previous survey undertaken for the mine was conducted in April (wet/summer season survey which therefore augments the potential species data collected during this site visit, the data was further supplemented by a database of any listed species which are known from other studies to occur in the broad vicinity of the site. The lists of amphibians, reptiles and mammals for the site are based on those observed at the site as well as those likely to occur in the area based on their distribution and habitat preferences. This represents a sufficiently conservative and cautious approach that takes account of the study limitations.

There is no quantitative analysis of the resource base for the protected trees (*Vachellia erioloba* and *Vachellia haematoxylon*) thus it is not known how many of the trees can be removed from an area without detrimentally affecting the overall population numbers

Once mining activities commence within an area the biodiversity within the area and its immediate surrounds is impacted. Impacts related to amendments need to consider the impacts to the biodiversity holistically and not just the impacts created by the amendment. An issue with assessing impacts related to biodiversity in terms of a phased approach is that areas become disturbed which results in biodiversity functionality degrading. The loss of biodiversity as a result of the initial phase, alters the perceived sensitivity of the area, hence it is preferable to assess a development in its entirety, and not only the proposed amendments, to ensure that the cumulative impacts as a result of all the phases are adequately assessed.

This report deals exclusively with a defined assessment / study area and the nature and extent of water resources outside this focal area is largely informed by extrapolation of data collected and can be considered of low confidence. This is especially applicable for water resource units that extend well beyond the scope of this assessment (i.e. upstream or downstream).

The riparian boundaries delineated are based on sampling points along transects and thus the outer boundary of water resource units between these transects / sampling points was extrapolated using knowledge of the site, aerial photography, contours and the ecologists' experience. Sampling by its nature, means that generally not all aspects of ecosystems can be assessed and identified.

The PES and EIS assessments undertaken are largely qualitative assessment tools and thus the results are open to professional opinion and interpretation. The Ecological Importance and Sensitivity assessment did not specifically address the finer-scale biological aspects of the water courses such as fauna.

The impact descriptions and assessment are based on the author's understanding of the proposed development based on the site visit and information provided. The assessment of impacts and recommendation of mitigation measures was informed by the site-specific ecological concerns arising from the field survey and based on the assessor's working knowledge and experience. Due to the complexities of ecological systems and the sensitive dependence on initial conditions, any predictions of the effects of perturbation are made with very low confidence. Evaluation of the significance of impacts with mitigation takes into account mitigation measures and best management practice.

## 2. REGULATORY AND LEGISLATIVE OVERVIEW

A summary of the relevant portions of the Acts which govern the activities and potential impacts to the environment associated with the development are listed below. Provided that standard mitigation and impact avoidance measures are implemented, not all the activities listed in the Acts below would actually be triggered.

### **National Environmental Management Act (NEMA) (Act No 107, 1998):**

NEMA requires that measures are taken that "prevent pollution and ecological degradation; promote conservation; and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development." In addition:

- That the disturbance of ecosystems and loss of biological diversity are avoided, or where they cannot be altogether avoided, are minimised and remedied;
- That a risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions; and
- Sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands, and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure.

### **National Environmental Management: Biodiversity Act (NEM:BA) (Act 10 of 2004):**

The National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA) provides for listing threatened or protected ecosystems, in one of four categories: critically endangered (CR), endangered (EN), vulnerable (VU) or protected. In terms of the EIA regulations, a basic assessment report is required for the transformation or removal of indigenous vegetation in a critically endangered or endangered ecosystem regardless of the extent of transformation that will occur.

NEM:BA also deals with endangered, threatened and otherwise controlled species, under the TOPS Regulations (Threatened or Protected Species Regulations). The Act provides for listing of species as threatened or protected, under one of the following categories:

- **Critically Endangered:** any indigenous species facing an extremely high risk of extinction in the wild in the immediate future.
- **Endangered:** any indigenous species facing a high risk of extinction in the wild in the near future, although it is not a critically endangered species.

- **Vulnerable:** any indigenous species facing an extremely high risk of extinction in the wild in the medium-term future; although it is not a critically endangered species or an endangered species.
- **Protected species:** any species which is of such high conservation value or national importance that it requires national protection. Species listed in this category include, among others, species listed in terms of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

A TOPS permit is required for any activities involving any TOPS listed species.

#### **National Forests Act (No. 84 of 1998):**

The National Forests Act provides for the protection of forests as well as specific tree species, quoting directly from the Act: *“no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree or any forest product derived from a protected tree, except under a license or exemption granted by the Minister to an applicant and subject to such period and conditions as may be stipulated”*. A permit is required for the destruction or transplant or transport of any protected tree species.

#### **National Veld and Forest Fire Act (Act No. 101 of 1998)**

The purpose of this Act is to prevent and combat veld, forest and mountain fires. The Act provides for a variety of institutions, methods and practices for achieving the purpose such as the formation of fire protection associations. It also places responsibility on landowners to develop and maintain firebreaks as well as be sufficiently prepared to combat veld fires in terms of equipment as well as suitably trained personnel.

#### **Conservation of Agricultural Resources Act (Act 43 of 1983):**

The Conservation of Agricultural Resources Act provides for the regulation of control over the utilisation of the natural agricultural resources in order to promote the conservation of soil, water and vegetation and provides for combating weeds and invader plant species. The Conservation of Agricultural Resources Act defines different categories of alien plants and those listed under Category 1 are prohibited and must be controlled while those listed under Category 2 must be grown within a demarcated area under permit. Category 3 plants includes ornamental plants that may no longer be planted but existing plants may remain provided that all reasonable steps are taken to prevent the spreading thereof, except within the floodline of water courses and wetlands.

#### **Northern Cape Nature Conservation Act, No. 9 of 2009: (NCNCA)**



The Northern Cape Nature Conservation Act provides inter alia for the sustainable utilisation of wild animals, aquatic biota and plants as well as permitting and trade regulations regarding wild fauna and flora within the province. In terms of this act the following section may be relevant with regards to any security fencing the development may require.

Manipulation of boundary fences 19. No Person may –

*(a) erect, alter remove or partly remove or cause to be erected, altered removed or partly removed, any fence, whether on a common boundary or on such person's own property, in such a manner that any wild animal which as a result thereof gains access or may gain access to the property or a camp on the property, cannot escape or is likely not to be able to escape therefrom;*

The Act also lists protected fauna and flora under 3 schedules ranging from Endangered (Schedule 1), protected (schedule 2) to common (schedule 3). The majority of mammals, reptiles and amphibians are listed under Schedule 2, except for listed species which are under Schedule 1. A permit is required for any activities which involve species listed under schedule 1 or 2. A permit obtainable from the DAERL permit office in Kimberly would be required for the site clearing. A permit would also be required to destroy or translocate any nationally or provincially listed species from the site. A single permit, which covers all of these permitting requirements as well as meets TOPS regulations, is used.

#### **National Water Act, No 36 of 1998**

This Act imposes 'duty of care' on all landowners, to ensure that water resources are not polluted.

The following Clause in terms of the National Water Act is applicable in this case:

It stipulates that, "An owner of land, a person in control of land or a person who occupies or uses the land on which (a) any activity or process is or was performed or undertaken; which causes, has caused or likely to cause pollution of a water resource, must take all reasonable measures to prevent any such pollution from occurring, continuing or recurring"

### **3. METHODOLOGY**

The site visit for the report was conducted during July 2020. During the site visit, the different biodiversity features, habitat, vegetation and landscape units present at the site were identified and mapped in the field. Walk-through-surveys were conducted, and all plant and animal species observed were recorded. Active searches for reptiles and amphibians were also conducted within habitats likely to harbor or be important for such species. The presence of sensitive habitats such as wetlands or pans and unique edaphic environments such as rocky outcrops or quartz patches were noted in the field if present and recorded on a GPS and mapped onto satellite imagery of the site.

### 3.1. FLORA

Satellite images were used to identify homogenous vegetation/habitat units within the proposed development area. These were then sampled on the ground with the aid of a GSP to navigate in order to characterise the species composition. The following quantitative data was collected:

- species composition,
- cover estimation of each species according to the Braun-Blanquet scale,
- vegetation height,
- amount of bare soil and rock cover,
- slope, aspect
- presence of biotic disturbances, e.g. grazing, animal burrows, etc.

Additional checklists of plant species were compiled by traversing a linear route and recording species as they were encountered. Searches for listed and protected plant species at the site were conducted and all listed plant species observed were recorded. This search was then repeated to update the information originally obtained.

### 3.2. FAUNA

The faunal study was undertaken as a desktop / literature survey combined with a field survey. The tasks included in each are given below.

#### Desktop/literature survey:

A desktop survey was undertaken to determine the red data reptile, amphibian, mammalian and bird species occurring in the quarter degree square in which the proposed mining areas falls. The likelihood of red data species occurring on-site has been determined using the i) distribution maps in the red data reference books and ii) a comparison of the habitat described from the field survey. This process was repeated for the updated report.

#### Field survey:

The habitats on-site were assessed to compare with habitat requirements of red data species determined during the literature survey. During the site visit the presence and identification of bird and mammal species was determined using the following methods / techniques:

- Identification by visual observation.
- Identification of bird and mammal calls.
- Identification of spoor.
- Identification of faeces.
- Presence of burrows and / or nests.

### 3.3. FRESHWATER ASSESSMENT

Under Section 1(1)(xxiv) of the National Water Act (Act No. 36 of 1998) (NWA), a 'watercourse' is defined as:

- a river or spring;
- a natural channel in which water flows regularly or intermittently;
- a wetland, lake or dam into which, or from which, water flows; and
- any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

This specialist study focused on the assessment of the Witeegte and the GaMorgara watercourses and their associated habitats/ecosystems likely to be measurably affected by the proposed development.

The desktop delineation of all surface water resources (i.e. rivers, streams and wetlands) within 500m of the proposed development (i.e. the DWS regulated area for Water Use in terms of Section 21 of the National Water Act) was undertaken by analysing available contour data and colour aerial photography, supplemented by Google Earth™ imagery where applicable. The risk posed by the development to freshwater ecosystems was screened at a desktop level. The field assessment included, a River condition/Present Ecological State (PES) and River Ecological Importance & Sensitivity (EIS) assessment, using Rapid Index of Habitat Integrity (IHI) tool for rivers (Kleynhans, 1996) and DWAF Riverine EIS tool (Kleynhans, 1999).

#### *Riparian areas delineation*

The location of drainage features and boundary of any riparian areas (also known as the riparian zone) was delineated according to the methods in the Department of Water Affairs wetland delineation manual 'A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas' (DWAF, 2005). Like wetlands, riparian areas have their own unique set of indicators required in order to delineate these features. In the absence of typical wetland features, riparian area indicators were used instead to identify and delineate the edge of riparian areas, in accordance with the DWAF delineation manual, which included:

- Alluvial soils and deposited material: this includes relatively recently deposited sand, mud, etc. deposited by flowing water that can be used to confirm the topographical and vegetation indicators.
- Channel morphology/topography associated with the watercourse: the outer edge of the macro-channel bank associated with a river/stream provides a rough indication of the outer edge of a riparian area.
- Vegetation composition & structure: unlike the delineation of wetland areas where hydromorphic soils are the primary indicator, the delineation of riparian areas relies

primarily on vegetation indicators. Using vegetation, the outer boundary of a riparian area must be adjacent to a watercourse and can be defined as the zone where a distinctive change occurs with respects to:

- Species composition relative to adjacent terrestrial areas; and
- Changes in the physical structure such as vigour or robustness of growth forms of species similar to that of adjacent terrestrial areas (growth form refers to the health, compactness, crowding, size, structure and numbers of individual plants).

Note that the sole reliance on one indicator can be misleading (e.g. many species of plants can successfully grow both in and out of wet areas) and a combination of all three indicators should therefore be used to provide for a logical, defensible (higher level of confidence) and technical basis for riparian area delineation

#### *Riverine Present Ecological State (PES) – Index of Habitat Integrity (IHI)*

Habitat is one of the most important factors that determine the health of river ecosystems since the availability and diversity of habitats (in-stream and riparian areas) are important determinants of the biota that are present in a river system (Kleynhans, 1996). The ‘habitat integrity’ of a river refers to the “maintenance of a balanced composition of physical-chemical and habitat characteristics on a temporal and spatial scale that are comparable to the characteristics of natural habitats of the region”

The evaluation of Habitat Integrity (HI) provides a measure of the degree to which a river has been modified from its natural state. The methodology (DWAF, 1999) involves a qualitative assessment of the number and severity of anthropogenic perturbations on a river and the damage they potentially inflict upon the system. These disturbances include both abiotic and biotic factors, which are regarded as the primary causes of degradation of a river. The severity of each impact is ranked using a six-point scale with 0 (no impact), 1 to 5 (small impact), 6 to 10 (moderate impact), 11 to 15 (large impact), 16 to 20 (serious impact) and 21 to 25 (critical impact).

The Habitat Integrity Assessment is based on assessment of the impacts of two components of the river, the riparian zone and the instream habitat. Assessments are made separately for both components, but data for the riparian zone are interpreted primarily in terms of the potential impact on the instream component. The estimated impact of each criterion is calculated as follows:

$$\text{Rating for the criterion} / \text{maximum value (25)} \times \text{weight (percent)}$$

The estimated impacts of all criteria calculated in this way are summed, expressed as a percentage and subtracted from 100 to arrive at an assessment of habitat integrity for the instream and riparian components respectively. The total scores for the instream and riparian zone components are then used to place the habitat integrity of both in a specific habitat category

Category	Description	Score
<b>A: Natural</b>	No discernible impact, or the modification is located in such a way that it has no impact on habitat quality, diversity, size and variability.	90-100
<b>B: Good</b>	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	80-89
<b>C: Fair</b>	Moderately modified. A loss and change of natural habitat and biota have occurred but the basic ecosystem functions are still predominantly unchanged.	60-79
<b>D: Poor</b>	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
<b>E: Seriously Modified</b>	The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
<b>F: Critically Modified</b>	Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In worst instances, basic ecosystem functions have been destroyed and changes are irreversible.	0-19

### *Riverine Ecological Importance and Sensitivity (EIS)*

The Ecological Importance and Sensitivity (EIS) of riparian areas is an expression of the importance of the aquatic resource for the maintenance of biological diversity and ecological functioning on local and wider scales; whilst Ecological Sensitivity (or fragility) refers to a system's ability to resist disturbance and its capability to recover from disturbance once it has occurred (Kleynhans & Louw, 2008). For the purposes of this assessment, the EIS assessment for riparian areas was based on rating the following criteria using the scheme in the table below:

- Riparian & in-stream biota: referring to the presence and status of biota (including fauna & flora). This includes aspects of species richness/diversity, the presence of rare/endangered species, unique species/endemics, species that are sensitive to changes in flows/water quality.
- Riparian & in-stream habitat: including the diversity of habitat types within the in-stream and riparian zones, the sensitivity of habitats to changes in flow/water quality and the importance of riparian areas as migration routes/ecological corridors as well as the conservation importance of areas.

Criteria	Rating Score				
	0-1	2	3	4	5
Presence of rare/endangered species	None	Low	Moderate	High	Very High
Populations of Unique Species					
Presence of species considered intolerant/sensitive to changes					
Diversity of habitat types	Very low	Low	Moderate	High	Very High
Importance in terms of migration routes/ecological corridors					
Presence of refugia/Refuge value of habitat types					
Sensitivity to Changes in the Natural Hydrological Regime					
Flood Storage, Energy Dissipation Particulate/Element Removal					
Conservation importance	None	Low	Moderate	High	Very High

The scores assigned to the criteria in the table above were used to rate the overall EIS of the sections within the area of the mining right, according to the table below, which was based on the criteria used by DWS for river eco-classification (Kleynhans & Louw, 2008) and the WET-Health wetland integrity assessment method (Macfarlane *et al.*, 2008).

EIS Score	EIS Rating	General Description
≤1	Very Low	Features are not ecologically important and sensitive at any scale. The biodiversity of these areas is typically ubiquitous with low sensitivity to anthropogenic disturbances and play an insignificant role in providing ecological services.
>1 <2	Low	Features regarded as somewhat ecologically important and sensitive at a local scale. The functioning and/or biodiversity features have a low-medium sensitivity to anthropogenic disturbances. They typically play a very small role in providing ecological services at the local scale.
>2 ≤3	Medium	Features that are considered to be ecologically important and sensitive at a local scale. The functioning and/or biodiversity of these features is not usually sensitive to anthropogenic disturbances. They typically play a small role in providing ecological services at the local scale.
>3 ≤4	High	Features that are considered to be ecologically important and sensitive at a regional scale. The functioning and/or biodiversity of these features are typically moderately sensitive to anthropogenic disturbances. They typically play an important role in providing ecological services at the local scale.
>4	Very High	Features that are considered ecologically important and sensitive on a national or even international level. The functioning and/or biodiversity of these features are usually very sensitive to anthropogenic disturbances. This includes areas that play a major role in providing goods and services at a local or regional level.

### 3.4. ASSESSMENT OF IMPACTS

#### Criteria used in the assessment of impacts

PART A: DEFINITION 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	VH	
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.						



## 4. DESCRIPTION OF THE AFFECTED ENVIRONMENT- BASELINE

### 4.1. BROAD-SCALE VEGETATION PATTERNS

The study area falls within the Kathu Bushveld (Mucina & Rutherford 2006). The Kathu Bushveld which is described as an open savannah with the Camel Thorn<sup>1</sup>, *Vachellia erioloba* (formerly known as *Acacia erioloba*) and Shepards Tree, *Boscia albitrunca* as the prominent trees. The shrub layer contains the Grey Camel Thorn, *Vachellia haematoxylon* (formerly known as *Acacia haematoxylon*) Black thorn *Senegalia mellifera*, (formerly known as *Acacia mellifera*) Blue bush, *Diospyros lycioides* and *Lycium hirsutum*. The grass layer is very variable.

### 4.2. PLANT COMMUNITY DESCRIPTION

The study area has been disturbed by the existing mine, with large areas that have already been cleared for the mining operation.

The site consists of a mixture of vegetation that displays various slight structural changes and dominance in woody vegetation. Distinct broad vegetation communities could be identified within the study area, these vegetation types are described in more detail below, and are presented on the map (Figure 4.1).

#### **VTU 1            *Vachellia haematoxylon* Savannah**

This community has a moderate grass cover (50-60%), the shrub layer is moderately developed. *Vachellia haematoxylon* is the dominant shrub species. The tree layer is poorly developed with individuals of *Vachellia erioloba* occurring within the community. Common grass species include, *Schmidtia pappophoroides* (dominant), *Eragrostis lehmanniana*, *Eragrostis micrantha*, *Stipagrostis uniplumis*, *Aristida adscension* and *Aristida vestita*. Other common species within this vegetation type included, *Acanthosicyos naudiniana*, *Tribulus zeyheri*, *Gnidia polycephala*, *Helichrysum argyrosphaerum* and *Monochema incanum*. Areas within this vegetation community have been overgrazed.

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<sup>1</sup> Unlike scientific names, common names are almost always different for speakers of different languages. They may also vary regionally within a language. Some floral species do not have recognized common names. The use of common names is therefore not generally used with respect to plant species.



**Plate 4.1:** *Vachellia haematoxylon* dominates the shrub layer within this vegetation type.

#### **VTU 2      *Senegalia mellifera* Mixed Woodland**

*Senegalia mellifera* (Black thorn) constitutes the dominant shrub species within this community. It is characterised by a moderate to high shrub density with a poor to moderate grass coverage (40–60%) in some areas the *Senegalia mellifera* forms dense thickets. Other common shrub and tree species within this vegetation community include *Grewia flava*, *Vachellia erioloba*, *Vachellia haematoxylon* and *Ziziphus mucronata*. Common grass species include *Eragrostis lehmanniana*, *Aristida congesta*, *Pogonarthria squarrosa*, *Eragrostis tricophora*, *Eragrostis echinochloidea*, *Aristida adscensionis*, *Schmidtia pappophoroides* and *Tragus racemosus*. Patches of this vegetation type have been over utilised and consequently karroid shrub vegetation has invaded. Stands of *Rhigosum trichotomum* dispersed between the moderate grass cover can be observed within this vegetation community. Other species include, *Salsola patentipilosa*, *Polygala leptophylla*, *Chysocomma ciliata* (Bitterkaroo) and *Melolobium candicans* (Honey Bush).



**Plate 4.2:** *Senegalia mellifera* constitutes the dominant shrub species within the *Senegalia mellifera* Mixed Woodland.

### **VTU 3                      *Vachellia erioloba* Savannah**

*Vachellia erioloba* is the most prominent woody component within this vegetation type, it occurs in patches throughout the study area. This vegetation is distinctive owing to the height of the tree layer, which forms a distinct canopy coverage, this vegetation type occurs in pockets within the study area. Three vegetation strata are evident within this vegetation unit. There is a prominent tree layer between 2.5m – 8m, a shrub layer, between 1.5m – 2.5m and a grass layer with an average height of 70cm. *Vachellia erioloba*, *V. hebeclada*, *Ziziphus muconata*, and *Grewia flava* are common within this vegetation unit. The grass layer was dominated by *Schmidtia kalihariensis*, however species such as *Eragrostis lehmanniana*, *Stipagrostis uniplumis*, *Aristida stipitata* and *Aristida congesta* were common. Other common species included *Tribulus zeyheri*, *Acanthosicyos naudiniana* and *Helichrysum* spp



**Plate 4.3:** *Vachellia erioloba* is the most prominent woody component within this vegetation type

#### **VTU 4 Riverine Vegetation**

This vegetation type is found within the Ga-Mogara and Witleegte non-perennial streams in the area. It consists of a grassy layer with scattered trees and shrubs. The soil has a higher clay content within these areas (loamy sand) and is lighter in colour. These areas have a higher moisture content and are therefore generally heavily utilised. Species such as *Schmidtia kalihariensis*, *Enneapogon cenchroides*, *Aristida stipitata*, *Cynodon dactylon*, *Cyperus margaritaceus* and *Eustachys paspaloides* were noted within this vegetation type. *Prosopis glandulosa*, *Vachellia karroo*, *Ziziphus mucronata*, *Senegalia mellifera* and *Vachellia erioloba* dominate the woody component. The heavy utilisation has resulted in the dense invasion of *Prosopis glandulosa* (a declared invader) in large sections of this vegetation type resulting in a disturbance to this community. This community is discussed in more detail in section 4.6. below.





**Plate 4.4:** The non-perennial water course within the study area. Some sections have been over utilised resulting in the invasion of *Prosopis glandulosa*

**VTU 5      *Tarchonanthus camphoratus* – *Vachellia karroo* Scrub**

This vegetation type occurs on the well drained shallow stony soils which are underlain by calcrete. This community is characteristically short with *Vachellia karroo* and *Tarchonanthus camphoratus* dominating the shrub stratum, *Lycium hirsutum* and *Senegalia mellifera* are also present within this community. Dwarf karroid shrubs are prominent within the community and consist of species such as *Pteronia glauca*, *Pentzia calcarea*, and *Chrysocoma ciliata*.



**Plate 4.5:** This community is characteristically short and occurs on the well drained shallow stony soils

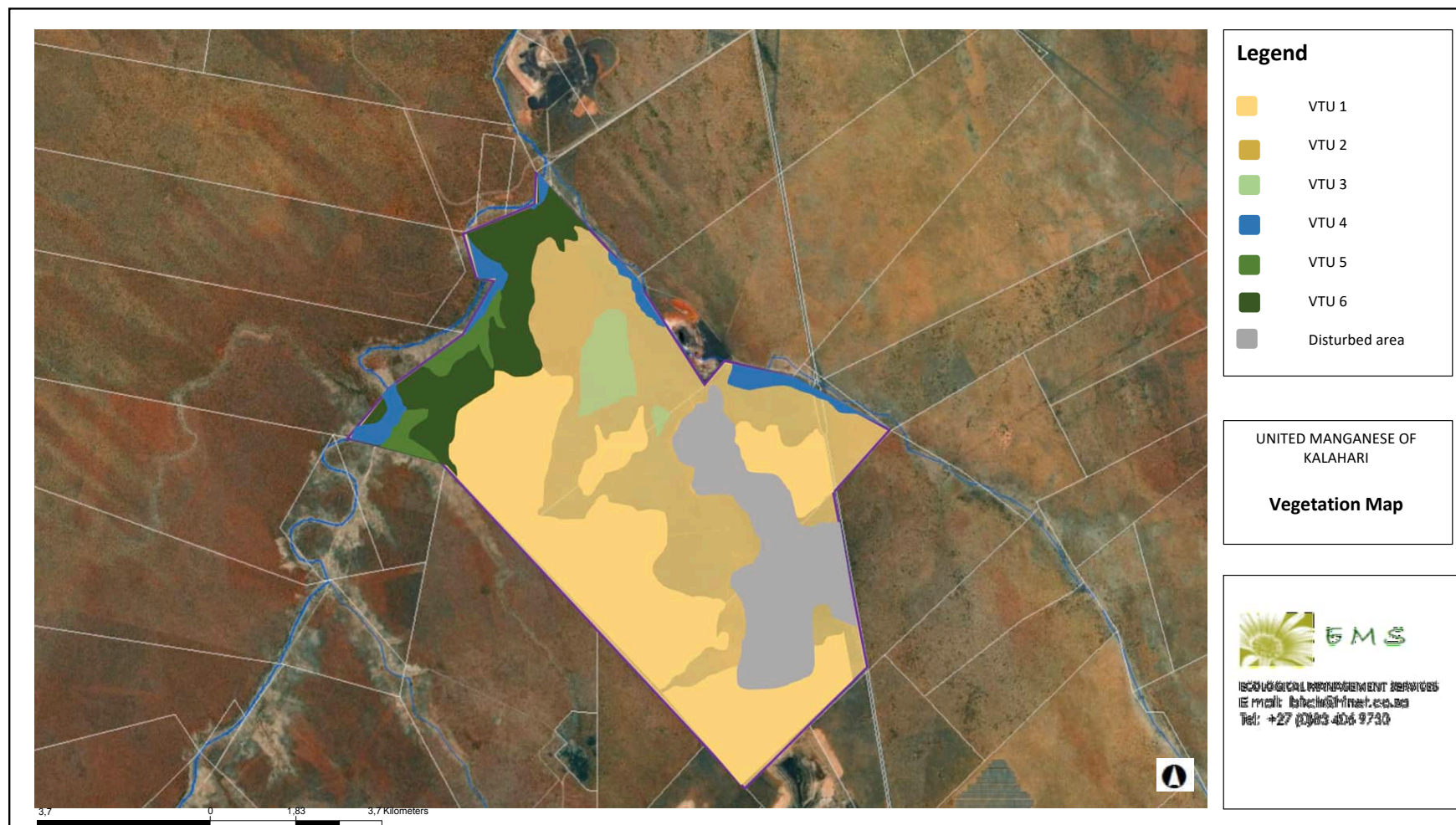
**VTU 6      *Tarchonanthus camphoratus* – *Schmidtia pappophoroides* Scrub**

This vegetation type is characterised by a high percentage occurrence of *Tarchonanthus camphoratus*. Although *T. camphoratus* is the dominant shrub, species such as *Grewia flava*, *Vachellia karroo*, *Vachellia erioloba* and *Olea europaea* are also found within this vegetation type. The grass layer is very patchy, but in some areas it is moderately well developed. Species such as, *Schmidtia pappophoroides*, *Eragrostis lehmanniana*, *Pogonarthria squarrosa*, *Aristida meridionalis* and *Aristida congesta* were common.



**Plate 4.6:** Although *T. camphoratus* is the dominant shrub, species such as *Grewia flava*, *Vachellia karroo*, *Vachellia erioloba* and *Olea europaea* are also found within this vegetation type.





**Figure 4.1:** Vegetation type unit distribution in and around the proposed mining footprint.

**Table 4.1:** Protected species that possibly occur on site.

Species	Legislation	Conservation status	Potential of occurrence on site
<i>Vachellia erioloba</i>	National Forests Act 1998	Protected	Recorded on site
<i>Vachellia haematoxylon</i>	National Forests Act 1998	Protected	Recorded on site
<i>Moraea longistyla</i>	NCNCA	Schedule 2	Not recorded during field survey, <b>Low</b> potential of occurrence
<i>Moraea pallida</i>	NCNCA	Schedule 2	Not recorded during field survey, <b>High</b> potential of occurrence
<i>Babiana hypogaea</i>	NCNCA	Schedule 2	Not recorded during field survey, <b>Moderate</b> potential of occurrence
<i>Harpagophytum procumbens</i> Devil's claw	NCNCA	Schedule 1	Not recorded during field survey, <b>High</b> potential of occurrence
<i>Boophone disticha</i>	NCNCA	Schedule 2	Not recorded during field survey, <b>High</b> potential of occurrence
<i>Brunsvigia radula</i>	NCNCA	Schedule 2	Not recorded during field survey, <b>Low</b> potential of occurrence
<i>Orthanthera jasminiflora</i>	NCNCA	Schedule 2	Not recorded during field survey, <b>Low</b> potential of occurrence
<i>Boscia albitrunca</i>	NCNCA	Schedule 2	Recorded on site
<i>Crassula captella</i>	NCNCA	Schedule 2	Not recorded during field survey, <b>Low</b> potential of occurrence
<i>Kalanchoe brachyloba</i>	NCNCA	Schedule 2	Not recorded during field survey, <b>Moderate</b> potential of occurrence
<i>Ruschia griquensis</i>	NCNCA	Schedule 2	Not recorded during field survey, <b>Moderate</b> potential of occurrence
<i>Olea europaea</i>	NCNCA	Schedule 2	Recorded on site
<i>Oxalis haedulipes</i>	NCNCA	Schedule 2	Not recorded during field survey, <b>Low</b> potential of occurrence

Owing to the narrow temporal window of sampling some species may not have been recorded, this however does not preclude them from occurring within the development site. Species that could possibly occur have been included in the species checklist. It is therefore recommended that prior to clearing an additional walk through is conducted. In order to remove species listed in Schedule 1 & 2 of the NCNCA, during site clearing activities an integrated permit application will have to be made to the DAERL to obtain the required permission to remove and/or translocate these species from site. In order to remove the protected trees a license application will have to be made to the Forestry section of the Department of Forestry, Fisheries and the Environment (DFFE)

#### 4.3. CRITICAL BIODIVERSITY AREAS & BROAD-SCALE PROCESSES

Kathu bushveld is classified as least threatened (target 16%), however this vegetation type is not conserved in any statutory conservation areas and more than 1% has already been transformed, threats are from mining and to a lesser extent heavy grazing pressure.

The study area falls within the Griqualand West Centre of Endemism (GWC) (Van Wyk & Smith, 2001). A centre of plant endemism is an area with high concentrations of plant species with very





Ecosystem Priority Area (NFEPA). The study area does not fall within a critical biodiversity area as identified in the Northern Cape Critical Biodiversity Areas project 2016. The Ga-Mogara river which runs along the north western boundary and the Witleegte water course on the north eastern boundary of the mine area falls within an ecological support area (ESA) (appendix 2). An ESA is an area that must retain its ecological processes. A biodiversity sector plan or bioregional plan should provide land-use guidelines for ESAs, generally CBA land-use guidelines propose no mining within ESAs.

The proposed mining area does not fall within a River FEPA (Fresh Water Ecosystem Priority Area) but is located in an Upstream Management Area (see Appendix 2 for map). Upstream Management Areas are sub- quaternary catchments in which human activities need to be managed to prevent degradation of downstream river FEPAs. There are no identified NFEPA wetlands within the study area.

The study site and surrounding area does not fall within an Important Bird and Biodiversity Area (IBA). IBAs are sites of international significance for the conservation of the world's birds and other biodiversity.

#### **4.4. ALIEN/INVASIVE SPECIES**

The Conservation of Agricultural Resources Act (CARA) regulates and restricts the propagation, harbouring and sale of invasive alien plant and weed species listed in a set of Regulations published in terms of the Act. CARA was amended in 2001 and is administered by the National Department of Agriculture.

The National Environmental Management: Biodiversity Act (NEMBA – Act no. 10 of 2004) regulates all invasive organisms in South Africa, including a wide range of fauna and flora. All listed IAPs are divided into four categories in accordance with the Government Gazette Notice No. 40166 of July 2016 as listed below:

- **Category 1a (PROHIBITED): Listed Invasive Species**

A person in control of a Category 1a Listed Invasive Species must comply with the provisions of section 73(2) of the Act; immediately take steps to combat or eradicate listed invasive species in compliance with sections 75(1), (2) and (3) of the Act; and allow an authorised official from the Department to enter onto land to monitor, assist with or implement the combatting or eradication of the listed invasive species.

- **Category 1b (PROHIBITED / Exempted if in Possession or Under control): Listed Invasive Species**

A person in control of a Category 1 b Listed Invasive Species must control the listed invasive species in compliance with sections 75(1), (2) and (3) of the Act. A person contemplated in sub-regulation (2) must allow an authorised official from the Department to enter onto the land to monitor, assist with or implement the control of the listed invasive species, or compliance with the Invasive Species Management Programme contemplated in section 75(4) of the Act.

- **Category 2 (PERMIT REQUIRED): Listed Invasive Species**

Category 2 Listed Invasive Species are those species listed by notice in terms of section 70(1)(a) of the Act as species which require a permit to carry out a restricted activity within an area specified in the Notice or an area specified in the permit, as the case may be. A landowner on whose land a Category 2 Listed Invasive Species occurs or person in possession of a permit, must ensure that the specimens of the species do not spread outside of the land or the area specified in the Notice or permit. Unless otherwise specified in the Notice, any species listed as a Category 2 Listed Invasive Species that occurs outside the specified area contemplated in sub-regulation (1), must, for purposes of these regulations, be considered to be a Category 1 b Listed Invasive Species and must be managed according to Regulation 3. Notwithstanding the specific exemptions relating to existing plantations in respect of Listed Invasive Plant Species published in Government Gazette No. 37886, Notice 599 of 1 August 2014 (as amended), any person or organ of state must ensure that the specimens of such Listed Invasive Plant Species do not spread outside of the land over which they have control.

- **Category 3 (PROHIBITED): Listed Invasive Species**

Category 3 Listed Invasive Species are species that are listed by notice in terms of section 70(1)(a) of the Act, as species which are subject to exemptions in terms of section 71(3) and prohibitions in terms of section 71A of the Act, as specified in the Notice. Any plant species identified as a Category 3 Listed Invasive Species that occurs in riparian areas, must, for the purposes of these regulations, be considered to be a Category 1b Listed Invasive Species and must be managed according to regulation 3.

Species		Category
<i>Argemone mexicana</i>	Yellow flowered Mexican Poppy	1b
<i>Atriplex nummularia</i>	Old Man Salt Bush	2
<i>Pennisetum setaceum</i>	Fountain Grass	1b
<i>Prosopis cf. glandulosa</i>	Mesquite	3
<i>Opuntia humifusa</i>	Prickly pear	1b
<i>Xanthium spinosum</i>	Spiny cocklebur	1b
<i>Argemone ochroleuca</i>	White flowered Mexican poppy	1b

**Table 4.3:** Alien invasive species that occur in and around the property

#### 4.5. POPULATIONS OF SENSITIVE AND/OR THREATENED FAUNAL SPECIES

A large section of this property has already been disturbed by the mining activity which has resulted in some disturbance to the faunal population on site. Disturbances that alter the natural environment have two effects namely, it may cause the loss of certain species due to the destruction of habitat. It may also cause the influx of other species previously unable to colonise an area owing to lack of suitable habitat or because they have been excluded through competition.

It was not possible to compile a complete list of species present on the property during the field survey owing to the limited time frame of the assessment. It is therefore important to note that many species that potentially occur on-site may not have been identified thus emphasis was placed on the habitat in order to determine potential occurrence of species. The potential of occurrence is also assessed for the immediate surrounding area as to establish the possibility of ecological linking corridors for certain species.

Based on the bird species identified while on-site, the proposed development site hosts both grassland and bushveld bird species.

The loose sandy soils which occurs over a large portion of the study site, makes these areas suitable for burrowing mammals. Species such as, Suricate, Common Mole rat, and ground squirrels were observed on site. During the site visit a fairly large group of Kudu were observed. Other than direct sightings, other observations such as droppings and tracks from animals such as warthog were noted and, the tell-tale signs of porcupine was also observed.



**Plate 4.7:** Water pipe that has been chewed through by a Porcupine, scats and tracks noted in area.

#### **Reptiles Species of Conservation Concern**

No critically endangered, endangered, vulnerable, near threatened, critically rare, rare or declining terrapin, tortoises, snakes or lizards were identified as occurring in the quarter degree square 2722BD, based on the distribution maps available in the South African Red Data Book for reptiles (Bates *et. al.* 2014) and The Southern African Reptile Conservation Assessment (SARCA). The conservation status was cross checked on the IUCN website to determine most recent status listing for these species.

#### **Amphibians of Conservation Concern**

No critically endangered, endangered, vulnerable, near threatened, critically rare, rare or declining amphibians were identified as occurring in the quarter degree squares 2722BD, based on the distribution maps available in the South African Red Data Book for amphibians (Minter *et al.*, 2004) Du Preez and Carruthers (2009) and the South African Frog Atlas project.

### Birds of Conservation Concern

A list of all birds of conservation concern occurring in the quarter degree square 2722BD, was extracted from the SABAP 1 and SABAP 2 databases and Birdlife South Africa's Important Bird Areas and from the Red Data Book of Birds (Taylor *et al* 2015) with the distribution being confirmed in Roberts – Birds of Southern Africa, 7<sup>th</sup> edition (Hockey *et al.*, 2005). The IUCN 3.1. status is also presented in the table. Based on an evaluation of the habitat requirements for these red data species, the potential of these species occurring either on-site or within 500m of the property boundary is provided in Table 4.4 below.

Common Name	Scientific Name	Conservation Status (*Regional, Global)	Suitable Habitat requirements <sup>2</sup>	Potential for Occurrence On-site and surrounding area
Martial Eagle	<i>Polemaetus bellicosus</i>	Endangered, Endangered	Woodland, savannah or grassland with clumps of large trees or power pylons for nest sites	<b>High</b> – Nesting habitat in the Mixed Savannah
Secretary bird	<i>Sagittarius serpentarius</i>	Vulnerable, Endangered	Requires open grassland with scattered trees, shrubland, open Mixed Savannah.	<b>High</b> – Patches of open savannah will accommodate this species.
Ludwig's Bustard	<i>Neotis ludwigii</i>	Endangered, Endangered	Requires semi-arid dwarf shrublands, occasionally visiting the southern Kalahari	<b>Medium</b> – Moderate to high shrub density throughout the sit

**Table 4.4:** Bird species of conservation concern identified as occurring in and around the quarter degree squares and the potential for occurrence on the site.

### Mammals of Conservation Concern

A list of all mammal species of conservation concern occurring in the quarter degree squares 2722BD, was extrapolated from the Red Data Book for Mammals (EWT, 2004) and the MammalMAP, the Mammal Atlas of Africa database. Based on an evaluation of the habitat requirements for these red data species (EWT, 2004; Skinner and Chimimba, 2005), the potential of these species occurring either on-site or within 500m of the property boundary is provided in Table 4.5 below.

COMMON NAME	SCIENTIFIC NAME	CONSERVATION STATUS <sup>3</sup>	SUITABLE HABITAT ON-SITE <sup>4</sup>	POTENTIAL FOR OCCURRENCE ON-SITE AND SURROUNDING AREA
Dent's Horseshoe Bat	<i>Rhinolophus denti</i>	Near threatened	<b>Limited</b> – Requires <i>substantial</i> cover such as caves and rock crevices.	<b>Very little</b> – Roosting habitat in the form of rock crevices may be available in the old mining area adjacent to the site. However, as the landscape in the area is flat sand

<sup>2</sup> Habitat requirements determined using the following reference material: Harrison *et al.*, 1997a; Harrison *et al.*, 1997b; ; Hockey *et al.*, 2005

<sup>3</sup> Status based on listing in the National Red List of Mammals 2016

<sup>4</sup> Habitat requirements determined using the following reference material: Skinner and Smithers, 1990; EWT, 2004; Skinner and Chimimba, 2005

COMMON NAME	SCIENTIFIC NAME	CONSERVATION STATUS <sup>3</sup>	SUITABLE HABITAT ON-SITE <sup>4</sup>	POTENTIAL FOR OCCURRENCE ON-SITE AND SURROUNDING AREA
				veld and does not offer suitable roosting habitat for this species, it is unlikely that this species would have colonised the adjacent mining areas.
Honey badger	<i>Mellivora capensis</i>	Least Concern (Protected TOPS)	<b>High</b> – As they are catholic in habitat requirements, they are likely to occur on-site.	<b>High</b> – Suitable habitat within the study area.
South African Hedgehog	<i>Atelerix frontalis</i>	Near threatened (Protected TOPS)	<b>High</b> – Require ample groundcover and dry places for nesting.	<b>High to Medium</b> – Suitable habitat available.

**Table 4.5:** Mammal species of conservation concern identified as occurring in and around the quarter degree squares and the potential for occurrence on the site.

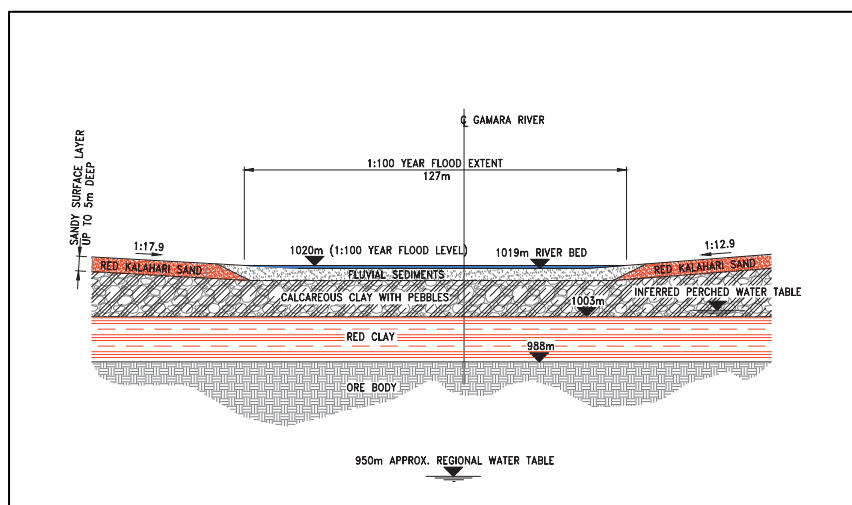
#### 4.6. FRESHWATER FEATURES

Two water courses namely the Ga-Morgara and Witleegte occur in and around the mining right area which falls within the Quaternary catchment D41K. The mining right area does not fall within a National Freshwater Ecosystem Priority Area (NFEPA) or a fish support area but does form part of an Upstream Management Area for the Molopo River. Upstream Management Areas, are sub-quaternary catchments in which human activities need to be managed to prevent degradation of downstream river FEPAs. These two water courses are ephemeral systems, which only have water flow following intense rainfall events but it is generally short lived. The Ga-Mogara River, only flowing with a reoccurrence interval of around 13 years on average (local farmers have indicated flow episodes as only 3 times during the past 46 years, namely during the years 1974, 1976 and 1988).

The soils within the Ga-Mogara River and Witleegte consist of fine materials, with low moisture contents. The soil chemistry of soil in the Gamogara River has a clayey-sand texture consisting of 18 to 24% clay particles and 72 to 80% sand particles. This slows down the water infiltration rate resulting in higher organic carbon content in the topsoil layer (2.70%) as compared to the surrounding area. As a result of slow, vertical soil-water movement in the riverbed soil profiles, cations of magnesium, calcium and potassium becomes mobile and accumulates in soil surface horizons, especially with the high evaporation rate experienced on the project site. Cations levels are extremely high (Mg at 223 mg/kg; Ca at 3663 mg/kg and K at 194mg/kg) (TerraAfrica 2015).

A perched water table has been identified on the Ga-Mogara at least 15 m beneath the river bed, the depth of which indicates that the river loses surface water flow to ground water as opposed to gaining water from a shallow water table. As there is no shallow water table beneath the river bed, as well as a very flat river bed it can be deduced that there is no significant subsurface flow in the river for the Ga-Mogara and by assumption for the Witleegte.

The Ga-Mogara and Witleegte Rivers consists of two zones, the river bed and the riparian zone<sup>5</sup>. Riparian zones can be distinguished from adjacent terrestrial areas through their association with the physical structure (banks) of the river or stream, as well as the distinctive structural changes between the riparian and upland terrestrial areas. The dense grass cover in the river bed clearly stands out from the surrounding vegetation where shrubs and trees predominate. This can be explained by both the change in the substrate that makes up the river bed and the advantage grass has in accessing shallow soil moisture over shrubs and trees which are better at accessing deeper water sources. Sections of the river bed of both water courses are however extensively invaded by *Prosopis glandulosa*, in some areas forming a dense impenetrable thicket. Only small sections of both water courses actually travers the mining right area.



**Figure 4.3:** Conceptual geological section through the Ga-Mogara River

<sup>5</sup> Riparian zones are described as “the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent areas”. South African National Water Act; Act 36 of 1998





**Plate 4.8:** The distinction between the flat grassy river bed and the sloping banks of the riparian zone is easily observable in this photo of the Ga-Mogara River.



**Plate 4.9:** The distinction between the bank containing the riparian vegetation (background) and the river channel (foreground) is not always very distinct, as is evident in this photo of a section of the Witleegte



**Plate 4.10:** The riparian zone typically has species such as *Ziziphus mucronata* and *Vachellia erioloba* within the shrub and tree layer

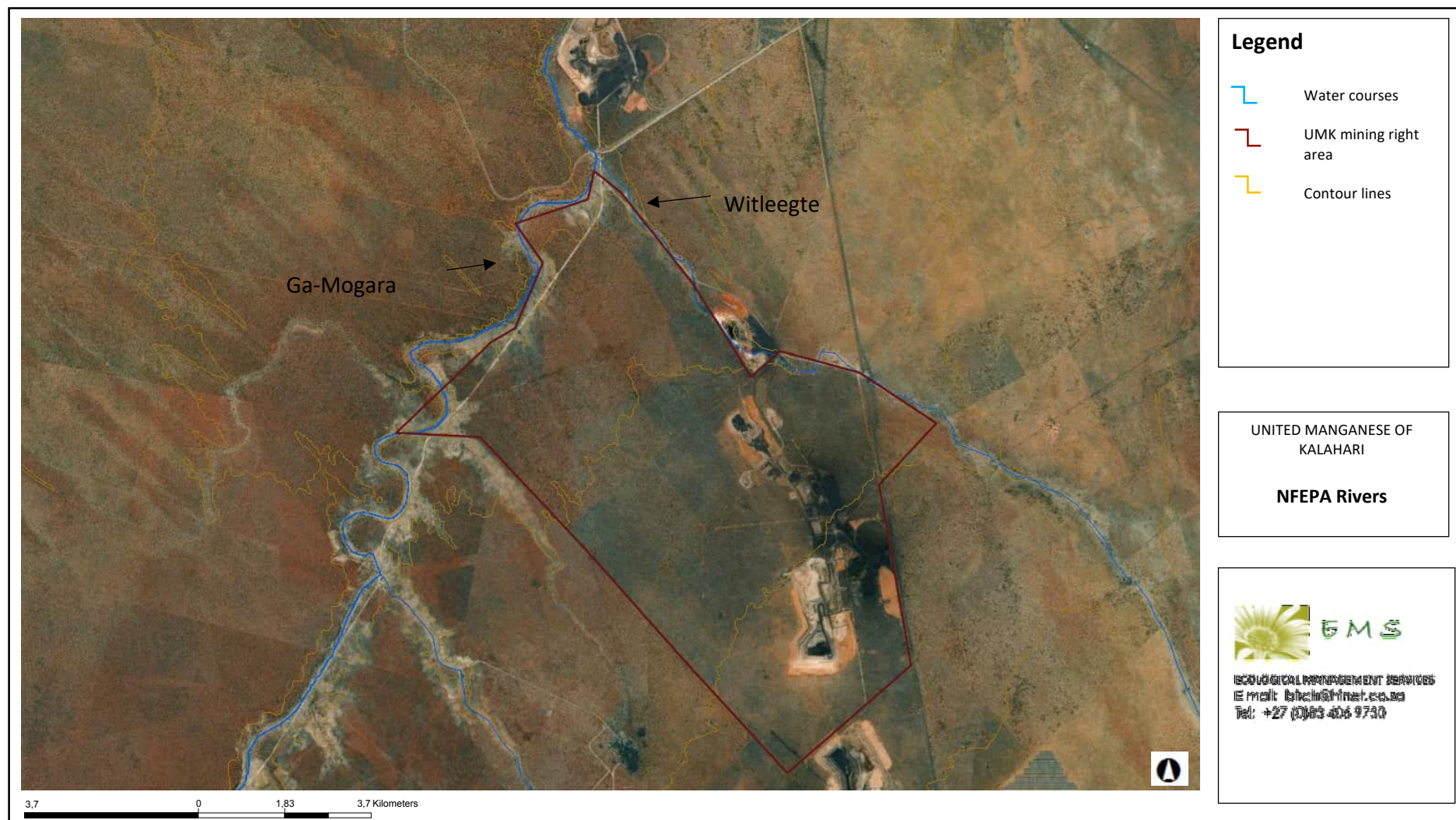


**Plate 4.11:** The dense grassy layer in areas of the river bed.



**Plate 4.12:** Section of river bed that has been invade by *Prosopis glandulosa*





**Figure 4.4:** The Water Courses found in and around the UMK proposed mining footprint

Owing to the very sporadic flow of water in the water channel none of the vegetation species that are listed as obligate wetland species are present within the river bed. According to the National Water Act classification system for wetlands, no wetlands based on plant species present are present.

### ***Present Ecological State (PES)***

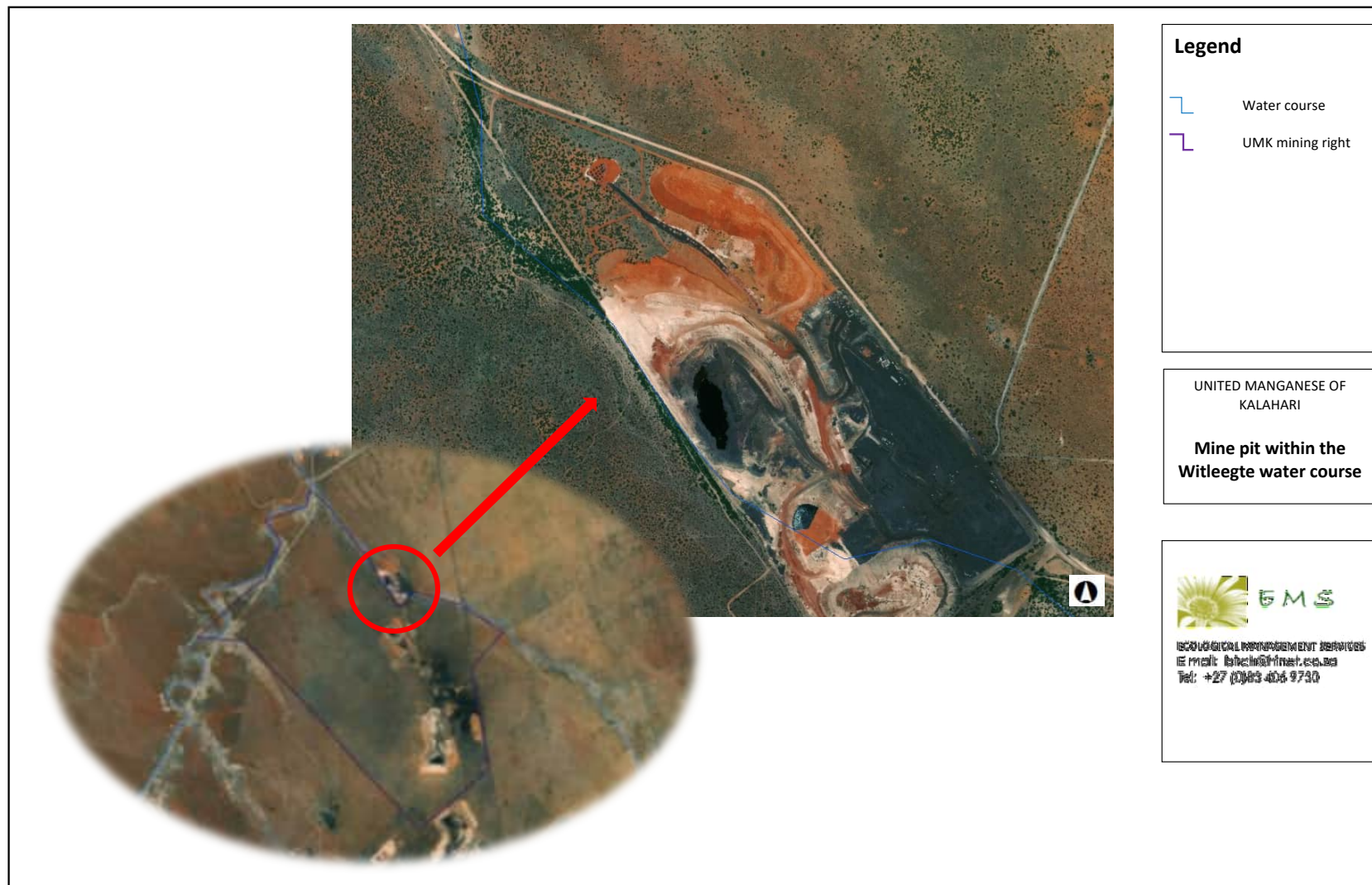
The results of the PES assessment that was completed for the potentially affected rivers are presented in Table 4.6. This rapid assessment was conducted following the Habitat Integrity assessment method for river ecosystems described in section 3. The overall results were that the Ga-Mogara is in a fair ecological condition, with a PES Category of C (“Moderately modified.”) for both the instream and riparian components of the river systems, however the Witleegte is in a poor condition with a PES Category of D (“Largely Modified”), as a large section of the water course in the area has been completely interrupted by the Sebilo Resources mining pit located on the boundary of the UMK MRA.

Criteria	Ga-Mogara	Witleegte	Criteria	Ga-Mogara	Witleegte
Water Abstraction	6	5	Vegetation Removal	6	12
Flow Modification	6	22	Exotic Vegetation	15	20
Bed Modification	10	22	Bank erosion	5	5
Channel Modification	8	22	Channel Modification	15	22
Water Quality	3	3	Water abstraction	2	2
Inundation	6	6	Inundation	4	3
Exotic Macrophytes	0	0	Flow Modification	2	22
Exotic Fauna	0	0	Water quality	3	3
Solid waste disposal	6	5			
INSTREAM HI Score	78	57	RIPARIAN ZONE HI Score	74	56
PES Class	<b>C</b>	<b>D</b>	PES Class	<b>C</b>	<b>D</b>

**Table 4.6:** Results for the Habitat Integrity assessment

### ***Riverine Ecological Importance and Sensitivity (EIS)***

EIS considers a number of biotic and habitat determinants surmised to indicate either importance or sensitivity. The ecological importance of a river is an expression of its importance to the maintenance of biological diversity and ecological functioning on local and wider scales while ecological sensitivity (or fragility) refers to a system’s ability to resist disturbance and its capability to recover from disturbance once it has occurred. The results of the EIS assessment are provided in Table 4.7.



**Figure 4.5:** The location of the Sebilo Resources mining pit within the Witleegte River Course, on the boundary of the UMK MRA.



Criteria	Score	
	Ga-Mogara	Witleegte
Presence of rare/endangered species	1	1
Populations of Unique Species	0	0
Presence of species considered intolerant/sensitive to changes	2	2
Diversity of habitat types	2	2
Importance in terms of migration routes/ecological corridors	2	2
Presence of refugia/Refuge value of habitat types	0	0
Sensitivity to Changes in the Natural Hydrological Regime	1	1
Flood Storage, Energy Dissipation Particulate/Element Removal &	3	2
Conservation importance	3	2
EIS score	1.5	1.3
EIS category	low	low

**Table 4.7:** Results of the EIS assessment for the affected watercourses

Both the Ga-Mogara and the Witleegte had a low EIS score. A low value is given when water courses are regarded as somewhat ecologically important and sensitive at a local scale. The functioning and/or biodiversity features have a low-medium sensitivity to anthropogenic disturbances. They typically play a small role in providing ecological services at the local scale.

### **Buffer zones**

A buffer zone is typically an area of vegetated, un-developed land surrounding a resource that is maintained to protect, support and screen flora and fauna associated with a resource from the disturbances associated with neighbouring land uses and / or a proposed development (i.e. 'edge effects'). As freshwater resources (including riparian habitats) are regarded as inherently ecologically sensitive habitat units, the designation of conservation buffers allows for the protection of these habitat units that could potentially emanate from terrestrial-based anthropogenic activities. Buffer zones are therefore, typically required to protect and minimise the edge impacts to the identified freshwater resources.

A national protocol for buffer zone determination around rivers, wetlands and estuaries (Macfarlane et al., 2014) has been developed and represents emerging best-practice in aquatic buffer zone determination, this methodology was used in the delineation of an appropriate buffer zone for the riparian habitat in the mining right area. Buffers zones are informed by the outcomes of the aquatic ecosystems PES (Present Ecological State) and EIS (Ecological Importance & Sensitivity) and the outcome of this assessment showed that a 15m buffer zone around the riparian vegetation would adequately protect the riparian area from edge effects for most of the water course area that runs through the mining right site.



**Figure 4.6:** Map showing the buffer zone delineation around the water course area within the mining right site

## 5. SITE SENSITIVITY & ADDITIONAL LOSS OF BIODIVERSITY

The classification of areas into different sensitivity classes is based on information collected at various levels. This includes the national conservation status of the vegetation, the presence of species of special concern and the condition of the vegetation

Vegetation types can be categorised according to their conservation status, which is in turn, assessed according to the degree of the transformation relative to the expected extent of each vegetation type. The status of a habitat or vegetation type is based on how much of its original area still remains intact relative to various thresholds. The original extent of a vegetation type is as presented in the national vegetation map (Mucina & Rutherford 2006) and is the extent of the vegetation type in the absence of any historical human impact. On a national scale the thresholds are as depicted in Table 5.1 as determined by best available scientific approaches.

**Table 5.1:** Determining ecosystem status (from Driver *et al* 2005).

habitat remaining (%)	80-100	Least Threatened	LT
	60-80	Vulnerable	VU
	*BT -60	Endangered	EN
	0-*BT	Critically endangered	CR

\*BT = biodiversity target (minimum conservation required)

The level at which an ecosystem becomes Critically Endangered differs from one ecosystem to another and varies from 16% to 36% (Driver *et al* 2005).

Updated transformation information is often required to improve the conservation assessment. For any given vegetation type. Although it is listed that 1% of Kathu Bushveld has been transformed (this figure is probably higher given the threats from mining) and this vegetation type is not statutorily conserved however it is classified as Least Threatened.

On a local scale the various habitat types or vegetation communities may have varying degrees of sensitivity or conservation value owing to their particular species composition or habitat structure.

Sensitivity of habitats are assessed using a combination of criteria as follows:



	Criterion	Definition
1	Conservation status of untransformed habitats occurring in the study area	The extent of each vegetation type occurring within the study area that is conserved and/or transformed relative to a targeted amount required for conservation
2	Presence and number of Red Data species and other species of special concern	Presence or potential presence of Red Data species within habitats
3	Within-habitat species richness of flora and the between-habitat (beta) diversity of the site	Presence or potential presence of Red Data Species within habitats.
4	The type or nature of topography of the site, ie presence of ridges koppies etc	Steepness and/or nature of topography in the study area.
5	The type and nature of important ecological processes on site, especially hydrological processes, ie wetlands drainage lines etc.	Habitats and/or terrain features that represent ecological processes such as water-flow migration routes etc.

The first two of these criteria are the most commonly used criteria for assessing the conservation value of a site and also constitute the criterion most commonly employed to justify the conservation of a site.

In order to advise the impact assessment and the proposed mitigation, a sensitivity map has been generated for the property using a number of criteria. In order to quantify and detail the sensitive areas in terms of the criteria used to assess sensitivity, the site was demarcated into a number of manageable blocks. A table was created to list each of the sensitivity criteria and a value assigned to each criteria. Each block was then assessed in terms of its relative sensitivity value. This produced a quantifiable sensitivity map. The criteria used to assess the sensitivity included;

Current state of degradation	1 = (80-100% degraded), Very degraded, highly transformed 2 = (60 -79% degraded), moderately transformed 3 = (40 - 59%) degraded, some transformation 4 = (20 -39% degraded, slightly transformed 5 = (0-19%) degraded Good condition
Slope & drainage	1 = Flat 2 = Gently undulating 3 = Slight slope 4 = Slope less than 5° 5 = Slope 5° or greater
Potential for erosion	1= Low

	2 = Medium
	3 = High
Presence of Red Data Species	0 = No
	1 = Yes
Suitable habitat for RD species	0 = No
	1 = Yes
Potential habitat fragmentation	1 = Low
	2 = Low – moderate
	3 = Moderate
	4 = Moderate - high
	5 = High
Importance to biodiversity& Ecosystem Functioning	1 = Low
	2 = Low – moderate
	3 = Moderate
	4 = Moderate - high
	5 = High

Areas have been classified as follows:

- **Low (0-9)** sensitivity areas are already highly transformed and/or already contain development. Any development in these areas will not have a significant environmental impact.
- **Medium (10-15)** sensitivity areas: The vegetation and habitats in these areas have had some degree of disturbance and may include some potential habitat for red data species and/or limited protected species. Development in these areas, would not have a severe environmental impact but the effects should be easily mitigated.
- **Medium- High (16-20)** sensitivity areas included natural areas of either confirmed occurrence of numerous protected species or ideal red data species habitat. Development in these areas, would have a significant environmental impact thus would be subject to strict guidelines and mitigation measures.
- **High (21-25)** sensitivity areas included areas that contain critically endangered, endangered, vulnerable, near threatened, critically rare, rare or declining species, critical habitat, important ecosystem processes or the presence of CBAs. Any development in these areas would have a significant environmental impact. No development should ideally take place in these areas, but it is recognised that in certain exceptional cases, development may need to take place. Under these conditions very strict development guidelines would be required, and only under guarantee that similar areas would be conserved thus reducing the risk of development.

Only a portion of the site is designated to the mining operation. The remainder of the property will be left in its natural state. Thus only a portion of the property will be directly affected by the mining, the remainder of the property could be indirectly subjected to the impacts of mining.

Figure 5.1 shows the overlay of the areas of sensitivity with that of the planned expansion of the mining infrastructure and operation.

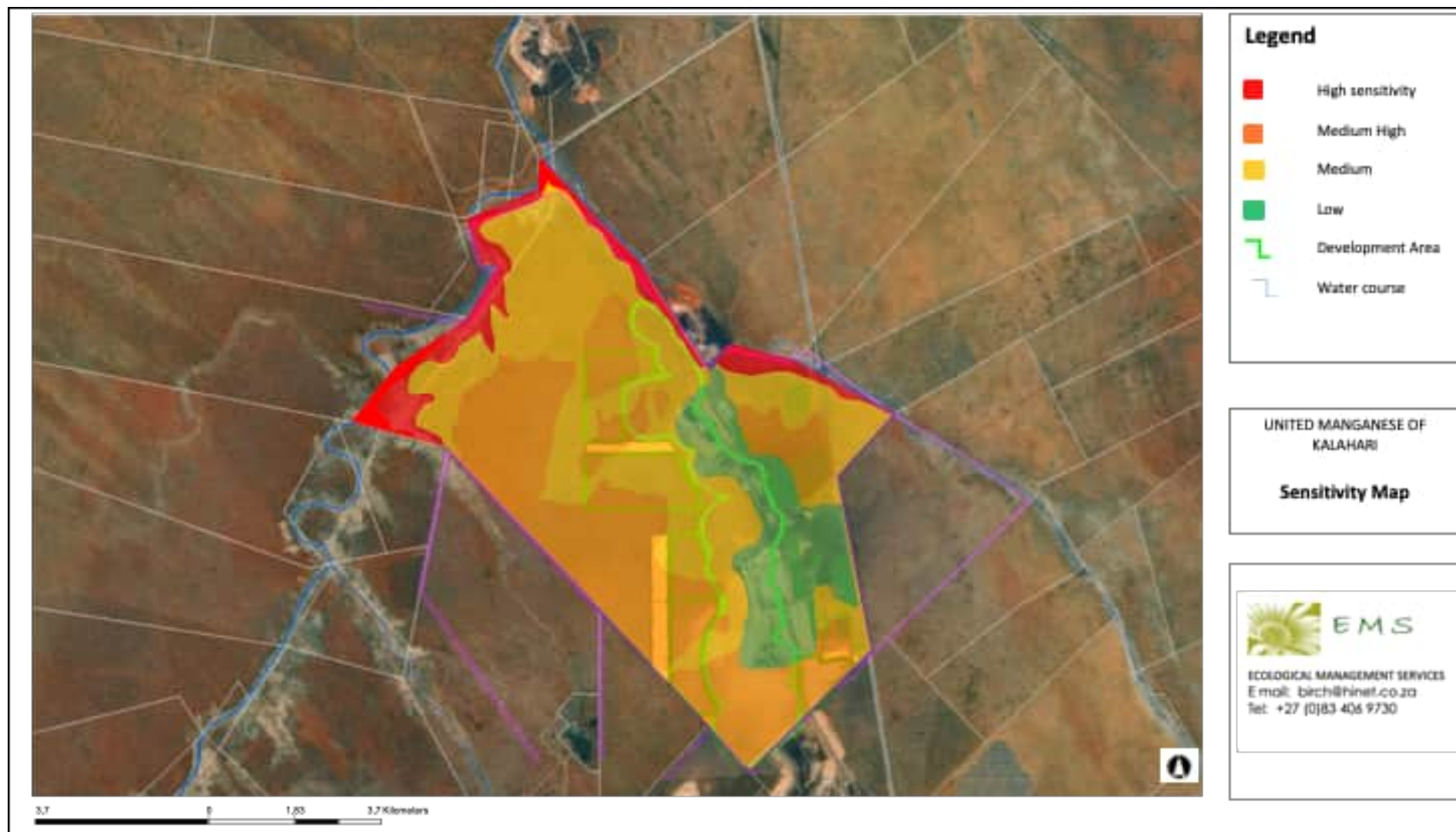
Areas of LOW sensitivity areas are already highly transformed and/or already contain development.

The areas that have a Medium-high sensitivity rating are the areas that fall within the *Vachellia haematoxylon* Savannah and the *Vachellia erioloba* Savannah. This is attributed to the presence of the large number of protected trees species that occur within them.

*Vachellia haematoxylon* is classified as a protected species under the National Forests Act of 1998 (Act 84 of 1998), and has a narrow distribution range. The *V. haematoxylon* woodlands in the area around Kuruman are not well conserved and are under threat from activities such as mining thus the loss of these woodlands has a significant impact.

The *Vachellia erioloba* is also protected species under the National Forests Act of 1998 (Act 84 of 1998). Larger trees are important as nesting and as perching sites but the groups of smaller trees provide a unique habitat acting as a nursery for other plant species and creating important habitats for faunal species.

Other areas regarded to have a high sensitivity include the water course areas that traverse the site and their associated riparian zones, these areas have been demarcated on the sensitivity map to include the buffer zone area and the ecological support area.



**Figure 5.1:** Site sensitivity map overlaid with the spatial extent of the planned mining infrastructure and operation

The planned changes will include additional clearing of vegetation in order to expand the existing approved infrastructure and operations, this will include ;

- 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).
- Expansion of the pit (458.54 Ha)

In additional new surface infrastructure will be developed which will include;

- 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)(84Ha)
  - Central West Sand Stockpile (40.9 Ha)
  - J Block West WRD(133Ha)
  - J Block West Sand Stockpile(46.5Ha)
  - J Block East WRD(63.5Ha)
  - J Block East Sand Stockpile(16.5Ha)
  - Powerline West WRD(196ha)
  - Powerline West Sand Stockpile(35,9Ha)
  - A Block West WRD (145 Ha)
- Product stockpile area within the approved sinter plant area (21.4 Ha);
- TUP stockpile area (12.4 Ha)
- Truck staging area (20.4 ha);
- Hard park areas (Phase 1 and 3) (14.3 Ha);
- Barlow's Store (1 Ha);
- Explosive depo and associated service road (13.1 Ha); and
- Engineering salvage yard (temporal and permanent) (2.43 Ha).

Thus approximately an additional 1404ha will be cleared to accommodate the proposed changes to the development footprint.

Of these planned changes, Hard Park areas, Barlow's store, Explosive depo, service road, salvage yard, Modular crushing plant, fuel storage farm and EME workshop, will all take place in areas that have already been disturbed by the mining activity and will not result in the loss of additional

primary vegetation or ecological linking corridors. These are in areas considered to have a low sensitivity where additional development will not have a significant environmental impact.



**Plate 5.1:** The area earmarked for the expansion of the truck staging site.

The areas for the additional waste rock dumps, and stockpiles are within moderately-high and moderately sensitive areas. These areas have a higher conservation priority because of the presence of large numbers of protected tree species. The density of these protected trees varies greatly within the areas but can be as high as 25 trees/ha for *Vachellia erioloba* and up to 45 trees/ha for *Vachellia haematoxylon*. Thus, for every additional 100ha that is cleared as part of the extended mining area, an additional loss of 2500 protected *V. erioloba* trees and 4500 protected *V. haematoxylon* trees could result, depending on the plant community. Thus, the proposed new mining and infrastructure layout, will result in the additional loss of a significant amount of protected trees.

Although some of these sites are situated close to current mining operations mostly the condition of the vegetation is still good and there is little evidence of detrimental edge effects, such as impacts from dust. The TUP stockpile area did show a number of dead *Senegalia mellifera* shrubs but mostly these sites have not deviated much from pre-mining condition. The number of faunal indicators observed on site shows signs that there is still an active faunal population on site which would be further impacted by additional land clearing and depletion of available habitat on site.

The water course areas that traverse the site and their associated riparian zones are considered to be high sensitivity areas, these areas have been demarcated on the sensitivity map to include the buffer zone area and the ecological support area. Although the planned pit extension does encroach into the area demarcated as a CBA- Ecological Support Area for the Witleegte River it falls outside the 15m riparian buffer zone. The location of the Sebilo Resources pit within the river

has already seriously disrupted the ecological functioning of this system and the delineation of the ecological support area should reflect this.





**Figure 5.2:** The northern section of the planned pit expansion falls within an ESA for the Witleegte River but falls outside the 15m riparian buffer zone



## 6. POTENTIAL IMPACTS TO THE BIODIVERSITY AND FRESHWATER ECOSYSTEMS

### 6.1. IMPACTS ASSOCIATED WITH THE EXPANSION OF MINING OPERATIONS

#### *Description of impacts*

The amendments to the approved EMPr include the expansion of mining operations and infrastructure development. These expansions will result in an additional  $\approx 955$ ha of land clearance. In order to comprehensively assess the impacts to the biodiversity the expansion operation should be assessed as part of the whole mining operation and not in isolation. In other words, the amendment needs to be assessed in terms of the original area of clearance as well as the additional area. Assessing the amendment in isolation would not give a true reflection of the cumulative impact of the various phases of the project on the biodiversity as it relates to the project site as well as the greater area in which the site occurs.

These amendments have the potential to impact on the biodiversity and freshwater ecosystems in the following ways;

- *Additional loss of Natural vegetation, Alien invasion and further habitat fragmentation*

Vegetation clearing will occur as a result of mining and changes to the infrastructure. This will cause additional fragmentation and habitat disturbance in the landscape. This disturbance destroys primary vegetation. As primary vegetation is more functional in an ecosystem, this could irreversibly transform the vegetation characteristics and faunal populations in the area. Clearing of additional surface areas has the effect of creating unnatural open spaces through the vegetation and the matrix of the landscape.

Additional clearance of primary vegetation allows secondary pioneer species or invasive plants to enter and re-colonise disturbed areas, thus increasing the possibility of Alien species invading. Invasion of Alien species in this area is already a concern within the water courses, parts of the Ga-Mogara and Witleegte have areas where these species have colonized the river beds. Further fragmentation and disruption of the ecosystem could potentially exacerbate this issue.

Cumulative impacts are those that result from the successive, incremental, and/or combined effects of an action, project, or activity when added to other existing, planned, and/or reasonably anticipated future ones. Additional transformation of intact habitat from the proposed additional

infrastructure contributes to the fragmentation of the landscape and could potentially disrupt the connectivity of the landscape for fauna and flora and impair their ability to respond to environmental fluctuations. The UMK mine falls within the Kathu Bushveld vegetation type, which although is listed as least concerned, it is regarded as poorly protected. There are at present 4 other mining areas within a 10 km radius of the UMK mine, all impacting on the Kathu Bushveld. The loss of unprotected/poorly protected vegetation types on a cumulative basis from the broader area may impact the countries' ability to meet its conservation targets. It is this cumulative effect of additional clearing and loss of vegetation that increases the significance of this impact on the UMK mine area as a result of the proposed infrastructure changes. This impact could have a permanent, prominent change to the natural habitat and ecosystem function, beyond the boundary of the site, and although some mitigation is possible through rehabilitation, there is no guarantee that the rehabilitation will be successful in re-establishing proper ecosystem functionality.

- *Additional loss of Protected Flora and Faunal species of conservation concern*

The proposed new mining and infrastructure layout will result in the additional loss of a substantial number of protected trees. This loss will be as a direct result of vegetation clearance but may also result from the indirect impacts of dust generation. The impact could be temporary and reverse on mine closure (e.g. dust from roads) or could be permanent resulting in permanent changes in the ecosystem. While the activities causing the impacts happen on the site, they could result in offsite impacts and regional effects (e.g. important vegetation habitat loss on site could result in the loss of important faunal species from the greater area). This impact could persist post closure and is difficult to mitigate. The cumulative impact of protected species loss from the large amount of mining in the area increases the significance of this impact.

The area surrounding the UMK mine contains protected trees which have been impacted because of the various developments in the greater area. Resulting in an ever-increasing amount of these protected trees being lost from the area. The biodiversity is degraded by many small impacts that individually do not appear to threaten these species' persistence but could have a significant impact on this system's ability to function.

- *Intentional/accidental killing of fauna*

Smaller fauna will inevitably be killed during land clearing activities. The area still contains faunal populations that could be impacted by additional land clearing activities. Increased vehicle traffic could result in an increase in road-kill incidences beyond the boundary of the mine. Any additional lighting has the potential to add to the impact of artificial illumination on faunal species (particularly invertebrates) through an increase in area as well as intensity. This impact will persist as long as the mine is in operation and requires lighting, but is limited to the area of the site, and can be mitigated.

- *Sedimentation and contamination of freshwater ecosystems*

Two water courses namely the Ga-Morgara and Witleegte run through the area. These are classified as ecological support areas and, generally CBA land-use guidelines propose no mining within ESAs. However there has already been some mining within these two river courses. The Mokala mine (to the north of UMK mine) has already undertaken a river diversion along the portion of the Ga-Moraga River, in order to accommodate the pit expansion into the river course. South of this area are two open pits (the Hotazel Pit & the York Pit which are part of Kudumane Mine) that encroach within the ESA of the river. An old pit is located within the Witleegte just before the confluence between the Ga-Morgara and the Witleegte. Between the Vlermuisleegte water course and the Witleegte are two additional large mining areas, Tshipi Borwa Mine as well as the old Mamatwan Mine. Thus, there are already large amounts of disturbances along the water courses and additional vegetation clearance within the area will further fragment the ESA, diminishing its functionality. Potential impacts to the water course and riparian habitat of the watercourses are likely to take place with vegetation clearance from the surrounding area. With disturbance of the vegetation adjacent to the watercourses, it is also likely that the watercourses will be vulnerable to encroachment of pioneer and alien invasive species, thereby having a potential impact on the species composition of the watercourses. Following rainfall events, the cleared areas surrounding the watercourses will be vulnerable to erosion which may result in sedimentation runoff into the water course as well as a possibility of contamination. It is possible this impact could occur during the life of the mine, intermittently affecting areas in the immediate surrounds of the mine. The severity would depend on the size of the areas exposed, their proximity to the water courses and rainfall events. Mitigation measures can be implemented to reduce the significance of this impact.

### ***Mitigation measures***

A comprehensive rehabilitation plan to revegetate the area will mitigate the impact to biodiversity to some extent. Generally, it is recommended that to mitigate the effects of mining a complete rehabilitation/restoration of an area to the pre-mining state is required. In arid and semi-arid environments however, the restorative process is often very slow and it can take several decades for a system to be restored its pre-mining state, but the likelihood of the area reaching this ideal state is not very high. In these arid systems its often more realistic to settle for a functioning state rather than a pre-mining state, which is what is considered in terms of post mitigation assessment. The re-vegetation plan must include the establishment of protected trees within the rehabilitated areas. The progress of tree growth and recruitment must be monitored and actively managed to ensure that the rehabilitated areas reflect the surrounding vegetation in terms of structure and composition. With mining it is not always practical to avoid protected plants owing to the position of the mineral resource. A search and rescue operation is not a feasible or practical option for these protected trees. Where protected trees occur within the planned infrastructure areas, losses

can be lessened by re-designing the infrastructure which will minimize the impact to individual trees. Only the actual development footprint must be disturbed, the surrounding edges must be regarded as no-go areas. The non-mined areas of the mining right site must be well managed to ensure functioning ecological linking corridors of these sites with the surrounding undisturbed properties. The intentional killing of fauna can be mitigated through education and training and the enforcement of a strict policy against the killing of fauna. A comprehensive Alien Invasive Plant removal programme must be drawn up and implemented for the property. A biodiversity Action Plan for the unmined areas of the mining right is recommended which should include monitoring of these sites. Storm water management, implementation of berms and protocols with respect to containment of spillages will need to be strictly applied and enforced to avoid/mitigate contamination of the water courses.

### Assessment of Impact:

Impact	Additional loss of Natural vegetation, Alien invasion and further habitat fragmentation	
Attribute	Pre-mitigation	Post-mitigation
Intensity	H	M
Duration	VH	H
Extent	M	L
Consequence	H	M
Probability	H	H
Significance	H	M
Impact	Additional loss of protected floral and/or faunal species	
Attribute	Pre-mitigation	Post-mitigation
Intensity	H	M
Duration	VH	H
Extent	VL	VL
Consequence	H	M
Probability	H	H
Significance	H	M
Impact	Intentional/accidental killing of fauna	
Attribute	Pre-mitigation	Post-mitigation
Intensity	M	L
Duration	H	H
Extent	L	L
Consequence	M	M
Probability	M	L
Significance	L	VL
Impact	Sedimentation and contamination of freshwater ecosystems	
Attribute	Pre-mitigation	Post-mitigation
Intensity	M	L
Duration	H	M
Extent	M	L
Consequence	M	L
Probability	M	M
Significance	L	VL

## 7. RECOMMENDATIONS AND CONCLUSION

Changes to the infrastructure layout and the increase in the mining footprint will result in the clearing of additional vegetation and the further destruction of the natural habitat within the study area. The significance of these impacts will be affected by the success of the mitigation measures implemented and the rehabilitation programme for the mine.

The UMK mine has a direct impact to the surface biodiversity and freshwater ecosystem, however the indirect loss of species and habitat as a result from issues such as dust and lowering of the water table further increases the significance of the impact to the biodiversity. These impacts may have a much wider consequence to the surface biodiversity and freshwater ecosystem owing to the cumulative effect of increased mining in the broader area. The more mining that occurs on site and in the surrounding area the greater the pressure that is placed on the biodiversity and freshwater ecosystems of the area.

The proposed increase in infrastructure and mining operations will result in impacts on the biodiversity. The impacts to the biodiversity, which are of concern with respect to the proposed amendments is the potential loss of additional protected trees. The continued clearing of *Vachellia erioloba* and *Vachellia haematoxylon* woodlands in the region is a cause for concern as the exact extent of this resource is unknown. It is unclear as to how much development this vegetation type can sustain without being irreversibly damaged resulting in a loss of biodiversity within the Northern Cape. It is very difficult to mitigate this impact. Thus, it is likely that there will be residual impacts to the biodiversity in the area as a result of the proposed amendments.

The mine has already undertaken an offset for the original mining area. The need for an additional biodiversity offset has been investigated as part of this amendment application. This biodiversity offset recommendation should be incorporated into the conditions of the Environmental Authorisation for the proposed amendments.

Additional recommendations include

- Pre-clearance surveys, of areas to be cleared, for species suitable to search and rescue operations.
- All cleared areas should be re-seeded once the topsoil has been replaced with a seed mixture reflecting the natural vegetation.
- Prior to the clearing of the protected floral species the relevant permits must be obtained from the relevant authorities.

- A comprehensive monitoring programme of the protected trees within the surrounding area must be undertaken. This monitoring will need to be conducted on an individual tree basis as well as monitoring at a community level. A suitably qualified professional should assist in developing such a monitoring programme
- Disturbing the smallest area possible should be enforced. A long-term comprehensive alien eradication programme should be compiled by a relevant specialist and implemented, this process will need to be continuously monitored and updated.
- All the mitigation and management recommendations as per the approved EMPr should be observed for the additional areas that will be disturbed.

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## APPENDIX 1

## SPECIES LISTS

## PLANT SPECIES LIST

FAMILY	SPECIES	IUCN	NCNC
ACANTHACEAE	Monechma genistifolium (Engl.) C.B.Clarke subsp. australe (P.G.Mey.) Munday	LC	
	Monechma incanum (Nees) C.B.Clarke	LC	
	Barleria rigida Nees	LC	
	Barleria macrostegia Nees	LC	
	Blepharis integrifolia (L.f.) E.Mey. ex Schinz var. integrifolia	LC	
	Justicia protracta (Nees) T.Anderson subsp. protracta	LC	
AMARANTHACEAE	Hermestaedtia fleckii (Schinz) Baker & C.B.Clarke	LC	
	Pupalia lappacea (L.) A.Juss. var. lappacea	LC	
	Sericorema remotiflora (Hook.f.) Lopr.	LC	
	Achyranthes aspera L. var. aspera [	NE naturalised	
	Alternanthera pungens Kunth	NE naturalised	
	Alternanthera sessilis (L.) DC.	NE naturalised	
	Amaranthus thunbergii Moq.	LC	
	Kyphocarpa angustifolia (Moq.) Lopr	LC	
AMARYLLIDACEAE	Boophone disticha (L.f.) Herb	Declining	Schedule 2
	Brunsvigia radula (Jacq.) Aiton	Vulnerable	Schedule 2
ANACARDIACEAE	Searsia dregeana (Sond.) Moffett	LC	
	Searsia erosa (Thunb.) Moffett	LC	
	Searsia lancea (L.f.) F.A.Barkley	LC	
	Searsia tenuinervis (Engl.) Moffett	LC	
	Searsia undulata (Jacq.) T.S.Yi, A.J.Mill. & J.Wen	LC	
	Searsia tridactyla (Burch.) Moffett	LC	
	Trachyandra asperata var. macowanii	LC	
ANTHERICACEAE:	Asclepias burchellii Schlechter	NE naturalised	
ASCLEPIADACEAE	Asparagus africanus Lam	LC	
ASPARAGACEAE	Asparagus laricinus Burch.	LC	
	Asparagus retrofractus L.	LC	
	Asparagus suaveolens Burch.	LC	
	Orthanthera jasminiflora (Decne.) Schinz	LC	Schedule 2
APOCYNACEAE	Pentarrhinum insipidum E.Mey.	LC	
	Berkheya ferox O.Hoffm. var. tomentosa Roessler	LC	
ASTERACEAE	Chrysocoma ciliata L	LC	
	Gazania krebsiana Less. subsp. krebsiana	LC	
	Dimorphotheca zeyheri Sond.	LC	
	Geigeria ornativa O.Hoffm. subsp. ornativa	LC	
	Geigeria brevifolia (DC.) Harv.	LC	
	Helichrysum argyrosphaerum DC	LC	
	Helichrysum dregeanum Sond. & Harv	LC	
	Helichrysum zeyheri Less.	LC	
	Nidorella hottentotica DC	LC	

	Nidorella resedifolia DC. subsp. resedifolia	LC	
	Nolletia ciliaris (DC.) Steetz		
	Pentzia calcarea Kies	LC	
	Pentzia incana (Thunb.) Kuntze	LC	
	Pegolettia retrofracta (Thunb.) Kies	LC	
	Pteronia glauca Thunb. subsp. arcuata (Dinter) Merxm.	LC	
	Dicoma macrocephala DC. [	LC	
	Dicoma schinzii O.Hoffm.	LC	
	Felicia muricata (Thunb.) Nees subsp. muricata [	LC	
	Senecio burchellii DC.	LC	
	Senecio glutinarius DC.	LC	
	Tripteris aghillana DC. var. aghillana	LC	
	Tarchonanthus camphoratus L	LC	
	Tagetes minuta L	NE Naturalised	
	Verbesina encelioides (Cav.) Benth. & Hook. var. encelioides	NE Naturalised	
	Xanthium spinosum L	NE Naturalised	
BIGNONIACEAE	Rhigozum trichotomum Burch	LC	
BORAGINACEAE	Ehretia rigida (Thunb.) Druce subsp. rigida	LC	
BRASSICACEAE	Lepidium africanum (Burm.f.) DC. subsp. africanum	LC	
BUDDLEJACEAE	Buddleja saligna Willd.	LC	
CAPPARACEAE	Cleome angustifolia Forssk. subsp. diandra (Burch.) Kers	LC	
	Cleome monophylla L.	LC	
	Boscia albitrunca (Burch.) Gilg & Gilg-Ben.	LC	Schedule 2
	Cadaba aphylla (Thunb.) Wild	LC	
CACTACEAE	Opuntia humifusa (Raf.) Raf.	NE	
CELASTRACEAE	Putterlickia pyracantha (L.) Szyszyl..	LC	
	Gymnosporia heterophylla (Eckl. & Zeyh.) Loes	LC	
CHENOPODIACEAE	Salsola kali L.	NE Naturalised	
	Salsola tuberculata (Moq.) Fenzl.	LC	
	Salsola patentipilosa Botsch.	LC	
	Atriplex nummularia Lindl. subsp. nummularia	NE Naturalised	
	Chenopodium album L.	NE Naturalised	
	Chenopodium multifidum L.	NE Naturalised	
COLCHICACEAE	Ornithoglossum viride (L.f.) Aiton	LC	
COMBRETACEAE	Terminalia sericea Burch. ex DC.	LC	
COMMELINACEAE	Commelina africana L. var. africana	LC	
CONVOLVULACEAE	Merremia verecunda Rendle	LC	
	Evolvulus alsinoides (L.) L.	LC	
	Ipomoea bolusiana Schinz	LC	
	Ipomoea obscura (L.) Ker Gawl. var. obscura	LC	
	Seddera capensis (E.Mey. ex Choisy) Hallier f.	LC	
CRASSULACEAE	Crassula capitella Thunb. subsp. thyrsoiflora (Thunb.) Toelken	LC	Schedule 2
	Kalanchoe brachyloba Welw. ex Britten	LC	Schedule 2
CUCURBITACEAE	Acanthosicyos naudinianus (Sond.) C.Jeffrey	LC	
	Cucumis africanus L.f.	LC	
CYPERACEAE	Cyperus margaritaceus Vahl var. margaritaceus.	LC	
	Cyperus bellus Kunth	LC	

	<i>Cyperus squarrosus</i> L.	LC	
	<i>Cyperus austro-africanus</i> C.Archer & Goetgh.	LC	
EBENACEAE	<i>Diospyros lycioides</i> Desf. subsp. <i>lycioides</i>	LC	
	<i>Diospyros pallens</i> (Thunb.) F.White	LC	
EUPHORBIACEAE	<i>Euphorbia mauritanica</i> L.	LC	
FABACEAE	<i>Crotalaria virgultalis</i> Burch. ex DC.	LC	
	<i>Crotalaria spartioides</i> DC	LC	
	<i>Chamaecrista mimosoides</i> (L.) Greene	LC	
	<i>Cullen tomentosum</i> (Thunb.) J.W.Grimes	LC	
	<i>Calobota cuspidosa</i> (Burch.) Boatwr. & B.-E.van Wyk	LC	
	<i>Dichrostachys cinerea</i> (L.) Wight & Arn. subsp. <i>africana</i>	LC	
	<i>Elephantorrhiza elephantina</i> (Burch.) Skeels	LC	
	<i>Lessertia macrostachya</i> DC. var. <i>macrostachya</i>	LC	
	<i>Lotononis crumanina</i> Burch. ex Benth.	LC	
	<i>Melolobium candicans</i> (E.Mey.) Eckl. & Zeyh.	LC	
	<i>Melolobium humile</i> Eckl. & Zeyh.	LC	
	<i>Pomaria burchellii</i> (DC.) B.B.Simpson & G.P.Lewis subsp. <i>burchellii</i>	LC	
	<i>Prosopis glandulosa</i> Torr. var. <i>glandulosa</i>	NE naturalised	
	<i>Tephrosia burchellii</i> Burt Davy	LC	
	<i>Tephrosia elongata</i> E.Mey. var. <i>elongata</i>	LC	
	<i>Vachellia erioloba</i> E.Mey	LC	
	<i>Vachellia haematoxylon</i> Willd.	LC	
	<i>Vachellia hebeclada</i> DC. subsp. <i>hebeclada</i>	LC	
	<i>Vachellia karroo</i> Hayne	LC	
	<i>Senegalia mellifera</i>	LC	
	<i>Senna italica</i> Mill. subsp. <i>micrantha</i> (Brenan) Lock	LC	
	<i>Indigofera alternans</i> DC. var. <i>alternans</i>	LC	
	<i>Indigofera daleoides</i> Benth. ex Harv. var. <i>daleoides</i>	LC	
	<i>Indigofera cryptantha</i> Benth. ex Harv. var. <i>cryptantha</i>	LC	
	<i>Indigofera velutina</i> E.Mey	LC	
	<i>Indigofera vicioides</i> Jaub. & Spach var. <i>vicioides</i>	LC	
	<i>Otoptera burchellii</i> DC.	LC	
	<i>Rhynchosia confusa</i> Burt Davy	LC	
	<i>Rhynchosia totta</i> (Thunb.) DC. var. <i>totta</i>	LC	
	<i>Indigastrium argyraeum</i>	LC	
	<i>Indigofera hololeuca</i>	LC	
	<i>Tylosema esculentum</i> (Burch.) A.Schreib.	LC	
GENTIANACEAE	<i>Sebaea exigua</i> (Oliv.) Schinz	LC	
	<i>Exochaenium grande</i> (E.Mey.) Griseb.	LC	
GISEKIACEAE	<i>Gisekia pharnacioides</i> L. var. <i>pharnacioides</i>	LC	
IRIDACEAE	<i>Moraea longistyla</i> (Goldblatt) Goldblatt	LC	Schedule 2
	<i>Moraea pallida</i> (Baker) Goldblatt	LC	Schedule 2
	<i>Babiana hypogaea</i> Burch.	LC	Schedule 2
LAMIACEAE	<i>Stachys spathulata</i> Burch. ex Benth.	LC	
	<i>Salvia verbenaca</i> L.	LC	
	<i>Acrotome inflata</i> Benth	LC	

	<i>Leucas capensis</i> (Benth.) Engl	LC	
LOPHIOCARPACEAE	<i>Corbichonia rubriolacea</i> (Friedrich) C.Jeffrey	LC	
	<i>Lophiocarpus polystachyus</i> Turcz	LC	
MALPIGHIACEAE	<i>Triaspis hypericoides</i> (DC.) Burch. subsp. <i>hypericoides</i>	LC	
MALVACEAE	<i>Grewia flava</i> DC.	LC	
	<i>Hermannia comosa</i> Burch. ex DC.	LC	
	<i>Hermannia jacobaeifolia</i> (Turcz.) R.A.Dyer	LC	
	<i>Hermannia tomentosa</i> (Turcz.) Schinz ex Engl.	LC	
	<i>Hibiscus pusillus</i> Thunb.	LC	
	<i>Hibiscus elliottiae</i> Harv..	LC	
	<i>Melhania didyma</i> Eckl. & Zeyh	LC	
	<i>Melhania rehmannii</i> Szyszyl.	LC	
	<i>Pavonia burchellii</i> (DC.) R.A.Dyer	LC	
	<i>Sida dregei</i> Burt Davy	LC	
	<i>Sida cordifolia</i> L. subsp. <i>cordifolia</i>	LC	
	<i>Waltheria indica</i> L	LC	
MENISPERMACEAE	<i>Antizoma angustifolia</i> (Burch.) Miers ex Harv	LC	
MESEMBRYANTHEMACEAE	<i>Ruschia griquensis</i> (L.Bolus) Schwantes [	LC	Schedule 2
	<i>Limeum viscosum</i> (J.Gay) Fenzl subsp. <i>viscosum</i> var. <i>viscosum</i>	LC	
MOLLUGINACEAE	<i>Olea europaea</i> L. subsp. <i>africana</i> (Mill.) P.S.Green	LC	Schedule 2
OLEACEAE	<i>Striga gesnerioides</i> (Willd.) Vatke	LC	
OROBANCHACEAE	<i>Striga asiatica</i> (L.) Kuntze	LC	
OXALIDACEAE	<i>Oxalis haedulipes</i> T.M.Salter	LC	Schedule 2
PAPAVERACEAE	<i>Argemone mexicana</i> L.	NE naturalised	
	<i>Argemone ochroleuca</i>	NE naturalised	
PEDALIACEAE	<i>Harpagophytum procumbens</i>		Schedule 1
	<i>Sesamum capense</i> Burm.f.	LC	
	<i>Ceratotheca triloba</i> (Bernh.) Hook.f.	LC	
PLUMBAGINACEAE	<i>Plumbago auriculata</i> Lam.	LC	
PHYLLANTHACEAE	<i>Phyllanthus maderaspatensis</i> L.	LC	
	<i>Phyllanthus parvulus</i> Sond. var. <i>garipensis</i> (E.Mey. ex Dr†ge) Radcl.-Sm.	LC	
POACEAE	<i>Aristida adscensionis</i> L.	LC	
	<i>Aristida diffusa</i> Trin. subsp. <i>diffusa</i>	LC	
	<i>Aristida meridionalis</i> Henrard	LC	
	<i>Andropogon chinensis</i> (Nees) Merr	LC	
	<i>Diheteropogon amplexens</i> (Nees) Clayton var. <i>amplexens</i>	LC	
	<i>Centropodia glauca</i> (Nees) Cope.	LC	
	<i>Chrysopogon serrulatus</i> Trin.	LC	
	<i>Enneapogon cenchroides</i> (Licht. ex Roem. & Schult.) C.E.Hubb.	LC	
	<i>Elionurus muticus</i> (Spreng.) Kunth	LC	
	<i>Hyparrhenia hirta</i> (L.) Stapf	LC	
	<i>Megaloprotachne albescens</i> C.E.Hubb.	LC	
	<i>Melinis repens</i> (Willd.) Zizka subsp. <i>grandiflora</i> (Hochst.) Zizka	LC	
	<i>Tricholaena monachne</i> (Trin.) Stapf & C.E.Hubb.	LC	
	<i>Trichoneura grandiglumis</i> (Nees) Ekman	LC	

	Schmidtia kalahariensis Stent	LC
	Schmidtia pappophoroides Steud.	LC
	Setaria verticillata (L.) P.Beauv.	LC
	Stipagrostis ciliata (Desf.) De Winter var. capensis (Trin. & Rupr.) De Winter	LC
	Stipagrostis uniplumis (Licht.) De Winter var. uniplumis	LC
	Schizachyrium sanguineum (Retz.) Alston	LC
	Themeda triandra Forssk	LC
	Tragus berteronianus Schult	LC
	Tragus koelerioides Asch	LC
	Tragus racemosus (L.) All.	LC
	Antheophora argentea Gooss.	LC
	Antheophora pubescens Nees	LC
	Aristida congesta Roem. & Schult. subsp. congesta	LC
	Aristida stipitata Hack. subsp. spicata (De Winter) Melderis	LC
	Aristida vestita Thunb.	LC
	Brachiaria marlothii (Hack.) Stent	LC
	Brachiaria nigropedata (Ficalho & Hiern) Stapf	LC
	Cenchrus ciliaris L.	LC
	Coelachyrum yemenicum (Schweinf.) S.M.Phillips	LC
	Cymbopogon pospischilii (K.Schum.) C.E.Hubb.	NE naturalised
	Cynodon dactylon (L.) Pers.	LC
	Digitaria eriantha Steud.	LC
	Digitaria polyphylla Henrard	LC
	Enneapogon desvauxii P.Beauv.	LC
	Eragrostis echinoclodea Stapf	LC
	Eragrostis lehmanniana Nees var. lehmanniana	LC
	Eragrostis micrantha Hack.	LC
	Eragrostis obtusa Munro ex Ficalho & Hiern	LC
	Eragrostis chloromelas Steud	LC
	Eragrostis curvula (Schrud.) Nees	LC
	Eragrostis pallens Hack. [	LC
	Eragrostis trichophora Coss. & Durieu	LC
	Eustachys paspaloides (Vahl) Lanza & Mattei	LC
	Fingerhuthia africana Lehm.	LC
	Heteropogon contortus (L.) Roem. & Schult.	LC
	Leptochloa fusca (L.) Kunth	LC
	Panicum maximum Jacq.	LC
	Pogonarthria squarrosa (Roem. & Schult.) Pilg.	LC
	Pennisetum setaceum (Forssk.) Chiov	NE
	Schmidtia pappophoroides Steud.	LC
	Sporobolus fimbriatus (Trin.) Nees	LC
	Stipagrostis obtusa (Delile) Nees	LC
	Stipagrostis uniplumis (Licht.) De Winter var. uniplumis	LC
	Triraphis andropogonoides (Steud.) E.Phillips	LC
POLYGALACEAE	Polygala leptophylla Burch. var. leptophylla	LC
	Polygala seminuda Harv.	LC



	<i>Oxygonum delagoense</i> Kuntze	LC	
PORTULACACEAE	<i>Talinum caffrum</i> (Thunb.) Eckl. & Zeyh	LC	
RHAMNACEAE	<i>Ziziphus mucronata</i> Willd. subsp. <i>mucronata</i>	LC	
	<i>Helinus spartioides</i> (Engl.) Schinz ex Engl. [	LC	
RICCIACEAE	<i>Riccia albolimbata</i> S.W.Arnell	LC	
RUBIACEAE	<i>Anthospermum rigidum</i> Eckl. & Zeyh. subsp. <i>rigidum</i>	LC	
SANTALACEAE	<i>Thesium hystericoides</i> A.W.Hill	LC	
	<i>Thesium hystrix</i> A.W.Hill	LC	
	<i>Viscum rotundifolium</i> L.f.	LC	
SCROPHULARIACEAE	<i>Selago mixta</i> Hilliard	LC	
	<i>Aptosimum elongatum</i> Engl.	LC	
	<i>Aptosimum junceum</i> (Hiern) Philcox	LC	
	<i>Aptosimum lineare</i> Marloth & Engl. var. <i>lineare</i>	LC	
	<i>Peliostomum leucorrhizum</i> E.Mey. ex Benth.	LC	
	<i>Jamesbrittenia crassicaulis</i> (Benth.) Hilliard	LC	Schedule 2
	<i>Sutera griquensis</i> Hiern	LC	
	<i>Selago geniculata</i> L.f.	LC	
	<i>Selago densiflora</i> Rolfe	LC	
	<i>Chaenostoma halimifolium</i> Benth.	LC	
	<i>Selago alopecuroides</i> Rolfe	LC	
	<i>Selago saxatilis</i> E.Mey. [	LC	
SOLANACEAE	<i>Lycium oxycarpum</i> Dunal	LC	
	<i>Lycium hirsutum</i> Dunal	LC	
	<i>Solanum capense</i> L	LC	
	<i>Solanum lichtensteinii</i> Willd	LC	
	<i>Solanum campylacanthum</i> subsp. <i>panduriforme</i>	LC	
	<i>Solanum supinum</i> Dunal var. <i>supinum</i>	LC	
THYMELAEACEAE	<i>Gnidia polycephala</i> (C.A.Mey.) Gilg	LC	
VAHLIACEAE	<i>Vahlia capensis</i> (L.f.) Thunb. subsp. <i>vulgaris</i> Bridson var. <i>linearis</i> E.Mey. ex Bridson	LC	
VERBENACEAE	<i>Chascanum hederaceum</i> (Sond.) Moldenke var. <i>hederaceum</i>	LC	
	<i>Chascanum incisum</i> (H.Pearson) Moldenke	LC	
	<i>Lantana rugosa</i> Thunb.	LC	
ZYGOPHYLLACEAE	<i>Tribulus terrestris</i> L.	LC	
	<i>Tribulus zeyheri</i> Sond. subsp. <i>zeyheri</i>	LC	

## FAUNAL SPECIES CHECK LIST FOR THE AREA

### REPTILES

Family Name	Species Name	Common Name
Agamidae	<i>Agama aculeata</i> subsp. <i>aculeata</i>	Ground agama
Lacertidae	<i>Heliobolus lugubris</i>	Bushveld Lizard
Lacertidae	<i>Pedioplanis lineocellata</i>	Spotted Sand lizard
Gekkonidae	<i>Chondrodactylus bibronii</i>	Bibron's Gecko
Lacertidae	<i>Heliobolus lugubris</i>	Bushveld Lizard
Lacertidae	<i>Pedioplanis lineocellata</i>	Spotted Sand Lizard
Lacertidae	<i>Pedioplanis namaquensis</i>	Namaqua Sand Lizard

### AMPHIBIANS

Family Name	Species Name	Common Name
Bufonidae	<i>Amietophrynus poweri</i>	Power's Toad
Hyperoliidae	<i>Kassina senegalensis</i>	Senegal kassina
Pyxicephalidae	<i>Cacosternum boettgeri</i>	Common Dainty Frog
Pyxicephalidae	<i>Tomopterna cryptotis</i>	Common Sand Frog
<b>BIRDS</b>		
Family Name	Species Name	Common Name
Alaudidae	<i>Calendulauda africanoides</i>	Fawn-coloured Lark
Alaudidae	<i>Calendulauda sabota</i>	Sabota Lark
Alaudidae	<i>Chersomanes albofasciata</i>	Spike-heeled Lark
Alaudidae	<i>Eremopterix verticalis</i>	Grey-backed Sparrowlark
Alaudidae	<i>Mirafrapa apiata</i>	Cape Clapper Lark
Anatidae	<i>Anas erythrorhynchos</i>	Red-billed Teal
Apodidae	<i>Apus affinis</i>	Little Swift
Bucerotidae	<i>Tockus leucomelas</i>	Southern Yellow-billed Hornbill
Bucerotidae	<i>Tockus nasutus</i>	African Grey Hornbill
Burhinidae	<i>Burhinus capensis</i>	Spotted Thick-knee
Capitonidae	<i>Tricholaema leucomelas</i>	Acacia Pied Barbet
Charadriidae	<i>Charadrius tricollaris</i>	Three-banded Plover
Charadriidae	<i>Vanellus armatus</i>	Blacksmith Lapwing
Charadriidae	<i>Vanellus coronatus</i>	Crowned Lapwing
Coliidae	<i>Colius colius</i>	White-backed Mousebird
Coliidae	<i>Urocolius indicus</i>	Red-faced Mousebird
Coraciidae	<i>Coracias caudatus</i>	Lilac-breasted Roller
Coraciidae	<i>Coracias naevius</i>	Purple Roller
Cuculidae	<i>Chrysococcyx caprius</i>	Diderick Cuckoo
Dicruridae	<i>Dicrurus adsimilis</i>	Fork-tailed Drongo
Estrildidae	<i>Amadina erythrocephala</i>	Red-headed Finch
Estrildidae	<i>Estrilda astrild</i>	Common Waxbill
Estrildidae	<i>Estrilda erythronotos</i>	Black-faced Waxbill
Estrildidae	<i>Granatina granatina</i>	Violet-eared Waxbill
Estrildidae	<i>Pytilia melba</i>	Green-winged Pytilia
Fringillidae	<i>Crithagra atrogularis</i>	Black-throated Canary
Fringillidae	<i>Crithagra flaviventris</i>	Yellow Canary
Fringillidae	<i>Emberiza flaviventris</i>	Golden-breasted Bunting
Fringillidae	<i>Emberiza impetuanii</i>	Lark-like Bunting
Glareolidae	<i>Cursorius rufus</i>	Burchell's Courser
Halcyonidae	<i>Alcedo cristata</i>	Malachite Kingfisher
Hirundinidae	<i>Hirundo albigularis</i>	White-throated Swallow
Hirundinidae	<i>Hirundo cucullata</i>	Greater Striped Swallow
Hirundinidae	<i>Hirundo fuligula</i>	Rock Martin
Hirundinidae	<i>Hirundo rustica</i>	Barn Swallow
Hirundinidae	<i>Hirundo semirufa</i>	Red-breasted Swallow
Hirundinidae	<i>Hirundo spilodera</i>	South African Cliff-Swallow
Hirundinidae	<i>Riparia paludicola</i>	Brown-throated Martin
Laniidae	<i>Lanius collaris</i>	Common Fiscal
Laniidae	<i>Lanius collurio</i>	Red-backed Shrike
Laniidae	<i>Lanius minor</i>	Lesser Grey Shrike
Malaconotidae	<i>Laniarius atrococcineus</i>	Crimson-breasted Shrike
Malaconotidae	<i>Tchagra australis</i>	Brown-crowned Tchagra
Malaconotidae	<i>Telophorus zeylonus</i>	Bokmakierie
Meropidae	<i>Merops apiaster</i>	European Bee-eater
Meropidae	<i>Merops hirundineus</i>	Swallow-tailed Bee-eater
Motacillidae	<i>Anthus cinnamomeus</i>	African Pipit
Motacillidae	<i>Motacilla capensis</i>	Cape Wagtail

Muscicapidae	<i>Batis pririt</i>	Pririt Batis
Muscicapidae	<i>Bradornis infuscatus</i>	Chat Flycatcher
Muscicapidae	<i>Bradornis mariquensis</i>	Marico Flycatcher
Muscicapidae	<i>Sigelus silens</i>	Fiscal Flycatcher
Nectariniidae	<i>Cinnyris mariquensis</i>	Marico Sunbird
Numididae	<i>Numida meleagris</i>	Helmeted Guineafowl
Otididae	<i>Afrotis afraoides</i>	Northern Black Korhaan
Otididae	<i>Lophotis ruficrista</i>	Red-crested Korhaan
Otididae	<i>Neotis ludwigii</i>	Ludwigii Bustard
Paridae	<i>Parus cinerascens</i>	Ashy Tit
Phalacrocoracidae	<i>Phalacrocorax africanus</i>	Reed Cormorant
Phasianidae	<i>Pternistis adspersus</i>	Red-billed Spurfowl
Phoeniculidae	<i>Rhinopomastus cyanomelas</i>	Common Scimitarbill
Plataleidae	<i>Platalea alba</i>	African Spoonbill
Plataleidae	<i>Plegadis falcinellus</i>	Glossy Ibis
Plataleidae	<i>Threskiornis aethiopicus</i>	African Sacred Ibis
Podicipedidae	<i>Tachybaptus ruficollis</i>	Little Grebe
Pteroclididae	<i>Pterocles bicinctus</i>	Double-banded Sandgrouse
Pteroclididae	<i>Pterocles burchelli</i>	Burchell's Sandgrouse
Pteroclididae	<i>Pterocles namaqua</i>	Namaqua Sandgrouse
Pycnonotidae	<i>Pycnonotus nigricans</i>	African Red-eyed Bulbul
Rallidae	<i>Fulica cristata</i>	Red-knobbed Coot
Rallidae	<i>Gallinula chloropus</i>	Common Moorhen
Sagittariidae	<i>Sagittarius serpentarius</i>	Secretarybird
Scolopacidae	<i>Actitis hypoleucos</i>	Common Sandpiper
Scolopacidae	<i>Calidris ferruginea</i>	Curlew Sandpiper
Scolopacidae	<i>Gallinago nigripennis</i>	African Snipe
Scopidae	<i>Scopus umbretta</i>	Hamerkop
Strigidae	<i>Bubo lacteus</i>	Verreaux's Eagle-Owl
Strigidae	<i>Glaucidium perlatum</i>	Pearl-spotted Owlet
Struthionidae	<i>Struthio camelus</i>	Common Ostrich
Sturnidae	<i>Creatophora cinerea</i>	Wattled Starling
Sturnidae	<i>Lamprotornis nitens</i>	Cape Glossy Starling
Sturnidae	<i>Onychognathus nabouroup</i>	Pale-winged Starling
Timaliidae	<i>Turdoides bicolor</i>	Southern Pied Babbler
Viduidae	<i>Vidua regia</i>	Shaft-tailed Whydah
Sylviidae	<i>Acrocephalus baeticatus</i>	African Reed-Warbler
Turdidae	<i>Cercomela familiaris</i>	Familiar Chat
Turdidae	<i>Cercotrichas paena</i>	Kalahari Scrub-Robin
Sylviidae	<i>Cisticola aridulus</i>	Desert Cisticola
Sylviidae	<i>Cisticola tinniens</i>	Levaillant's Cisticola
Columbidae	<i>Columba guinea</i>	Speckled Pigeon
Ardeidae	<i>Egretta garzetta</i>	Little Egret
Accipitridae	<i>Elanus caeruleus</i>	Black-shouldered Kite
Sylviidae	<i>Eremomela icteropygialis</i>	Yellow-bellied Eremomela
Falconidae	<i>Falco rupicolus</i>	Rock Kestrel
Accipitridae	<i>Melierax canorus</i>	Southern Pale Chanting Goshawk
Accipitridae	<i>Melierax gabar</i>	Gabar Goshawk
Turdidae	<i>Myrmecocichla formicivora</i>	Ant-eating Chat
Ardeidae	<i>Nycticorax nycticorax</i>	Black-crowned Night-Heron
Columbidae	<i>Oena capensis</i>	Namaqua Dove
Turdidae	<i>Oenanthe pileata</i>	Capped Wheatear
Sylviidae	<i>Parisoma subcaeruleum</i>	Chestnut-vented Tit-Babbler
Ploceidae	<i>Passer diffusus</i>	Southern Grey-headed Sparrow

Ploceidae	<i>Passer domesticus</i>	House Sparrow
Ploceidae	<i>Passer melanurus</i>	Cape Sparrow
Ploceidae	<i>Philetaurus socius</i>	Sociable Weaver
Ploceidae	<i>Plocepasser mahali</i>	White-browed Sparrow-Weaver
Ploceidae	<i>Ploceus velatus</i>	Southern Masked-Weaver
Accipitridae	<i>Polemaetus bellicosus</i>	Martial Eagle
Sylviidae	<i>Prinia flavicans</i>	Black-chested Prinia
Ploceidae	<i>Quelea quelea</i>	Red-billed Quelea
Ploceidae	<i>Sporopipes squamifrons</i>	Scaly-feathered Finch
Columbidae	<i>Streptopelia capicola</i>	Cape Turtle-Dove
Columbidae	<i>Streptopelia senegalensis</i>	Laughing Dove
Sylviidae	<i>Sylvia borin</i>	Garden Warbler
Sylviidae	<i>Sylvietta rufescens</i>	Long-billed Crombec

**INVERTEBRATES**

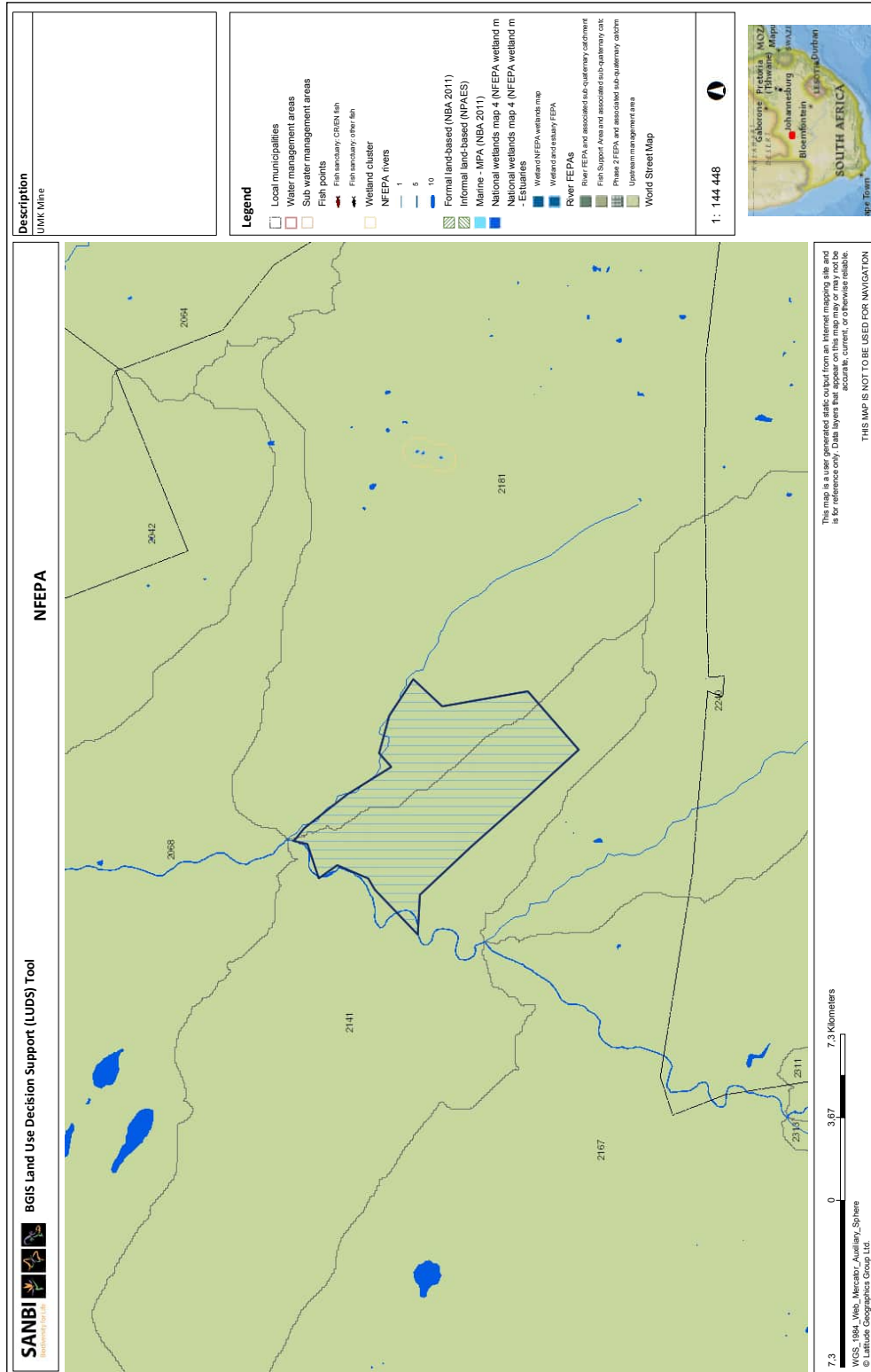
Family Name	Species Name	Common Name
Hesperiidae	<i>Leucochitonea levubu</i>	White-cloaked Skipper butterfly
Hesperiidae	<i>Pelopidas mathias</i>	Lesser Millets Skipper butterfly
Lycaenidae	<i>Azanus jesous jesous</i>	Topaz spotted blue butterfly
Lycaenidae	<i>Cigaritis phanes</i>	Silver bar butterfly
Pieridae	<i>Catopsilia florella</i>	African Migrant butterfly
Pieridae	<i>Colotis agoye bowkeri</i>	Speckled Sulphur tip butterfly
	<i>Colotis subfasciatus subfasciatus</i>	
Pieridae		Lemon tip butterfly
Lycaenidae	<i>Aloeides gowani</i>	Gowan's copper butterfly
Pieridae	<i>Eurema brigitta subsp. brigitta</i>	Small grass yellow butterfly

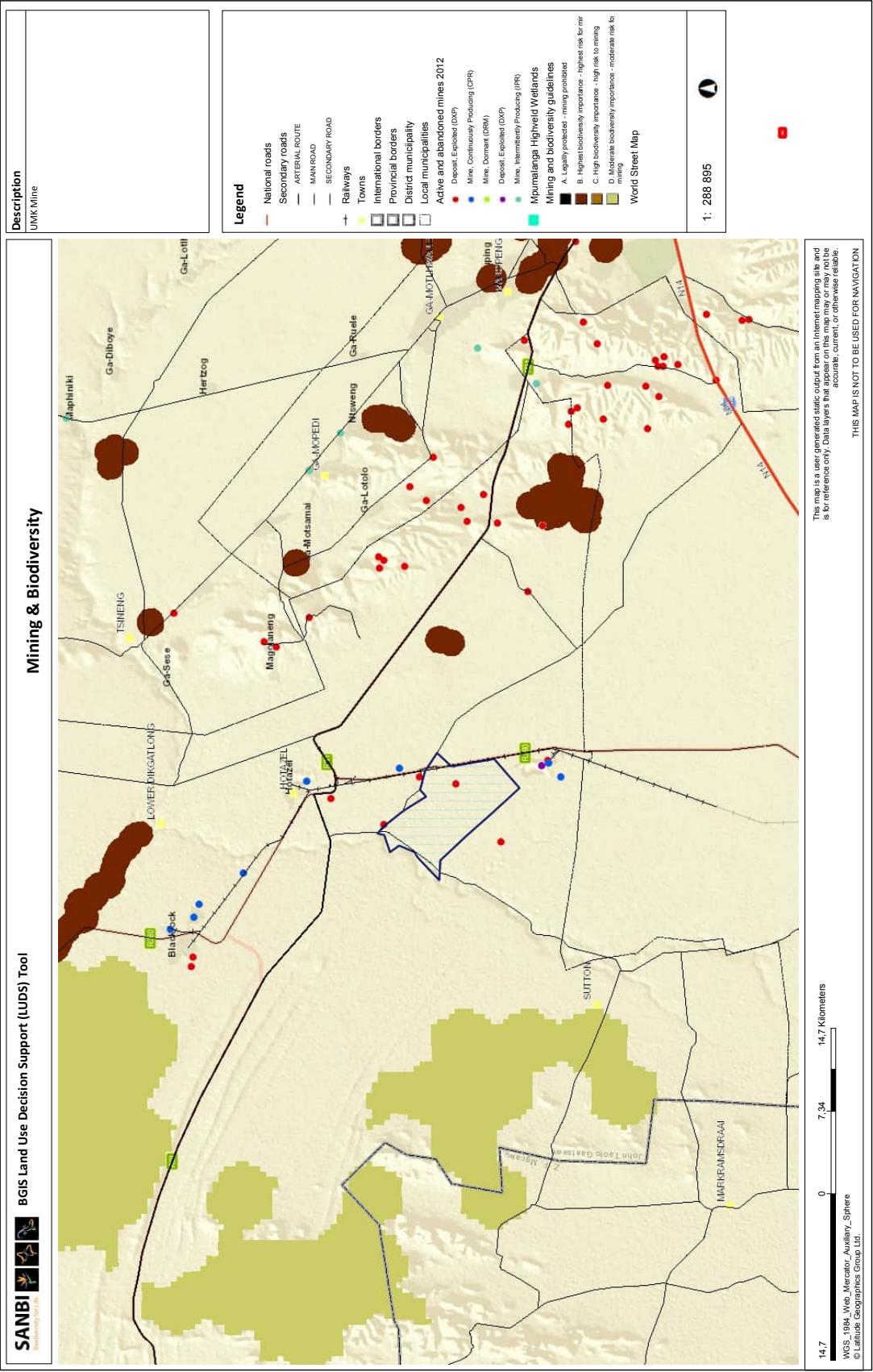
**MAMMALS**

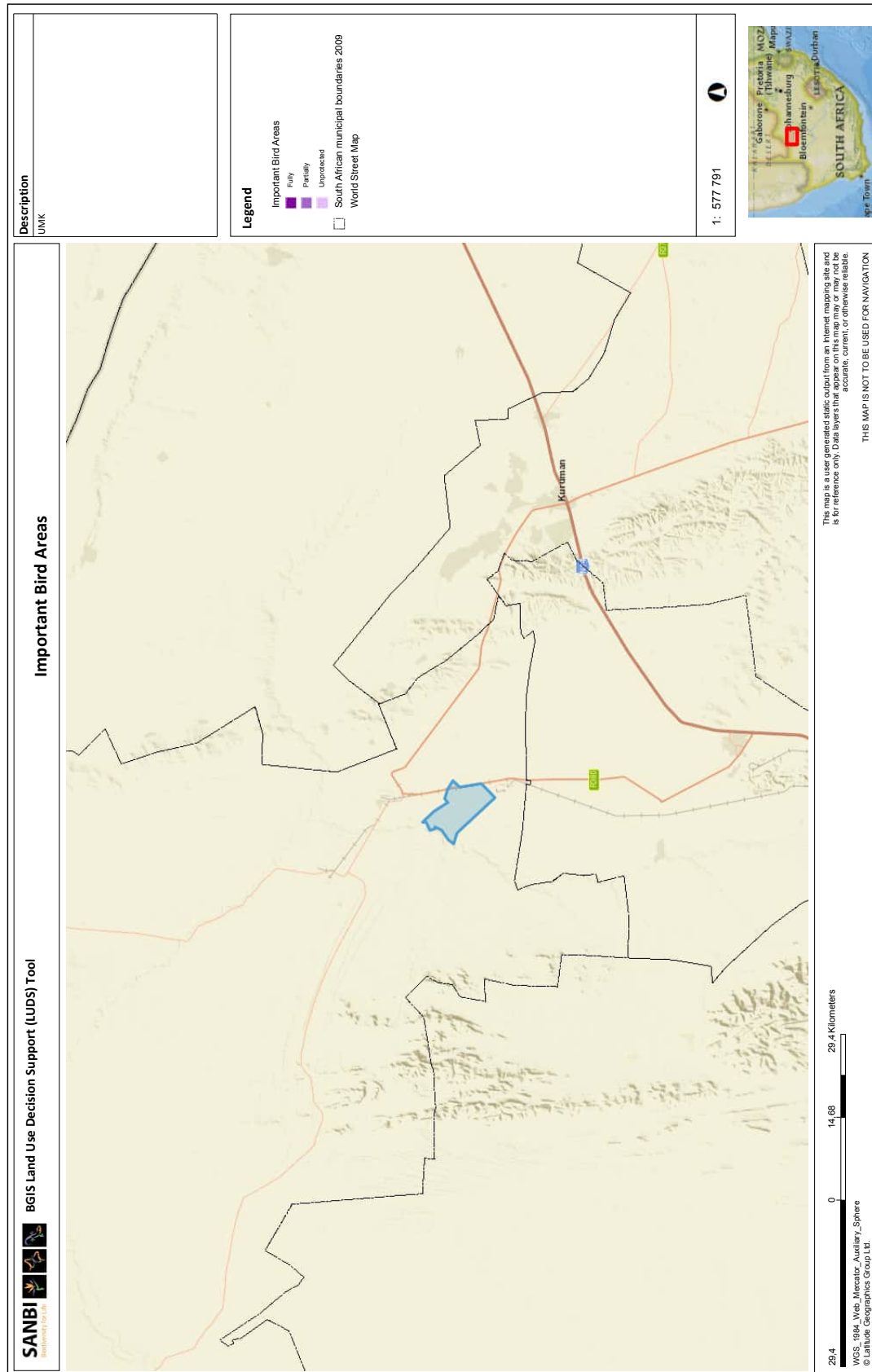
Family Name	Species Name	Common Name
Suidae	<i>Phacochoerus africanus</i>	Warthog
Bovidae	<i>Raphicerus campestris</i>	Steenbok
Hespestidae	<i>Cynictis penicillata</i>	Yellow Mongoose
Orycteropodidae	<i>Orycteropus afer</i>	Aardvark
Muridae	<i>Thallomys nigricauda</i>	Black tailed tree rat
Rhinolophidae	<i>Rhinolophus denti</i>	Dent's horseshoe bat
Miniopteridae.	<i>Miniopterus schreibersii</i>	Schreibers' long-fingered bat
Mustelidae	<i>Mellivorinae capensis</i>	Honey Badger
Erinaceidae	<i>Atelerix frontalis</i>	South Africa Hedgehog
Herpestidae	<i>Suricata suricatta</i>	Suricate
Bathyergidae	<i>Cryotomys hottentots</i>	Common mole rat
Sciuridae	<i>Xerus inauris</i>	Cape ground squirrel

# APPENDIX 2

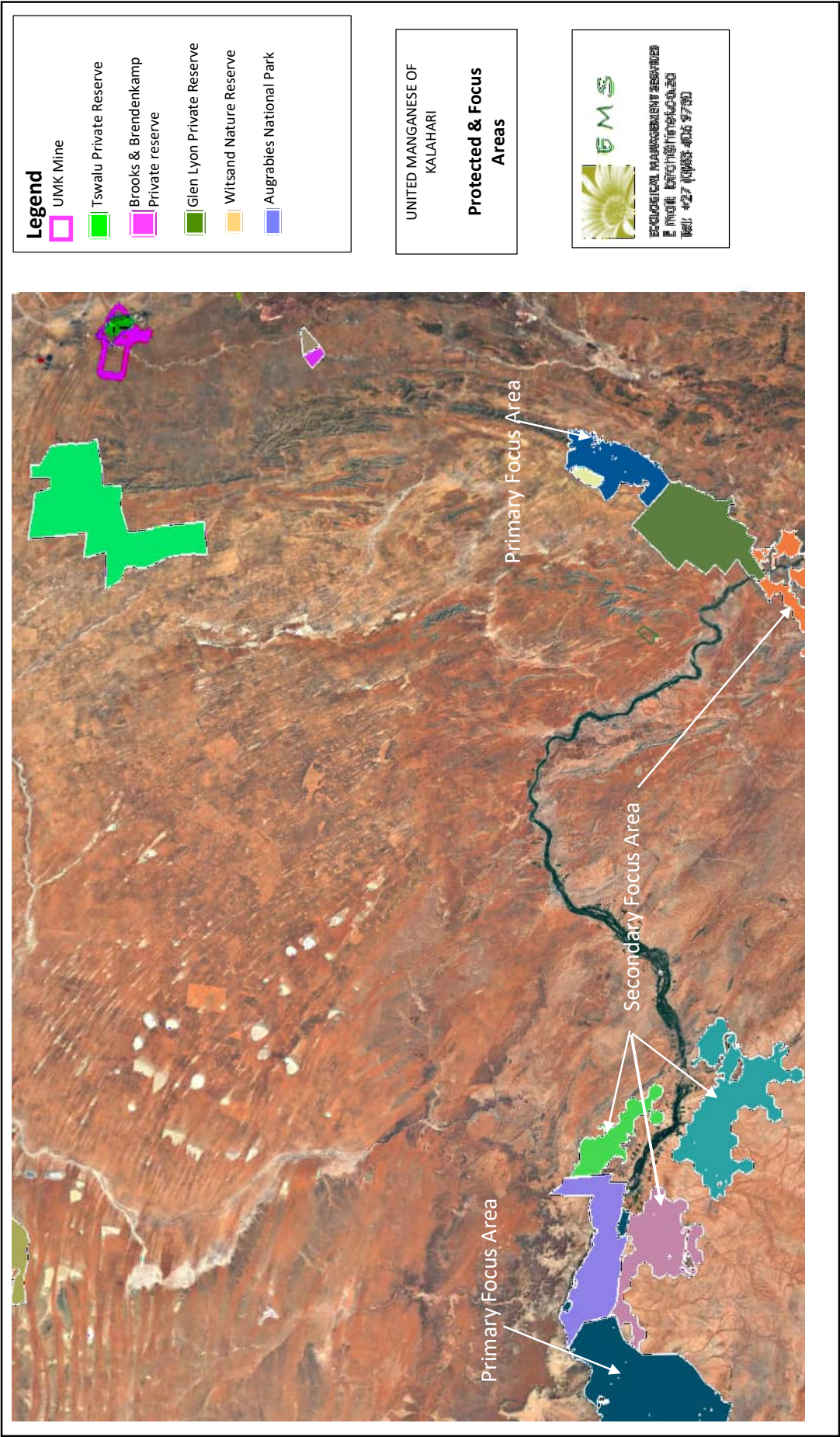
## REGIONAL CONSERVATION PLANNING

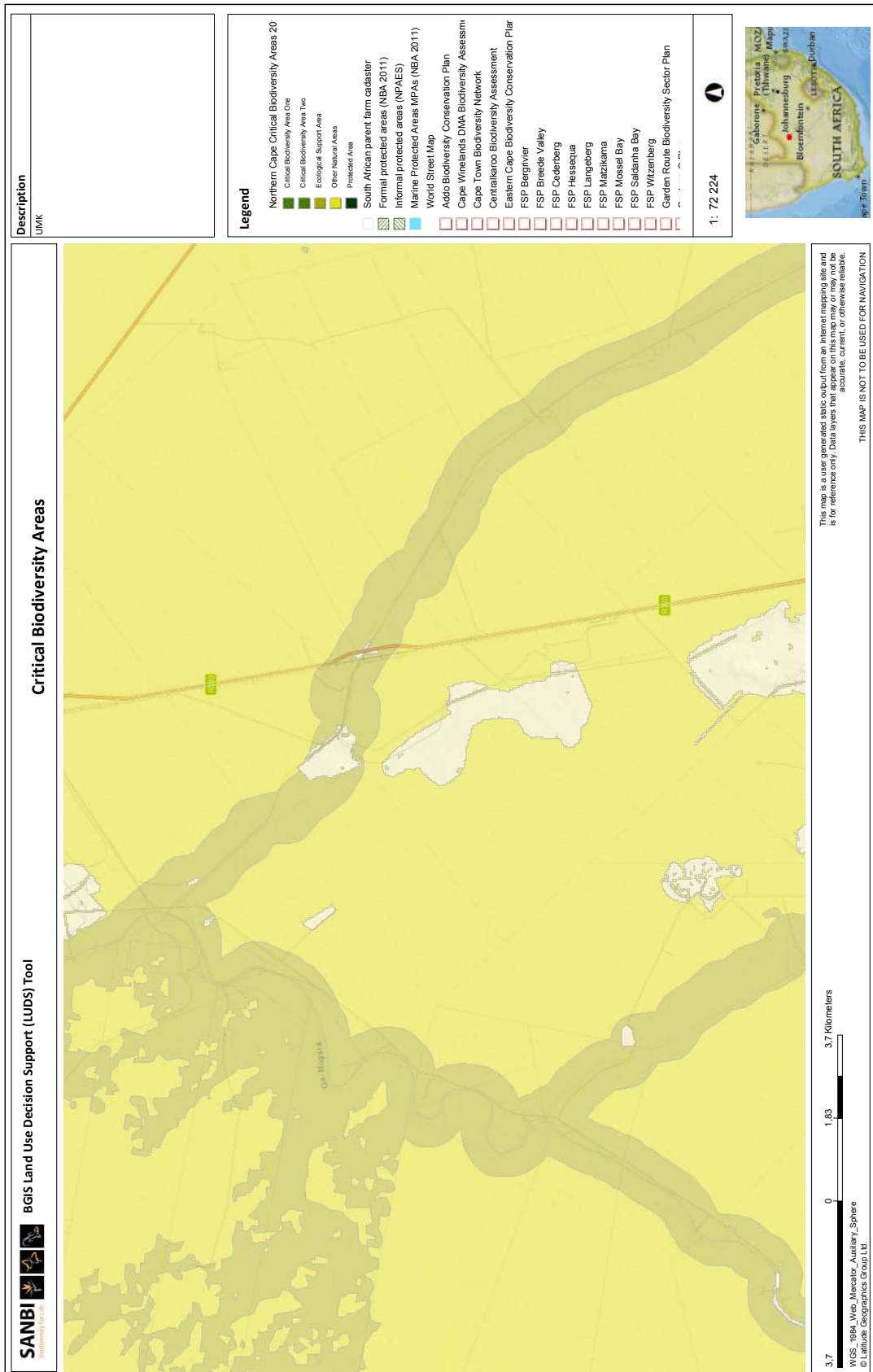












## APPENDIX 3

### DETAILS OF SPECIALIST

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## ABRIDGED CURRICULUM VITA

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### NATALIE VIVIENNE BIRCH

Date of birth: 21 August 1972

### QUALIFICATIONS

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BSc (Rhodes University) – Botany and Zoology

BSc (Hons) Wildlife Management, Pretoria University

PhD (Rhodes University)

### PHD DISSERTATION

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Vegetation potential of natural rangelands in the mid Fish River Valley. Towards a sustainable and acceptable management system.

### RESEARCH INTERESTS

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My academic interests cover various areas dealing with ecological functioning, and wildlife management, with a special interest in the functioning and management of arid and semi arid rangelands.

### ACADEMIC AWARD

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Awarded a medal in 2001 by the Grassland Society of Southern Africa for: Outstanding Student in Range and Forage Science

### PROFESSIONAL EXPERIENCE

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1999 – 2000	<u>Eastern Cape Parks Board</u>	Ecologist
2000 -2002	<u>Coastal &amp; Environmental Services</u>	Consultant
2003 – present	<u>Ecological Management Services</u>	Owner/Consultant

I am a founding member of Ecological Management Services, which is based in Kimberley, and we specialise in ecological management and impact assessment. Although we are based in Kimberley

we cover most of South Africa and have projects in the Eastern Cape, Free State, North West Province, Northern Cape and Gauteng. We have undertaken impact assessments for various types of developments including urban and rural developments, agricultural developments, as well as developments within the mining sector. We also provide specialist input to various types of projects and have formulated biodiversity offset studies required to offset impacts from large developments.

A selection of recent work is as follows:

- Department of Agriculture Northern Cape—Hopetown Piggery
- Department of Agriculture Northern Cape—Phillipstown Piggery
- Department of Agriculture Northern Cape—Chikiana Piggery
- Department of Agriculture Northern Cape—De Aar Hydroponics
- Sidi Parani—Fertilizer granulation plant in Christiana
- Tiva Enviro Services - Biodiversity study for De Aar Hospital
- Ghaap Ostrich Abattoir—Biodiversity Study
- Amakhala Nature Reserve—Development of lodge facilities
- IG van der Merwe Trust—Residential development, Douglas
- Valrena Trust—Residential development along Vaal River
- Idstone Pty Ltd—Development of irrigation ground for seed potatoes production
- Tiaan Trust—Development of irrigation ground
- C F Scholtz & Seuns - Development of irrigation ground for growing of crops
- Kosie Smith Trust - Development of irrigation ground for growing seed potatoes
- Bakgat Trust—Development of irrigation ground for growing of crops
- Mount Carmel (pty) Ltd—Development of irrigation ground for growing of crops
- Koppieskraal Plase Rietrivier Beperk—Development of irrigation ground for seed potatoes production
- Genade Boerdery (PTY) Ltd—Development of irrigation ground for growing of crops
- Santarose Investments (Pty) Ltd - Development of irrigation ground for seed potatoes production
- Valrena Trust—Development of irrigation ground for growing of crops
- Middeldrift Dairy Trust—Establishment of Dairy
- Eliweni Wildlife (Pty) Ltd - Lodge Development on Amakhala Nature Reserve
- Idstone Pty Ltd—Development of irrigation ground for the growing of seed potatoes
- Trisa Trust—Development of irrigation ground for the growing of seed potatoes
- GWK Pty Ltd—Development of irrigation pivots and vineyards
- Blair Athol Golf course development
- Rolfontein Nature Reserve lodge development
- SLR—Ecological Specialist survey for Kudumane Mine
- Biodiversity offset plan—UMK mine
- Biodiversity Action Plan for UMK mine
- Biodiversity offset Kudumane Mine
- IDC—Ecological Management & Business Plan: Siyancuma Women in Game Initiative
- Swanvest 123 Pty Ltd—Wolverfontein Breeding Facility
- De Beers—Ecological Evaluation and Management Plan for Kleinsee Game Farm
- Kalahari Oryx Game Reserve—Risk Assessment introduction of Lion
- Department of Land Affairs—Ecological Management and Business plan for Thwane Commonage

- Mauricedale Game Ranch—Paardefontein Specialist Vegetation Survey
- Santrosa Investments Pty Ltd—Olie Rivier Game Farm HA
- Manzi Safaris Habitat Assessment
- Thuru Lodge—Risk Assessment & Habitat Analysis
- Dugmore brothers—Habitat assessment Hartebeesthoek
- Schutte Boerdery Trust—Habitat Assessment Glenfrere
- F G. Taljaard—Habitat Assessment Namakwari Game Reserve
- Rivierfront Wild - Doornfontein Habitat Assessment
- Sjobbolet Trust—Hartsvally Habitat Assessment
- Raltefontein Habitat Assessment
- Kalahari Oryx Game Reserve—Specialist Vegetation survey

#### PROFESSIONAL ASSOCIATIONS

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Grassland Society of Southern Africa

South African Council for Natural scientific Professions Registration number 400117/05

#### RESEARCH PUBLICATIONS

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Evans, N.V., Avis, A.M. and Palmer, A.R. 1997. Changes to the vegetation of the mid-Fish River valley, Eastern Cape South Africa, in response to land-use, as revealed by a direct gradient analysis. *African Journal of Range & Forage science*, **14**(2): 68-74.

Birch N.V., Avis, A.M. and Palmer, A.R. (1999) The Effect Of Land-Use On The Vegetation Communities Along A Topo-Moisture Gradient In The Mid-Fish River Valley, South Africa. *African Journal of Range & Forage science*, **16**(1): 1-8

Birch, N.V., Avis, A.M. and Palmer, A.R. 1999. Changes to the vegetation communities of natural rangelands in response to land-use in the mid-Fish River valley, South Africa. *People and Rangelands Building the Future* (Eds D. Eldridge & D. Freudenberger) pp.319-320 vol 1. Proceeding of the VI International Rangeland Congress, Townsville, Queensland, Australia