Ecological Management Services

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BIODIVERSITY SURVEY REPORT FOR THE PROPOSED MOKALA MANGANESE MINE, HOTAZEL NORTHERN CAPE

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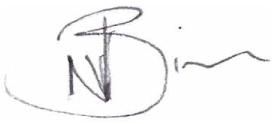
For
SLR Consulting (Africa) (Pty) Ltd (Pty)

August 2015

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, 2014;
- do not have and will not have any vested interest in the proposed 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, 2014;
- will provide the competent authority with access to all information at my disposal regarding the study.



Natalie Birch Pr. Sci. Nat 400117/05

August 2015

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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
DAFF	The Department of Agriculture, Forestry and Fisheries
DENC	Department of Environment and Nature Conservation
EIA	Environmental Impact Assessment
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. INTRODUCTION

Mokala Manganese (Pty) Ltd is planning on submitting a mining right application on the remaining extent (portion 0) of the farm Gloria 266 and the whole farm Kipling 271, near Hotazel, in the Northern Cape Province.

SLR has been appointed to conduct the EIA process required for this development and has in turn, appointed Ecological Management Services to perform a specialist fauna and flora assessment of the site as part of the EIA process. The report was complied by Dr N.V. Birch Pr. Sci Nat. (reg no 400117/05). Details of the specialist are attached in Appendix 3

1.1. TERMS OF REFERENCE & SCOPE OF WORK

This survey included;

- Desktop and field investigations to identify and map different habitats, concentrating on areas proposed for new infrastructure
- Assign species to each habitat through various sampling methods
- Rank each habitat type based on conservation importance (in terms of provincial biodiversity priorities) and ecological sensitivity
- Identify potential impacts (including cumulative) on ecology
- To have input, together with SLR, into project alternatives and ecology management measures going forward

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 (Mucina and Rutherford 2006).
- Information on plant and animal species recorded for the Quarter Degree Squares (QDS), was extracted from the SABIF/SIBIS 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 (2011).
- Threatened Ecosystem data was extracted from the NEM:BA listed ecosystems layer (SANBI 2008).
- 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 2008 (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 (SANBI's SIBIS and BGIS databases).
- Literature consulted includes Branch (1988) and Alexander and Marais (2007) 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 (2012) (See Table 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. The IUCN Red List Categories for fauna and flora. Species that fall within the categories in red and orange below are of conservation concern.

IUCN Red List Category
Critically Endangered (CR)
Endangered (EN)
Vulnerable (VU)
Near Threatened (NT)
Critically Rare
Rare
Declining
Data Deficient - Insufficient Information (DDD)
Data Deficient - Taxonomically Problematic (DDT)
Least Concern

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. The information presented in this report represents the wet/summer season survey. A full plant species list was compiled for the site from the site visits, this was complemented by a list 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.

At present there is no Systematic Biodiversity Conservation Plan for the Northern Cape other than the Namakwa District Biodiversity Sector Plan. Thus there is no fine scale biodiversity data available and consequently no Critical Biodiversity Areas have been defined for this area. Thus although there are no CBAs defined it should not be assumed that they don't exist. No information is currently available on the fine scale distribution of ADEs, type of plant association, (singly, in stands or gallery forests), aquifer association, condition of vegetation etc and therefore a precautionary approach should be taken when developing in and around these systems until such time that the research data indicates whether or not they are in fact CBAs.

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

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. The Draft National List of Threatened Ecosystems (Notice 1477 of 2009, Government Gazette No 32689, 6 November 2009) has been gazetted for public comment. The list of threatened terrestrial ecosystems supersedes the information regarding terrestrial ecosystem status in the NSBA 2004. 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. However, all of the vegetation types within and surrounding the study site are classified as Least Threatened.

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:

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 DENC 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.

3. METHODOLOGY

Three site visits were conducted, an initial survey was undertaken on the 7 November 2014, an additional quantitative site survey was conducted at the end of February 2015 and a tree density survey in August 2015. During the site visits, 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 across the site 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.

Flora

Aerial photographs & 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.

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.

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.

Protected tree density

Density is simply the number of trees per unit area and is generally reported as the number of trees per hectare.

Determining the number of plant species within an area can effectively be achieved by an actual count where every plant within the study area is counted or a sample count where the plants are counted within a number of sample sites and then extrapolated for the whole area. A sample count was preformed within the study area.

The area was divided into a number of sample points within each of the target development areas. The areas to be cleared had been pegged out so that the sampling could be undertaken in areas that were earmarked for clearing. A stratified random sampling system was employed over the area to ensure that all vegetation units within the target areas contained sufficient sample sites. At each sample point a 2x100m ($200m^2$) transect was laid out and the number of protected trees counted within each transect. These values were then converted to density values per ha.

Within each transect the protected trees encountered were counted according to height class and size structure. This was done to determine the demography of the population of trees within the study area.

The sized and height classes were measured as follows:

Height class: <50cm ; 50cm – 1m; 1m-2m; 2m-4m; 4m-6m; 6m-8m; >8m.

Stem diameter: <1cm; 1cm-2cm; 2cm-5cm; 5cm-7cm; 7cm-10cm; 10cm-15cm; 15cm-20cm; >20cm

4. DESCRIPTION OF THE AFFECTED ENVIRONMENT-BASELINE

4.1. BROAD-SCALE VEGETATION PATTERNS

The study area falls within the Kathu Bushveld and Gordonia Duneveld (Mucina & Rutherford 2006) The Kathu Bushveld which is described as an open savannah with the Camel Thorn[1], *Vachellia erioloba* (formerly known as *Acacia erioloba*) and Shepards Tree, *Boscia albitrunca* as the prominent trees. The shrub layer is dominated by Black thorn *Senegalia mellifera,* (formerly known as *Acacia mellifera*) Blue bush, *Diospyros lycioides* and River Honey-thorn, *Lycium hirsutum* and the grass layer is described as being vary variable. Gordonia duneveld typically occurs on the undulating dunes. It is an open shrubland with grasslands on the ridges and Grey Camel Thorn, *Vachellia haematoxylon* (formerly known as *Acacia haematoxylon*) on the dunes slopes, *Senegalia mellifera* is prominent on the lowers slopes and Three thorn, *Rhigozum trichotomum* is found in the interdune streets.

4.2. PLANT COMMUNITY DESCRIPTION

The site consists of a mixture of vegetation that displays various slight structural changes and dominance in woody vegetation. Five distinct 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).

Mixed *Vachellia* Savannah

This vegetation also contains a tree layer which is mainly comprised of tall *Vachellia erioloba* trees but is distinctive from the above vegetation type in that the density of the *V. erioloba* trees is less and the savannah forms a more open unit. Three vegetation strata are evident within this vegetation unit. There is a prominent tree layer between 2.5m – 6m, a shrub layer, between 1.5m – 2.5m and a grass layer with an average height of 70cm. *Vachellia erioloba, V. haematoxylon* (Grey Camel Thorn), and *Senegalia mellifera* (Black Thorn), are prominent within this vegetation type, however *Ziziphus muconata (*Buffalo thorn), *Grewia flava* (velvet raisin), *Terminalia* spp and *S. mellifera* also occur. The grass layer contained species such as *Eragrostis lehmanniana, Stipagrostis uniplumis* (bushman grass), *Setaria verticillata, Aristida stipitata* and *Aristida congesta* were common. Other common species include, *Tribulus zeyheri* (devils thorn), and *Walafrida geniculata*.

[1] 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: Mixed *Vachellia* Savannah

Senegalia mellifera 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/tree species within this vegetation community include *Grewia flava, 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 Woodland*

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, Indigofera alternans,* and *Monochema divaricatum.*

Plate 4.3: *Vachellia haematoxylon Savannah.* The protected *Vachellia haematoxylon* trees occur with a high density throughout this vegetation type.

Tarchonanthus camphoratus Scrub

This vegetation type occurs on the well drained shallow stony soils which are underlain by calcrete. This vegetation type is characteristically short and has a high percentage occurrence of *Tarchonanthus camphoratus* (Camphor bush). Although *T. camphoratus* is the dominant shrub, *Lycium hirsutum and Senegalia mellifera* are also present within this community. The grass layer consists of species such as, *Schmidtia pappophoroides* (Sand quick)*, Eragrostis lehmanniana, Stipagrostis uniplumis Aristida stipitata* and *Aristida congesta*. Dwarf karroid shrubs are prominent within the community and consist of species such as, *Pentzia calcarea Melolobium humile, Salsola patentipilosa,* and *Thesium hystrix.* Other common species included, *Berkheya ferox, Dimorphotheca zeyheri,* and *Geigeria ornativa.*

Plate 4.4: *Tarchonanthus camphoratus* Scrub

Riverine Vegetation

This vegetation type is found within the Ga-Mogara non-perennial stream which runs through the study area. It consists of a grassy layer with scattered trees and shrubs. Species such as *Vachellia erioloba, Ziziphus mucronata, Vachellia karroo, Bosica albitrunca*, *Enneapogon cenchroides, Aristida stipitata, Cynodon spp, Cyperus margaritaceus* and *Eustachys paspaloides* were noted within this vegetation type. In some areas this vegetation type has been heavily invaded by *Prosopis glandulosa* (Mesquite).

Plate 4.5: Riverine Vegetation

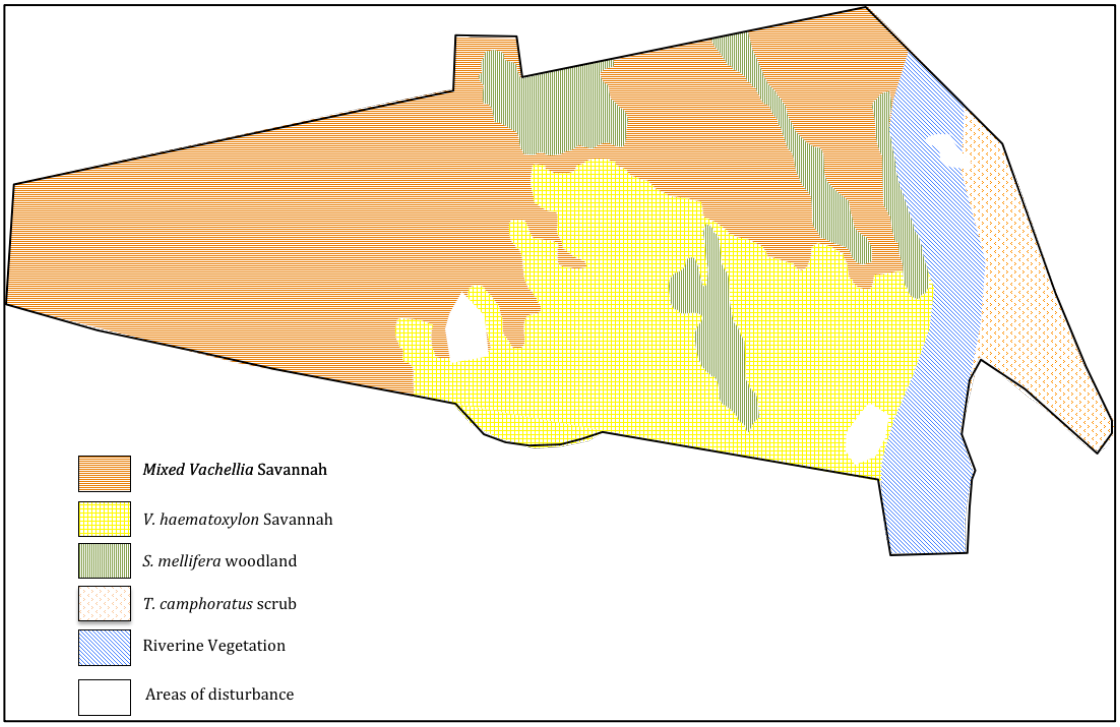

Figure 4.1: Vegetation distribution map within the proposed development area.

4.3. POPULATIONS OF SENSITIVE AND/OR THREATENED PLANT SPECIES

Historical records of Red List plant species were consulted in order to determine the likelihood of any such species occurring in the study area and these were searched for in the field. A List of threatened the plant species previously recorded in the quarter degree

grid in which the study area is situated was obtained from the South African National Biodiversity Institute, these species are listed in the table below

Species	Legislation	Conservation status	Potential of occurrence
Vachellia erioloba	National Forests Act 1998 Red List of South African plants	Protected Declining	Recorded on site
Vachellia haematoxylon	National Forests Act 1998	Protected	Recorded on site
Moraea longistyla	NCNCA	Schedule 2	Recorded on site
Moraea pallida	NCNCA	Schedule 2	Not recorded on site
Babiana hypogaea	NCNCA	Schedule 2	Not recorded on site
Harpagophytum procumbens Devil's claw	NCNCA	Schedule 1	Not recorded on site

Table 4.1: Protected species that possibly occur on site.

Owing to the narrow temporal window of sampling the fact that some of these species were not encountered does not preclude them from occurring within the development site, it is therefore recommended that prior to clearing an additional walk through is conducted. In order to remove these species during site clearing activities an integrated permit application will have to be made to the DENC to obtain the required permission to remove and/or translocate these species from site.

The tree species that were recorded on site that are protected in terms of the National Forests Act of 1998 (Act 84 of 1998) are *Vachellia erioloba,* and *Vachellia haematoxylon.* These trees vary in density across the different vegetation communities but were found in each community.

The results from the density survey conducted on site are given in the table below.

Area	Species	Density per 200m²	Density per ha (10 000m²)
Pit area	*V. haematoxylon*	3,746 ± 1,079	187,3
	V. erioloba	0,172 ± 1,821	8,6
Plant area	*V. haematoxylon*	1,097 ± 0,891	54,85
	V. erioloba	0,414 ± 0,134	20,7
Stockpile area	*V. haematoxylon*	0.678 ± 1,191	33,90
	V. erioloba	0,356± 0,791	17,8
Administration area	*V. haematoxylon*	0,045± 0,101	2,25
	V. erioloba	1,107± 0,057	55,35

Table 4.2: Calculated density values for the proposed development areas

The proposed pit area largely falls within the *V. haematoxylon* Savannah and therefore has the highest density of *Vachellia haematoxylon* trees. A portion of the pit area does however fall within the Ga-Mogara non-perennial stream. Typically the vegetation in this area has a higher proportion of *V. erioloba* trees and much less *V. haematoxylon*. This variation is denoted by the higher standard of deviation of the sample points, as there was a significant difference in tree numbers between the plots sampled in the Ga-Mogara and those in adjacent areas of the planned pit.

The area that contained the highest density of *V. erioloba* trees was within the administration area. This area has a small patch, where the density and size classes, of *V. erioloba* is different to the surrounding area. However the amount of trees affected in this area can be reduced, by positioning the buildings to avoid as many trees as possible. The area also does not require strip clearing thus trees can be left relatively undisturbed between the actual buildings

Figure 4.2 shows the size class distribution of the two tree species sampled. The majority of the *V. haematoxylon* on site are characterized as shrubs, between 1m-2m tall. They are multi-stemmed with an average stem diameter of approximately 3cm. Plants below 50cm accounted for the smallest percentage of the population, with plants larger than 2m comprising 14% of the population. No *V. haematoxylon's* taller than 4m were counted within the sample plots.

Plants below 50cm and between 4m-6m comprised the largest height classes for the *V. erioloba* population on site. No individuals between 1m-2m were recorded in the plots. The plants below 50cm were mostly below grass height and are not easily observable at a cursory glance.

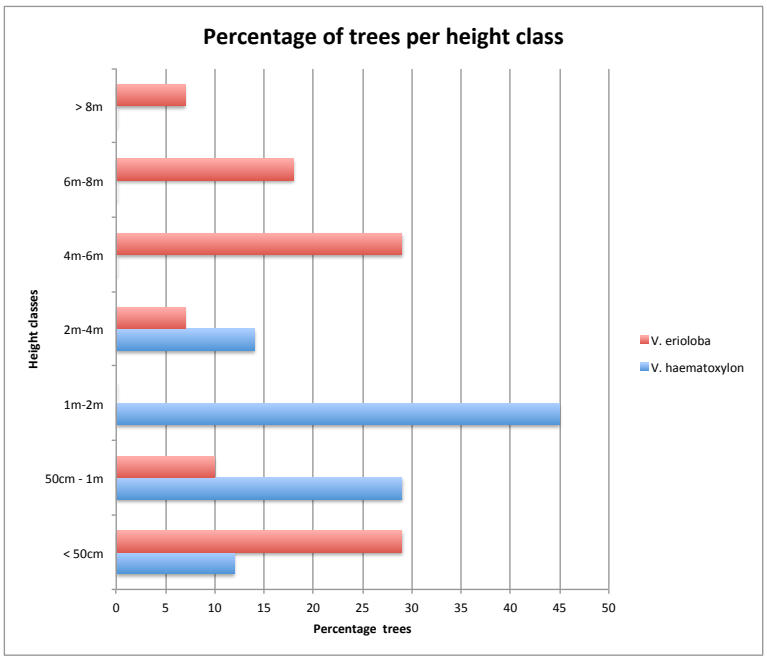

Figure 4.2: Percentage representation of *V. erioloba* and *V. haematoxylon* within size classes on the proposed Mokala Mine site.

Plate 4.6: Typical example of the *Vachellia erioloba* trees that occur on site

Plate 4.7: Typical example of the *Vachellia haematoxylon* shrub that occurs on site.

4.4. 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 Gordonia duneveld is classified as least threatened (Target 16%). Approximately 14% is statutorily conserved in the Kgalagadi Transfrontier Park. Very little is considered transformed.

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 restricted distributions, known as endemics. Centres of endemism are important because it is these areas, which if conserved, would safeguard the greatest number of plant species. They are extremely vulnerable; relatively small disturbances in a centre of endemism may easily pose a serious threat to its many range-restricted species. The GWC is one of the 84 African centres of endemism and one of 14 centres in southern Africa, and these centres are of global conservation significance. The GWC is considered a priority in the Northern Cape, as the number of threats to the area is increasing rapidly and it has been little researched and is poorly understood. Furthermore, this centre of endemism is extremely poorly conserved, and is a national conservation priority.

In terms of the mining and biodiversity guideline the study site does not fall into any biodiversity priority areas and is therefore not deemed a risk for mining (Appendix 2).

However the river area above the planned mine is considered to be of the highest biodiversity importance.

Focus areas for land-based protected area expansion are large, intact and unfragmented areas of high importance for biodiversity representation and ecological persistence, suitable for the creation or expansion of large protected areas. The focus areas were identified through a systematic biodiversity planning process undertaken as part of the development of the National Protected Area Expansion Strategy 2008 (NPAES). They present the best opportunities for meeting the ecosystem-specific protected area targets set in the NPAES, and were designed with strong emphasis on climate change resilience and requirements for freshwater ecosystems.

The proposed mining area does not fall within a NPAES focus area but is located approximately 7km from an area identified as a potential protected area for the eastern Kalahari bushveld (appendix 2). The study area is not considered a threatened ecosystem and does not fall within a National Freshwater Ecosystem Priority Area. No fine-scale conservation planning has been conducted for this area, thus no critical biodiversity areas have been identified. A gap analysis undertaken for this area (EMS 2011) has revealed that information on an important ecosystem was lacking within the available biodiversity databases, namely information on the Aquifer Dependent Ecosystems (ADE), which occur within the area. ADEs particularly in arid ecosystems provide habitats for an array of species and are considered important in ecological processes and making available resources for the biodiversity in an area that would otherwise not be available. Thus ADEs could be considered critical biodiversity areas (CBA) for the study area, and thus would need to be mapped and assessed, even though ADEs are not specifically classified as a CBA in terms of SANBI databases. ADE's within the area that would be particularly critical are the terrestrial ADE's associated with species such as *Vachellia erioloba,* and *Vachellia haematoxylon.*

A study conducted by David Hoare Consulting (2013) showed that *Vachellia erioloba* occurred as scattered to more concentrated individuals throughout the region. However there appeared to be higher densities along the banks of the main channel of the Kuruman and Ga-Mogara Rivers in the area around Hotazel, and thus there would appear to be an ADE relationship associated with these non-perennial streams and the *Vachellia erioloba*. At present there is insufficient research data to determine whether these streams and their surrounding vegetation are in fact CBA and therefore a precautionary approach should be used until such time that the research data indicates that they are not CBA.

4.5. ALIEN/INVASIVE SPECIES

Alien/invasive species are controlled in terms of Regulation 15 and Regulation 16 (R. 280 of 2001) of the Conservation of Agricultural Resources Act (No. 43 of 1993). Regulation 15 divides the plants into three categories as indicated below:

Category 1: Plants that must be removed and destroyed immediately.
These plants serve no economic purpose and possess characteristics that are harmful to humans, animals and the environment.
Category 2: Plants that may only be grown under controlled conditions.
These plants have certain useful qualities and are allowed in demarcated areas. In other areas they must be eradicated and controlled.

Category 3: Plants that may no longer be planted. Mostly ornamental plants. These are alien plants that have escaped from or are growing in gardens, but are proven to be invaders. No further planting is allowed. Existing plants may remain (except those within the flood line, 30 m from a watercourse or in a wetland) and must be prevented from spreading

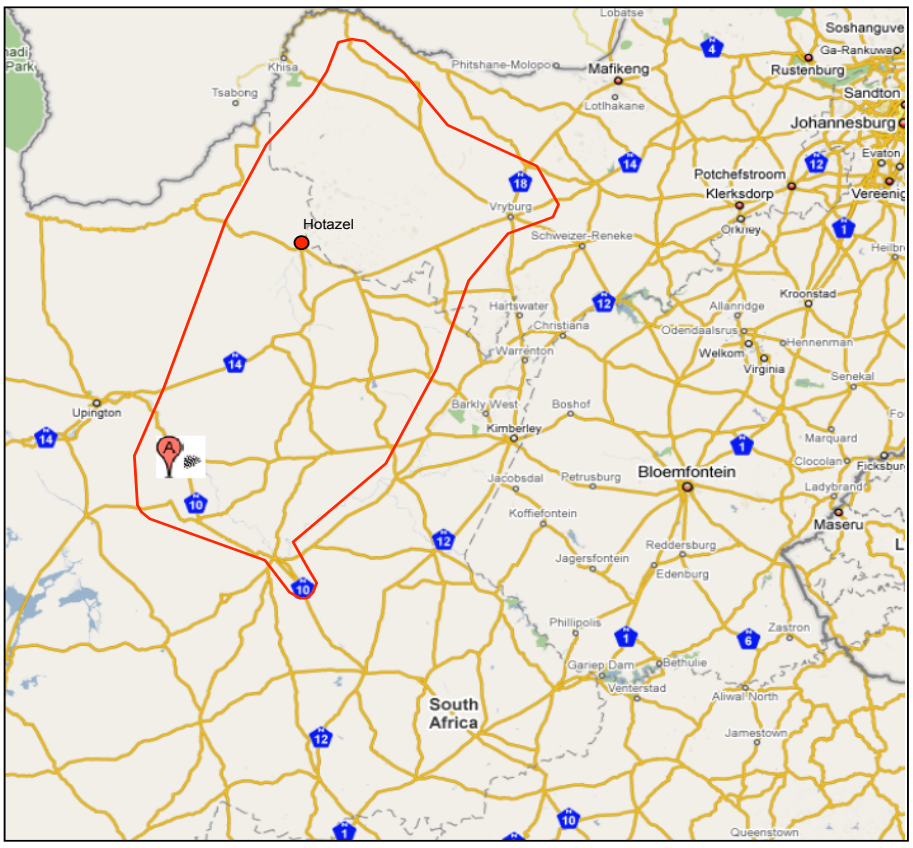

Figure 4.3: The approximate extent of the Griqualand West Center of Endemism (indicated in red).

Alien and alien invasive species recorded in and around the property are listed in the table below:

Species		Category
Argemone mexicana	Mexican Poppy	1
Argemone ochroleuca	White Flowered Mexican Poppy	1
Prosopis cf. *glandulosa*	Mesquite	2
Prosopis velutina	Mesquite	2
Datura stramonium	Thorn apple	1

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

4.6. AREAS OF DISTURBANCE

There are small patches within the property that have been disturbed such as the old crusher yard and the borrow pit area adjacent to the Ga-Mogara River. A tarred road also runs through the property.

Other types of disturbances are associated with past farming practices, such as disturbances caused by over grazing, and trampling effects.

4.7. POPULATIONS OF SENSITIVE AND/OR THREATENED FAUNAL SPECIES

Disturbance factors such as mining activities and agricultural activities result in disturbances to the naturally occurring faunal species. The farming practises and the surrounding mining activity, have already disturbed the local faunal population. Very few faunal species observations were made during the site visit thus emphasis was rather placed on the habitat in order to determine potential occurrence of species

Based on the bird species identified while on-site, the proposed development site hosts both grassland and bushveld bird species. Grassland species observed included, the Diederik Cuckoo, European bea-eater, and the White throated swallow. While species that prefer bush or scrub included, Red faced mousebird, Fork tailed Drongo, Ashy tit, Redeyed Bulbul, and Clapper lark .

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, White-tailed Mongoose, and ground squirrels were observed on site.

Reptiles Species of Conservation Concern

No red data terrapin, tortoises, snakes or lizards were identified as occurring in the quarter degree square 2722BB, based on the distribution maps available in the South African Red Data Book for reptiles (Branch, 1988 and Alexander and Marais (2007)) 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 red data amphibians were identified as occurring in the quarter degree squares 2722BB, 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 red data bird species occurring in the quarter degree square 2722BB, 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 (Barnes, 2000) with the distribution being confirmed in Roberts – Birds of Southern Africa, 7th 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.

Mammals of Conservation Concern

A list of all red data mammal species occurring in the quarter degree squares 2722BB, was extrapolated from the Red Data Book for Mammals (EWT, 2004). 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.

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

Common Name	Scientific Name	Conservation Status	Suitable Habitat requirements[2]	Potential for Occurrence On-site
Martial Eagle	*Polemaetus bellicosus*	Vulnerable *Near Threatened**	Woodland, savannah or grassland with clumps of large trees or power pylons for nest sites	High – Nesting habitat in the Mixed Savannah
Secretarybird	*Sagittarius serpentarius*	Near threatened *Vulnerable**	Requires open grassland with scattered trees, shrubland, open Mixed Savannah.	High – Patches of open savannah will accommodate this species.
African Whitebacked	*Gyps africanus*	Vulnerable	Savannah and bushveld.	High -No nest sites were

[2] Habitat requirements determined using the following reference material: Harrison *et al.*, 1997a; Harrison *et al.*, 1997b; Barnes, 2000; Hockey *et al.*, 2005

Common Name	Scientific Name	Conservation Status	Suitable Habitat requirements[2]	Potential for Occurrence On-site
Vulture		*Endangered**	Nest in tall trees (*Vachellia erioloba*).	recorded within the planned development area. However the presence of large *Vachellia erioloba* trees presents ideal nesting habitat for these birds.
Kori Bustard	*Ardeotis kori*	Vulnerable *Least Concern**	Dry thornveld grassland, arid scrub requires the cover of some trees	Medium – Moderate to high shrub density throughout the site
Black stork	*Ciconia bigra*	Near threatened *Least Concern**	Marshes, dams rivers and estuaries breeds in mountainous regions	Low – No suitable habitat on site, may occur during periods of high rainfall
Lesser Kestrel	*Falco naumanni*	Vulnerable *Least Concern**	Open semi arid grasslands, usually avoids wooded areas.	Low: - Area too densely wooded for ideal habitat.
Bateleur	*Terathopius ecaudatus*	Vulnerable	Wide variety of woodland types, savannah and open plains	**Medium** – Some suitable habitat on site
Lappetfaced Vulture	*Torgos tracheliotos*	Vulnerable	Savannah; semi arid regions closely associated with *Vachellia* spp, *Bosica albitrunca* and *Terminalia pruniode*s	**High** Suitable habitat on site particularly within the Mixed Savannah

Table 4.5: Mammal species of conservation concern identified as occurring in the quarter degree square 2722BB and the potential for occurrence on the proposed prospecting site.

COMMON NAME	SCIENTIFIC NAME	CONSERVATION STATUS	SUITABLE HABITAT ON-SITE[3]	POTENTIAL FOR OCCURRENCE ON-SITE
Dent's Horseshoe Bat	*Rhinolophus denti*	Near threatened	**Limited** – Requires *substantial* cover such as caves and rock crevices.	**Very little** – 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 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	*Mellivora capensis*	Near threatened	**High** – As they are catholic in habitat requirements, they are likely to occur on-site.	**High** – Suitable habitat within the study area.
Schreiber's long-fingered bat	*Miniopterus schreibersii*	Near threatened	**Limited** – Suitable cover such as caves and mine adits determines distribution.	**Very little** – No caves or mine adits occur on-site. In addition, as the landscape in the area is generally flat sand veld and does not offer suitable roosting habitat for this species, it is unlikely that this species would have colonised the area.
South African	*Atelerix frontalis*	Near threatened	**High –** Require	**High** to **Medium** –

[3] Habitat requirements determined using the following reference material: Skinner and Smithers, 1990; EWT, 2004; Skinner and Chimimba, 2005

COMMON NAME	SCIENTIFIC NAME	CONSERVATION STATUS	SUITABLE HABITAT ON-SITE[3]	POTENTIAL FOR OCCURRENCE ON-SITE
Hedgehog			ample groundcover and dry places for nesting.	Suitable habitat available.

5. SITE SENSITIVITY

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.

habitat remaining (%)

80-100	Least threatened	LT
60-80	vulnerable	VU
*BT -60	endangered	EN
0-*BT	Critically endangered	CR

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

The national status is based on 1996 National Landcover data (Fairbanks *et al* 2000) and is, therefore out of date. Additional transformation has taken place since 1996 and it is for this reason updated transformation information is often required to improve the conservation assessment. 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 of habitat structure.

Sensitivity of habitats and sites within the study area were 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.

The area of highest site sensitivity is the area of the Ga-Mogara non-perennial stream. Areas that contain a high density of the protected trees, (*Vachellia haematoxylon* and *Vachellia erioloba*) namely, the mixed *Vachellia* Savannah and the *V. haematoxylon* Savannah are considered more site sensitive owing to the presence of these tree and can therefore be classified as moderately sensitive in terms of the site. The areas containing the *S. mellifera* woodland can be considered to have a low sensitivity as these areas have been encroached by *S. mellifera* as a result of disturbance factors, mostly likely overgrazing. The *T. camphoratus* scrub also has a lower site sensitivity, it contains much fewer protected trees (in comparison to the other vegetation types) and has also been affected by disturbance factors such as overgrazing.

An overlay of the proposed development layout shows that the planned development will impact on all of the communities. The protected trees occur throughout the planned

development area. The trees do not occur in clusters that can easily be avoided, but occur more uniformly throughout the vegetation communities. Only avoiding development within entire communities would significantly reduce the impact to the protected trees

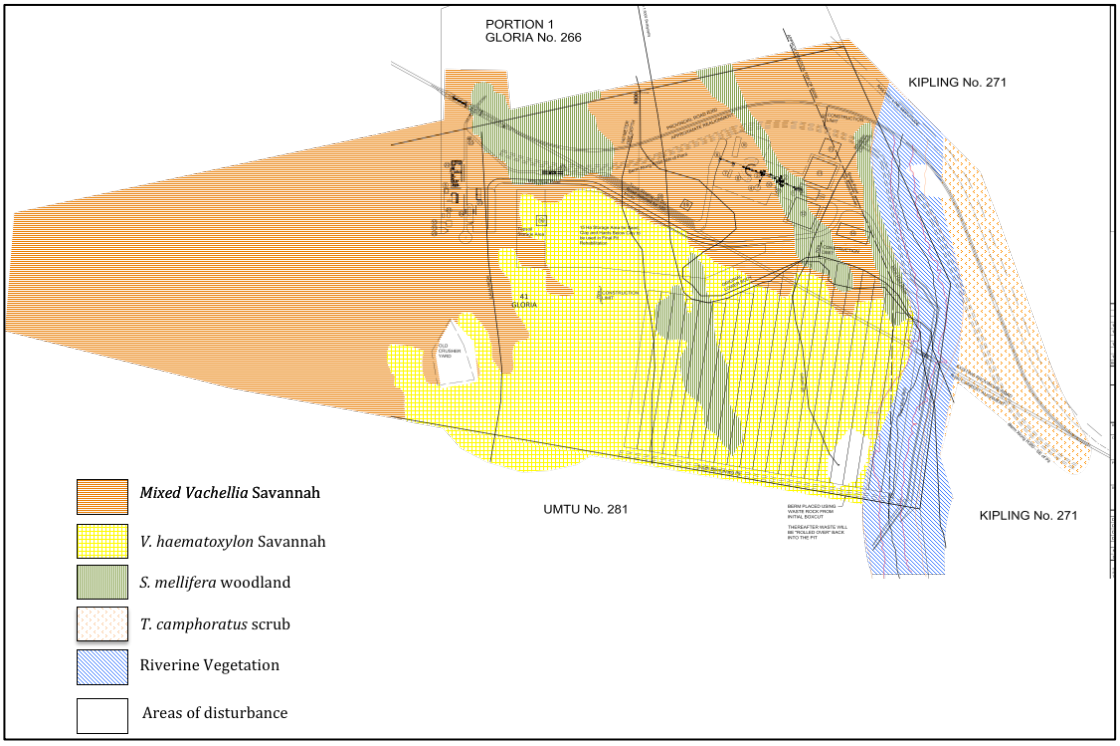

Figure 5.1: Overlay of proposed layout plan and the vegetation distribution map.

As part of the proposed project, two site layout alternatives were considered. In this regard, Option 1 includes the location of the proposed infrastructure to the south of the existing R380. Option 2 includes the realignment of the R380 and the location of the proposed infrastructure to the north and south of the current R380.

The alternative layout plan does not significantly alter the impact to the protected trees as the infrastructure within the alternative is still largely within the Mixed *Vachellia* Savannah, thus the same plant communities are still affected.

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 (its distribution is shown below in green). The *V. haematoxylon* woodlands in the area are not well conserved and are under threat from activities such as mining thus the loss of these woodlands has a significant impact.

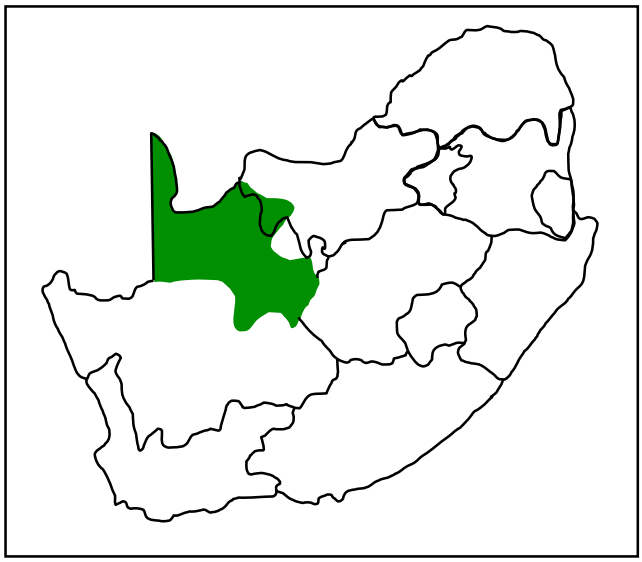

Figure 5.2: The distribution range of *Vachellia haematoxylon*

The removal of *Vachellia erioloba* trees not only results in a loss of the species richness in the area but has impacts on the ecosystem function of the area. *Vachellia erioloba* largely grow in clusters. The establishment of these assemblages within the microhabitat is slow, and may take decades, so established trees, are needed to facilitate their existence. These trees are also important as nesting and as perching sites. Tree rats (*Thallomys paedulcus*), sociable weavers (*Philetarius socius*) and many species of raptors and vultures have been found to nest preferentially in large trees. Other data collected in the southeastern Kalahari suggests that most other cup-nesting bird species also preferentially select larger trees as nest sites. Holes within large, dead or dying trees are crucial for hole nesting species (e.g. African Hoopoe *Upupa epops*, Scimitarbilled woodhoopoe *Rhinopomastus cyanomelas*), and the densities of these species appear to be governed by the densities of camelthorns.

Both rivers and wetlands are listed as types of watercourses and are afforded appropriate protection under the National Water Act and associated regulations. Thus no development should take place within riparian systems unless exemption from the regulation is applied for and obtained. The area of the Ga-Mogara non-perennial stream therefore needs to be considered when determining areas of sensitivity. The Ga-Mogara non-perennial stream consists of two zones, the river bed and the riparian zone[4]. 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.

[4] 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 and 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

The National Freshwater Ecosystem Priority Areas (NFEPA) (2011), database was consulted to define the aquatic ecology of the river systems close to or within the study area that may be of ecological importance. According to this database the area of the Ga-Mogara within the study site is classified as an upstream management area (appendix 2). Upstream Management Areas, are sub-quaternary catchments in which human activities need to be managed to prevent degradation of downstream river FEPAs and Fish Support Areas.

Plate 5.1: The Riparian zone of the Ga-Moraga. The obligate riparian plant species, *Ziziphus mucronata* ,is present within the riparian zone of the Ga-Moraga.

Plate 5.2: Riverbed of the Ga-Moraga, this section has been invaded by *Prosopis spp.*

A Desktop Assessment of the PESEIS for this section of the Ga-Moraga shows that the Present Ecological State (PES) is classified as C, which means it is moderately modified, some loss and change of natural habitat and biota has occurred, but the basic ecosystem functions are still predominantly unchanged. The ecological importance (EI) of a river is an expression of its importance to the maintenance of biological diversity and ecological functioning on local and wider scales and this is considered to be moderate for this section of the Ga-Moraga. Ecological sensitivity (ES) refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred. The ES for this section of the Ga-Moraga is considered to be very low.
Vegetation is a key component of the wetland definition in the National Water Act, since the definition of wetlands states that, under normal circumstances, wetland vegetation (species adapted to life in saturated soil) must be present for an area to be classified as a wetland. However wetland vegetation can respond relatively rapidly to alterations in hydrology, or to site disturbance. In wetlands where the inflows have been reduced or are very sporadic, the current vegetation cover may be comprised of terrestrial vegetation even though the site is a wetland (albeit dried out).

Owing to the sporadic flow of water in the water channel none of the vegetation species that are listed as obligate or facultative wetland species (DWAF 2008) are present within the river bed. According to the National Water Act classification system for wetlands, no wetlands based on plant species present are located within the proposed project area Delineating wetland areas within this region cannot be based on the presence of plant species composition but will have to rely on redoxymorphic features in the soil and topography.

Aquifer Dependent Ecosystems (ADEs) occur throughout the South African landscape in areas where aquifer flows and discharge influence ecological patterns and processes. They are ecosystems, which require groundwater from aquifers for all or part of their life-cycle. A study conducted by David Hoare Consulting (2013) showed that there would appear to be an ADE relationship associated with the non-perennial streams in the area, such as the Ga-Moraga. At present there is insufficient research data to determine whether these streams and their surrounding vegetation are in fact Critical Biodiversity Areas (CBA). No information is currently available on the fine scale distribution of ADEs, type of plant association, (singly, in stands or gallery forests), aquifer association, condition of vegetation etc and therefore a precautionary approach should be taken when developing in and around these streams until such time that the research data indicates whether or not they are in fact CBAs and how these areas are impacted by development.

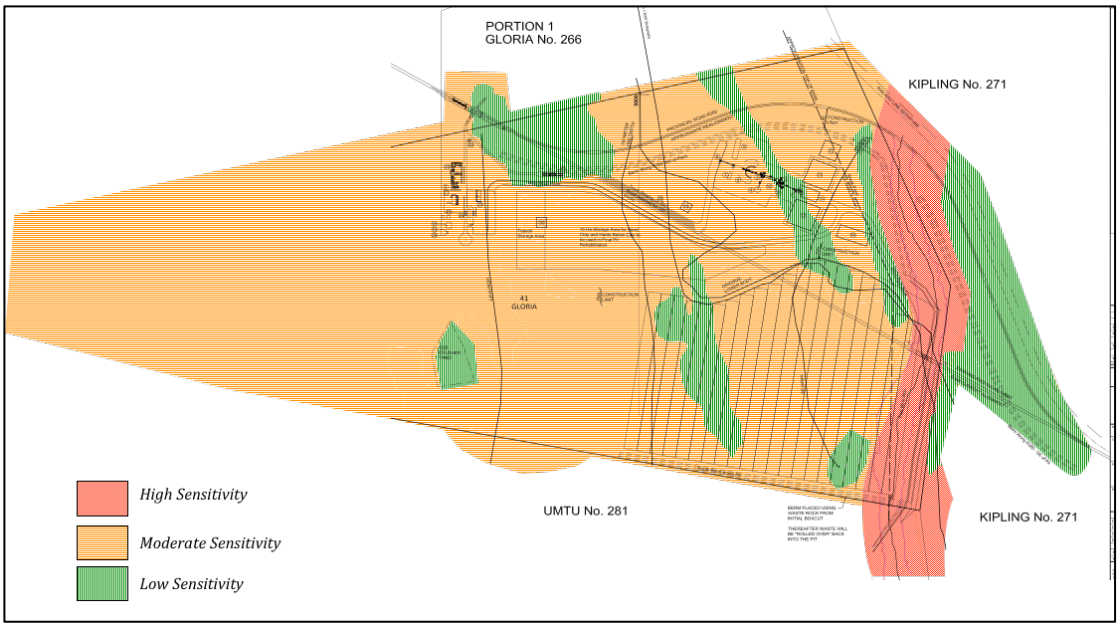

Figure 5.3: Overlay of the sensitive area map and the proposed layout plan .

6. POTENTIAL IMPACTS

6.1. VEGETATION AND FLORISTICS

6.1.1. Loss of natural vegetation

Project phase:

Construction Operational Decommissioning Closure

Description of impact:

The vegetation in the path of mining and within the infrastructure areas will be completely and permanently removed. This causes vegetation fragmentation and habitat disturbance in the landscape. This disturbance destroys primary vegetation and allows secondary pioneer species or invasive plants to enter and re-colonise disturbed areas. As primary vegetation is more functional in an ecosystem, this could irreversibly transform the vegetation characteristics in the area. The vegetation within the study area consists of primary vegetation in a moderate condition. Mitigation measures such as comprehensive rehabilitation of disturbed areas, a search and rescue operation prior to clearing, strict adherence to disturbing only the mining footprint area and conservation of ecological corridors can help reduce the significance of this impact.

Assessment of Impact:

Mitigation	Severity	Duration	Spatial	Consequence	Probability	Significance
Before mitigation	H	H	L	H	H	H
After mitigation	M	M	L	M	M	M

6.1.2. Loss of sensitive habitats and protected floral species

Project phase:

Construction Operational Decommissioning Closure

Description of impact:

The clearing of vegetation in the path of mining and within the infrastructure areas will result in the direct loss of a significant amount of protected trees. The removal of *Vachellia erioloba* (Camel Thorn) and *Vachellia haematoxylon* (Grey Camel Thorn) trees not only results in a loss of the species richness in the area but has impacts on the ecosystem function of the area.

This proposed site falls within the Griqualand West Centre of Endemism. A significant amount of mining is taking place within this centre of endemism which is a cause for

concern as this centre of endemism is under researched and not well understood thus vital aspects may be lost or disturbed because of a lack of fundamental knowledge which could assist in protecting this centre of endemism. The cumulative impacts of mining in this area exacerbates the potential risk of losing information and/or ecosystem function owing to a lack of basic research information within this area.

In terms of the PESEIS Assessment the Ga-Moraga's capability to recover from disturbance is considered to be very low. Thus any disturbance to this watercourse could have a long term effect on the surrounding biodiversity and ecosystem functioning of the area.

Mitigation measures such as avoiding areas of high sensitivity (where possible) within the planned development area will assist in mitigating this impact.

Some mining impacts do not result in the immediate loss of natural habitat and important species but are cumulative on the structure and function of individual plants and ecosystems, and in some cases could ultimately result in permanent loss of species and natural habitat.

These impacts are an indirect result of mining activities within the mine footprint and include:

- Dust generation and fallout from all activities;
- Groundwater draw down associated with the pit

These impacts affect the ecological functioning of ecosystems and may result in deterioration of habitats and loss of sensitive species.

The impact could be temporary and reverse on mine closure (e.g. dust from roads) or could be permanent (e.g. ground-water dewatering) 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.

Groundwater draw down

Aquifer dependent ecosystems (ADEs) are ecosystems which depend on groundwater in, or discharging from, an aquifer. They are distinctive because of their connection to the aquifer and would be fundamentally altered in terms of their structure and functions if groundwater was no longer available. ADEs found on Kalahari sands are characterised by the abundance of *Vachellia erioloba*, a species which is sensitive to changes in depth to the water table as well as *Vachellia haematoxylon, Vachellia karroo, Rhus lancea,*

Tamarix usneoides, and *Euclea pseudebenus.* There is a growing body of research which has found that these trees - singly, in stands and as gallery forests - are keystone ecosystems. These deep-rooted species are thought to act as nutrient pumps but it is equally likely that they are providing water to shallower-rooted plants via hydraulic lift. ADEs particularly in arid ecosystems provide habitats for an array of species and are considered important in ecological processes by making available resources for the biodiversity in an area that would otherwise not be available.

A high rainfall year is needed to stimulate seed germination and promote seedling recruitment in groundwater dependent phreatophytes such as *Vachellia erioloba*. The rainfall wets the profile down to the water table to the extent that rapid root growth by the seedlings enables them to reach the capillary fringe above the water table before the soil layers above it dry out. The young plants are then no longer vulnerable to variations in rainfall. A seedling only 25 cm high can have roots longer than 320 cm suggesting that a large portion of their growth energy is directed to root development, in order to enable the plants to become drought resistant as soon as possible.

Very little research in the Kalahari has focused on water consumption by the various types of vegetation and on the partitioning of transpired water between water that is extracted from different depths of the unsaturated zone and that which originates from the saturated zone. Thus it is very difficult to predict the extent to which altering the water levels in the aquifers may impact on these ecosystems. A study on the Gamagara River close to Kathu to evaluate the effects of dewatering due to mining activities (Institute for Water Research, 2012) shows that along the main tributary, the largest hydrological output from the system is due to riparian evapotranspiration. Such evapotranspiration constitutes approximately 96% of water loss from the system in unaffected areas and 99% in mining-affected areas where water abstraction has taken place (Institute for Water Research, 2012). The difference is small, but indicates that there is very little margin of change that can be tolerated before ecosystem stress will occur. Ecosystem change, i.e. increased mortality rates of trees, would be expected in areas of increased abstraction.

Unfortunately there is very limited research information on how the ADE plants access the water and at what depth they are accessing this water, what the effect of changing the ground water system would have on the plants and vegetation structure within the ADE and how this would affect ecosystem function on a landscape scale.

In terms of dewatering, larger trees will be most at risk because they are less flexible in root growth. Small trees are more flexible because they can grow down to the depths

necessary. However, for big trees, a sudden drop in the water table can effectively put them into a situation where they can't reach the water. The effects of dewatering have been studied in Namibia (with a plant ecophysiologist, Prof William Stock from the University of Cape Town). His findings suggests that although trees may sometimes have very deep roots, it does not mean that "adult" trees can lower their roots any more in response to a drop in the water level. Although camel thorns have very deep recorded root depths, extending their roots so deep is not necessarily what they "prefer" to do and that they only extend their roots down as far as necessary.

This would suggest that the dewatering as a result of mining would have the greatest negative impact on large trees within the study area and that these negative impacts would be exacerbated during periods of drought which could result in large scale mortalities of large trees in particular and the destruction of the aquifer dependent ecosystem.

Once the ground water impact zone has been determined by the relevant specialists the area of possible dewatering must be overlayed with the vegetation map to determine the extent of the possible impacts to the vegetation particularly, the protected trees. There is the potential that additional protected trees could be lost indirectly through the lowering of the water table.

Engineering measures can sometimes be applied, to minimize the predicted groundwater impacts. The mitigation measures however must be developed on a site-specific basis, but could include measures such as, Artificial recharge: Groundwater from the pumped discharge can be re-injected back into the ground, either to prevent lowering of groundwater levels and corresponding ground settlement, or to prevent depletion of groundwater resources.

Dust

There are few detailed studies of the effects of dust deposition on ecology.

Dust may cause physical injury to tree leaves and bark, reduced fruit setting and cause a general reduction in growth. Dusting of stigmatic surfaces can completely suppress fruit production and dust may also inhibit pollen germination. Dust can cause blockage and damage to stomata, shading, abrasion of leaf surface or cuticle, and cumulative effects e.g. drought stress on already stressed species as dust can cause a reduction in photosynthesis and diffusive resistance and an increase in leaf temperature, the latter two effects making the tree more likely to be susceptible to drought. These changes in the vegetation may also affect animal communities, from vertebrate grazers to soil invertebrates, which could result in the alteration of cycles of decomposition.

There are also chemical effects of dust, either directly on the plant surface or on the soil. Dust deposited on the ground may produce changes in soil chemistry, which may in the longer-term result in changes in plant chemistry, species competition and community structure. However, the soil type surrounding a mineral site will probably reflect the mineral being worked, so this is unlikely to be a common problem. The effects of dust are not always permanent and relief may occur after periods of rain. However in an area where the rainfall is low and erratic the respite received from rainfall may not be significant.

A dust dispersion model is required to assess the potential for additional protected trees to be lost indirectly because of the negative affects of dust on vegetation and ecology.

Assessment of Impact:

Loss of sensitive habitats and protected floral species	Mitigation	Severity	Duration	Spatial	Consequence	Probability	Significance
Vegetation clearing	Before mitigation	H	H	L	H	H	H
	After mitigation	M	M	L	M	M	M
Dewatering	Before mitigation	H	H	M	H	M	M
	After mitigation	M	M	L	M	L	L
Dust	Before mitigation	M	M	L	M	M	M
	After mitigation	L	L	L	L	L	L

6.1.3. Introduction or spread of alien species

Project phase:

Construction Operational Decommissioning Closure

Description of impact:

The disturbance associated with mining and associated infrastructure may lead to the introduction of alien plants species or the further spread of existing alien species within the area. Invasive species are now regarded as the second-leading threat to imperilled species, behind only habitat destruction. Invasive species affect our natural biodiversity in a number of ways. They may compete directly with natural species for food or space, may compete indirectly by changing the food web or physical environment, or hybridize with indigenous species. Rare species with limited ranges and restricted habitat

requirements are often particularly vulnerable to the influence of these alien invaders. Invasive plants have claimed about 8 percent or 10 million hectares of land suitable for agricultural use in South Africa. These invasive alien plants steal about seven percent of South Africa's water bulk every year.

Assessment of Impact:

Mitigation	Severity	Duration	Spatial	Consequence	Probability	Significance
Before mitigation	H	M	L	M	M	M
After mitigation	L	L	L	L	L	L

6.2. FAUNA

6.2.1. Fragmentation of habitat

Project phase:

Construction Operational

Description of impact:

Termite mounds, burrows, nests and vegetation on which small mammals, insects, amphibians and reptiles are heavily reliant will be destroyed during clearing activities associated with mining, causing the permanent displacement of these animals.

During the construction and operational phases of mining vegetation will be cleared this has the effect of creating unnatural open space through the vegetation and the matrix of the landscape. Due to this cleared open space, some species that habitually seek out protective cover for movement across the landscape may be prevented from moving across this open space due to the fear of predation. For smaller species, it limits movement and restricts access to foraging sites. This results in reduced population density of prey species (invertebrates and/or smaller birds and/or smaller mammals and/or herpetofauna) which then reduces the food availability for predators (invertebrates and/or smaller birds and/or smaller mammals and/or herpetofauna). The area surrounding the proposed mine site has already been disturbed and altered and the removal of more natural vegetation results in a cumulative impact which significantly increases the significance of habitat fragmentation. Mitigation measures such as comprehensive rehabilitation of disturbed areas, strict adherence to disturbing only the mining footprint area and conservation of ecological corridors can help reduce the significance of this impact. The implementation of a Biodiversity Action Plan will also assist in conserving the undeveloped areas within the property, which will aid in mitigating the impact of habitat fragmentation.

Assessment of Impact:

Mitigation	Severity	Duration	Spatial	Consequence	Probability	Significance
Before mitigation	H	H	L	H	H	H
After mitigation	M	M	L	M	M	M

6.2.2. Intentional/accidental killing of fauna

Project phase:

Construction Operational Decommissioning

Description of impact:

Smaller fauna will inevitably be killed during land clearing activities, as these activities will destroy their habitat. In addition to unintentional killing of fauna, some faunal species, particularly herpetofaunal species, are often intentionally killed as they are thought to be dangerous. Large exposed excavations could result in some faunal species falling in and being killed or being unable to escape from the excavation ultimately leading to death. It is not possible to mitigate against the unintentional killing of fauna as a result of land clear, however the intentional killing of fauna can be mitigated through education and training and the enforcement of strict policy against the killing of fauna.

Assessment of Impact:

Mitigation	Severity	Duration	Spatial	Consequence	Probability	Significance
Before mitigation	H	M	L	M	M	M
After mitigation	L	L	L	L	L	L

6.2.3. Anthropogenic disturbances

Project phase:

Construction Operational Decommissioning

Description of impact:

Anthropogenic disturbances include aspects such as the on-site waste generation, vibrations caused by earth moving equipment, campfires and illumination of the site. These aspects will impact on invertebrate species more than any other faunal species. These anthropogenic disturbances impact on the way invertebrates forage. For example; some invertebrates use vibrations caused by their prey to locate and catch them. Vibrations caused by earth moving equipment will make this impossible. It is not possible to mitigate this impact.

Assessment of Impact:

Mitigation	Severity	Duration	Spatial	Consequence	Probability	Significance
Before mitigation	L	M	L	L	M	L

6.2.4. Loss of faunal species of conservation concern

Project phase:

Construction Operational Decommissioning Closure

Description of impact:

A number of faunal species of conservation concern have the potential to occur in the area and the loss of habitat could result in a reduction in number or loss of the species from the area. Although important habitat for these animals would still remain within the surrounding area the increase in the loss of natural vegetation and habitat fragmentation from surrounding mining results in a cumulative impact which significantly increases the magnitude of this potential impact. This impact can be mitigated to some extent by ensuring that ecological corridors are maintained throughout the property and by setting up a Biodiversity Action Plan to ensure that the undeveloped/mined areas within the property are properly conserved and maintained. .

Assessment of Impact:

Mitigation	Severity	Duration	Spatial	Consequence	Probability	Significance
Before mitigation	H	H	L	H	H	H
After mitigation	M	M	L	L	M	M

7. RECOMMENDATIONS AND CONCLUSION

Mining of this area will result in the clearing of vegetation and the destruction of the natural habitat within and surrounding the mining area. The significance of the impacts will also be affected by the success of the mitigation measures implemented and the rehabilitation programme for the mining area.

The planned mine will have a direct impact to the surface biodiversity, 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 owing to the cumulative effect of increased mining in the area.

Changes to the aquifers on which the surface ecosystem are dependent could potentially impact on individual species as well as entire ADEs, the consequences of which could potentially transcend the boundaries of the immediate mining area. The severity of this impact would depend on the extent of disturbance to the aquifers, the dependence of the ecosystem on the aquifer and other environmental factors such as rainfall.

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. Thus 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. The cumulative effects of development in this area exacerbate the potential risk of losing information and/or ecosystem function owing to a lack of basic research information within this area. However it is unlikely that the development of this site would compromise the overall functioning of the biodiversity within this area.

With respect to the proposed mining project the largest area that will be cleared of vegetation will be that of the pit. The extent of the open pit will be 93ha, thus approximately 17 419 *V. haematoxylon* trees and 800 *V. erioloba* trees will need to be cleared from the pit area alone. The DAFF will likely thus ask for a biodiversity offset to form part of the conditions for Environmental Authorisation and the license to remove the protected trees

The size classes indicate that the growth form of the *Vachellia haematoxylon* on the site is characterized as a shrub, there are no large trees of this species that will be cleared from site.

In its basic form size classes (height and stem diameter) correlates with age structure of a population of trees in such a way that overall size class distribution can be understood as a reflection of the species ability to regenerate. A large number of seedlings but no saplings, pole-sized individuals or large trees would denote an unsuccessful invasion with a high seedling mortality. A large number of seedlings, several saplings and a few poles would constitute an invasion. Many seedlings and progressively fewer saplings, poles and large trees would reflect a population that is successfully replacing itself. A species with very few juvenile forms and many mature trees would represent a population that is failing to replace itself.

There is insufficient data collected from site in terms of other variables that could influence growth and development of the trees, namely, long term rainfall figures and disturbances factors such as fire and herbivory to accurately interpret the information from the population size class distribution collected during the sampling process. Both populations are however showing some seedling recruitment, although one would expect the seedling recruitment for the *V. haematoxylon* to be higher, given the percentages of the more mature trees in the population group. Given the data collected it is not feasible to make an assumption on whether this represents, an imminent threat to the population in terms of its sustainability or an effect from a disturbance such as a fire.

Recommendations to mitigate the impacts to the ecology include but are not limited to:

- Preconstruction surveys of the development footprints 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 as is currently found (harvesting of seed from similar areas within the study area should be undertaken). This may be used in conjunction with a commercially available mix as this will ensure a good vegetation coverage and soil stability. Species such as *Stipagrostis* are good sand binders and aid in stabilising the substrate and are present within the study area.
- Pods of *Vachellia erioloba*, and *Vachellia haematoxylon* should be collected from the area in order to aid in the re-establishment of these species. These seeds do however require artificial scarring/acid washing in order to aid in germination. The establishment of these trees will form a pivotal part in the rehabilitation of this area post mining as *V. erioloba* increases habitat heterogeneity. *V. erioloba* increases species richness by providing habitats and services for a variety of plants, reptiles, birds and mammals. Evidence also suggests that *V. erioloba* obtains nitrogen from deep ground water and then cycles nutrients from great depths, making them available above ground. High nutrient levels and shade of

the subcanopy microhabitat increase survivorship of shade tolerant fleshy fruited plants. This microhabitat enables a suite of species, not adapted to conditions, to exist in this environment, thus enriching overall biodiversity. These plants provide a valuable food resource for a number of bird and mammal species.

- Prior to the clearing of the protected floral species the relevant permits must be obtained from the relevant authorities (see section 3.2).
- A comprehensive monitoring programme of the protected trees within the area must be undertaken. This monitoring will need to be conducted on an individual tree basis as well as monitoring on a community level.
- The possibility and practicality of removing dust from protected trees could be investigated as part of an experimentation process for the mine, in an attempt to determine if and how this could be achieved. Should the experimentation process prove successful the techniques developed could assist in minimizing the stresses of the trees, particularly within linking corridors inside the mining area. New innovative techniques to mitigate the effects of mining on biodiversity are continually being sort to lessen the destructive affects of these developments.
- A comprehensive alien invasive eradication programme should be drawn up and implemented.
- A biodiversity action plan for the mining area should be drawn up and implemented.

The recommendations and monitoring programme as discussed above should form part of the conditions of the environmental authorisation. Proper and comprehensive measures must be taken with respect to the diversion of the Ga-Mogara non-perennial stream to ensure that the system processes are not disrupted. Suitable rehabilitation of all disturbed sites must be undertaken

The impact on biodiversity from the proposed site development will be significant but it is not so significant as to preclude the site from development provided the management and mitigation measures are implemented.

Consultation during study

A number of data sources were consulted and used for this study. Public consultation did not form part of the initial field investigation and report writing. Public consultation did however form part of the EIA process and to this end all biodiversity comments were forwarded. Only two biodiversity related comments were received during the public consultation process, these were as follows:

Comment raised by Eben Anthonissen (on the 15 April 2015): It is important to note, that when it comes to protected plant species, the Tolbos is not taken into consideration.

Response provided: *Boophane disticha*, (commonly known as Tolbos) status is listed as declining and as such was considered in this study, however no *Boophane disticha* plants were observed on site during the field investigation.

Issues raised by Moses Ramakulukusha from the Department of Environment and Nature Conservation (on the *15 April 2015)*: Will there be a biodiversity offset.

Response provided: The need for a biodiversity offset will only be finalized once the survey to count the number of protected trees that will need to be removed has been completed. A biodiversity offset investigation can then be implemented to determine the need for such an offset, as well as what type of offset would be required.

Issues raised by Jacoline Mans, Chief Forester, Department of Agriculture, Forestry and Fisheries) on 3 August 2015: The report indicated that about 148 ha of natural vegetation would be disturbed as part of the proposed development. It would include realignment of a section of the R380 road and realignment of a section of the Ga-Mogara drainage channel, affecting sensitive areas. Large protected Camel thorn trees are usually associated with the riparian vegetation on the banks of the Ga-Mogara River, hence it is anticipated that a large number of protected trees would be destroyed as a result of the proposed activities and that an environmental offset may be required to compensate for the permanent loss of slow growing protected trees.

A detailed assessment should be undertaken during the EIA phase to provide an accurate estimation of the number of protected trees per size classes, which might be directly affected by the proposed development. Please supply this information to the DAFF as soon as possible.

Response provided: A detailed survey was undertaken of the site to count the number of protected trees in their various size classes that would be affected/removed as a result of the proposed development. The results of the survey have been included in this biodiversity report.

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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	
	Barleria irritans Nees	LC	
	Blepharis integrifolia (L.f.) E.Mey. ex Schinz var. integrifolia	LC	
	Monechma divaricatum (Nees) C.B.Clarke	LC	
	Monechma genistifolium subsp. australe	LC	
AMARANTHACEAE	Hermbstaedtia fleckii (Schinz) Baker & C.B.Clarke	LC	
	Pupalia lappacea (L.) A.Juss. var. lappacea	LC	
	Sericorema remotiflora (Hook.f.) Lopr.	LC	
	Sericorema sericea (Schinz) Lopr.	LC	
	Hermbstaedtia fleckii	LC	
ANACARDIACEAE	Searsia dregeana (Sond.) Moffett	LC	
	Searsia erosa (Thunb.) Moffett	LC	
	Searsia tenuinervis (Engl.) Moffett	LC	
	Searsia lancea (L.f.) F.A.Barkley	LC	
ASPARAGACEAE	Asparagus exuvialis Burch. forma exuvialis	LC	
	Asparagus nelsii Schinz	LC	
	Asparagus suaveolens Burch.	LC	
ASTERACEAE	Berkheya ferox O.Hoffm. var. tomentosa Roessler	LC	
	Dimorphotheca zeyheri Sond.	LC	
	Geigeria ornativa O.Hoffm. subsp. ornativa	LC	
	Pentzia calcarea Kies	LC	
	Amellus tridactylus DC. subsp. arenarius (S.Moore) Rommel	LC	
	Aster squamatus (Spreng.) Hieron.	NE Naturalised	
	Dicoma schinzii O.Hoffm.	LC	
	Felicia fascicularis DC.	LC	
	Felicia namaquana (Harv.) Merxm.	LC	
	Geigeria filifolia Mattf.	LC	
	Geigeria ornativa O.Hoffm. subsp. ornativa	LC	
	Kleinia longiflora DC.	LC	
	Osteospermum muricatum E.Mey. ex DC. subsp. muricatum	LC	
	Pseudognaphalium luteo-album (L.) Hilliard & B.L.Burtt	NE naturalised	
	Pulicaria scabra (Thunb.) Druce	LC	
	Berkheya ferox var. tomentosa	LC	
	Tarchonanthus camphoratus L	Lc	
BIGNONIACEAE	Rhigozum trichotomum Burch	LC	
BORAGINACEAE	Heliotropium strigosum Willd.	LC	
CAMPANULACEAE	Wahlenbergia androsacea A.DC.	LC	

CAPPARACEAE	Cleome angustifolia Forssk. subsp. diandra (Burch.) Kers	LC
CELASTRACEAE	Gymnosporia buxifolia (L.) Szyszyl.	LC
	Putterlickia saxatilis (Burch.) M.Jordaan	LC
CHENOPODIACEAE	Salsola kali L.	NE Naturalised
	Salsola patentipilosa Botsch.	LC
	Atriplex semibaccata R.Br. var. appendiculata Aellen	LC
	Chenopodium ambrosioides L.	NE Naturalised
	Salsola rabieana I.Verd.	LC
COMBRETACEAE	Terminalia sericea Burch. ex DC.	LC
COMMELINACEAE	Commelina livingstonii C.B.Clarke	LC
CONVOLVULACEAE	Merremia verecunda Rendle	LC
	Evolvulus alsinoides (L.) L.	LC
	Seddera capensis (E.Mey. ex Choisy) Hallier f.	LC
CUCURBITACEAE	Acanthosicyos naudinianus (Sond.) C.Jeffrey	LC
	Cucumis africanus L.f.	LC
	Acanthosicyos naudinianus (Sond.) C.Jeffrey	LC
	Coccinia rehmannii Cogn.	LC
	Trochomeria debilis (Sond.) Hook.f.	LC
CYPERACEAE	Cyperus margaritaceus Vahl var. margaritaceus.	LC
ELATINACEAE	Bergia anagalloides E.Mey. ex Fenzl	LC
EUPHORBIACEAE	Euphorbia duseimata R.A.Dyer	LC
	Euphorbia pseudotuberosa Pax	LC
	Euphorbia wilmaniae Marloth	LC
	Tragia dioica Sond.	LC
FABACEAE	Crotalaria virgultalis Burch. ex DC.	LC
	Cullen tomentosum (Thunb.) J.W.Grimes	LC
	Melolobium candicans (E.Mey.) Eckl. & Zeyh.	LC
	Melolobium humile Eckl. & Zeyh.	LC
	Prosopis glandulosa Torr. var. glandulosa	NE naturalised
	Prosopis velutina Wooton	NE naturalised
	Tephrosia burchellii Burtt Davy	LC
	Vachellia erioloba E.Mey	Declining
	Vachellia haematoxylon Willd.	LC
	Vachellia karroo Hayne	LC
	Senegalia mellifera	LC
	Crotalaria griquensis L.Bolus	LC
	Indigofera alternans DC. var. alternans	LC
	Indigofera daleoides Benth. ex Harv. var. daleoides	LC
	Melolobium microphyllum (L.f.) Eckl. & Zeyh.	LC
	Otoptera burchellii DC.	LC
	Pomaria lactea (Schinz) B.B.Simpson & G.P.Lewis	LC
	Rhynchosia confusa Burtt Davy	LC
	Rhynchosia totta (Thunb.) DC. var. totta	LC
	Tephrosia purpurea (L.) Pers. subsp. leptostachya (DC.) Brummitt var. leptostachya	LC
	Indigastrum argyraeum	LC
	Indigofera hololeuca	LC

GISEKIACEAE	Gisekia africana (Lour.) Kuntze var. pedunculata (Oliv.) Brenan	LC	
	Gisekia pharnacioides L. var. pharnacioides	LC	
HYACINTHACEAE	Dipcadi marlothii Engl.	LC	
	Ledebouria apertiflora (Baker) Jessop	LC	
IRIDACEAE	Moraea longistyla (Goldblatt) Goldblatt	LC	Schedule 2
	Moraea pallida (Baker) Goldblatt	LC	Schedule 2
	Babiana hypogaea Burch.	LC	Schedule 2
LAMIACEAE	Stachys spathulata Burch. ex Benth.	LC	
	Salvia verbenaca L.	LC	
	Ocimum americanum L. var. americanum	LC	
	Ocimum filamentosum Forssk.	LC	
LOBELIACEAE	Lobelia thermalis Thunb.	LC	
LOPHIOCARPACEAE	Corbichonia rubriviolacea (Friedrich) C.Jeffrey	LC	
MALVACEAE	Grewia flava DC.	LC	
	Hermannia comosa Burch. ex DC.	LC	
	Hermannia modesta (Ehrenb.) Mast.	LC	
	Hermannia tomentosa (Turcz.) Schinz ex Engl.	LC	
	Hibiscus engleri K.Schum.	LC	
	Hibiscus fleckii GŸrke	LC	
	Hibiscus micranthus L.f. var. micranthus	LC	
	Melhania burchellii DC.	LC	
	Sida ovata Forssk.	LC	
	Grewia flava	LC	
MOLLUGINACEAE	Limeum myosotis H.Walter var. myosotis	LC	
MONTINIACEAE	Montinia caryophyllacea Thunb.	LC	
OROBANCHACEAE	Striga gesnerioides (Willd.) Vatke	LC	
PAPAVERACEAE	Argemone mexicana L.	NE naturalised	
	Argemone ochroleuca	NE naturalised	
PEDALIACEAE	Harpagophytum procumbens		Schedule 1
PHYLLANTHACEAE	Phyllanthus maderaspatensis L.	LC	
	Phyllanthus parvulus Sond. var. garipensis (E.Mey. ex Dr†ge) Radcl.-Sm.	LC	
	Phyllanthus parvulus Sond. var. parvulus	LC	
POACEAE	Aristida adscensionis L.	LC	
	Chrysopogon serrulatus Trin.	LC	
	Enneapogon cenchroides (Licht. ex Roem. & Schult.) C.E.Hubb.	LC	
	Megaloprotachne albescens C.E.Hubb.	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	
	Tragus racemosus (L.) All.	LC	
	Tricholaena monachne (Trin.) Stapf & C.E.Hubb.	LC	
	Anthephora argentea Gooss.	LC	

	Anthephora 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
	Centrapodia glauca Nees) Cope	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 echinochloidea Stapf	LC
	Eragrostis lehmanniana Nees var. lehmanniana	LC
	Eragrostis nindensis Ficalho & Hiern	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
	Melinis repens (Willd.) Zizka subsp. repens	LC
	Oropetium capense Stapf	LC
	Panicum maximum Jacq.	LC
	Pogonarthria squarrosa (Roem. & Schult.) Pilg.	LC
	Schmidtia pappophoroides Steud.	LC
	Sporobolus acinifolius Stapf	LC
	Sporobolus fimbriatus (Trin.) Nees	LC
	Sporobolus ioclados (Trin.) Nees	LC
	Stipagrostis obtusa (Delile) Nees	LC
	Stipagrostis uniplumis (Licht.) De Winter var. uniplumis	LC
	Tragus racemosus (L.) All.	LC
	Triraphis andropogonoides (Steud.) E.Phillips	LC
POLYGALACEAE	Polygala leptophylla Burch. var. leptophylla	LC
	Polygala seminuda Harv.	LC
	Polygala leptophylla Burch. var. armata (Chodat) Paiva	LC
	Oxygonum delagoense Kuntze	LC
	Portulaca hereroensis Schinz	LC
	Portulaca kermesina N.E.Br.	LC
RHAMNACEAE	Ziziphus mucronata Willd. subsp. mucronata	LC
	Helinus spartioides (Engl.) Schinz ex Engl.	LC
RICCIACEAE	Riccia albolimbata S.W.Arnell	LC
SANTALACEAE	Thesium hystricoides A.W.Hill	LC
	Thesium hystrix A.W.Hill	LC

SCROPHULARIACEAE	Selago mixta Hilliard	LC
	Aptosimum elongatum Engl.	LC
	Aptosimum junceum (Hiern) Philcox	LC
	Aptosimum lineare Marloth & Engl. var. lineare	LC
	Peliostomum leucorrhizum E.Mey. ex Benth.	LC
	Selago mixta	LC
SOLANACEAE	Datura stramonium L.	NE naturalised
	Lycium cinereum Thunb.	LC
	Lycium hirsutum Dunal	LC
	Lycium pilifolium C.H.Wright	LC
	Solanum burchellii Dunal	LC
	Solanum catombelense Peyr.	LC
VAHLIACEAE	Vahlia capensis (L.f.) Thunb. subsp. vulgaris Bridson var. linearis E.Mey. ex Bridson	LC
VERBENACEAE	Chascanum hederaceum (Sond.) Moldenke var. hederaceum	LC
	Lantana rugosa Thunb.	LC
ZYGOPHYLLACEAE	Tribulus terrestris L.	LC
	Tribulus zeyheri Sond. subsp. zeyheri	LC

FAUNAL SPECIES CHECK LIST

REPTILES		
Family Name	**Species Name**	**Common Name**
Agamidae	*Agama aculeata subsp. aculeata*	Ground agama
Lacertidae	*Heliobolus lugubris*	Bushveld Lizard
Lacertidae	*Pedioplanis lineoocellata*	Spotted Sand lizard
Gekkonidae	*Chondrodactylus bibronii*	Bibron's Gecko
Lacertidae	*Heliobolus lugubris*	Bushveld Lizard
Lacertidae	*Pedioplanis lineoocellata*	Spotted Sand Lizard
Lacertidae	*Pedioplanis namaquensis*	Namaqua Sand Lizard
AMPHIBIANS		
Family Name	**Species Name**	**Common Name**
Bufonidae	*Amietophrynus poweri*	Power's Toad
Hyperoliidae	*Kassina senegalensis*	Senegal kassina
Pyxicephalidae	*Cacosternum boettgeri*	Common Dainty Frog
Pyxicephalidae	*Tomopterna cryptotis*	Common Sand Frog
BIRDS		
Family Name	**Species Name**	**Common Name**
Accipitridae	*Torgos tracheliotos*	Lappetfaced Vulture
Accipitridae	*Gyps africanus*	African Whitebacked Vulture
Accipitridae	*Terathopius ecaudatus*	Bateleur
Alaudidae	*Calendulauda africanoides*	Fawn-coloured Lark
Alaudidae	*Calendulauda sabota*	Sabota Lark
Alaudidae	*Chersomanes albofasciata*	Spike-heeled Lark
Alaudidae	*Eremopterix verticalis*	Grey-backed Sparrowlark
Alaudidae	*Mirafra apiata*	Cape Clapper Lark
Anatidae	*Anas erythrorhyncha*	Red-billed Teal
Anatidae	*Anas undulata*	Yellow-billed Duck
Anatidae	*Dendrocygna viduata*	White-faced Duck
Apodidae	*Apus affinis*	Little Swift
Bucerotidae	*Tockus leucomelas*	Southern Yellow-billed Hornbill

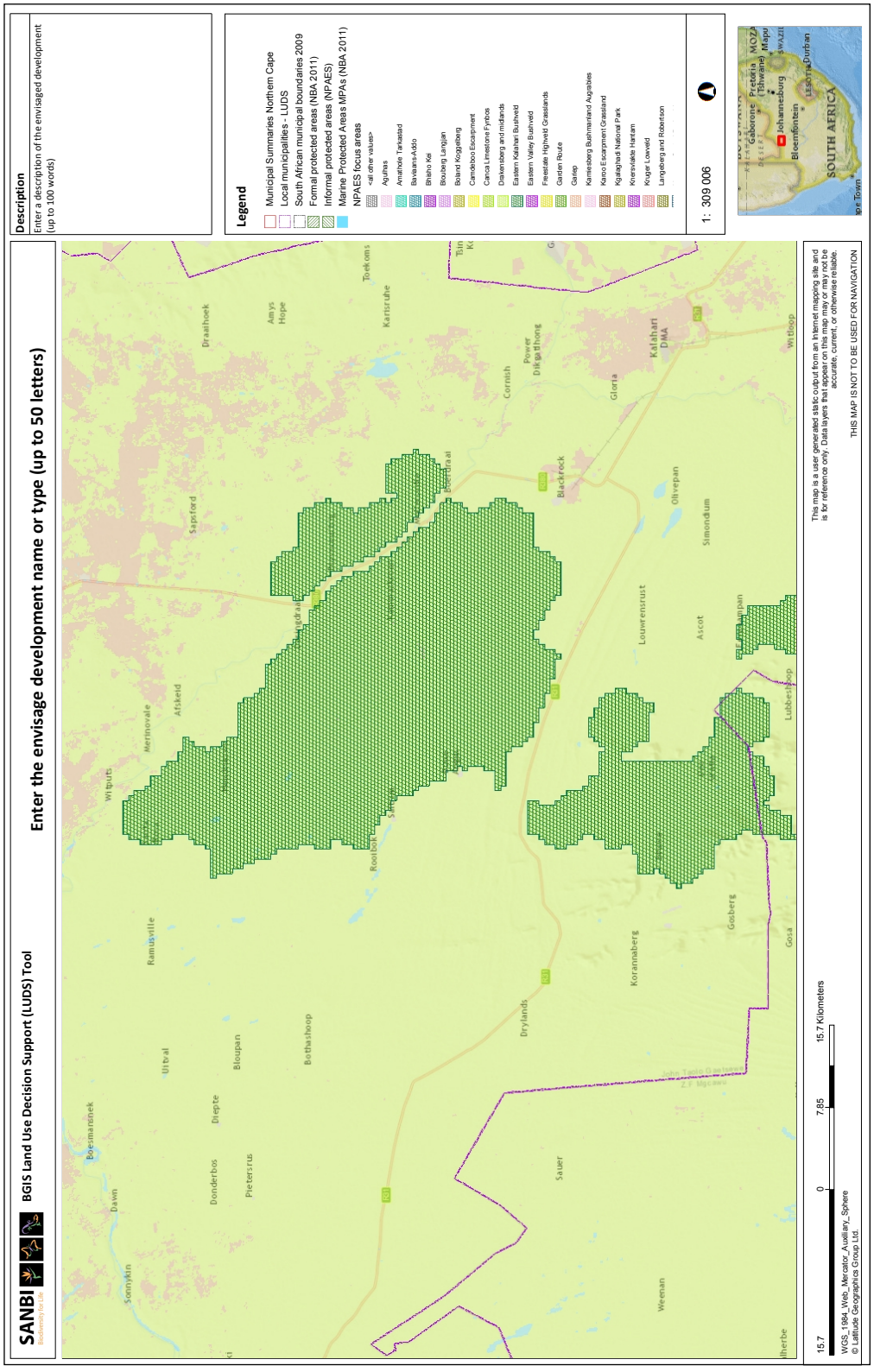
Bucerotidae	*Tockus nasutus*	African Grey Hornbill
Burhinidae	*Burhinus capensis*	Spotted Thick-knee
Capitonidae	*Tricholaema leucomelas*	Acacia Pied Barbet
Charadriidae	*Charadrius tricollaris*	Three-banded Plover
Charadriidae	*Vanellus armatus*	Blacksmith Lapwing
Charadriidae	*Vanellus coronatus*	Crowned Lapwing
Ciconiidae	*Ciconia nigra*	Black Stork
Coliidae	*Colius colius*	White-backed Mousebird
Coliidae	*Urocolius indicus*	Red-faced Mousebird
Coraciidae	*Coracias caudatus*	Lilac-breasted Roller
Coraciidae	*Coracias naevius*	Purple Roller
Cuculidae	*Chrysococcyx caprius*	Diderick Cuckoo
Dicruridae	*Dicrurus adsimilis*	Fork-tailed Drongo
Estrildidae	*Amadina erythrocephala*	Red-headed Finch
Estrildidae	*Estrilda astrild*	Common Waxbill
Estrildidae	*Estrilda erythronotos*	Black-faced Waxbill
Estrildidae	*Granatina granatina*	Violet-eared Waxbill
Estrildidae	*Pytilia melba*	Green-winged Pytilia
Falconidae	*Falco naumanni*	Lesser Kestrel
Falconidae	*Falco rupicoloides*	Greater Kestrel
Fringillidae	*Crithagra atrogularis*	Black-throated Canary
Fringillidae	*Crithagra flaviventris*	Yellow Canary
Fringillidae	*Emberiza flaviventris*	Golden-breasted Bunting
Fringillidae	*Emberiza impetuani*	Lark-like Bunting
Glareolidae	*Cursorius rufus*	Burchell's Courser
Halcyonidae	*Alcedo cristata*	Malachite Kingfisher
Hirundinidae	*Hirundo albigularis*	White-throated Swallow
Hirundinidae	*Hirundo cucullata*	Greater Striped Swallow
Hirundinidae	*Hirundo fuligula*	Rock Martin
Hirundinidae	*Hirundo rustica*	Barn Swallow
Hirundinidae	*Hirundo semirufa*	Red-breasted Swallow
Hirundinidae	*Hirundo spilodera*	South African Cliff-Swallow
Hirundinidae	*Riparia paludicola*	Brown-throated Martin
Laniidae	*Lanius collaris*	Common Fiscal
Laniidae	*Lanius collurio*	Red-backed Shrike
Laniidae	*Lanius minor*	Lesser Grey Shrike
Malaconotidae	*Laniarius atrococcineus*	Crimson-breasted Shrike
Malaconotidae	*Tchagra australis*	Brown-crowned Tchagra
Malaconotidae	*Telophorus zeylonus*	Bokmakierie
Meropidae	*Merops apiaster*	European Bee-eater
Meropidae	*Merops hirundineus*	Swallow-tailed Bee-eater
Motacillidae	*Anthus cinnamomeus*	African Pipit
Motacillidae	*Motacilla capensis*	Cape Wagtail
Muscicapidae	*Batis pririt*	Pririt Batis
Muscicapidae	*Bradornis infuscatus*	Chat Flycatcher
Muscicapidae	*Bradornis mariquensis*	Marico Flycatcher
Muscicapidae	*Sigelus silens*	Fiscal Flycatcher
Nectariniidae	*Cinnyris mariquensis*	Marico Sunbird
Numididae	*Numida meleagris*	Helmeted Guineafowl
Otididae	*Eupodotis afra*	Southern Black Korhaan
Otididae	*Lophotis ruficrista*	Red-crested Korhaan
Otididae	*Ardeotis kori*	Kori Bustard
Paridae	*Parus cinerascens*	Ashy Tit
Phalacrocoracidae	*Phalacrocorax africanus*	Reed Cormorant

Phasianidae	*Pternistis adspersus*	Red-billed Spurfowl
Phoeniculidae	*Rhinopomastus cyanomelas*	Common Scimitarbill
Plataleidae	*Platalea alba*	African Spoonbill
Plataleidae	*Plegadis falcinellus*	Glossy Ibis
Plataleidae	*Threskiornis aethiopicus*	African Sacred Ibis
Podicipedidae	*Tachybaptus ruficollis*	Little Grebe
Pteroclididae	*Pterocles bicinctus*	Double-banded Sandgrouse
Pteroclididae	*Pterocles burchelli*	Burchell's Sandgrouse
Pteroclididae	*Pterocles namaqua*	Namaqua Sandgrouse
Pycnonotidae	*Pycnonotus nigricans*	African Red-eyed Bulbul
Rallidae	*Fulica cristata*	Red-knobbed Coot
Rallidae	*Gallinula chloropus*	Common Moorhen
Sagittariidae	*Sagittarius serpentarius*	Secretarybird
Scolopacidae	*Actitis hypoleucos*	Common Sandpiper
Scolopacidae	*Calidris ferruginea*	Curlew Sandpiper
Scolopacidae	*Gallinago nigripennis*	African Snipe
Scopidae	*Scopus umbretta*	Hamerkop
Strigidae	*Bubo lacteus*	Verreaux's Eagle-Owl
Strigidae	*Glaucidium perlatum*	Pearl-spotted Owlet
Struthionidae	*Struthio camelus*	Common Ostrich
Sturnidae	*Creatophora cinerea*	Wattled Starling
Sturnidae	*Lamprotornis nitens*	Cape Glossy Starling
Sturnidae	*Onychognathus nabouroup*	Pale-winged Starling
Timaliidae	*Turdoides bicolor*	Southern Pied Babbler
Viduidae	*Vidua regia*	Shaft-tailed Whydah
Sylviidae	*Acrocephalus baeticatus*	African Reed-Warbler
Turdidae	*Cercomela familiaris*	Familiar Chat
Turdidae	*Cercotrichas paena*	Kalahari Scrub-Robin
Sylviidae	*Cisticola aridulus*	Desert Cisticola
Sylviidae	*Cisticola tinniens*	Levaillant's Cisticola
Columbidae	*Columba guinea*	Speckled Pigeon
Ardeidae	*Egretta garzetta*	Little Egret
Accipitridae	*Elanus caeruleus*	Black-shouldered Kite
Sylviidae	*Eremomela icteropygialis*	Yellow-bellied Eremomela
Falconidae	*Falco rupicolus*	Rock Kestrel
Accipitridae	*Melierax canorus*	Southern Pale Chanting Goshawk
Accipitridae	*Melierax gabar*	Gabar Goshawk
Turdidae	*Myrmecocichla formicivora*	Ant-eating Chat
Ardeidae	*Nycticorax nycticorax*	Black-crowned Night-Heron
Columbidae	*Oena capensis*	Namaqua Dove
Turdidae	*Oenanthe pileata*	Capped Wheatear
Sylviidae	*Parisoma subcaeruleum*	Chestnut-vented Tit-Babbler
Ploceidae	*Passer diffusus*	Southern Grey-headed Sparrow
Ploceidae	*Passer domesticus*	House Sparrow
Ploceidae	*Passer melanurus*	Cape Sparrow
Ploceidae	*Philetairus socius*	Sociable Weaver
Ploceidae	*Plocepasser mahali*	White-browed Sparrow-Weaver
Ploceidae	*Ploceus velatus*	Southern Masked-Weaver
Accipitridae	*Polemaetus bellicosus*	Martial Eagle
Sylviidae	*Prinia flavicans*	Black-chested Prinia
Ploceidae	*Quelea quelea*	Red-billed Quelea
Ploceidae	*Sporopipes squamifrons*	Scaly-feathered Finch
Columbidae	*Streptopelia capicola*	Cape Turtle-Dove

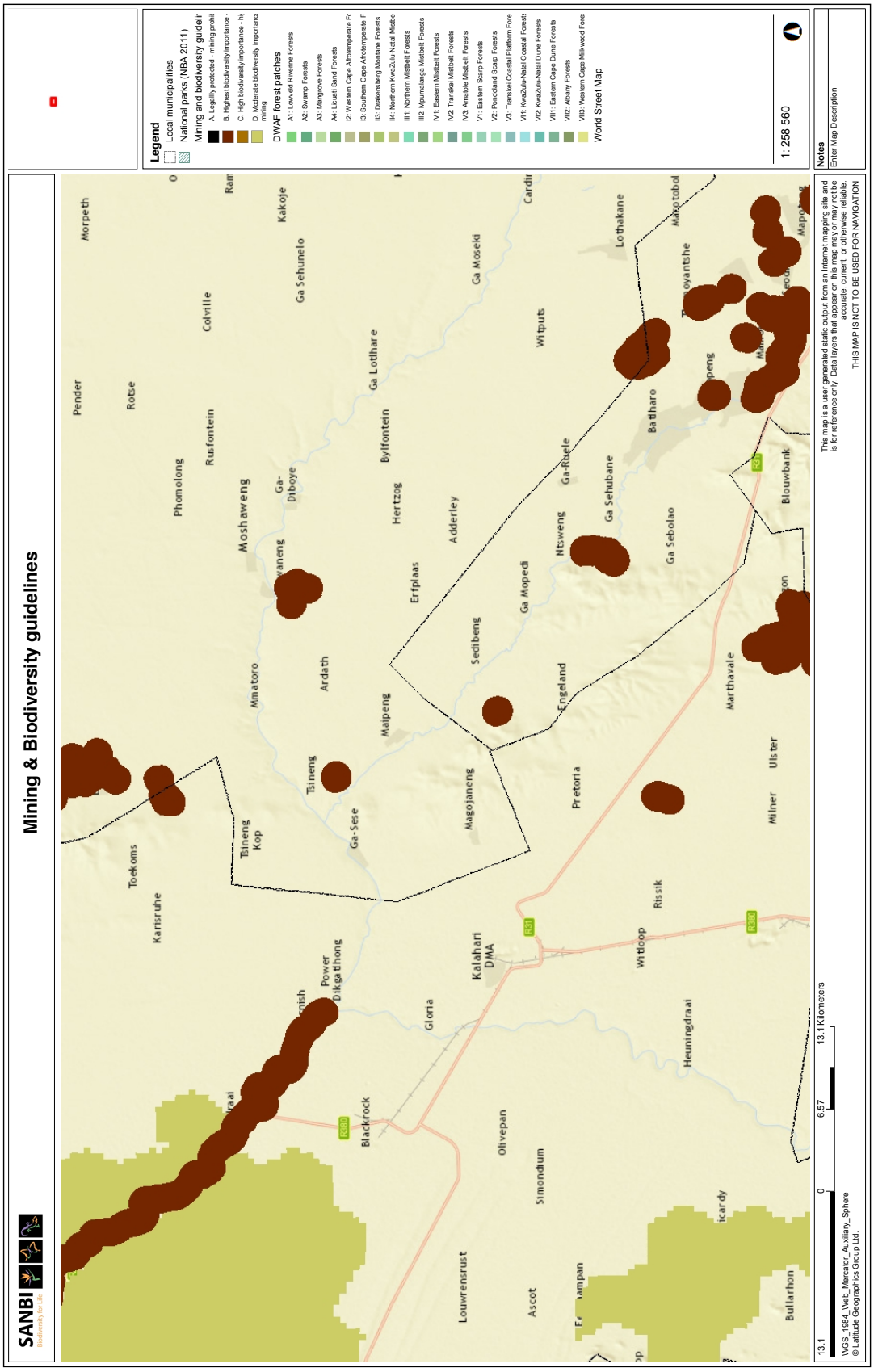
Columbidae	*Streptopelia senegalensis*	Laughing Dove
Sylviidae	*Sylvia borin*	Garden Warbler
Sylviidae	*Sylvietta rufescens*	Long-billed Crombec
INVERTEBRATES		
Family Name	**Species Name**	**Common Name**
Hesperiidae	*Leucochitonea levubu*	White-cloaked Skipper butterfly
Hesperiidae	*Pelopidas mathias*	Lesser Millets Skipper butterfly
Lycaenidae	*Azanus jesous jesous*	Topaz spotted blue butterfly
Lycaenidae	*Cigaritis phanes*	Silver bar butterfly
Pieridae	*Catopsilia florella*	African Migrant butterfly
Pieridae	*Colotis agoye bowkeri*	Speckled Sulphur tip butterfly
Pieridae	*Colotis subfasciatus subfasciatus*	Lemon tip butterfly
Lycaenidae	*Aloeides gowani*	Gowan's copper butterfly
Pieridae	*Eurema brigitta subsp. brigitta*	Small grass yellow butterfly
MAMMALS		
Family Name	**Species Name**	**Common Name**
Suidae	*Phacochoerus africanus*	Warthog
Bovidae	*Raphicerus campestris*	Steenbok
Hespestidae	*Cynictis penicillata*	Yellow Mongoose
Orycteropdidae	*Orycteropus afer*	Aardvark
Muridae	*Thallomys nigricauda*	Black tailed tree rat

APPENDIX 2

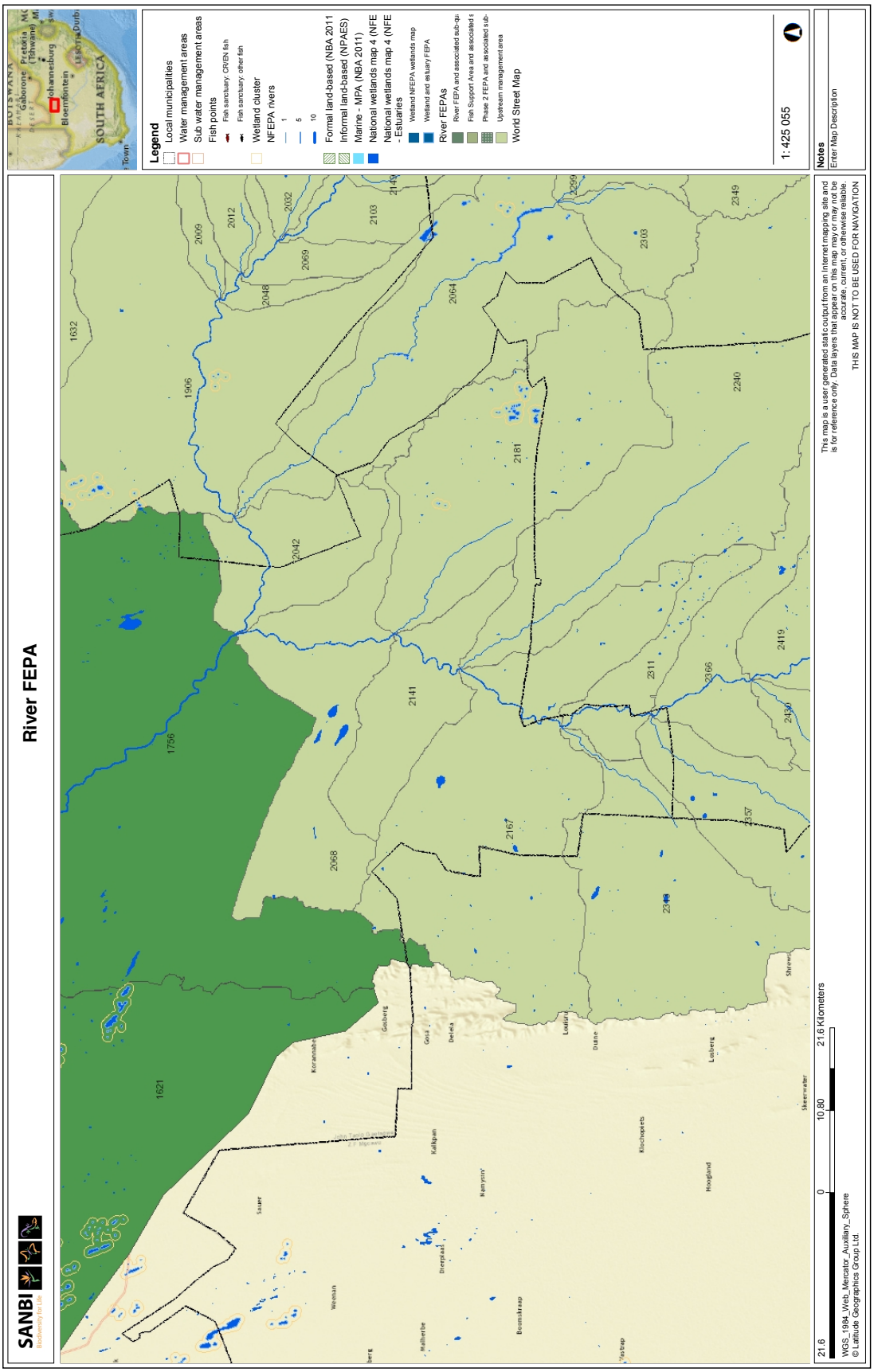
REGIONAL CONSERVATION PLANNING - -NPAES focus areas



MINING AND BIODIVERSITY GUIDELINES



NATIONAL FRESHWATER ECOSYSTEM PRIORITY AREAS - RIVERS



APPENDIX 3

DETAILS OF SPECIALIST

ABRIDGED CURRICULUM VITA

NATALIE VIVIENNE BIRCH

Date of birth: 21 August 1972

QUALIFICATIONS

BSc (Rhodes University) – Botany and Zoology

BSc (Hons) Wildlife Management, Pretoria University

PhD (Rhodes University)

PHD DISSERTATION

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

RESEARCH INTERESTS

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

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

PROFESSIONAL EXPERIENCE

1999 – 2000	Eastern Cape Parks Board	Ecologist
2000 -2002	Coastal & Environmental Services	Consultant
2003 – present	Ecological Management Services	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 off set 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
- Middledrift 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
- Sjibbolet Trust—Hartsvalley Habitat Assessment
- Raltefontein Habitat Assessment
- Kalahari Oryx Game Reserve—Specialist Vegetation survey

PROFESSIONAL ASSOCIATIONS

Grassland Society of Southern Africa

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

RESEARCH PUBLICATIONS

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