Boscia
ECOLOGICAL CONSULTING

ECOLOGICAL ASSESSMENT REPORT

Wepex Trading (Pty) Ltd

Glosam Iron and Manganese Mining Site

Remaining extent of the Farm Gloucester 674

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Wepex Trading (Pty) Ltd

Remaining extent of the farm Gloucester 674 (Glosam)

District of Postmasburg

Northern Cape Province

Ecological Assessment Report in application for Environmental Authorisation related to a Mining Right Application that was lodged with the Department of Mineral Resources

January 2021

EXECUTIVE SUMMARY

Wepex Trading Pty (Ltd) has been the holder of a Prospecting Right (NC 11815 PR), since 2017, to prospect for Iron and Manganese Ore on the Remaining extent of the Farm Gloucester 674 (Glosam), Postmasburg District Municipality, Northern Cape Province. This Prospecting Right is valid for 5 years and will be expiring in 2022. The company now endeavours to mine the same area and have submitted a Mining Right application, which triggers the requirement to apply for Environmental Authorisation. An ecological assessment is required in order to consider the impacts that the proposed activities might have on the ecological integrity of the property. This ecological assessment report is an updated version of the original report that was submitted along with the Prospecting Right EA application in 2016. It describes the ecological characteristics of the proposed mining area, identifies the source of impacts from the operation, and assesses these impacts, as well as the residual impacts after closure.

Seven plant communities were identified on site of which the thornveld on historic mine footprint, shrubland on manganese ridges and woodland along the ephemeral stream are associated with the core mining area. These areas are considered to be of high and very high sensitivity respectively. The most profound impacts are expected to be related to alterations and the possible destruction of the ephemeral stream, alteration to soil character, loss of soil fertility, loss of plant species of conservation concern and contribution to the cumulative effects of other mining activities in the region. A number of species of conservation concern is found in the earmarked habitats and will most certainly be damaged or removed. The most severe effect will be on the protected *Boscia albitrunca,* which is widespread across the study area. A licence application regarding protected trees should be lodged with Department of Agriculture, Forestry and Fisheries prior to any potential disturbances to these trees. A permit application regarding protected flora as well as the harvesting of indigenous vegetation also need to be lodged with the Northern Cape Department of Environment and Nature Conservation prior to any clearance of vegetation.

Overall, the proposed mining activities will impact the ecological integrity of Glosam, with associated impacts mainly considered to be moderately high. If the mining operation is managed with best environmental practise in mind, followed by effective rehabilitation efforts, these impacts can be reduced. Therefore, environmental authorisation should only be granted on condition that the applicant commits to the adherence of effective avoidance, management, mitigation and rehabilitation measures.

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1. INTRODUCTION

1.1. Background information

Since 2017, Wepex Trading Pty (Ltd) has been the holder of a Prospecting Right (NC 11815 PR) to prospect for Iron and Manganese Ore on the Remaining extent of the Farm Gloucester 674 (from here on referred to as Glosam). This Prospecting Right is valid for 5 years and will be expiring in 2022. The company now endeavours to mine the same area and has submitted a Mining Right application. The Mining Right Area is located within the Postmasburg District Municipality of the Northern Cape Province and lies 35 km north of Postmasburg and 40 km south of Kathu on the R325 (Figure 1). The total extent of the mining area is 1 165.8 ha.

The Mining Right application triggers the requirement to apply for Environmental Authorisation. An ecological assessment is required in order to consider the impacts that the proposed activities might have on the ecological integrity of the property and therefore Boscia Ecological Consulting has been appointed to provide an updated ecological assessment report. This ecological assessment report is therefore an updated version of the original report that was submitted along with the Prospecting Right EA application in 2016. It describes the ecological characteristics of the proposed mining area, identifies species of conservation concern, identifies invasive and encroaching species and their distribution, indicates the source of impacts from the mining operation and assesses these impacts as well as the residual impacts after closure. A desktop revision was performed, which incorporated the information from the field investigation that was performed in 2016 to obtain ecological information for the proposed area and identify the ecological characteristics and sensitivity of the site.

A variety of avoidance and mitigation measures associated with each identified impact are recommended to reduce the likely impact of the operation. Ecological responsibilities pertaining to relevant conservation legislation are also indicated. These should all be included in the EMPR.

Figure 1. The location of the proposed mining area is indicated in red.

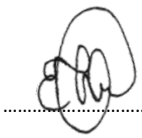
1.2. Scope of study

The specific terms of reference for the study include the following:

- update the 2016 ecological assessment report by incorporating a new desktop review and data obtained from the original field investigation in order to identify and describe different habitats and associated species of conservation concern within the environment that may be affected by the proposed activity;
- identify the relative ecological sensitivity of the project area;
- produce an assessment report that:
  - indicates identified habitats and fauna and flora species, along with their ecological sensitivity,
  - determines the potential impacts of the project on biodiversity,
  - provides mitigation measures and recommendations to limit project impacts.
  - indicates ecological responsibilities pertaining to relevant conservation legislation.

1.3. Details of the specialist consultant

Company Name:	Boscia Ecological Consulting cc	**Registration no:**	2011/048041/23
Address	PostNet Suite #194 Private Bag X2 Diamond 8305		
Contact Person	Dr Elizabeth (Betsie) Milne		
Contact Details	Cell: 082 992 1261	Email: BosciaEcology@gmail.com	
Qualifications	PhD Botany (Nelson Mandela Metropolitan University) Masters Environmental Management (University of the Free State) BTech Nature Conservation (Tshwane University of Technology)		

Declaration of independence	I, Elizabeth (Betsie) Milne declare that I: • act as the independent specialist in this application; • regard the information contained in this report as it relates to my specialist input/study to be true and correct; • do not have, and will not have any financial interest in the undertaking of the activity; other than the remuneration of work performed in terms of the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act; • have and will not have any vested interest in the activity proceedings; • have no, and will not engage in conflicting interest in the undertaking of the activities; • undertake to disclose to the component 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 and any specific environmental management Act; • will provide the competent authority with access to all information at my disposal regarding the study.  .....

1.4. Description of the proposed activity

Mining activities on Glosam is based on Manganese and Iron Ore deposits that are associated with the western belt of the Postmasburg Manganese Field and the Asbesheuwels Iron Formation (Figure 2). These deposits are found up to a depth of 60 m and will be primarily be extracted through opencast methods. The ore bodies will be excavated by using large excavators, including excavators fitted with pneumatic rock hammers. Drilling and blasting might also be required to assist with the opening of excavations. Dumper trucks will then be used to haul the ore to a processing plant where it is crushed, screened and sorted to size. For the strip mining, high grade ore will be recovered from dumps and then transported to the processing plant.

Mining activities will make use of existing infrastructure and roads that have been created during prospecting activities, but additional haul roads will be created in order to access new excavations. The mine expects to process 1 00 000 tonnes of material per annum over a period of 10 years.

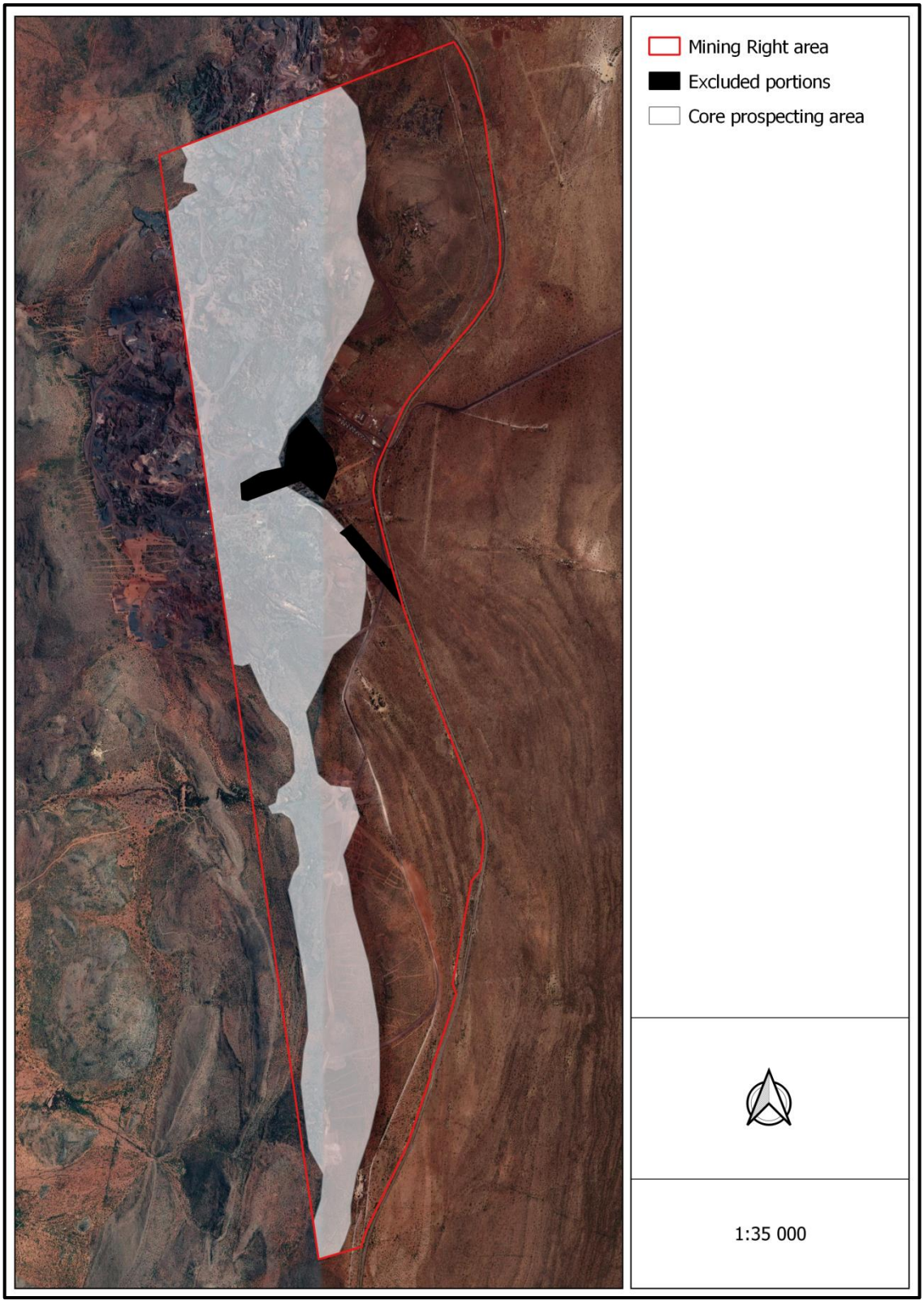


Figure 2. An indication of the core area where mining activities are expected to take place.

2. METHODOLOGY

The study comprised a combination of field and desktop surveys for fauna and flora data collection in order to obtain the most comprehensive data set for the assessment. The fieldwork component for this report was conducted on 24 and 25 July 2016, but observations made during a site investigation on 23 February 2016 for a rehabilitation plan on a preceding project, is also included here. Most data for the desktop component was obtained from the quarter degree square that includes the study area (2823AA).

2.1. Flora

2.1.1. Field survey

For the field work component, satellite images were used to identify homogenous vegetation units within the proposed mining area. Representative sampling plots were allocated in these units and sampled with the aid of a GPS in order to characterise the species composition. The following quantitative data was collected:

- Species composition
- Species percentage cover
- Amount of bare soil and rock cover
- Presence of biotic and anthropogenic disturbances

Additional checklists of plant species were compiled during the surveys by traversing a linear route and recording species as they were encountered in each unit.

2.1.2. Desktop survey

For the desktop component, the South African National Vegetation Map (Mucina and Rutherford 2012) was used to obtain data on broad scale vegetation types and their conservation status. The South African National Biodiversity Institute's (SANBI) BGIS database and the regional Environmental Management Framework were consulted to obtain biodiversity information for the Tsantsabane Local Municipality (NC085) - Z F Mgcawu District Municipality, in which the study area falls.

Further searches were undertaken specifically for Red List plant species within the current study area. Historical occurrences of Red List plant species were obtained from the SANBI: POSA database for the quarter degree squares that includes the study area (Figure 3). The IUCN conservation status of plants in the species list was also extracted from the SANBI database and is based on the Threatened Species Programme (SANBI 2020).

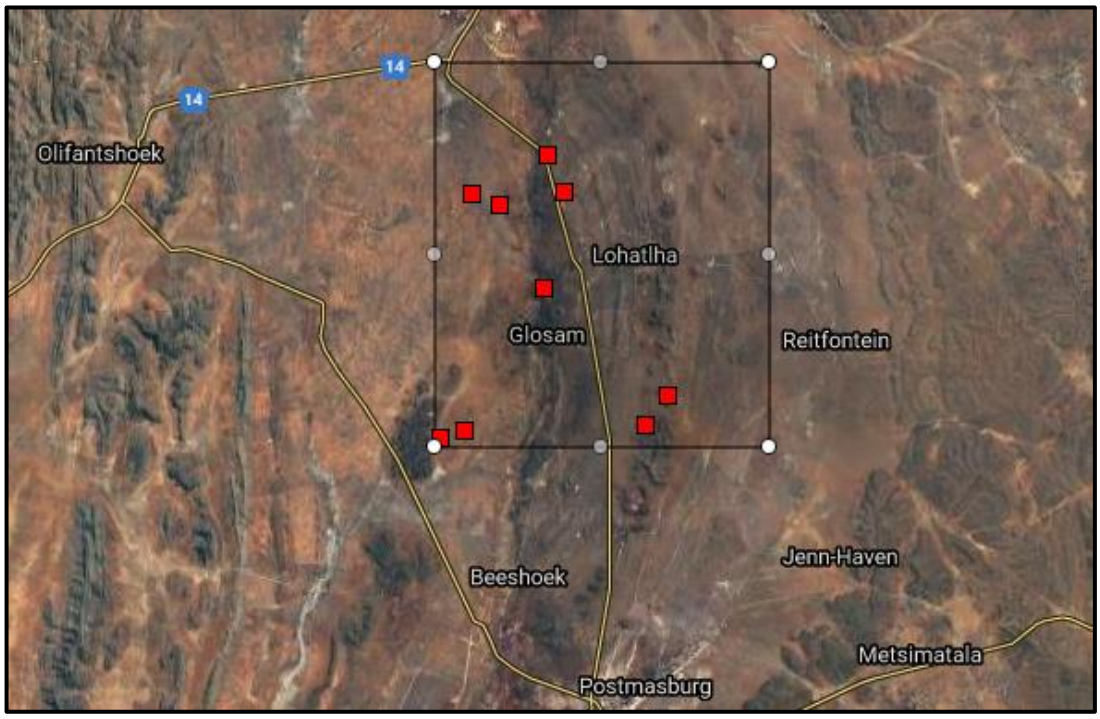


Figure 3. The extent of the map filter applied on the POSA website to extract species information is shown by the large black square. The small red squares indicate historical data points.

2.2. Fauna

2.2.1. Desktop survey

A desktop survey was undertaken to obtain lists of mammals, reptiles, amphibians, birds and arthropods which are likely to occur in the study area. These were derived based on distribution records from the literature, including Friedmann and Daly (2004) and Stuart and Stuart (2015) for mammals, Alexander and Marais (2007) and Bates et al. (2014) for reptiles, Du Preez and Carruthers (2009) for amphibians, Gibbon (2006) for birds, and (Picker et al. 2004) for arthropods.

Additional information on faunal distribution was extracted from the various databases hosted by the ADU web portal, http://adu.org.za, as well as from the Baboon Spider Atlas https://www.baboonspideratlas.co.za/, and iNaturalist https://www.inaturalist.org/. A map of important bird areas (BirdLifeSA 2015) was also consulted. 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.

The likelihood of Red Data species occurring on site has been determined using the distribution maps in the Red Data reference books (Friedmann and Daly 2004, Minter et al. 2004, Bates et al. 2014, Taylor et al. 2015, ADU 2016) and comparing their habitat preferences with the habitat described from the field survey. The conservation status of each species is also listed, based on the IUCN Red List Categories and Criteria (IUCN 2020) and/or the various red data books for the respective taxa.

2.2.2. Field survey

The faunal field survey was conducted concurrent with the vegetation survey. Habitats on site were assessed to compare with the habitat requirements of Red Date species. The presence of faunal species was determined as follows:

- Identification by visual observation
- Identification of bird and mammal calls
- Identification of signs (spoor, faeces, burrows and nests)

2.3. Assumptions and limitations

The field data included in this report is based on surveys conducted during 2016. It is not expected that any major habitat or plant community changes have occurred, apart from disturbances caused by the prospecting activities that have been taking place there since 2017. It was therefore not deemed necessary to conduct another field survey in order to update this report. The site visit for the study took place during winter, which was not the most optimal time of the year. However, many grasses and shrubs were flowering or bearing fruit and were therefore in an acceptable identifiable state for the assessment.

2.4. Sensitivity mapping and assessment

An ecological sensitivity map of the site was produced by integrating the information collected on site with the available ecological and biodiversity information available in the literature and various spatial databases.

The sensitivity mapping entails delineating different habitat units identified on the satellite images and assigning likely sensitivity values to the units based on their ecological properties, conservation value and the potential presence of species of conservation concern, as well as their probability of being affected by proposed activities. The sensitivity of the different units identified in the mapping procedure increased with probability and was rated according to the following scale:

Low: Areas of natural or transformed habitat with a low sensitivity where there is likely to be a negligible impact on ecological processes and terrestrial biodiversity. Most types of activities can proceed within these areas with little ecological impact.

Medium: Areas of natural or previously transformed land where the impacts are likely to be largely local and the risk of secondary impact such as erosion low. Activities within these areas can proceed with relatively little ecological impact provided that appropriate mitigation measures are taken.

High: Areas of natural or transformed land where a high impact is anticipated due to the high biodiversity value, sensitivity or important ecological role of the area. These areas may contain or be important habitat for faunal species or provide important ecological services such as water flow regulation or forage provision. Activities within these areas are undesirable and should only proceed with caution as it may not be possible to mitigate all impacts appropriately.

Very High: Critical and unique habitats that serve as habitat for species of conservation concern, or perform critical ecological roles. These areas are essentially no-go areas for activities and should be avoided as much as possible.

2.5. Impact assessment and mitigation

The criteria used to assess the significance of the impacts are shown in Table 1. The different project activities and associated infrastructure were identified and considered in order to identify and analyse the various possible impacts. The limits were defined in relation to project characteristics. Those for severity, extent, duration and probability are subjective, based on rule-of-thumb and experience. Natural and existing mitigation measures were considered. These natural mitigation measures were defined as natural conditions, conditions inherent in the project design and existing management measures, which alleviate impacts. The consequence value of the impacts was calculated by using the following formula:

$$\underset{\text{(Severity + Spatial Scope + Duration)}}{\textit{CONSEQUENCE}} \quad X \quad \underset{\text{(Frequency of activity + Frequency of impact)}}{\textit{PROBABILITY}}$$

Consequence of impacts is defined as follows:

Very Low: Impact would be negligible. Almost no mitigation and/or remedial activity would be needed, and any minor steps which might be needed would be easy, cheap and simple.

Low: Impact would have little real effect. Mitigation and/or remedial activity would be either easily achieved or little would be required or both.

Low – Medium: Impact would be real but not substantial within the bounds of those which could occur. Mitigation and/or remedial activity would be both feasible and fairly easily possible.

Medium – High: Impact would be real and rather substantial within the bounds of those which could occur. Mitigation and/or remedial activity would be feasible, but not necessarily possible without difficulty.

High: Impacts of substantial order. Mitigation and/or remedial activity would be feasible but difficult, expensive, time consuming or some combination of these.

Very High: Of the highest order possible within the bounds of impacts which could occur. There would be no possible mitigation and/or remedial activity to offset the impact at the spatial or time scale for which was predicted.

Table 1. Criteria used to assess the significance of expected impacts resulting from the proposed operation.

Weight	Severity	Spatial scope (Extent)	Duration
5	Disastrous	Trans boundary effects	Permanent
4	Catastrophic / major	National / Severe environmental damage	Residual
3	High/ Critical / Serious	Regional effect	Decommissioning
2	Medium / slightly harmful	Immediate surroundings / local / outside mine fence	Life of operation
1	Minimal/potentially harmful	Slight permit deviation / on-site	Short term / construction (6 months – 1 yrs.)
0	Insignificant / non-harmful	Activity specific / No effect / Controlled	Immediate (0 – 6 months)

Weight number		**1**	**2**	**3**	**4**	**5**
Frequency						
Probability	**Frequency of impact**	Highly unlikely	Rare	Low likelihood	Probable / possible	Certain
		Practically impossible	Conceivable but very unlikely	Only remotely possible	Unusual but possible	Definite
	Frequency of activity	Annually or less	6 monthly / temporarily	Infrequent	Frequently	Life of operation

CONSEQUENCE
(Severity + Spatial Scope + Duration)

PROBABILITY (Frequency of activity + Frequency of impact)															
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45
	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90
	7	14	21	28	35	42	49	56	63	70	77	84	91	98	105
	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120
	9	18	27	36	45	54	63	72	81	90	99	108	117	126	135
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150

Colour code	Significance rating	Value	**Negative impact** Management strategy	**Positive Impact** Management strategy
	VERY HIGH	126 – 150	Improve current management	Maintain current management
	HIGH	101 – 125	Improve current management	Maintain current management
	MEDIUM – HIGH	76 – 100	Improve current management	Maintain current management
	LOW – MEDIUM	51 – 75	Improve current management	Maintain current management
	LOW	26 – 50	Improve current management	Maintain current management
	VERY LOW	1 – 25	Improve current management	Maintain current management

3. DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1. Current and historic land use

The major land uses in the region are mining (manganese and iron ore) and agriculture. According to the Southern African Agricultural Geo-referenced Information System, the land capability of the plains in the east is non-arable with low potential grazing land, while the hills in the west are considered to be wilderness. The grazing capacity is 14 ha/LSU, with the agricultural region being demarcated for cattle farming. The property is categorised to have no suitability for crop yield.

Glosam is characterised by a fairly complex mining history. Various formal and informal mining companies have mined the area for iron ore and manganese between the late 1920s and 1984. This produced numerous open pits scattered across the site (Figure 4). These pits and associated road networks are still visible today as well as various building and structures related to the past mining activities; some of which are of archaeological significance. Exploration activities have also been performed over the past decade.

Current land use activities on the mining right area are indicated in Figure 4 and include existing infrastructure from the Wepex prospecting activities, two cell phone reception towers managed by MTN and Cell C, and a number of ESKOM power lines. Areas in the south of the mining right area are mainly used for grazing by livestock and wildlife and a Transnet railway track lines the eastern border of the mining right area. This railway line links the Kalahari mines with Port Elizabeth via Kimberley.

3.2. Geology and soils

The study area is predominantly underlain by the rocks of the Transvaal Supergroup, Griqualand West Sequence. Here, dolomitic limestone with subordinate coarsely crystalline dolomite of the Ghaapplato formation from the Campbell group covers a large area in the eastern half of the study area (Figure 5). Shale, flagstone, quartzite and conglomerate from the Gamagara Formation of the Postmasburg group are found in west, while the iron and manganese deposits are associated with the unconformity between the latter formations.

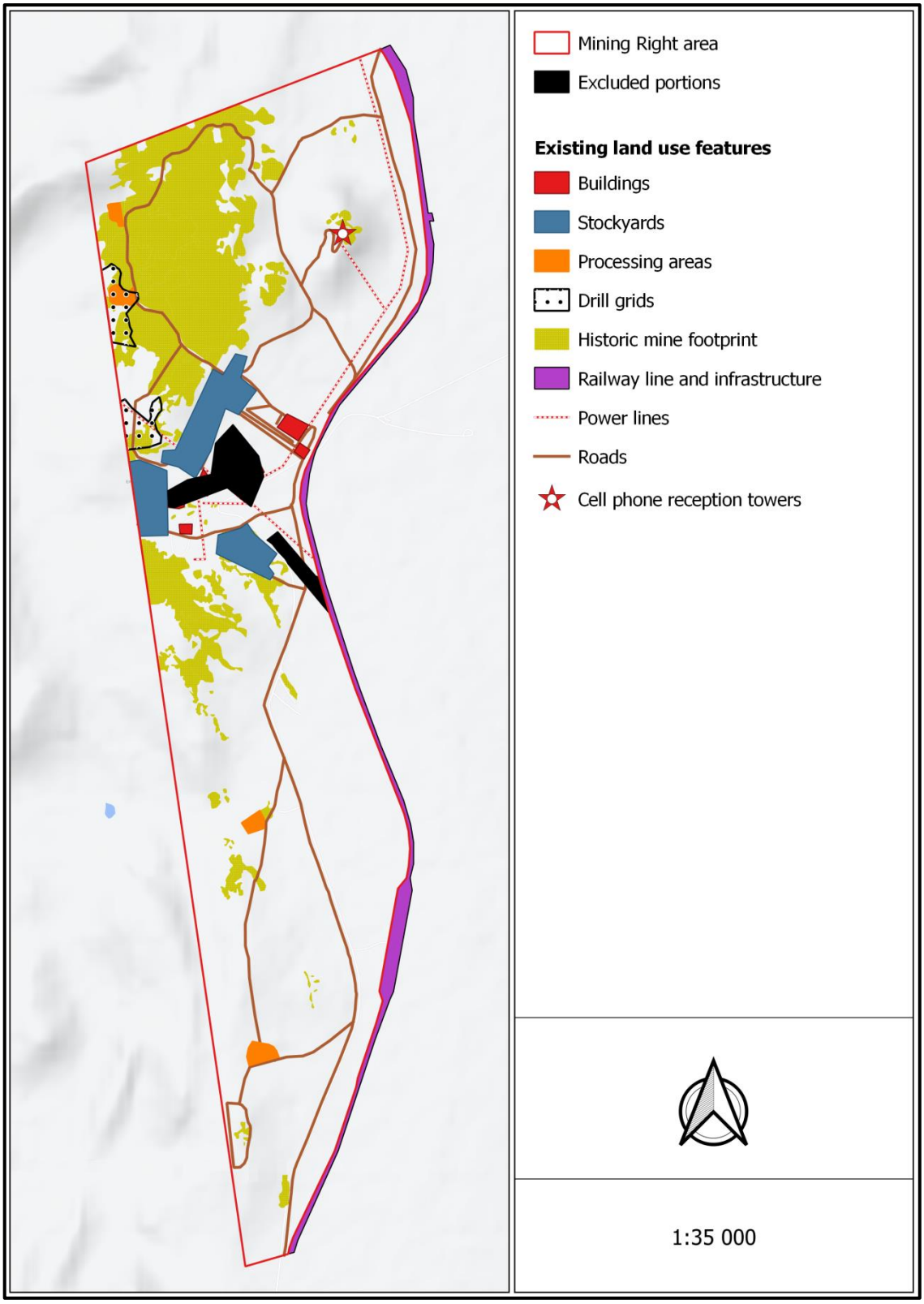


Figure 4. Existing land use features on Glosam.

The manganese ore deposit of Glosam is extremely irregular and has been deposited on a karstic landscape of the Cambellrand Subgroup, where the ferruginous manganese ore occur within large solution cavities. This was deposited as a wad trapped in karst hollows near the surface together with exogenic detrital material. Younger detrital manganese ore associated with the present day erosional surface accumulates along slopes and exposed karst topography. This is visible as scree and gravel on the floor of the historic mine pits.

Level plains with some relief (4), is the dominant terrain unit of the landscape in the eastern half of the mining area, which is closely associated with the Ag111 landtype (Figure 6 and Figure 7). The western half is however dominated by open hills and ridges, closely associated with the Ib238 landtype. These hills are rocky with minimal soil cover and the steep slopes produce high runoff erosion risks. On the plains, red-yellow apedal, freely drained soils with high base status are found. These soils have minimal development and are shallow (< 300 mm), occurring on hard or weathering rock. The rather flat terrain has low potential for runoff erosion. The sandy soils of the study area are prone to wind erosion. If badly eroded, the soils on Glosam have a very low potential to regenerate.

3.3. Vegetation

3.3.1. Broad-scale vegetation patterns

The study area falls within the Savanna Biome (Mucina and Rutherford 2012) and according to Mucina et al. (2005), two vegetation units are present on site (Figure 8); i.e. Kuruman Thornveld and Kuruman Mountain Bushveld. This map has however not been mapped at a very fine scale and therefore does not reflect the true character of the site.

Kuruman Thornveld is distributed in the North-West and Northern Cape Provinces, and lies at altitudes between 1 300 and 1 500 m. This unit is distributed east of Kuruman to Lykso, and south of Bendell towards Good Hope. The unit is presented as flat rocky plains and some sloping hills with very well-developed, closed shrub layer and well-developed open tree stratum consisting *Vachellia erioloba*. The unit mainly consists of Superficial Kalahari Group sediments, with deep red wind-blown sand, but Campbell Group dolomite and chert also occur. The dominant land types are Ae, Ai, Ag and Ah. The unit is not currently conserved within any formal conservation areas and is classified as being least threatened with very low erosion and 2% transformation. The herb *Gnaphalium englerianum* is the only endemic plant species know to occur in this unit.

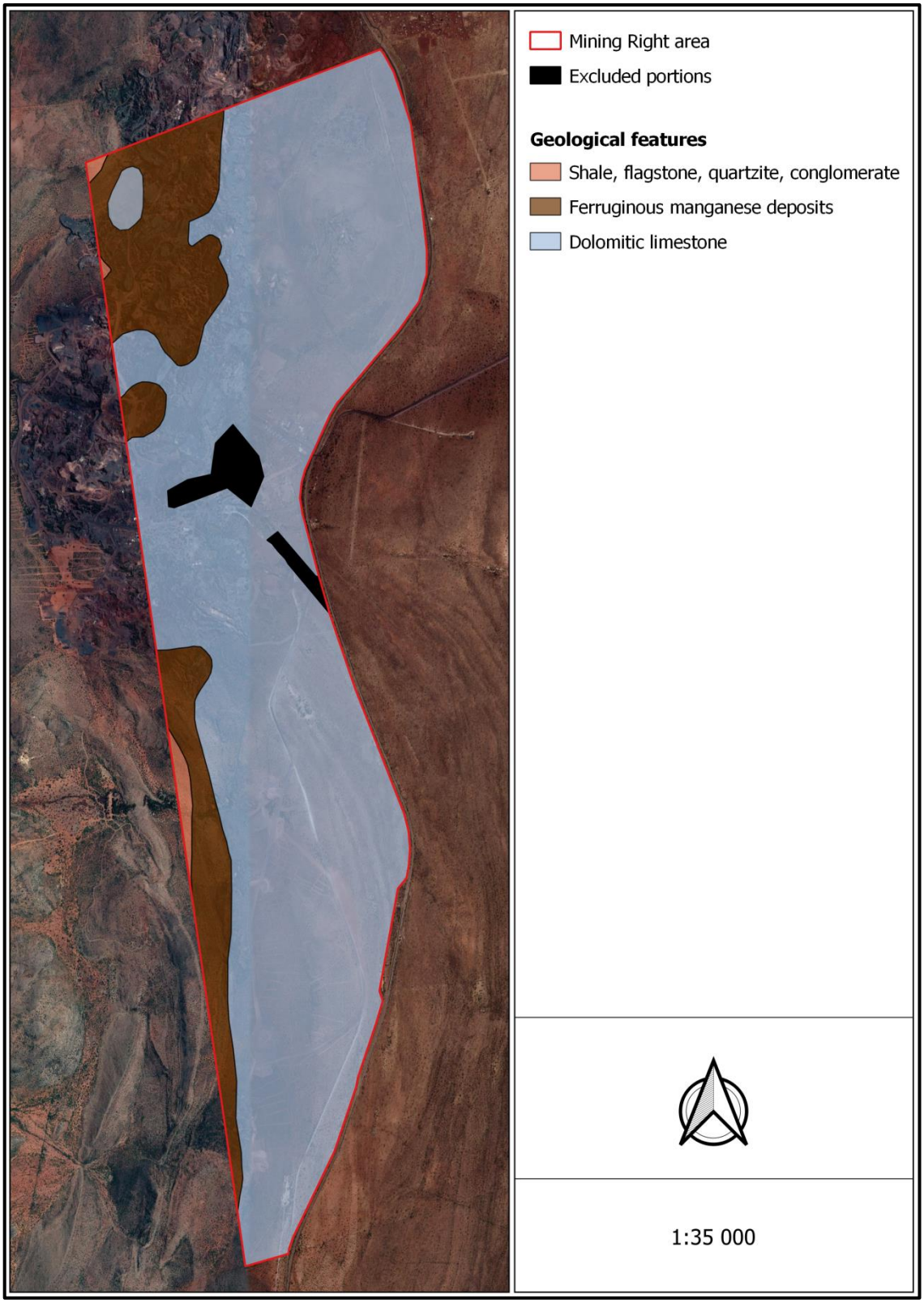


Figure 5. The distribution of geological features in the study area.

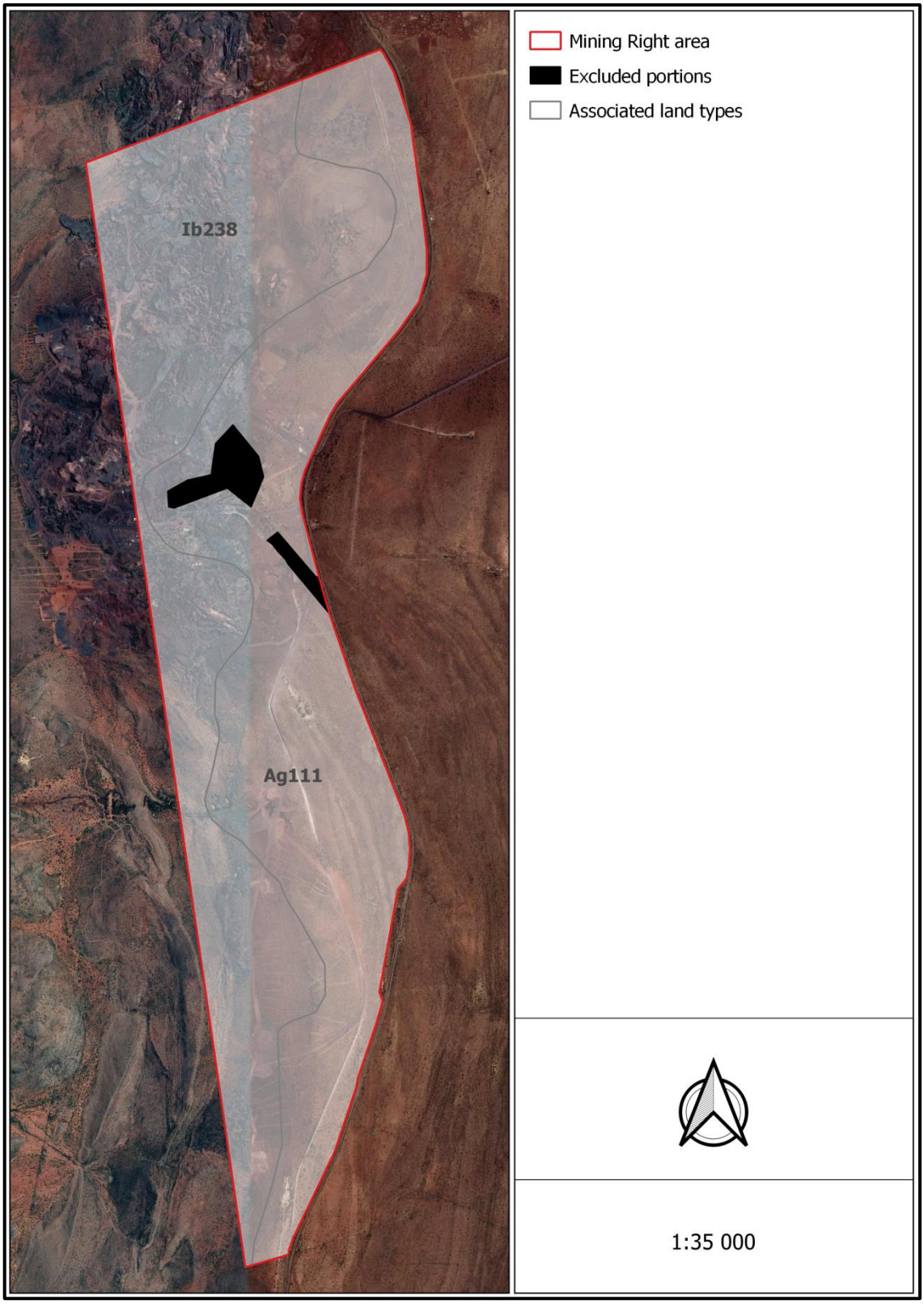


Figure 6. The dominant land types found in the study area.

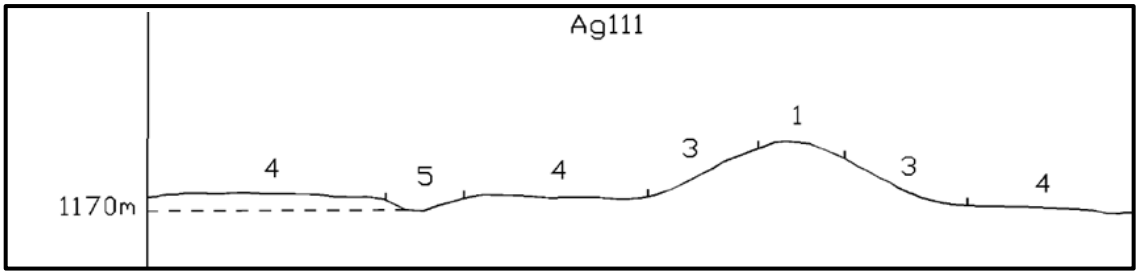


Figure 7. Terrain form sketch for the Ag111 land type of the study area. No terrain sketch is available for the Ib238 landtype.

Kuruman Mountain Bushveld is distributed in the Northern Cape and North-West Provinces at altitudes between 1 100 and 1 800 m. It stretches from the Asbestos Mountains southwest and northwest of Griekwastad, along the Kuruman Hills north of Danielskuil, passing west of Kuruman and re-emerging as isolated hills. The unit is typically presented as rolling hills with gentle to moderate slopes and hill pediment areas with an open shrubveld. Here, *Calobota cuspidosa* is conspicuous within a well-developed grass layer. The Hills consist of banded iron formation, with jasper, chert and riebeckite-asbestos of the Asbestos Hills Subgroup of the Griqualand West Supergroup. Soils are shallow, sandy and of the Hutton form. The most common land types are Ib, followed by Ae, Ic and Ag. The unit is considered to be least threatened and very little is transformed and with little erosion being present. It is not currently conserved within any formal conservation areas and the succulent *Euphorbia planiceps* is the only endemic species known from this unit.

3.3.2. Fine-scale vegetation patterns

The plant communities within the study area are delineated according to plant species correspondences, change in soil structure, topographical changes and disturbance regimes. The vegetation on site can be divided into seven distinct units (Figure 9) and are described below. These community descriptions include unique characteristics and the dominant species found in each unit. A complete plant species list, including those species likely to occur in the area is presented in Appendix 1.

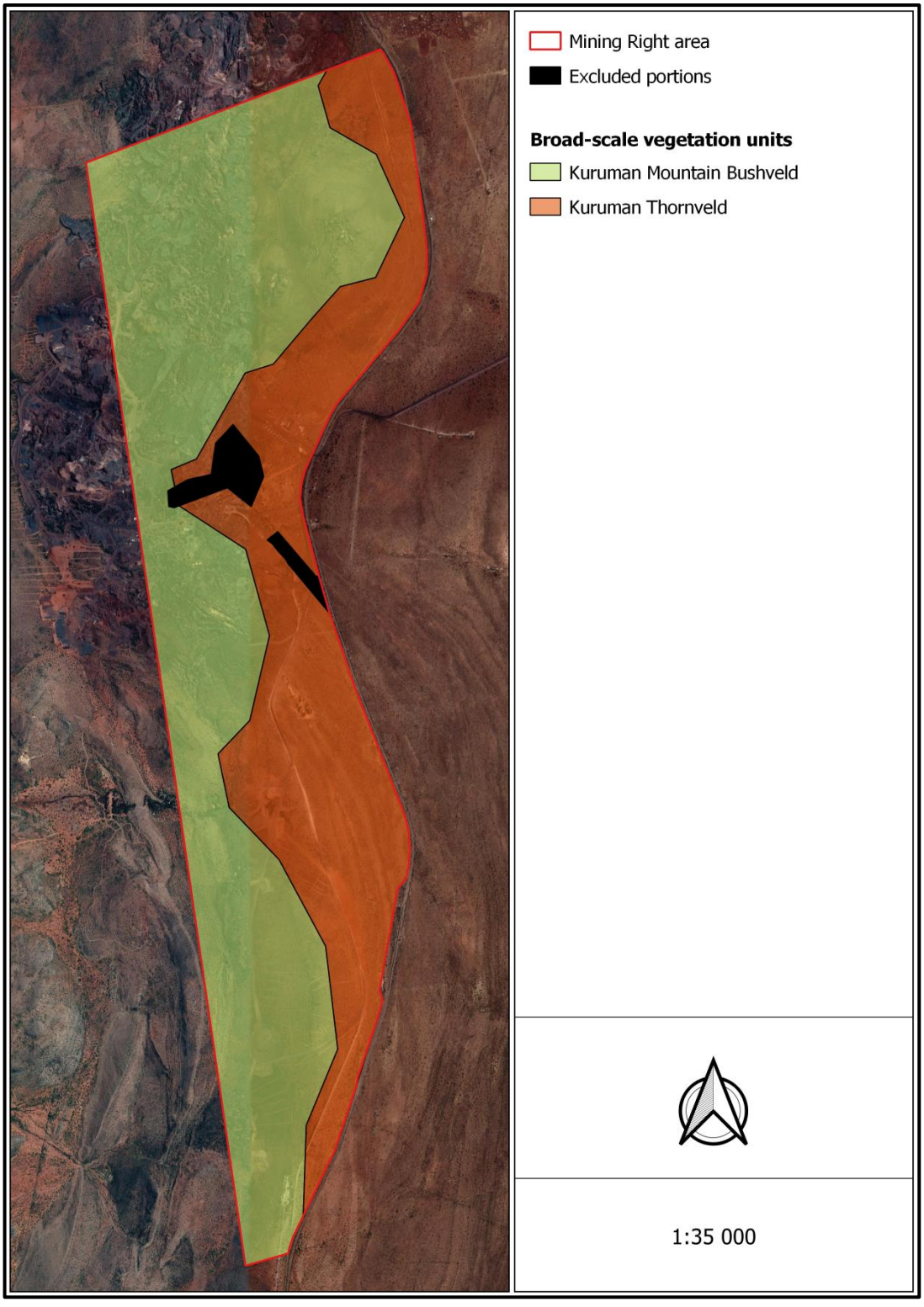


Figure 8. The distribution of broad-scale vegetation units in the study area.

Figure 9. The distribution of fine-scale vegetation units in the study area.

i) *Vachellia tortilis – Senegalia mellifera* thornveld on historic mine footprint

This community occurs on transformed land produced by historic mining and associated activities. It is primarily found in the northern half of the study area (Figure 9) where overgrown pits and dumps are conspicuous in the landscape (Figure 10). The vegetation mainly grows as dense thornveld in abandoned pits, but are more sparse on the old dumps where rainfall continuous to erode the slope substrates.

The plant community typically consist of tall shrubs and trees, where *Vachellia tortilis* and *Senegalia mellifera* are equally dominant. Other common species include *Tarchonanthus camphoratus, Grewia flava, Searsia burchellii, S. tridactyla, S. lancea, Euclea crispa, Ehretia alba, Ziziphus mucronata* and *Calobota cuspidosa*.

The grass layer is not well developed where dense stands of woody vegetation occur, but are primarily found where the trees and shrubs are more sparsely distributed. Species distribution is also rather patchy, but those common to this community include *Aristida congesta* subsp*. barbicollis, A. diffusa, Eragrostis rotifer, E. echinochloidea, E. chloromelas, Heteropogon contortus, Cenchrus ciliaris, Stipagrostis uniplumis, Enneapogon desvauxii,* and *E. cenchroides*.

Other species found here include *Lopholaena cneorifolia, Pegolettia retrofracta, Chrysocoma ciliata, Lepidium africanum* subsp. *divaricatum, Pollichia campestris, Hermannia vestita, Cadaba aphylla* and *Blepharis marginata*

The nationally protected tree *Boscia albitrunca* is a conspicuous shrub in this community and occurs at an estimated average density of three individuals per hectare. They are mainly found as stunted or young individuals (Figure 11). This species is also protected under provincial legislation. No other species of conservation concern was encountered here.

Exotic species include *Opuntia ficus-indica, O. lindheimeri, Prosopis glandulosa*, *Eucalyptus* sp., *Schinus molle, Salsola kali*, *Capsella bursa-pastoris* and *Chenopodium carinatum*.

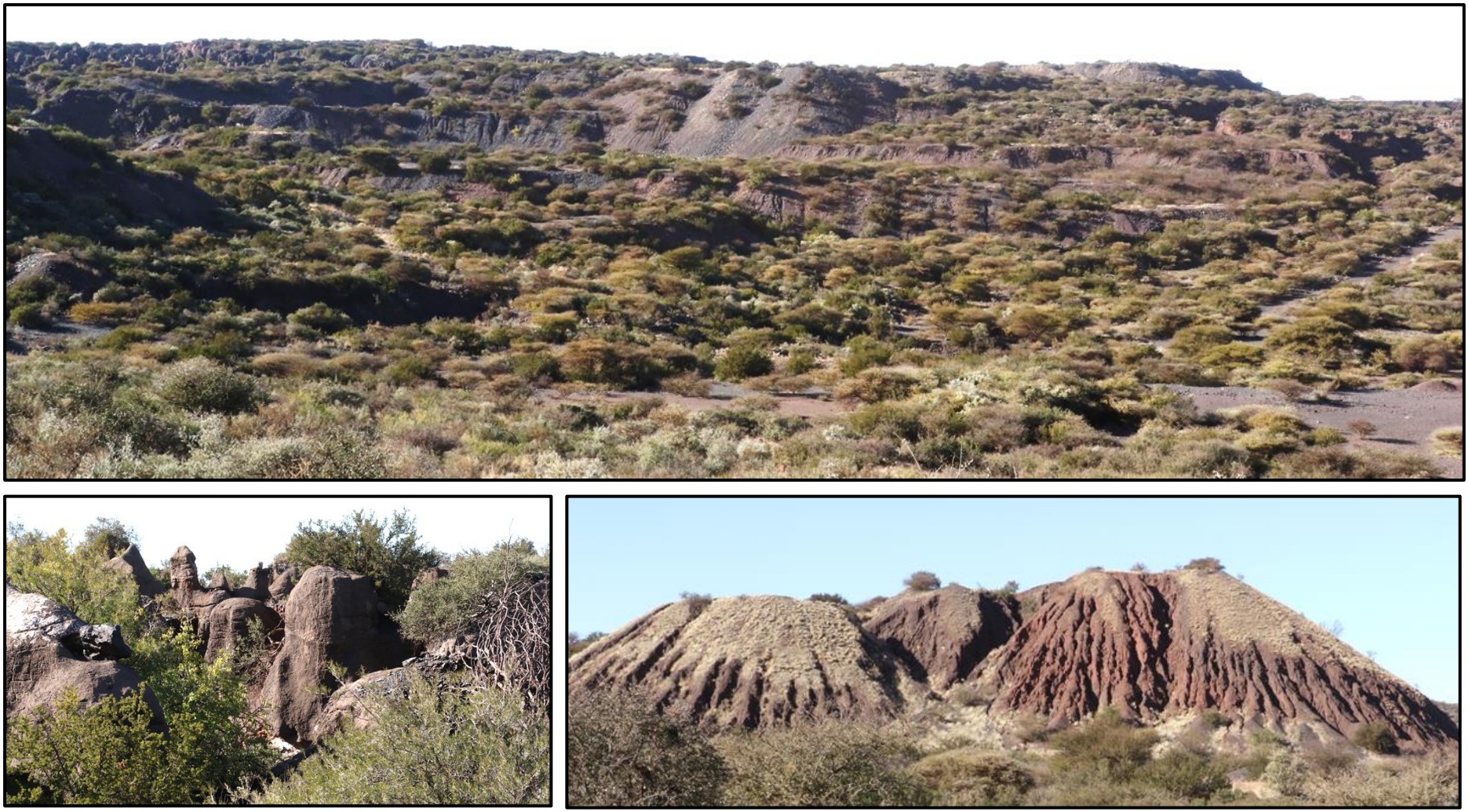


Figure 10. The historic mine footprint is presented as a thornveld that have re-established on pits and dumps and is a conspicuous feature of the landscape in the northern half of Glosam (top). The vegetation forms dense stands in the abandoned pits (bottom left), while the dumps are sparsely vegetated with high erosion risks (bottom right).

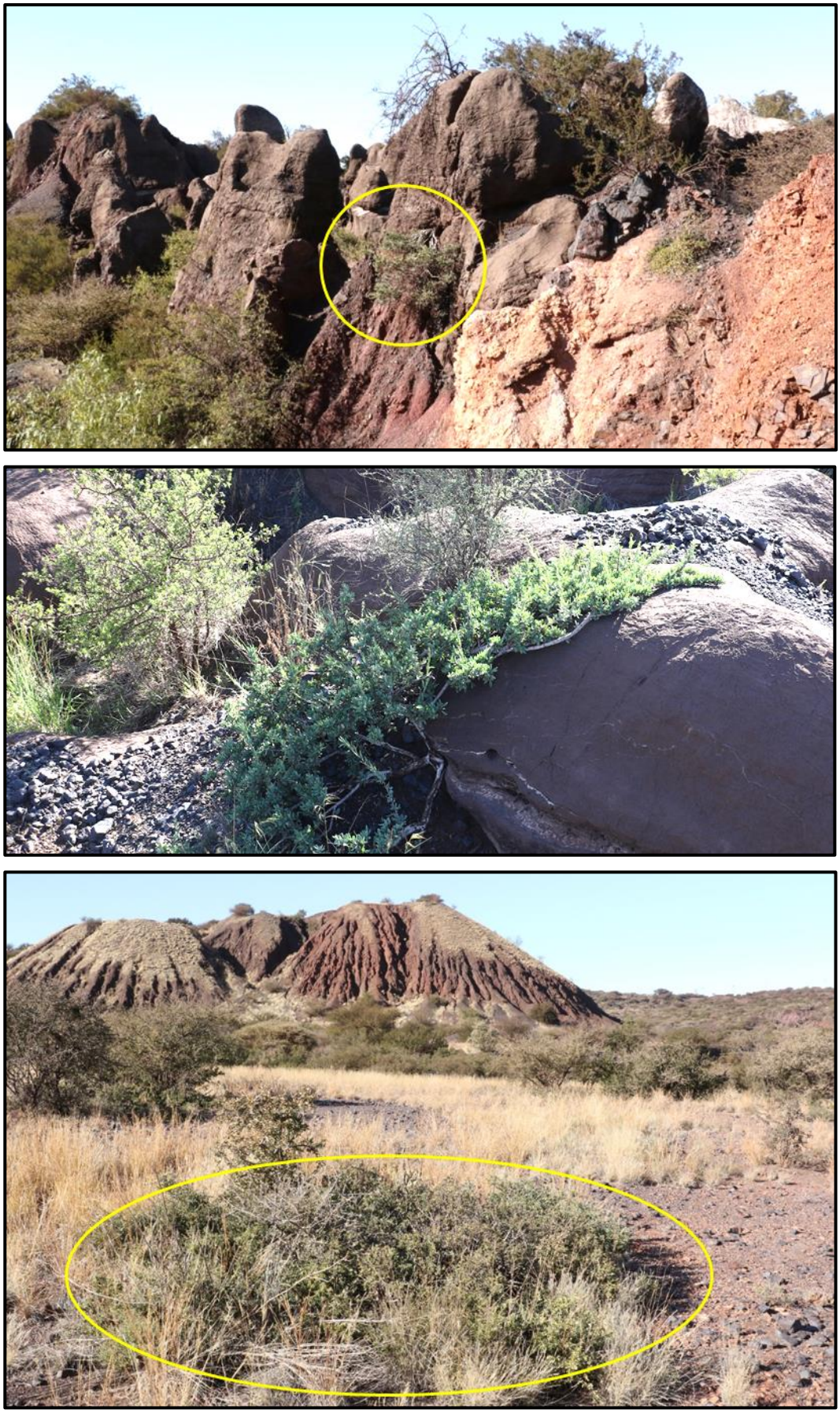


Figure 11. The protected tree *Boscia albitrunca* is widespread across the transformed footprint.

ii) *Olea europaea – Heteropogon contortus* open shrubland on dolomitic hills

This plant community is associated with the isolated hills in the north-eastern part of the study area (Figure 9). It is restricted to shallow soil and dolomitic rocks which constitute approximately 20 % of the ground cover. The vegetation is typically presented as an open shrubland, where shrubs are scattered in a grassy matrix (Figure 12).

Figure 12. The open shrubland on dolomitic hills are presented by shrubs that are scattered in a grassy matrix.

The tall shrub stratum is dominated by *Olea europaea* subsp. *africana*, but *Searsia tridactyla* and *Euclea undulata* are also very common. In some areas towards the footslopes *Croton gratissimus* var. *gratissimus* forms dominant patches. Other tall shrubs include *Putterlickia saxatilis, Tarchonanthus camphoratus, Ehretia alba, Euclea crispa, Rhigozum obovatum*, *Senegalia mellifera, Calobota cuspidosa* and *Lycium* sp. Common low shrubs include *Justicia thymifolia, J. puberula, Asparagus sp., Kleinia longiflora, Phyllanthus parvulus, Justicia divaricata, Solanum sp., Peliostomum origanoides, Melolobium candicans, Pegolettia retrofracta, Thesium lineatum* and *Selago sp*.

The well-developed grass layer is dominated by *Heteropogon contortus*, but *Digitaria eriantha* is also widespread. Other grasses include *Eustachys paspaloides, Themeda triandra, Fingerhuthia africana, Chrysopogon serrulatus, Eragrostis nindensis, Cenchrus ciliaris, Enneapogon scoparius, Aristida adscensionis* and *Brachiaria serrata.*

Albuca cf. *virens* subsp. *virens* is a conspicuous species in this unit and is found widespread within the grassy matrix. Other herbaceous species include *Massonia* sp., *Rhynchosia totta* var. *totta* and *Geigeria* sp.

No nationally protected trees or red list species were encountered in this unit, but provincially protected species include *Olea europaea* subsp. *africana*, *Lessertia frutescens, Pelargonium minimum* and *Jamesbrittenia* sp.

iii) *Searsia tridactyla – Aristida diffusa* shrubland on quartzite hills

This community is associated with hills of the Gamagara Formation that predominantly line a portion of the south-western border of the study area, but a small portion is also located in the north-western corner (Figure 9). Here, shrubs are scattered in a grassy matrix, with quartzite boulders and termitaria being conspicuous (Figure 13). Shallow, rocky soil constitutes approximately 20 % of the ground cover.

Searsia tridactyla is the most dominant tall shrub, but shrubs like *Tarchonanthus camphoratus, Calobota cuspidosa, Ehretia alba, Grewia flava, Senegalia mellifera* and *Euclea crispa* are also common. Species like *Putterlickia saxatilis, Rhigozum obovatum, Searsia burchellii, S. ciliata, S. pyroides, Dodonaea viscosa* var*. angustifolia* and *Euclea undulata* are also found here. Common lower shrubs include *Pegolettia retrofracta, Phyllanthus parvulus, Justicia thymifolia, Thesium lineatum, Peliostomum origanoides, Chrysocoma ciliata, Eriocephalus ericoides, Hermannia affinis, H. vestita, Kleinia longiflora, Leonotis pentadentata, Justicia divaricata, Pollichia campestris* and *Asparagus* spp*.*

The grass layer is very well developed and particularly species rich. *Aristida diffusa* dominates, but *Enneapogon scoparius, Brachiaria serrata, Heteropogon contortus, Aristida adscensionis, Eragrostis chloromelas* and *Stipagrostis uniplumis* are also very common. Other grasses like *Eragrostis lehmanniana, E. trichophora, E. nindensis, Fingerhuthia africana, Melinis repens, Aristida congesta* subsp*. congesta, Anthephora pubescens, Cymbopogon pospischilii, Digitaria eriantha, Eustachys paspaloides, Schmidtia pappophoroides, Sporobolus fimbriatus* and *Themeda triandra* also occur, but at lower densities.

Other species found in this unit include *Cleome rubella, Geigeria* sp., *Pellaea calomelanos* and *Cheilanthes eckloniana*, while the exotic *Opuntia lindheimeri* is also found here, especially where this unit transitions from the historic footprint. The listed (declining) *Boophone disticha* is also found here, along with nationally and provincially protected *Boscia albitrunca*, which occurs at densities of two individuals per ha. Species protected provincially include *Pelargonium minimum*, *Olea europaea* subsp. *africana*, *Freesia andersoniae*, *Stapelia* sp. and *Oxalis* sp.

Figure 13. The shrubland on quartzite hills can be defined by the quartzite boulders (top) and termitaria (bottom) found here.

iv) *Tarchonanthus camphoratus – Aristida adscensionis* open shrubland on dolomitic limestone

This plant community is associated with the plains in the east (Figure 9), where shallow dark red soils over dolomitic limestone constitute 20 % of the ground cover. The vegetation is presented as an open shrubland where tall shrubs are scattered in a predominantly low growing grassy-shrubby matrix (Figure 14).

Tarchonanthus camphoratus dominates the tall shrub strata, but *Grewia flava, Searsia ciliata, S. tridactyla*, *Senegalia mellifera, Olea europaea* subsp*. africana* and *Ziziphus mucronata* are also very common. *Ehretia alba, Euclea crispa, Rhigozum obovatum, Searsia burchellii, S. lancea* and *Vachellia tortilis* are widespread, but occur at much lower densities. Low shrub *Eriocephalus ericoides* is the most conspicuous woody species in the matrix vegetation, followed by *Pentzia calcarea* and *P. incana*, but *P. globosa*, *Aptosimum marlothii, Calobota cuspidosa, Chrysocoma ciliata, Leonotis pentadentata, Justicia divaricata, Asparagus* spp*.* and *Lycium* spp*.* are also very common. *Barleria rigida, Hermannia affinis, H. glabrata, Plinthus sericeus.* and *Viscum rotundifolium* occur at much lower densities.

Aristida adscensionis dominate the grass stratum, followed by *Aristida congesta* subsp. *barbicollis* and *Schmidtia pappophoroides*, but *Enneapogon scoparius, Fingerhuthia africana, Stipagrostis obtusa* and *S. uniplumis* are also very common. Other grasses like *Cymbopogon pospischilii, Digitaria eriantha, Eragrostis echinochloidea, E. lehmanniana, E. obtusa, E. rigidior E. trichophora, Heteropogon contortus, Sporobolus fimbriatus, Themeda triandra, Setaria verticillata, Aristida congesta* subsp*. congesta, A. stipitata, Cenchrus ciliaris, Enneapogon cenchroides, Pogonarthria squarrosa* and *Tragus sp.* occur at lower densities or have patchy distributions. Other herbaceous species found here include Dicoma capensis, Sesamum triphyllum and Geigeria sp.

The nationally protected trees *Boscia albitrunca* and *Vachellia erioloba* occur in this unit. *B. albitrunca* is widespread, but occur at an estimated density of one individual per hectare, while *V. erioloba* is very scarce and at least one large adult was observed (Figure 15). Other species of conservation concerns include *Gymnosporia buxifolia* and *Crassula setulosa*. Exotic species include *Opuntia lindheimeri*.

Figure 14. The vegetation associated with dolomitic limestone on the plains is presented as an open shrubland where tall shrubs are scattered in a predominantly low growing grassy-shrubby matrix.

Figure 15. The nationally protected *Vachellia erioloba* is scarce in the shrubland of the plains, but at least one tall individual were encountered during the survey (top). *Boscia albitrunca* is more widespread but occurs at low densities (bottom).

v) *Tarchonanthus camphoratus – Stipagrostis uniplumis* shrubland on manganese ridges

The ridges sandwiched between the plains and the hills of the Gamagara Formation are typically associated with pockets of ferruginous manganese deposits (Figure 9). Here shallow, gravelly soils and rocky outcrops constitute 20 % of the ground cover. Tall shrub stands are common, while grasses and low shrubs grow opportunistically in the shrub canopy gaps (Figure 16).

Tarchonanthus camphoratus is conspicuous, followed by *Searsia tridactyla*, *S. burchellii, Olea europaea* subsp. *africana*, *Senegalia mellifera* and *Ehretia alba*. *Justicia thymifolia* is particularly tall in this unit, with individuals up to 2 m being found. Other widespread species include *Putterlickia saxatilis Ziziphus mucronata, Calobota cuspidosa, Euclea crispa, E. undulata, Grewia flava, Rhigozum obovatum* and *Tarchonanthus obovatus.*

Common low shrubs include *Eriocephalus ericoides, Pentzia incana, Leonotis pentadentata, Felicia filifolia* subsp*. filifolia* and *Pegolettia retrofracta,* while *Aptosimum marlothii, Hermannia vestita, Justicia divaricata, Sericocoma avolans, Asparagus* spp*., Cadaba aphylla, Chrysocoma ciliata, Osteospermum oppositifolium, Hermannia affinis, Peliostomum origanoides, Pentzia calcarea, Selago sp.* and *Thesium lineatum* are also found here.

The grass layer is dominated by *Stipagrostis uniplumis,* but *Aristida congesta* subsp. *congesta* and *A. diffusa* are also very common. Other grasses found in this unit include *Aristida adscensionis, A. congesta* subsp*. barbicollis, Melinis repens, Cymbopogon pospischilii, Enneapogon cenchroides, E. scoparius, Eragrostis trichophora, Fingerhuthia africana, Heteropogon contortus, Schmidtia pappophoroides* and *Tragus* sp. The herb *Geigeria* sp. is also found here.

Nationally and provincially protected *Boscia albitrunca* is found at estimated densities of one individual per hectare, while provincially protected bulb *Freesia andersoniae* is also found here. No exotic species were encountered.

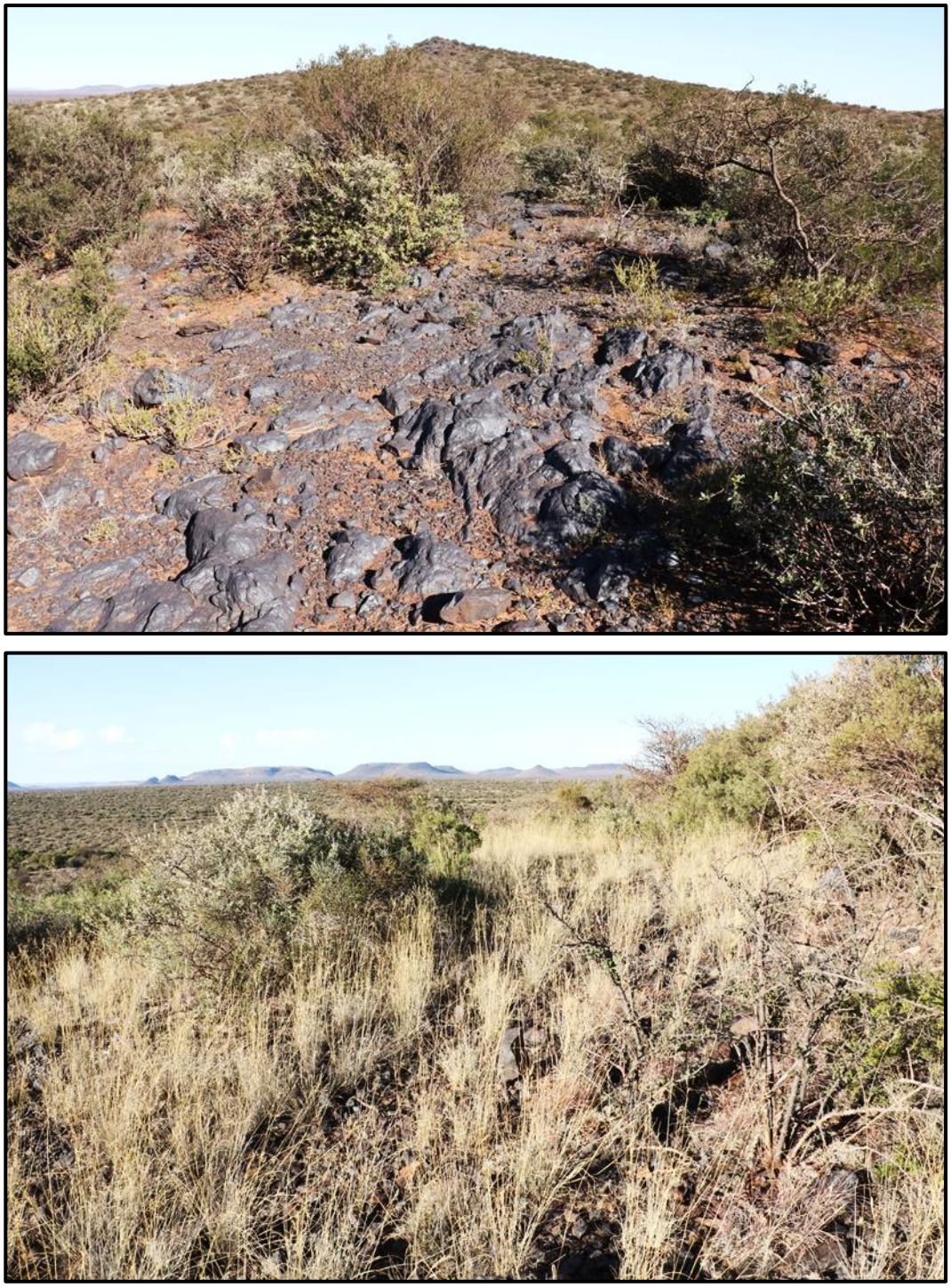


Figure 16. The vegetation associated with pockets of ferruginous manganese deposits grow on shallow, gravelly soils and rocky outcrops. Here tall shrubs are dominant, while grasses and low shrubs grow opportunistically in the canopy gaps.

vi) *Searsia lancea – Vachellia tortilis* woodland along the ephemeral stream

The ephemeral stream is located in the southern half of the study area and drains from the hills and ridges in the west, towards the plains in the east (Figure 9). Although the stream only flows intermittently, the vegetation represents typical riparian woodland. The active channel is not well defined, but it is distinguishable (Figure 17).

Trees and tall shrubs like *Vachellia tortilis, Searsia lancea, Tarchonanthus camphoratus, Ziziphus mucronata* and *Olea europaea* subsp. *africana* (provincially protected) form dense riparian woodland along the stream banks. Here, *Asparagus* spp. are also common. The herbaceous layer is dominated by grass species such as *Sporobolus fimbriatus, Panicum maximum, Setaria verticillata* and *Eragrostis trichophora*, while exotics like *Tagetes minuta* and *Capsella bursa-pastoris* are also conspicuous. The herbaceous layer is particularly dense in the open canopy.

Figure 17. The vegetation associated with the ephemeral stream forms typical riparian woodland (top). The active channel (yellow line) is not well defined, but distinguishable (bottom).

vii) *Rhigozum trichotomum – Eragrostis rigidior* shrubland on red sand

A very small pocket, where red sand constitute approximately 30 % of the ground cover, is found in the south-eastern corner of the study area (Figure 9). It appears as if this unit established opportunistically after wind-blown sand were deposited along this eastern fringe of the Gamagara hills. A very unique species assemblage is found here, but broad transitional zones occur between this unit and those associated with the hills of the Gamagara Formation and the manganese ridges. The density of species of conservation concern is also particularly high here.

The shrub component is primarily stunted, with *Rhigozum trichotomum* being the most dominant species (Figure 18). Other shrubs scattered across the unit include *Tarchonanthus camphoratus, Justicia thymifolia, Grewia flava, Rhigozum obovatum, Searsia burchellii, S. tridactyla, Ehretia alba, Senegalia mellifera, Putterlickia saxatilis, Calobota cuspidosa* and *Ziziphus mucronata*. Dwarf shrubs include *Eriocephalus ericoides, Pegolettia retrofracta, Pentzia incana, Thesium lineatum, Justicia divaricata, Felicia fascicularis* and *F. filifolia* subsp. *filifolia*.

The tall grass layer is not very well developed. Here, *Eragrostis rigidior* is most dominant, but *Schmidtia kalahariensis, S. pappophoroides, Stipagrostis uniplumis, Heteropogon contortus, Eragrostis trichophora, Brachiaria serrata* and *Cymbopogon pospischilii* are also very common.

The nationally protected *Boscia albitrunca* is very conspicuous and occurs at high densities, estimated at approximately five individuals per hectare. They are found as stunted and tall individuals across the unit (Figure 19). Other species of conservation concern include *Gymnosporia buxifolia* and *Olea europaea* subsp. *africana*. No exotics were encountered here.

Figure 18. The shrubland on red sand is represented by stunted tall shrubs, where *Rhigozum obovatum* dominates.

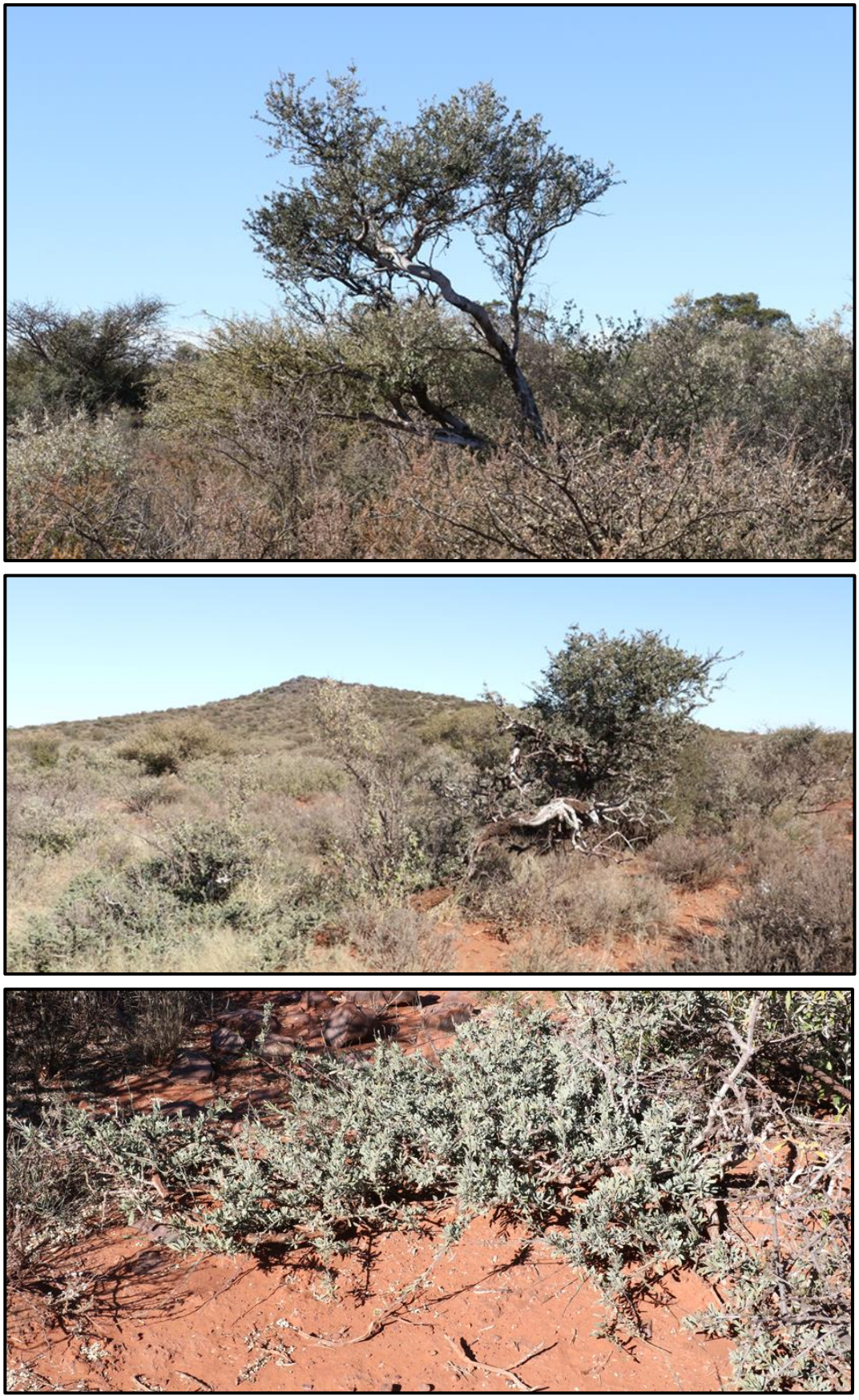


Figure 19. The nationally and provincially protected tree *Boscia albitrunca* is densely distributed on the small pocket of sand found in the south-western corner of the study area.

3.3.3. Population of sensitive, threatened and protected plant species

The SANBI Red List provides information on the national conservation status of South Africa's indigenous plants, while the National Forests Act (No. 84 of 1998) (NFA) and the Northern Cape Nature Conservation Act (Act No. 9 of 2009) (NCNCA) restricts activities regarding sensitive plant species. Section 15 of the NFA prevents any person to cut, disturb, damage, destroy or remove any protected tree; or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a licence granted by the Minister. Section 49 (1) and 50 (1) of the NCNCA states that no person may, without a permit pick, transport, possess, or trade in a specimen of a specially protected (Schedule 1) or protected (Schedule 2) plants. Furthermore, Section 51(2) states that no person may, without a permit, pick an indigenous plant (Schedule 3) in such manner that it constitutes large-scale harvesting.

Most of the species recorded in the area are classified as least concern; a category which include widespread and abundant taxa (Table 2). However, one species, i.e. *Hereroa wilmaniae*, is listed as “Data Deficient - Taxonomically Problematic” and although it was not encountered during the survey, historic records suggest that it occurs in the region, where it is known from the Asbestos Hills, Ghaap Plateau, Kuruman Hills, Langberg and river valleys in the Northern Cape.

Species protected in terms of the National Forests (NFA) Act No 84 of 1998 include *Vachellia erioloba, V. haematoxylon* and *Boscia albitrunca* (Table 2). *Boscia albitrunca* occurs widespread across the study area, while only one *Vachellia erioloba* individual was encountered on the plains. It is to be expected that many of these protected tree species will be destroyed during the proposed mining operation. Before any of these individuals are to be damaged or removed (seedlings to adults) during the operation, an application must be submitted to the Northern Cape Department of Agriculture, Forestry and Fisheries (DAFF) at least three months in advance to ensure that a licence is obtained from DAFF before such activities commence. *Vachellia haematoxylon* has been recorded in the region, where it is particularly common in the nearby dune fields, but does not occur on Glosam.

Table 2. Plant species found in the study area that are of conservation concern.

FAMILY	Scientific name	Status	NFA	NCNCA
AIZOACEAE (MESEM)	*Hereroa wilmaniae*	**DDT**		S2
AMARYLLIDACEAE	*Boophone disticha*			S2
APOCYNACEAE	*Stapelia* sp.			S2
CAPPARACEAE	*Boscia albitrunca*		**X**	S2
CELASTRACEAE	*Gymnosporia buxifolia*			S2
CRASSULACEAE	*Crassula capitella* subsp. *nodulosa*			S2
	Crassula setulosa			S2
	Kalanchoe rotundifolia			S2
EUPHORBIACEAE	*Euphorbia mauritanica*			S2
FABACEAE	*Lessertia frutescens*			**S1**
	Vachellia erioloba	LC	**X**	
	Vachellia haematoxylon	LC	**X**	
GERANIACEAE	*Pelargonium minimum*			**S1**
IRIDACEAE	*Freesia andersoniae*			S2
OLEACEAE	*Olea europaea* subsp. *africana*			S2
OXALIDACEAE	*Oxalis* sp.			S2
SCROPHULARIACEAE	*Jamesbrittenia* sp.			S2

Species which are protected in terms of the NCNCA are listed in Table 2. Those encountered during the survey include *Lessertia frutescens, Pelargonium minimum*, *Boophone disticha, Stapelia* sp., *Boscia albitrunca, Gymnosporia buxifolia, Crassula setulosa, Freesia andersoniae, Olea europaea* subsp. *africana, Oxalis* sp. *and Jamesbrittenia sp.* If any of these species are to be removed during the operation, a permit for the removal of protected species needs to be lodged with the Northern Cape, Department of Environment and Nature Conservation (DENC) before such activities commence. A projection for species of conservation concern is presented in Table 3 and a photographic guide of these species is attached as Appendix 3.

Additionally, according to Section 51(2) of the NCNCA, a permit application needs to be lodged with DENC for the large-scale clearance of indigenous (Schedule 3) vegetation, before such activities commence.

Table 3. A projection of community sizes and species of conservation concern in the study area.

Communities	Total size (ha)	Predicted extent to be affected (ha)	Associated species of conservation concern	Population density (ind/ha)	Estimated population to be affected by mining
Vachellia tortilis – Senegalia mellifera thornveld on historic mine footprint	± 450	± 450	*Boscia albitrunca*	3 - 5	± 2 000 – 3 000
Olea europaea – Heteropogon contortus open shrubland on dolomitic hills	± 48	± 8	*Olea europaea* *Lessertia frutescens* *Pelargonium minimum* *Jamesbrittenia* sp.	3 1 1 <1	± 25 ± 8 ± 8 < 8
Searsia tridactyla – Aristida diffusa shrubland on quartzite hills	± 57	± 6	*Boophone disticha* *Boscia albitrunca* *Olea europaea* *Pelargonium minimum* *Freesia andersoniae* *Stapelia* sp. *Oxalis* sp.	< 1 2 2 3 1 < 1 5	< 6 ± 12 ± 12 ± 18 ± 6 < 6 ± 30
Tarchonanthus camphoratus – Aristida adscensionis open shrubland on dolomitic limestone	± 400	± 20	*Boscia albitrunca* *Vachellia erioloba* *Gymnosporia buxifolia* *Crassula setulosa*	1 < 1 < 1 < 1	± 20 < 20 < 20 < 20
Tarchonanthus camphoratus – Stipagrostis uniplumis shrubland on manganese ridges	± 200	± 170	*Boscia albitrunca* *Freesia andersoniae*	1 3	± 170 ± 500
Searsia lancea – Vachellia tortilis woodland along the ephemeral stream	± 5	± 2.5	*Olea europaea*	2	± 6
Rhigozum trichotomum – Eragrostis rigidior shrubland on red sand	± 5	± 1	*Boscia albitrunca* *Gymnosporia buxifolia* *Olea europaea*	5 < 1 1	± 5 1 1

3.3.4. Weeds and invader plant species

Weeds and invasive species are controlled in terms of the National Environmental Management: Biodiversity (NEMBA) Act 10 of 2004, the Conservation of Agricultural Resources (CARA) Act 43 of 1993, as well as the NCNCA (Schedule 6). These are species that do not naturally occur in a given area and exhibit tendencies to invade that area, and others; at the cost of locally indigenous species. To govern the control of such species, NEMBA and CARA have divided weeds and invader species into categories (see Table 4). All declared weeds and invasive species recorded in and around the study area are listed in Table 5, along with their categories according to CARA, NEMBA and NCNCA.

Table 4. The categorisation of weeds and invader plant species, according to NEMBA and CARA.

NEMBA		CARA	
1a	Listed invasive species that must be combatted or eradicated.	**1**	Plant species 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.
1b	Listed invasive species that must be controlled.	**2**	Plant species that may 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.
2	Listed invasive species that require a permit to carry out a restricted activity within an area.	**3**	Plant species that may no longer be planted. These are alien plants that have escaped from, or are growing in gardens and 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.
3	Listed invasive species that are subject to exemptions and prohibitions		

Table 5. A list of declared weeds and invasive species recorded in the study area.

Scientific name	Common name	CARA	NEMBA	NCNCA
Opuntia ficus-indica	Sweet prickly pear	1	1b	S6
Opuntia lindheimeri	Small round - leaved prickly pear	1	1b	S6
Salsola kali	Tumbleweed	-	1b	-
Prosopis glandulosa	Honey mesquite	2	3	S6
Eucalyptus sp.	Gum tree	2	1b	S6

3.3.5. Indicators of bush encroachment

Bush encroacher species are controlled in terms of Regulation 16 of CARA; where land users of an area in which natural vegetation occurs and that contains communities of encroacher indicator plants are required to follow sound practices to prevent the deterioration of natural resources and to combat bush encroachment where it occurs. Declared indicators of bush encroachment in the Northern Cape, which were recorded in and around the study area, are listed in Table 6.

Table 6. A list of declared indicators of bush encroachment in the Northern Cape recorded in the study area.

Scientific name	Common name
Senegalia mellifera	Black thorn
Vachellia tortilis	Umbrella thorn
Euclea crispa	Blue guarri
Euclea undulata	Common guarri
Grewia flava	Wild raisin
Rhigozum trichotomum	Three-thorn rhigozum
Tarchonanthus camphoratus	Camphor bush

3.4. Faunal communities

According to Section 3(a) and 4(a) of the Northern Cape Nature Conservation (NCNCA) Act No. 9 of 2009, no person may, without a permit by any means hunt, kill, poison, capture, disturb, or injure any protected (Schedule 2) or specially protected (Schedule 1) wild animals. Furthermore, Section 12 (1) of NCNCA states that no person may, on a land of which he or she is not the owner, hunt a wild animal without the written permission from the landowner. According to the act “wild animal” means a live vertebrate or invertebrate animal, and the egg or spawn of such animal.

3.4.1. Mammals

As many as 54 terrestrial mammals and seven bat species have been recorded in the region (see Appendix 2). Of these, 16 are listed either in the IUCN or South African Red Data Book (Table 7).

Table 7. A list of mammal species found in the region, which are of conservation concern.

Scientific name	Common name	IUCN	SA RDB	NCNCA
Eidolon helvum	African Straw-coloured Fruit-bat	NT		
Rhinolophus clivosus	Geoffroy's Horseshoe Bat		NT	
Rhinolophus denti	Dent's Horseshoe Bat		NT	
Orycteropus afer	Aardvark			S1
Parotomys littledalei	Littledale's Whistling Rat		NT	
Gerbilliscus leucogaster	Bushveld Gerbil		DD	
Atelerix frontalis	South African Hedgehog		NT	S1
Proteles cristata	Aardwolf			S1
Felis silvestris	Wild Cat			S1
Felis nigripes	Black-footed Cat	VU		S1
Vulpes chama	Cape Fox			S1
Hyaena brunnea	Brown Hyaena	NT	NT	S1
Otocyon megalotis	Bat-eared Fox			S1
Ictonyx striatus	Striped Polecat			S1
Mellivora capensis	Honey Badger		NT	S1
Manis temminckii	Ground Pangolin	VU	VU	S1

Virtually all mammals of the study area are protected; either according to Schedule 1, 2 or 3 of NCNCA (see Appendix 2). During the site visit species that were encountered included Chacma Baboon, Cape Hare, Rock Hyrax and Common Duiker.

All of the listed bat species, along with the Honey Badger, Striped Polecat, Bat-eared Fox, Cape Fox, Wild Cat, Aardwolf and Aardvark have a high potential to occur on site, given their wide habitat tolerances or affinity for savanna habitats. The Bushveld Gerbil also has a high likelihood to occur on site, based on their association with sandy soils. The South African Hedgehog, Black-footed Cat and Ground Pangolin may occur in the area on account of their preferences for arid areas, but they are all rather skittish and will most likely occur at low densities. The Littledale's Whistling Rat has a moderate potential to occur on the property on account of its associations with *Lycium* bushes. They mainly prefer riverine habitats, which is only associated with the ephemeral stream, but *Lycium* spp. are common and widespread. The Brown Hyena will most likely not occur in the study area due to the numerous anthropogenic activities that have occurred on the farm over the past 30 years. This fencing network in the area has most likely also restricted their distribution here.

Apart from the Chacma Baboon, which was seen during the field survey, other problem animals (Schedule 4) also expected to occur here includes Black-backed Jackal, Vervet Monkey and Caracal.

3.4.2. Reptiles

Glosam lies within the distribution range of at least 36 reptile species (see Appendix 2). No listed species are known to occur in the area, but most reptiles of the study area are protected either according to Schedule 1 or 2 of NCNCA (see Appendix 2). Specially protected species include *Karusasaurus polyzonus* (Southern Karusa Lizard) and *Chamaeleo dilepis dilepis* (Common Flap-neck Chameleon). The Karusa Lizard is a rock-dwelling species inhabiting rocky outcrops, while the Common Flap-neck Chameleon is typically found high up in bushes or trees

South African endemics include *Pachydactylus mariquensis* (Common Banded Gecko), *Lamprophis aurora* (Aurora Snake) and *Homopus femoralis* (Greater Dwarf Tortoise). The Common Banded Gecko prefers sandy soil and sparse vegetation in a variety of habitats such as sandy plains and dry river beds. The Aurora Snake is often found near streams and under rocks and old termitaria, while the Greater Dwarf Tortoise occurs in rocky areas with dense vegetation where they take shelter among rocks or under plants.

The habitat diversity for reptiles on Glosam is high and includes rocky outcrops, sandy shrubland, open shrubland as well as relatively dense thornveld. Therefore, all of the specially protected species as well as the endemics are expected to occur on site.

3.4.3. Amphibians

Only 12 amphibian species have been recorded in the region (Appendix 2), indicating that the site does not potentially have a diverse frog community. This is however normal for an arid area. No natural permanent water was observed in site that would represent suitable breeding habitats for most of these species, but the ephemeral stream will be important during periods of flow or if pools of standing water form after heavy rainfall events. As a result, only those species which are relatively independent of water are likely to occur regularly in the area.

The Giant Bull Frog (*Pyxicephalus adspersus*) is listed as Near Threatened and is protected according to Schedule 1 of the NCNCA. They prefer seasonal shallow grassy pans, vleis and other rain-filled depressions in open flat areas of grassland or savanna, but mainly remain buried up to 1 m underground until conditions become favourable.

The site lies within the known distribution of this species and even though it has not been recorded from any of the quarter degree squares around the site, it could potentially occur on site. All other amphibians of the study area are protected according to Schedule 2 of NCNCA (see Appendix 2).

3.4.4. Avifauna

The site does not fall within or near, i.e. within 150 km, of any of the Important Bird Areas (IBA) defined by Birdlife South Africa. A total number of 259 bird species have been recorded from the area (Appendix 2). As many as 25 listed bird species are known from the study area, which are classified either as Vulnerable (VU), Near Threatened (NT), Endangered (EN) or Critically Endangered (CR) (Table 8). Furthermore, all birds are protected either according to Schedule 1, 2 or 3 of NCNCA (see Appendix 2). Those that are specially protected (Schedule 1) are also listed in Table 8.

Plants in general, from grass tufts to shrubs and tall trees, as well as rocky hillsides provide important micro-habitats to birds and therefore the entire study area is expected to host a diverse avifauna community. No bird species of conservation concern were encountered during the field survey but those expected to occur in the hills earmarked for mining include rock associated species (e.g. Black Eagle and African Rock Pipit) and several of the other protected raptors and owls. Many of these will occasionally pass over or forage, but it is also expected that some of them might be breeding or nesting on site.

Those species preferring more open shrublands or savannas (e.g. Kori Bustard, Short-clawed Lark, Martial Eagle, Vultures and Secretarybird) is expected to be primarily restricted to the plains. The protected water birds (e.g. Chestnut-banded Plover, Black-winged Pratincole, Marabou Stork, Common Moorhen, Maccoa Duck, Lesser Flamingo and Greater Flamingo) are not expected to be found on site due to the absence of suitable habitat.

Table 8. Bird species found in the study region that are of conservation concern.

Scientific name	Common name	IUCN	SA Bird Atlas	NCNCA
Accipiter badius	Shikra			S1
Anthropoides paradiseus	**Blue Crane**	**VU**	**NT**	
Anthus crenatus	**Rock Pipit**		**NT**	
Aquila rapax	**Tawny Eagle**		**EN**	
Aquila verreauxii	**Black Eagle**		**VU**	
Ardeotis kori	**Kori Bustard**	**NT**	**NT**	
Bubo africanus	Spotted Eagle Owl			S1
Bubo lacteus	Giant Eagle Owl			S1
Buteo rufofuscus	Jackal Buzzard			S1
Buteo vulpinus	Steppe Buzzard			S1
Caprimulgus europaeus	Eurasian Nightjar			S1
Caprimulgus rufigena	Rufouscheeked Nightjar			S1
Caprimulgus tristigma	Freckled Nightjar			S1
Charadrius pallidus	**Chestnutbanded Plover**	**NT**	**NT**	
Ciconia abdimii	**Abdim's Stork**		**NT**	
Ciconia nigra	**Black Stork**		**VU**	S1
Circaetus pectoralis	Blackbreasted Snake Eagle			S1
Circus maurus	**Black Harrier**	**VU**	**NT**	S1
Circus pygargus	Montagu's Harrier			S1
Circus ranivorus	**African Marsh Harrier**		**EN**	S1
Coracias garrulous	**Eurasian Roller**	**NT**	**NT**	
Cursorius rufus	**Burchell's Courser**		**VU**	
Elanus caeruleus	Black-shouldered Kite			S1
Falco biarmicus	**Lanner Falcon**		**VU**	S1
Falco chicquera	**Red-necked Falcon**	**NT**		S1
Falco naumanni	Lesser Kestrel			S1
Falco peregrinus	Peregrine Falcon			S1
Falco rupicolis	Rock Kestrel			S1
Falco rupicoloides	Greater Kestrel			S1
Gallinula chloropus	Common Moorhen			S1
Glareola nordmanni	**Blackwinged Pratincole**	**NT**	**NT**	S1
Glaucidium perlatum	Pearlspotted Owl			S1
Gyps africanus	**White-backed Vulture**	**CR**	**CR**	S1
Gyps coprotheres	**Cape Vulture**	**EN**	**EN**	S1
Haliaeetus vocifer	African Fish Eagle			S1
Leptoptilos crumeniferus	**Marabou Stork**		**NT**	S1
Melierax canorus	Pale Chanting Goshawk			S1
Melierax gabar	Gabar Goshawk			S1
Milvus migrans	Black Kite			S1
Neotis ludwigii	**Ludwig's Bustard**	**EN**	**EN**	S1
Oxyura maccoa	**Maccoa Duck**	**NT**	**NT**	
Phoenicopterus minor	**Lesser Flamingo**	**NT**	**NT**	S1
Phoenicopterus ruber	**Greater Flamingo**		**NT**	S1
Polemaetus bellicosus	**Martial Eagle**	**VU**	**EN**	S1
Polihierax semitorquatus	Pygmy Falcon			S1
Polyboroides typus	Gymnogene			S1
Ptilopsis granti	Southern White-faced Owl			S1
Sagittarius serpentarius	**Secretarybird**	**VU**	**VU**	S1
Torgos tracheliotus	**Lappet-faced Vulture**	**EN**	**EN**	S1
Tyto alba	Barn Owl			S1

3.4.5. Invertebrates

Invertebrates dominate inland habitats and play a significant role in the overall function of the ecosystem (Kremen et al. 1993, Weisser and Siemann 2004). Their immense species diversity makes it almost impossible to list all species that may possibly occur on site. Nevertheless, key morphospecies as well as species of conservation concern are discussed here.

Eight invertebrate species of the Northern Cape appear on the IUCN Red Data list of threatened species and are listed in Table 9. However, none of these species' distribution ranges overlap with that of the study area. In addition, those species that are specially protected according to Schedule 1 of the NCNCA include all Velvet worms as well as some baboon spider species, Stag Beetles and the Flightless Dung Beetle (Table 9). So far, none of these taxa have been formally recorded from the region, but it is likely that some of the Baboon Spiders occur on site. All Rock- Creeping- and Burrowing Scorpions are protected according to Schedule 2 of the NCNCA, along with a number of beetles, butterflies and moths (Table 9). Of these, Burrowing and Rock Scorpions as well as some Gossamer-winged Butterflies, Skippers, Brush-footed Butterflies and Satyrs have the highest likelihood to be found on site. All other invertebrates from the class Insecta and Arachnida are protected according to Schedule 3 of the NCNCA.

On Glosam, one major habitat delimit possible invertebrate communities, i.e. Bushveld vegetation for insect preference, according to Picker et al. (2004). Species associated with this habitat type are diverse and are widely distributed. Dung beetles and the dark blue pansy butterfly (*Junonia oenone*) are common in the area (Figure 20) and Glosam itself is expected to host high invertebrate richness and density, due to the diverse habitat opportunities on site.

Figure 20. Insects that have been recorded in the region include the dark blue pansy (left) and dung beetles (right).

Table 9. Invertebrate species found in the Northern Cape that are of conservation concern.

CLASS	ORDER	Scientific Name	Common name	Status
ARACHNIDA	MYGALOMORPHAE	*Ceratogyrus* spp.	Horned Baboon Spiders	S1
		Harpactira spp.	Common Baboon Spiders	S1
		Pterinochilus spp.	Goldenbrown Baboon Spiders	S1
	SCORPIONES	*Hadogenes* spp.	All Rock Scorpions	S2
		Opisthacanthus spp.	All Creeping Scorpions	S2
		Opistophthalmus spp.	All Burrowing Scorpions	S2
INSECTA	COLEOPTERA	*Circellium bacchus*	Flightless Dung Beetle	S1
		Colophon spp.	All Stag Beetles	S1
		Dromica spp.	Tiger Beetles (all species)	S2
		Graphipterus assimilis	Velvet Ground Beetle	S2
		Ichnestoma spp.	All Fruit Chafer Beetles	S2
		Manticora spp.	All Monster Tiger Beetles	S2
		Megacephala asperata	Tiger Beetle	S2
		Megacephala regalis	Tiger Beetle	S2
		Nigidius auriculatus	Stag Beetle	S2
		Oonotus adspersus	Stag Beetle	S2
		Oonotus interioris	Stag Beetle	S2
		Oonotus rex	Stag Beetle	S2
		Oonotus sericeus	Stag Beetle	S2
		Platychile pallida	Tiger Beetle	S2
		Prosopocoilus petitclerci	Stag Beetle	S2
		Prothyma guttipennis	Tiger Beetle	S2
	LEPIDOPTERA	*Lepidochrysops penningtoni*	Pennington's Blue	**DD**
		Lycaenidae	All Gossamer-winged Butterflies	S2
		Hepialidae	All Swift Moths	S2
		Hesperiidae	All Skippers	S2
		Nymphalidae	All Brush-footed Butterflies	S2
		Satyridae	All Satyrs	S2
	ORTHOPTERA	*Africariola longicauda*	Richtersveld Katydid	**VU**
		Alfredectes browni	Brown's Shieldback	**DD**
		Brinckiella serricauda	Serrated Winter Katydid	**DD**
		Brinckiella arboricola	Tree Winter Katydid	**EN**
		Brinckiella aptera	Mute Winter Katydid	**VU**
		Brinckiella karooensis	Karoo Winter Katydid	**VU**
		Brinckiella mauerbergerorum	Mauerberger's Winter Katydid	**VU**
ONYCHOPHORA			All Velvet worms	S1

3.5. Water resources

The National Water Act (36 of 1998) (NWA) provides a framework to protect water resources. According to this Act, a water resource includes a watercourse, surface water, estuary, or aquifer; whereas a water course includes:

a) a river or spring,
b) a natural channel in which water flows regularly or intermittently,
c) a wetland, lake or dam into which, or from which, water flows, and
d) any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse.

Any reference to a watercourse includes its bed and banks and a water resource does not only include the water within the system, but also the entire water cycle; i.e. evaporation, precipitation, the habitats and processes.

The purpose of this Act (Section 2) is to ensure that the nation's water resources are protected, used, developed, conserved, managed and controlled in ways which take into account amongst other factors - (g) protecting aquatic and associated ecosystems and their biological diversity and (h) reducing and preventing pollution and degradation of water resources.

No activity may take place within a watercourse unless it is authorised by the Department of Water and Sanitation (DWS). Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from the DWS in terms of Section 21 (c) and (i).

3.5.1. Surface water

Glosam falls within the Molopo D41J quaternary catchment of the Lower Vaal Water Management Area, as well as in the Neusberg D73A quaternary catchment of the Lower Orange Water Management Area (Figure 21). Both these quaternary catchments has been allocated a Present Ecological State (PES) of 'Largely natural' (B) by Delport and Mallory (2002) and Smook et al. (2002), and information regarding mean annual rainfall, evaporation potential and runoff for these quaternary catchments are provided in Table 10.

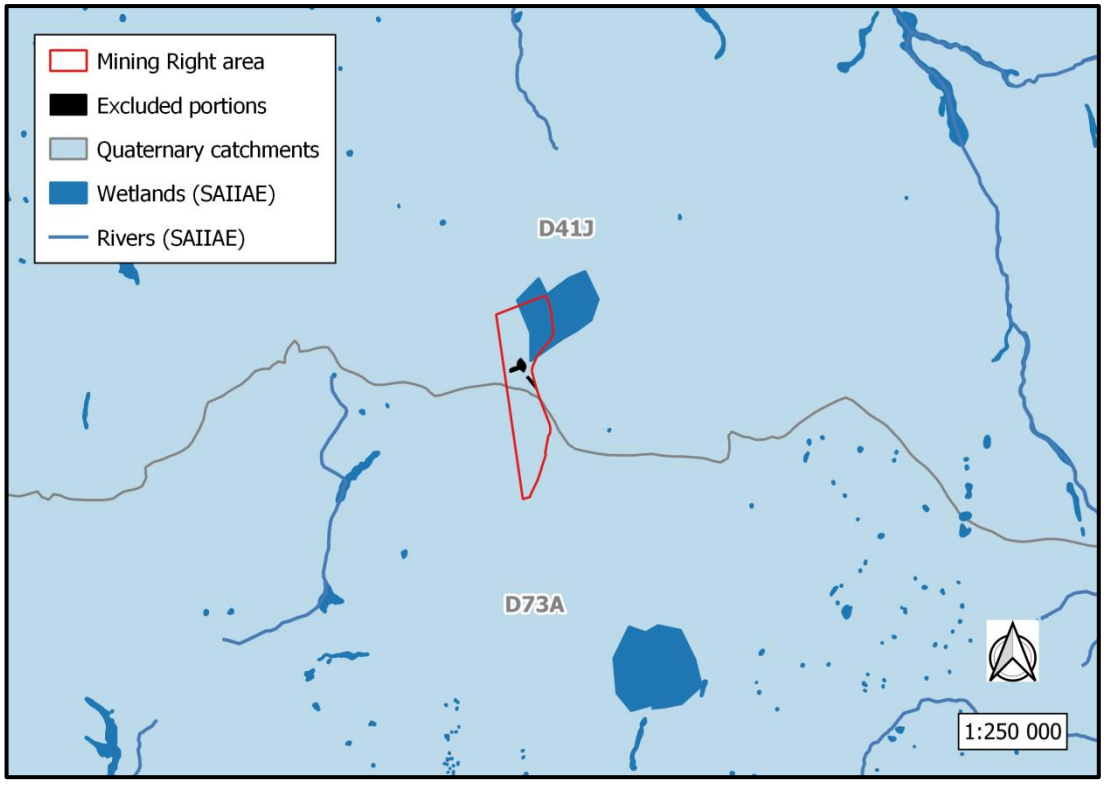


Figure 21. The locality of the proposed Glosam Mine in relation to quaternary catchments.

Table 10. Catchment characteristics for the Molopo- (Delport and Mallory 2002) and Neusberg (Smook et al. 2002) quaternary catchments in which the study area fall.

WMA	Quaternary catchment	Catchment Area (km^2)	Mean Annual Rainfall (mm)	Mean Annual Evaporation (mm)	Mean Annual Runoff (10^6 m^3)
Lower Vaal	D41J (Molopo)	3 878	358	2 350	4.85
Lower Orange	D73A (Neusberg)	3 238	*Not provided*	*Not provided*	*Not provided*

According to The South African Inventory of Inland Aquatic Ecosystems (SAIIAE), Glosam falls within the Eastern Kalahari Bushveld Bioregion, where 1.3 % of the land area is covered by inland wetlands, including depressions, floodplains, seeps and valley-bottom wetland types (Van Deventer et al. 2019). The spatial extent according to the present ecological status per wetland type is depicted in Table 11. Depressional wetlands are most abundant in this bioregion, with the majority being severely modified. Most of the remaining wetland types in this Bioregion are also moderately- to severely modified.

Table 11. Percentage of inland wetland spatial extent according to the present ecological status per wetland type of the Bioregion in which the proposed mining area falls.

Bioregion	Wetland type	Total Extent (%)	% Natural or near-natural (A/B)	% Moderately modified (C)	% Heavily to severely/critically modified (D/E/F)
Eastern Kalahari Bushveld	Depression	57.1	70.5	5.7	23.8
	Floodplain	2.2	0.6	48.8	50.5
	Seep	17.2	10	15.1	75
	Valley-bottom	23.5	0.9	29.6	69.5

One seep wetland occurs in the north-eastern corner of Glosam (Figure 22). According to SAIIAE it has already been critically modified by roads, railways and historic mining activities. Many of the drainage lines on Glosam have also already been destroyed by historic mining activities. However, an ephemeral stream and its associated drainage lines are still present in the southern half of the property (Figure 22).

3.5.2. Groundwater

According to the 1:1 000 000 Hydrogeological Map series of South Africa, Glosam is associated with fractured- and karst aquifer systems (Figure 23), with depths of 21 – 23 mbgl and average borehole yield ranging from 0.5 to 2.0 l/s. Both aquifers fall within a minor aquifer region (Matoti et al. 1999a), which is moderately-yielding aquifer systems of variable water quality. The fractured aquifer on Glosam has low susceptibility for contamination by anthropogenic activities and is regarded least vulnerable , however, the karst aquifer has high susceptibility for contamination by anthropogenic activities and is regarded most vulnerable (Matoti et al. 1999c, b)

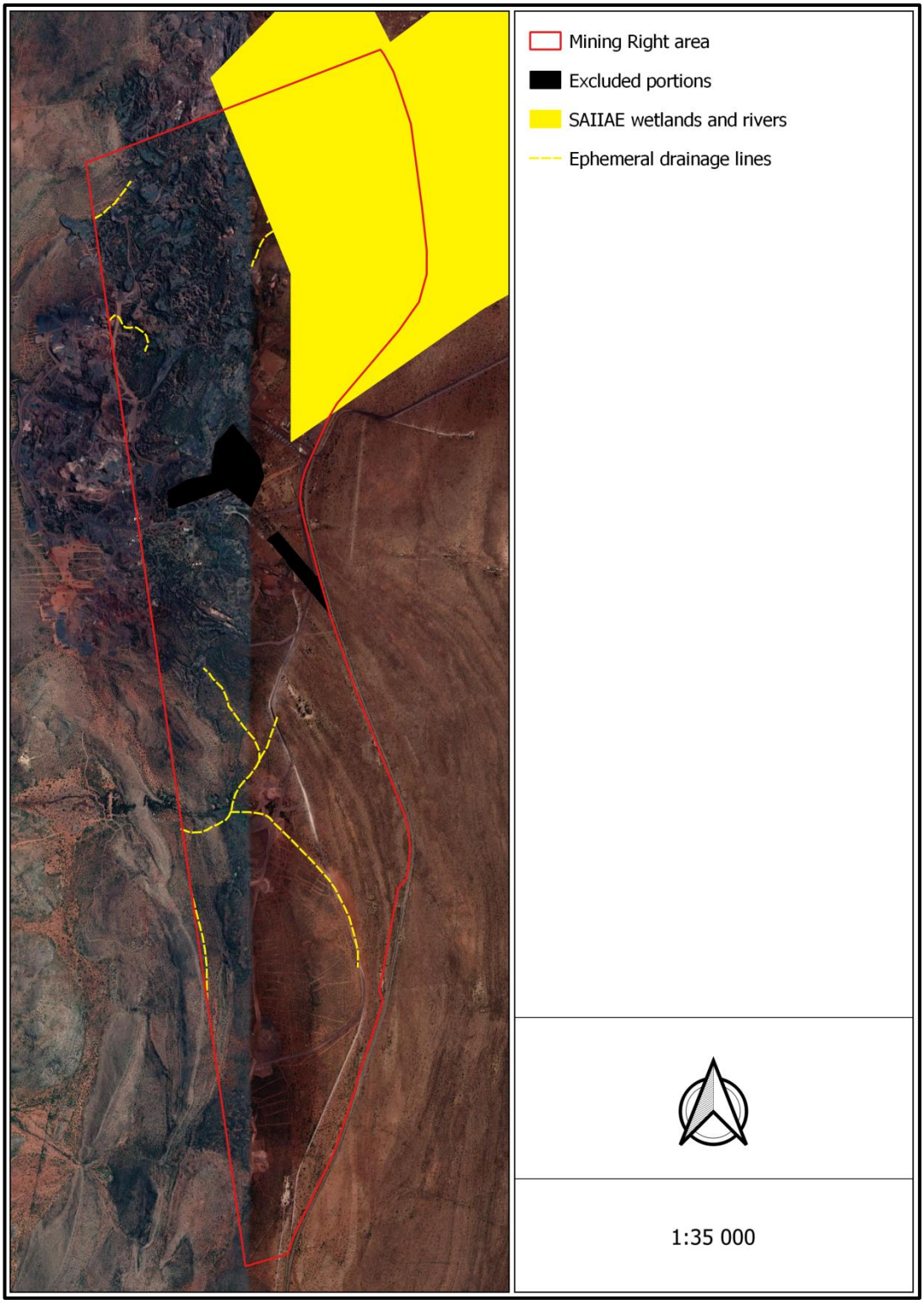


Figure 22. The location of SAIIAE wetlands and natural drainage lines in relation to the proposed mining right area.

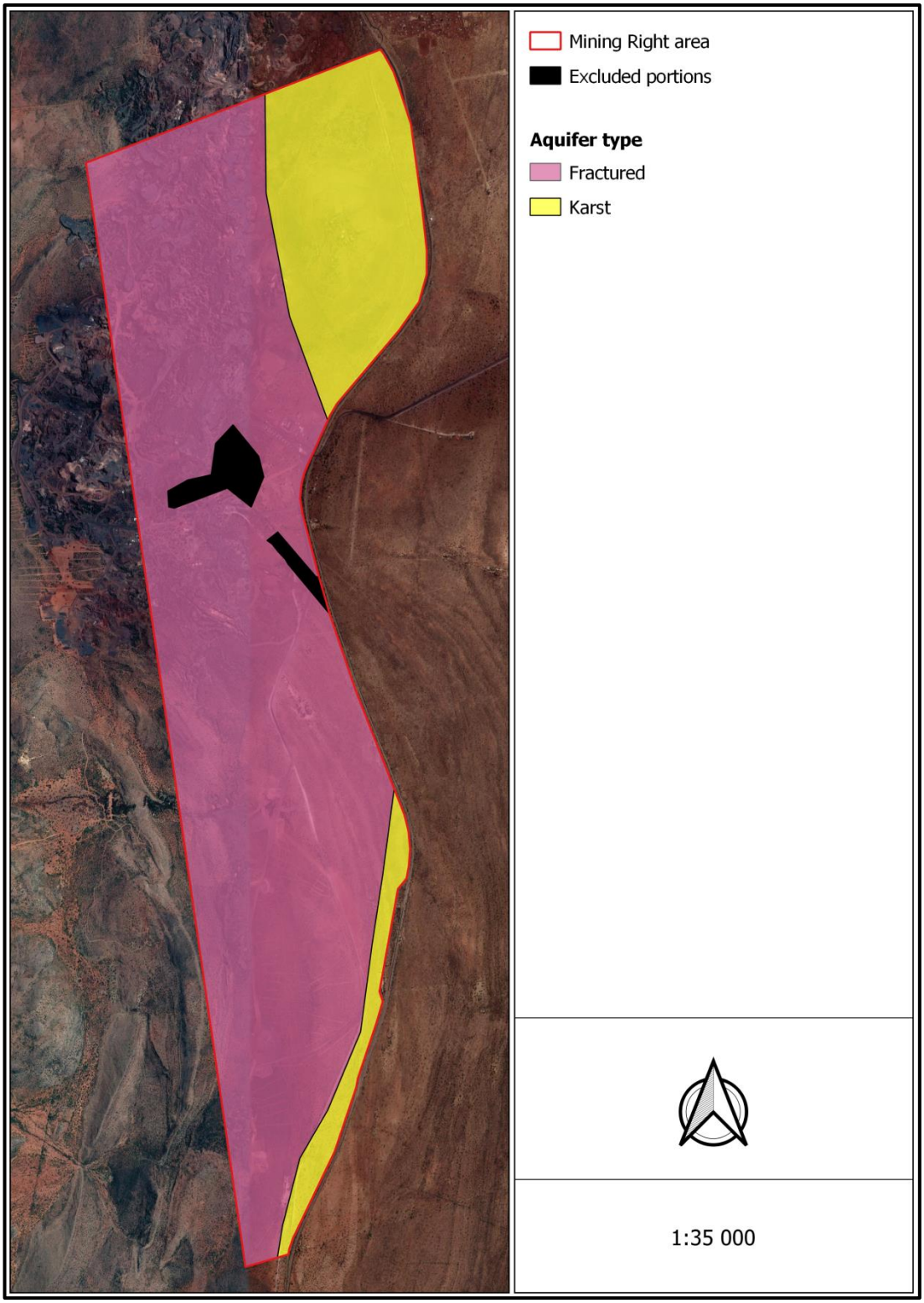


Figure 23. The location of aquifer systems in relation to the proposed mining right area.

3.6. Critical biodiversity areas and broad-scale processes

Northern Cape Critical Biodiversity Areas

The proposed mining site falls within critical biodiversity areas, as defined by the Northern Cape Critical Biodiversity Areas Map (Holness and Oosthuizen 2016). This map identifies biodiversity priority areas, called Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs), which, together with protected areas, are important for the persistence of a viable representative sample of all ecosystem types and species as well as the long-term ecological functioning of the landscape as a whole. Almost the entire study area comprises of *Ecological Support Areas* and *Other Natural Areas* (Figure 24). No *Critical Biodiversity Areas One*, *Critical Biodiversity Areas Two,* or *Protected Areas* occur in or near the study site.

Mining and Biodiversity Guidelines

Similarly, the Mining and Biodiversity Guidelines (DENC et al. 2013) does not classify any section of the study area to have biodiversity importance, and therefore does not constitute a high risk for mining. These guidelines were developed to identify and categorize biodiversity priority areas sensitive to the impacts of mining in order to support mainstreaming of biodiversity issues in decision making in the mining sector.

Conservation planning

Furthermore, the broad-scale vegetation units that cover the study area (Kuruman Mountain Bushveld and Kuruman Thornveld) is classified as least threatened and therefore no formal fine scale conservation planning has been conducted. Kuruman Mountain Bushveld has however been identified as a medium conservation priority area within the Siyanda Environmental Management Framework. The study area does however not fall within a proposed conservation area for the District Municipality, but has been included within the Siyanda Environmental Control Zone 1; i.e. a zone with potential sensitive groundwater resources. The karst aquifers that occur in the dolomite and lime stone rocks in the area represent a major strategic water resource. It is sensitive both in respect to the abstraction and potential pollution of groundwater. Therefore, a suggested management parameter is to prohibit the bulk storage of hazardous substances as well as unrehabilitated spoil heaps and mine dumps.

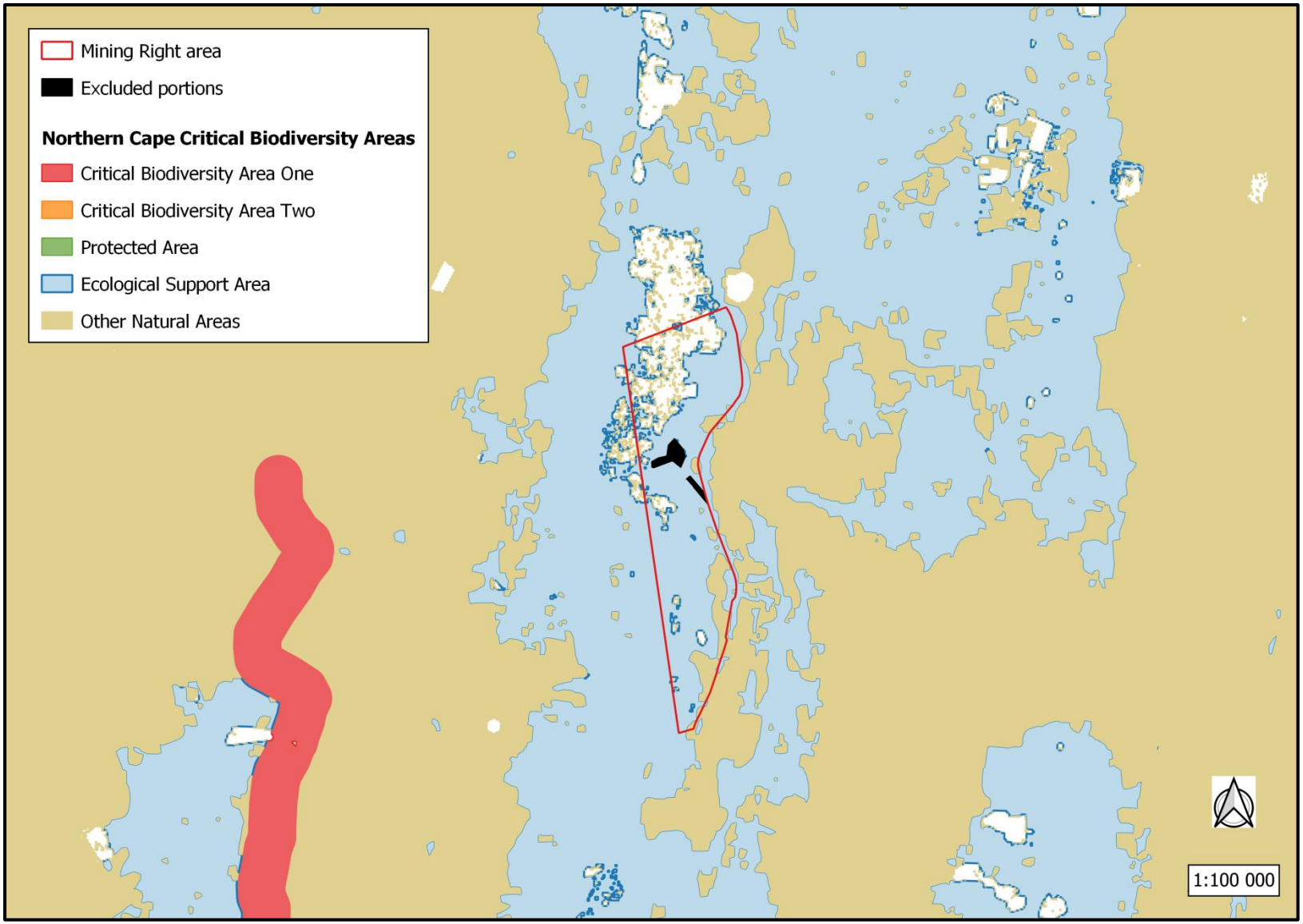


Figure 24. The study area in relation to the Northern Cape Critical Biodiversity Areas.

Environmental Screening

The National Web based Environmental Screening Tool does consider parts of the study area to be sensitive (**Error! Not a valid bookmark self-reference.**). This tool is a geographically based web-enabled application which allows a proponent intending to submit an application for environmental authorisation in terms of the Environmental Impact Assessment (EIA) Regulations 2014 (as amended), to screen their proposed site for any environmental sensitivity. Glosam is considered to be of low sensitivity based on the Plant- and Animal species Themes. Large parts of the study area are however considered to be of very high sensitivity based on the Aquatic- and Terrestrial Biodiversity Themes. The Terrestrial Biodiversity sensitivity is a direct function of the Ecological Support Areas classification on the Northern Cape Critical Biodiversity Areas Map. The Aquatic Biodiversity sensitivity is attributed to two factors. The seep wetland in the north-east of Glosam is regarded as a sensitive water resource, while quaternary catchment D73A, which comprise the southern half of Glosam, falls within a freshwater ecosystem priority area quinary catchment.

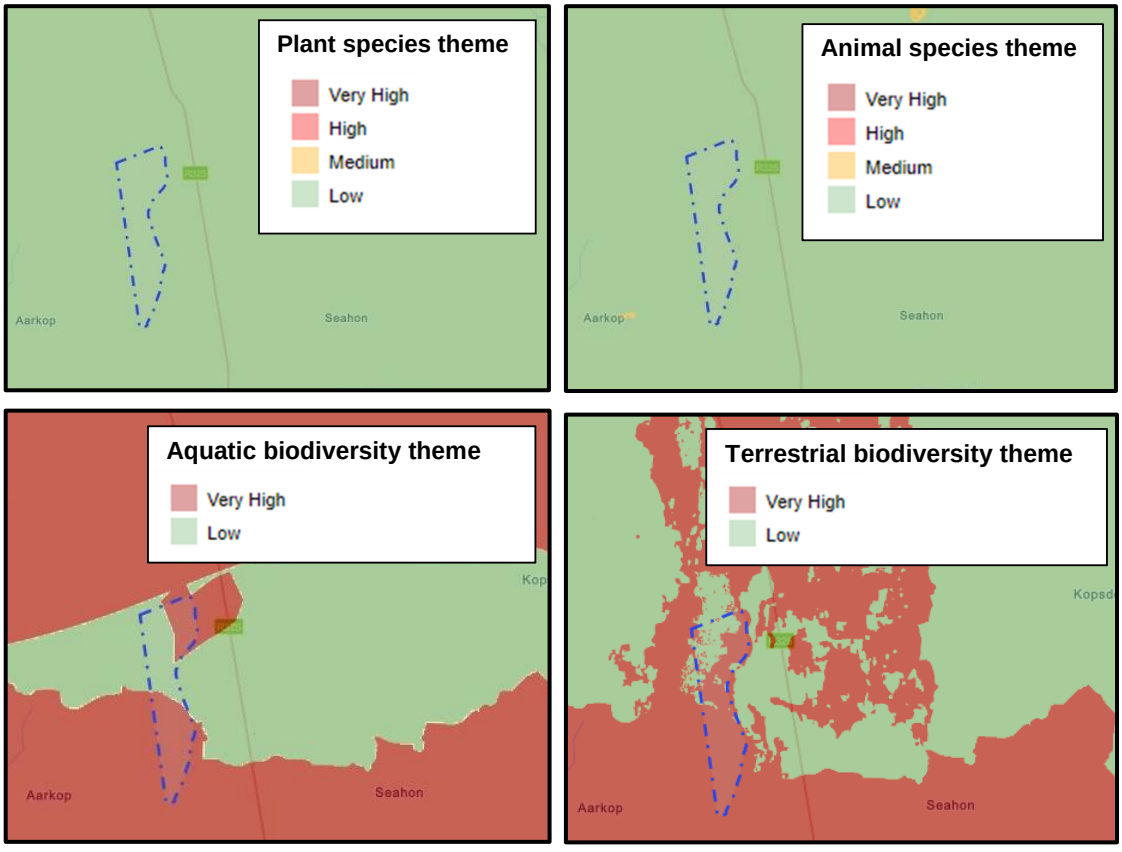


Figure 25. Environmental sensitivities associated with the study area, according to the National Web based Environmental Screening Tool.

Centres of Endemism

The study area also falls within the core area of the Griqualand West Centre (GWC) of Endemism (Frisby et al. 2019) (Figure 26). A centre of plant endemism is an area with high concentrations of plant species with very restricted distributions, known as endemics (Van Wyk and Smith 2001). Relatively small disturbances in a centre of endemism may easily pose a serious threat to its many range restricted species. Endemics are specifically vulnerable due to their restricted distribution ranges. Glosam falls within the Ironstone Hills - Asbestos Hills floristic region of the GWC. Fifteen of the 25 endemic and near endemic taxa identified in the GWC occur in this floristic region.

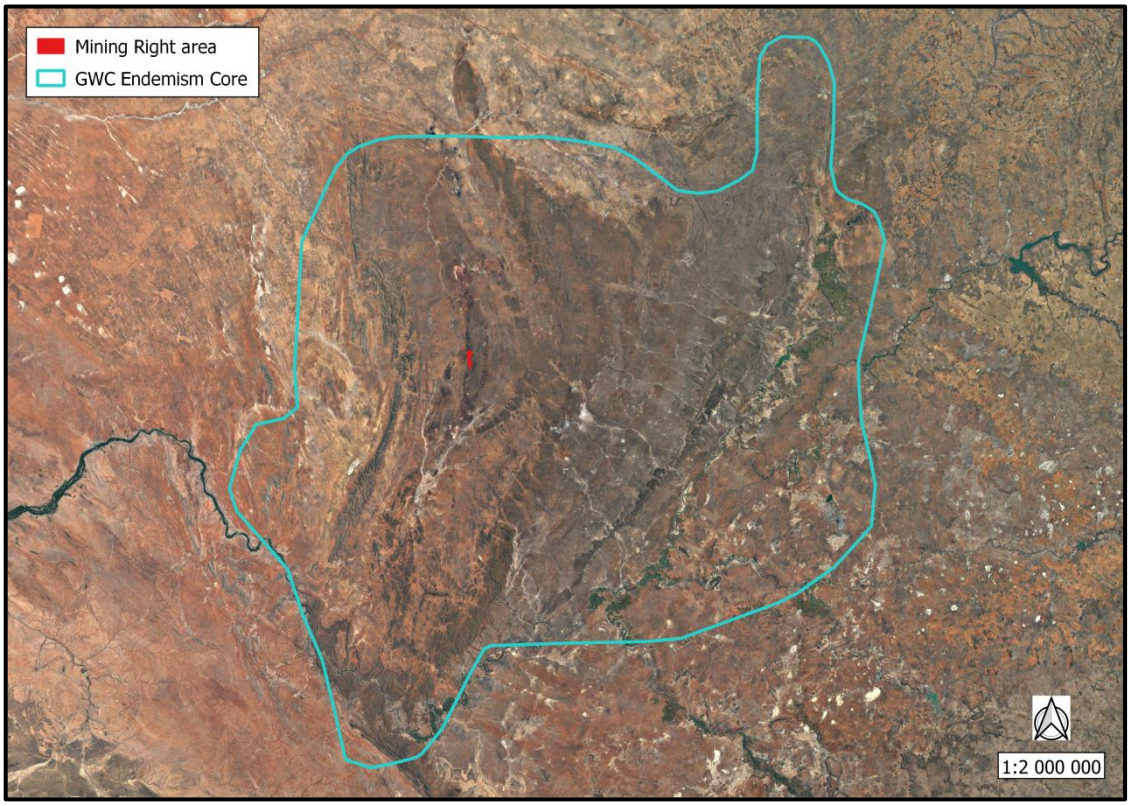


Figure 26. The Glosam Mining Right Application area in relation to the GWC core, according to Frisby et al. (2019).

Landscape-level wetland threat status

Within the vicinity of the proposed mining operation, the ecosystem threat status for most wetlands has been classified as Least Concern. However, two seeps, including the one occurring on site, are classified as Critically Endangered (Figure 27) and both are poorly protected.

Figure 27. The ecosystem threat status of wetlands occurring in the vicinity of the proposed mining right area.

Cumulative mining status overview

The study area falls within a zone where South Africa's largest economically most important deposits of manganese and the principle deposits of iron ore are found. The manganese zone extends northwards over a distance of 150 km, from just south of Postmasburg to as far as the Wessels and black rock Mines north of Hotazel, while the most significant iron ore deposits occur in the vicinity of Postmasburg and Sishen (Figure 28). The Glosam mining activities are therefore expected to contribute to the cumulative effect of mining in the region.

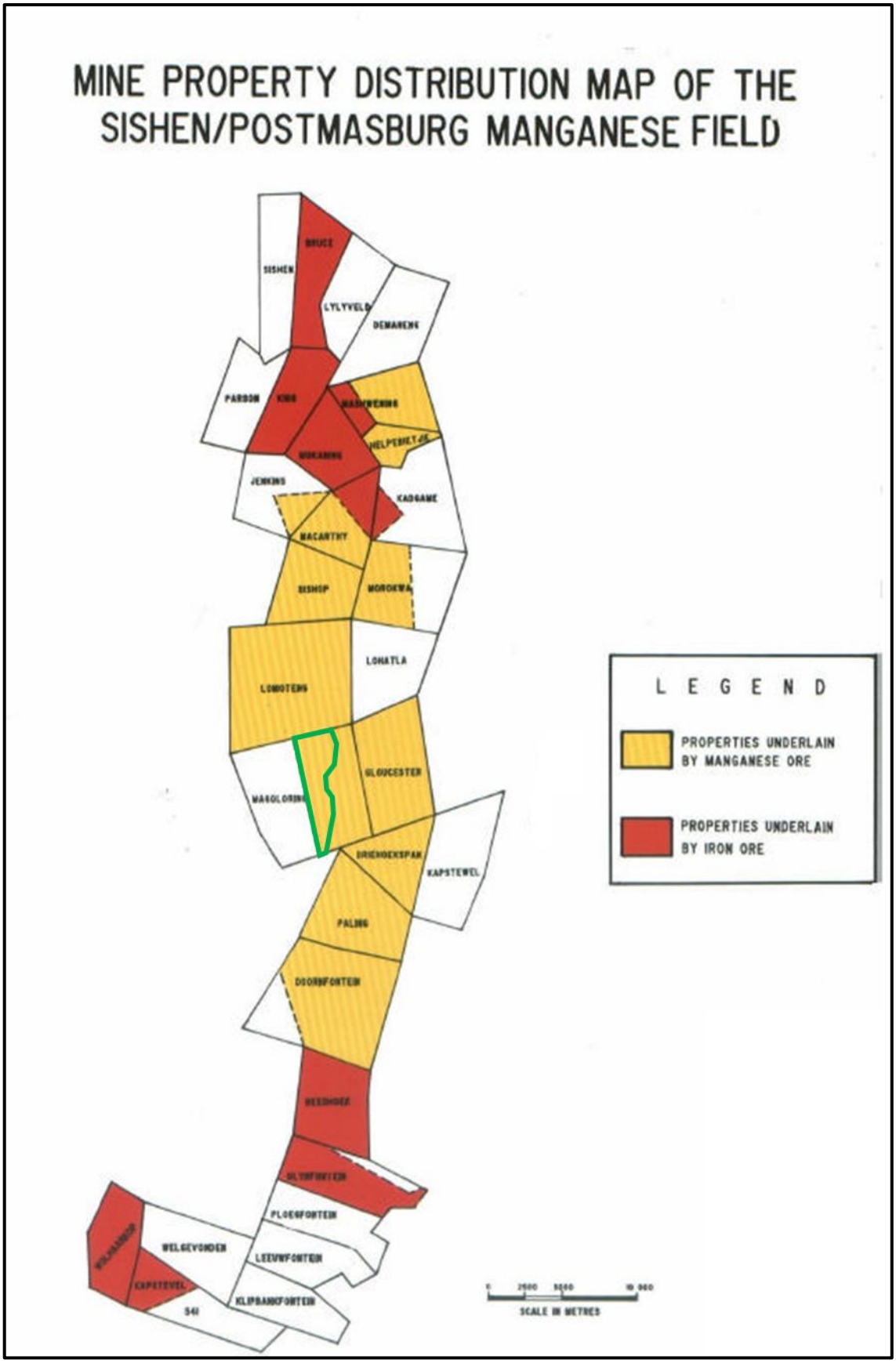


Figure 28. The distribution of mining properties in the Sishen/Postmasburg Manganese Field (Bonga 2005), with the proposed mining area indicated in green.

3.7. Site sensitivity

The sensitivity map for the proposed mining operation is illustrated in Figure 29. The ephemeral stream and seep is considered to be of very high sensitivity. Both these are watercourses, protected in terms of the National Water Act (Act No 36 of 1998) and play important hydrological functional roles in the catchment area. Furthermore, the seep is classified as a Critically Endangered Wetland Ecosystem. The ephemeral stream is also thought to host unique species adapted to ephemerality, which causes them to respond only when conditions are ideal. Very little is known about the ecological functioning of ephemeral streams, but it can be expected that when such habitats are destroyed, species are lost, along with potentially valuable scientific information.

The small pocket of sand in the south-western corner of the study area are also considered to be of very high sensitivity due to the high density of species of conservation concern, particularly *Boscia albitrunca,* found here. Such isolated communities are islands that usually host unique species assemblages compared to the surrounding communities and should be preserved.

The hills and ridges in the north and south-west of the study area, as well as the thornveld on historic mine footprint are considered to be of high sensitivity. Even though some of these areas have been mined historically, dense vegetation has re-established in the old pits over the past 30 years. Not only does a number of protected plant species occur here, but the rocky- and dense shrubland habitats are expected to provide unique micro habitats to various small mammals, reptiles and birds. Their steep slopes also provide high erosion risks during runoff. The ridges and historic mine footprint in particular fall within the core area earmarked for mining activities.

The remaining shrubland on the plains is considered to be of medium sensitivity on account of the low density of protected plant species found here. Even though this area is underlain by a karstic aquifer, the core mining activities are not expected to take place here. Any mining associated activities should nonetheless be strictly controlled in order to limit impacts on the species of conservation concern that do occur within the unit and any to prevent potential pollution to the aquifer.

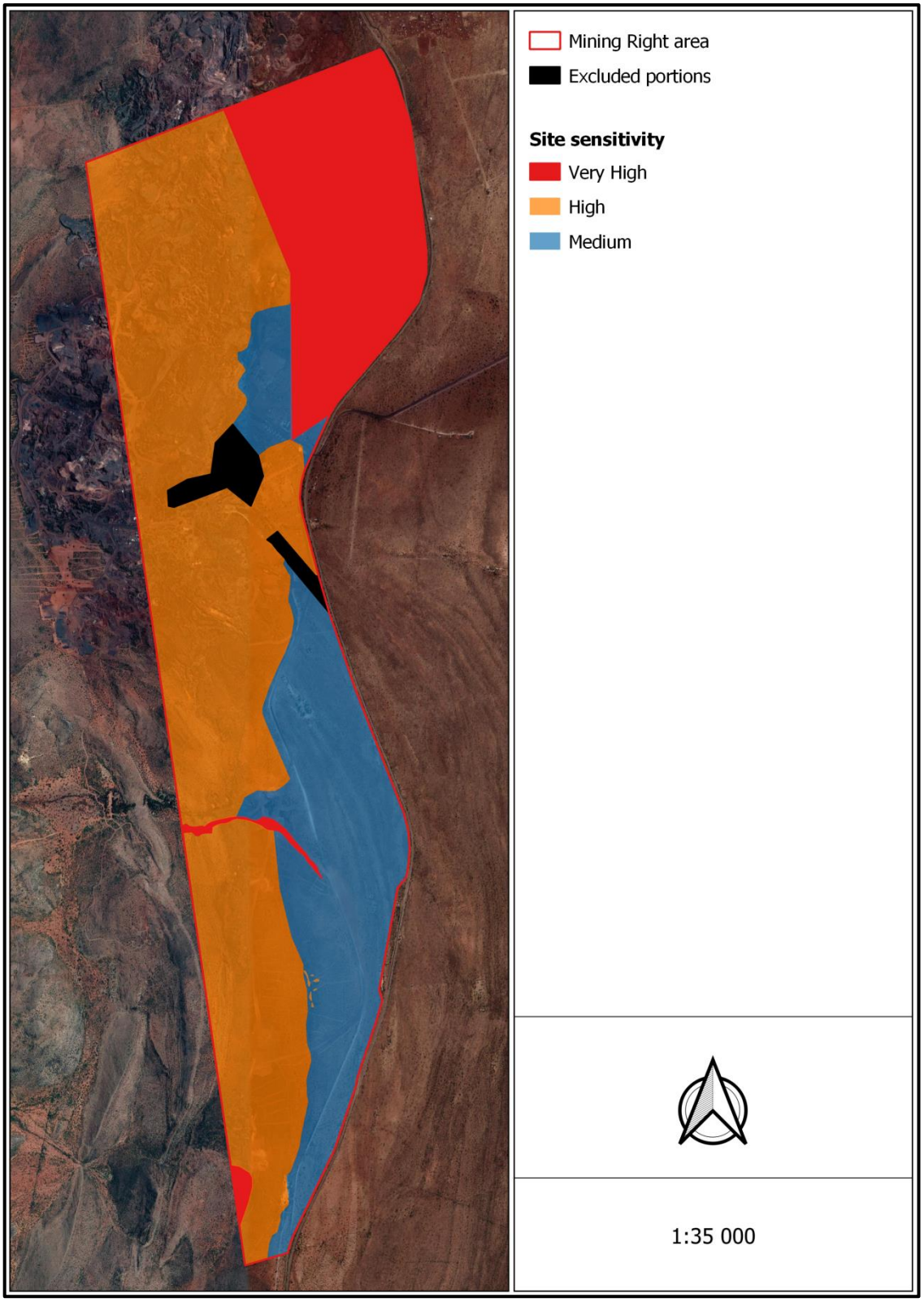


Figure 29. A sensitivity map for the proposed mining area.

4. IDENTIFICATION AND NATURE OF IMPACTS

In this section, all potential impacts and associated risk factors that may be generated by the Glosam mining operation are identified and described. A detailed analysis of each impact is provided in Table 12. Impacts are assessed in terms of the relevant ecological aspects and each impact is associated with specific mitigation measures, which with proper implementation, will serve to reduce the significance of the impact.

4.1. Topography, soil erosion and associated degradation of landscapes

4.1.1. Alteration of soil character and quality

Source of the impact

During clearing of an area for the excavation or stripping of ore, construction of infrastructure and roads, stockpiling, oil and petrochemical spills.

Description of the impact

Topsoil contains living organisms and seed banks that provide ecological resilience against disturbances, and any disturbances to the intact soil profile will change its ability to sustain natural ecological functioning. Vehicles and mining equipment may potentially leak hazardous fluids on the soil surface, which will cause soil pollution. Apart from the direct disturbances caused by the mining activities, soil compaction by dump loads as well as heavy machinery and vehicles will causes a decrease in large pores, and subsequently the water infiltration rate into soil.

Mitigation and monitoring

- Topsoil needs to be removed and stored separately during mining and the construction of roads, infrastructure and stockpile areas.
- These topsoil stockpiles must be kept as small as possible in order to prevent compaction and the formation of anaerobic conditions.
- Topsoil must be stockpiled for the shortest possible timeframes to ensure that the quality of the topsoil is not impaired.
- Topsoil must not be handled when the moisture content exceeds 12 %.
- Topsoil stockpiles must by no means be mixed with sub-soils.

Table 12. A detailed analysis of ecological impacts identified for the Glosam mining operation.

	IMPACT	Phase			Extent	Duration	Severity	Probability	Significance	Significance after Mitigation
		C	O	D						
Soil	Alteration of soil character and quality	✓	✓	✓	On-site (1)	Residual (4)	High (3)	Certain for life of operation (10)	Medium - High (80)	Low-Medium
	Loss of topsoil and soil fertility	✓	✓	✓	On-site (1)	Residual (4)	High (3)	Certain for life of operation (10)	Medium - High (80)	Low-Medium
	Increase in soil erosion	✓	✓		Local (2)	Decommissioning (3)	Medium (2)	Possible, frequently (8)	Low - Medium (56)	Low
Flora	Loss of indigenous vegetation	✓	✓		On-site (1)	Residual (4)	Medium (2)	Certain for life of operation (10)	Low - Medium (70)	Low-Medium
	Loss of Red data and/or protected floral species	✓	✓		On-site (1)	Residual (4)	High (3)	Certain for life of operation (10)	Medium - High (80)	Low-Medium
	Introduction or spread of alien species	✓	✓	✓	Local (2)	Residual (4)	Medium (2)	Possible, frequently (8)	Low-Medium (64)	Very low
	Bush encroachment	✓	✓	✓	On-site (1)	Residual (4)	Minimal (1)	Possible, infrequently (7)	Low (42)	Very low
Fauna	Habitat fragmentation	✓	✓		Regional (3)	Residual (4)	High (3)	Certain for life of operation (10)	Medium - High (100)	Low-Medium
	Disturbance, displacement and killing of fauna	✓	✓	✓	Local (2)	Decommissioning (2)	Medium (2)	Certain, for life of operation (10)	Low-Medium (60)	Low

Table 12 (cont.). A detailed analysis of ecological impacts identified for the Glosam mining operation.

	IMPACT	Phase			Extent	Duration	Severity	Probability	Significance	Significance after Mitigation
		C	O	D						
Water resources	Alteration/destruction of watercourses	✓	✓		Regional (3)	Permanent (5)	High (3)	Possible, infrequent (7)	Medium - High (77)	Low-Medium
	Contamination of surface water	✓	✓		Regional (3)	Residual (4)	Medium (2)	Possible, infrequent (7)	Low-Medium (63)	Low
	Siltation of surface water	✓	✓	✓	Regional (3)	Decommissioning (3)	Medium (2)	Possible, infrequent (7)	Low-Medium (56)	Low
	Contamination of the aquifer	✓	✓		Regional (3)	Permanent (5)	High (3)	Possible, for life of operation (9)	Medium - High (99)	Low-Medium
Cumulative	Compromise of broadscale ecological processes	✓	✓		Regional (3)	Residual (4)	High (2)	Certain for life of operation (10)	Medium - High (90)	Low-Medium

- The topsoil should be replaced as soon as possible on to the disturbed areas, thereby allowing for the re-growth of the seed bank contained within the topsoil.
- For restoration of the affected areas without topsoil, soils can be sourced from other sustainable areas and chemically changed to match with the surrounding environment.
- To restore areas where compacted soil occur, a ripper blade or deep plow can be pulled across the affected area to alleviate compaction.
- Encourage the growth of natural plant species in all affected areas by sowing indigenous seeds or by planting seedlings. Seeds can be acquired from renukaroo@gmail.com or can be harvested from plants in the adjacent pristine habitat.
- Vehicles and machinery should be regularly serviced and maintained.
- Refuelling and vehicle maintenance must take place in well demarcated areas and over suitable drip trays to prevent soil pollution.
- Drip trays must be available on site and installed under all stationary vehicles.
- Spill kits to clean up accidental spills from any accidental spillages must be well-marked and available on site.
- Workers must undergo induction to ensure that they are prepared for rapid clean-up procedures.
- Any soil or area that is contaminated must be cleaned immediately by removing the soil and disposing it as hazardous waste in the correct manner.

4.1.2. Loss of soil fertility

Source of the impact

During clearing of an area for the excavation or stripping of ore, construction of infrastructure and roads, stockpiling.

Description of the impact

Topsoil contains living organisms that naturally regulate the ecological functioning of a habitat. Therefore, any disturbances to the intact soil profile can result in soil sterilisation which will directly affect vegetation communities. Apart from the direct disturbances caused by the mining activities, loss of soil fertility can also occur through soil compaction by dump loads as well as heavy machinery and vehicles.

Mitigation and monitoring

- Topsoil needs to be removed and stored separately during mining and the construction of roads, infrastructure and stockpile areas.
- These topsoil stockpiles must be kept as small as possible in order to prevent compaction and the formation of anaerobic conditions.
- Topsoil must be stockpiled for the shortest possible timeframes to ensure that the quality of the topsoil is not impaired.
- Topsoil must not be handled when the moisture content exceeds 12 %.
- Topsoil stockpiles must by no means be mixed with sub-soils.
- The topsoil should be replaced as soon as possible on to the disturbed areas, thereby allowing for the re-growth of the seed bank contained within the topsoil.
- For restoration of the affected areas without topsoil, soils can be sourced from other sustainable areas and chemically changed to match with the surrounding environment.
- To restore areas where compacted soil occur, a ripper blade or deep plow can be pulled across the affected area to alleviate compaction.
- Encourage the growth of natural plant species in all affected areas by sowing indigenous seeds or by planting seedlings. Seeds can be acquired from renukaroo@gmail.com or can be harvested from plants in the adjacent pristine habitat.

4.1.3. Soil erosion

Source of the impact

During clearing of an area for the excavation or stripping of ore, construction of infrastructure and roads, stockpiling, natural events.

Description of the impact

Vegetation will be stripped for construction of new roads and mining areas and these areas will be bare and susceptible to erosion. Any topsoil-, overburden- and ore stockpiles can be eroded by wind, rain and flooding. Exposed sediments in the watercourses can be carried away during runoff causing downstream sediment deposition. Any leaking pipes can also cause additional water erosion.

Mitigation and monitoring

- Bare ground exposure should be minimised at all times in terms of the surface area and duration.

- Re-establishment of plant cover on disturbed areas must take place as soon as possible, once activities in the area have ceased.
- No new roads, infrastructure or mining areas should be developed over watercourses.
- Disturbances during the rainy season (November to March) should be monitored and controlled.
- Any potential run-off from exposed ground should be controlled with flow retarding barriers.
- Regular monitoring during the mining operation should be carried out to identify areas where erosion is occurring; followed by appropriate remedial actions.

4.2. Vegetation and floristics

4.2.1. Loss of indigenous vegetation

Source of the impact

During clearing of an area for the excavation or stripping of ore, construction of infrastructure and roads, stockpiling.

Description of the impact

The Glosam mining activities is expected to destroy a large area of natural vegetation. It is expected that the ecological functioning and biodiversity will take many years to fully recover. Vehicle traffic and mining activities generate lots of dust which can reduce the growth success and seed dispersal of many small plant species in the adjacent pristine areas.

Mitigation and monitoring

- Implement best practise principles to minimise the footprint of transformation, by keeping to existing roads and earmarked areas where possible.
- Implement effective avoidance measures to limit any activities in the watercourses, by applying the no-go principles around the watercourses, including appropriate buffer zones.
- Ensure measures for the adherence to a maximum speed limit of 40 km/h to minimise dust fallout and associated effects on plants in the adjacent pristine areas.
- Encourage the growth of natural plant species in all affected areas by sowing indigenous seeds or by planting seedlings. Seeds can be acquired from renukaroo@gmail.com or can be harvested from plants in the adjacent pristine habitat.
- Apply for permits to authorise the clearance of indigenous plants from DENC at least three months before such activities will commence.

4.2.2. Loss of Red data and/or protected floral species

Source of the impact

Removal of listed or protected plant species during clearing of an area for the excavation or stripping of ore, construction of infrastructure and roads, stockpiling. Intentional removal of listed or protected plant species for non-mine related purposes, e.g. illegal medicinal trade, cultural beliefs or fire wood collection.

Description of the impact

There are at least sixteen plant species of conservation concern present on the Glosam Mining Right area, with *Boscia albitrunca* being most common. Many of these protected species will most certainly be damaged or removed during the mining operation. Furthermore, any illegal fire wood collection or illegal harvesting of the plants for trade or medicinal use by staff, contractors or secondary land users could potentially have a negative impact on the population of these species.

Mitigation and monitoring

- The footprint areas of the mining activities must be scanned for Red Listed and protected plant species prior to any destructive activities.
- It is recommended that these plants are identified and marked prior to intended activity. These plants should ideally be incorporated into the design layout and left in situ. However, due to the nature of the proposed mining activities they will most likely all be removed or relocated if possible. The relevant permits from DAFF and/or DENC should be applied for at least three months before such activities will commence.
- A management plan should be implemented to ensure proper establishment of ex situ individuals, and should include a monitoring programme for at least two years after re-establishment in order to ensure successful translocation.
- The designation of an environmental officer is recommended to render guidance to the staff and contractors with respect to suitable areas for all related disturbance, and must ensure that all contractors and workers undergo Environmental Induction prior to commencing with work on site. The environmental induction should occur in the appropriate languages for the workers who may require translation.
- All those working on site must be educated about the conservation importance of the flora occurring on site as well as the legislation relating to protected species.
- Employ regulatory measures to ensure that no illegal harvesting takes place.

4.2.3. Introduction or spread of alien species

Source of the impact

During clearing of an area for the excavation or stripping of ore, construction of infrastructure and roads, stockpiling, improper rehabilitation practises.

Description of the impact

The extent of alien invasive species (i.e. *Opuntia* spp., *Salsola kali, Prosopis glandulosa* and *Eucalyptus* sp.) on Glosam is indicative of its complex land use history. Any anthropogenic disturbances to natural vegetation, especially the clearance of large areas of land, provide the opportunity for invasive plants to increase. This is due to their opportunistic nature of dispersal and establishing in disturbed areas. If invasive plants establish in disturbed areas, it may cause an impact beyond the boundaries of the mining site. These alien invasive species are thus a threat to surrounding natural vegetation and can result in the decrease of biodiversity as well as reduction in the ecological value and land use potential of the area. Therefore, if alien invasive species are not controlled and managed, their propagation into new areas could have a high impact on the surrounding natural vegetation in the long term. With proper mitigation, the impacts can be substantially reduced.

Mitigation and monitoring

- Implement best practise principles to minimise the footprint of transformation, by keeping to existing roads and earmarked areas where possible.
- Mechanical methods of control should be implemented pro-actively as soon as invasive species start to emerge.
- Regular follow-up monitoring of invasive control areas need to be implemented to ensure effective eradication.
- Encourage proper rehabilitation of disturbed areas through soil restoration and reseeding of indigenous plant species.

4.2.4. Encouraging bush encroachment

Source of the impact

During clearing of an area for the excavation or stripping of ore, construction of infrastructure and roads, stockpiling, improper rehabilitation practises.

Description of the impact

The extent of bush encroaching species on site indicates high levels of past disturbance interference in the natural ecosystem, primarily through historic landuse practises. Bush encroachment is a natural phenomenon characterised by the excessive expansion of certain shrub species at the expense of other plant species, especially grasses. On Glosam, these include *Tarchonanthus camphoratus, Rhigozum trichotomum, Euclea crispa, Euclea undulata, Senegalia mellifera, Grewia flava* and *Vachellia tortilis*. While general clearing of the area and mining activities destroy natural vegetation, bush encroaching plants can increase due to their aggressive nature in disturbed areas. If encroaching plants establish in disturbed areas, it may lower the potential for future land use and decrease biodiversity. With proper mitigation, the impacts can be substantially reduced. In fact, the proposed mining activities could potentially reduce the extent of these shrubs significantly. By clearing large stands of these species and effectively rehabilitating the cleared areas after mining activities have ceased, it can have a positive effect on the biodiversity.

Mitigation and monitoring

- Mechanical methods of control should be implemented pro-actively as soon as invasive species start to emerge.
- Regular follow-up monitoring of invasive control areas need to be implemented to ensure effective eradication.
- Encourage proper rehabilitation of disturbed areas through soil restoration and reseeding of indigenous plant species.

4.3. Fauna

4.3.1. Habitat fragmentation

Source of the impact

During clearing of an area for the excavation or stripping of ore, construction of infrastructure and roads, stockpiling.

Description of the impact

The mining activities will result in the loss of connectivity and fragmentation of natural habitats on a local scale. Fragmentation of habitats typically leads to the loss of migration corridors, in turn resulting in degeneration of the affected population's genetic make-up.

This usually results in a subsequent loss of genetic variability between meta-populations occurring within the study site. Pockets of fragmented natural habitats hinder the growth and development of populations.

Furthermore, aquatic organisms depend on specific geochemical conditions derived from local sediment. Certain species are highly specialised with specific habitat thresholds. Therefore, disturbances to the sediment in watercourses may also alter the habitat characteristics of the natural watercourses.

Mitigation and monitoring

- All activities associated with the mining operation must be planned, where possible in order to encourage faunal dispersal and should minimise dissection or fragmentation of any important faunal habitat type.
- The extent of the earmarked area should be demarcated on site layout plans. No staff, contractors or vehicles may leave the demarcated area except those authorised to do so.
- Those pristine areas surrounding the earmarked area that are not part of the demarcated area should be considered as a no go zone for employees, machinery or even visitors.
- No new roads should be created across a watercourse.
- No mining should take place in the ephemeral stream or in the vicinity of the seep wetland. If this is unavoidable, a water use license to alter the beds and banks of each earmarked watercourse should be obtained from DWS prior to such activities.
- After such a licence has been obtained, care should still be taken to minimise the footprint within each watercourse.
- Employ sound rehabilitation measures to restore characteristics of all affected habitats.

4.3.2. Disturbance, displacement and killing of fauna

Source of the impact

Vegetation clearing; increase in noise and vibration; human and vehicular movement on site resulting from mining activities.

Description of the impact

The transformation of natural habitats will result in the loss of micro habitats, affecting individual species and ecological processes. This will result in the displacement of faunal species that depend on such habitats, e.g. birds that nest in trees or animals residing in holes in the ground or among rocks.

Increased noise and vibration will disturb and possibly displace wildlife. Fast moving vehicles cause road kills of small mammals, birds, reptiles, amphibians and a large number of invertebrates. Intentional killing of snakes, reptiles, vultures and owls will negatively affect their local populations.

Mitigation and monitoring

- Careful planning of the operation is needed in order to avoid the destruction of pristine habitats and minimise the overall disturbance footprint.
- The extent of the mining activities should be demarcated on site layout plans, and no personnel or vehicles may leave the demarcated area except if authorised to do so. Areas surrounding the earmarked site that are not part of the demarcated area should be considered as a no go zone.
- No new roads should be created across a watercourse.
- If any of the protected wildlife species are directly threatened by habitat destruction or displacement during the mining operation, then the relevant permits from DENC should be obtained followed by the relevant mitigation procedures stipulated in the permits.
- No mining should take place in the ephemeral stream or in the vicinity of the seep wetland. If this is unavoidable, a water use license to alter the beds and banks of each earmarked watercourse should be obtained from DWS prior to such activities.
- After such a licence has been obtained, care should still be taken to minimise the footprint within each watercourse.
- Everyone on site must undergo environmental induction for awareness on not capturing or harming species that are often persecuted out of superstition and to be educated about the conservation importance of the fauna occurring on site.
- Reptiles and amphibians that are exposed during the clearing operations should be captured for later release or translocation by a qualified expert.
- Employ measures that ensure adherence to a maximum speed limit of 40 km/h as well as driving mindfully on site to lower the risk of animals being killed on the roads or elsewhere in the mining area.

4.4. Water resources

4.4.1. Alteration/destruction of watercourses

Source of the impact

During excavation or stripping of ore, construction of infrastructure and roads, stockpiling.

Description of the impact

During mining activities there is a possibility that the watercourses on site (i.e. wetland seep or ephemeral stream) might be altered or destroyed through direct activities taking place within these watercourses. This includes direct mining within the watercourses as well as development of roads, infrastructure or stockpiles within their active zones, catchment areas, or buffer zones. Such activities can completely change the hydrologic regime of the watercourses, which will not only compromise their ecological functioning, but also have downstream effects.

Mitigation and monitoring

- All activities associated with the mining operation must be planned in order to avoid any disturbances to the watercourses and their buffer zones.
- The extent of the watercourses along with their buffer zones should be delineated by a specialist and should be demarcated on site layout plans. No staff, contractors or vehicles may enter these demarcated watercourses.
- No new roads should be created across a watercourse.
- No mining should take place in the ephemeral stream or in the vicinity of the seep wetland.
- If this is unavoidable, a water use license to alter the beds and banks of each earmarked watercourse should be obtained from DWS prior to such activities.
- After such a licence has been obtained, care should still be taken to minimise the footprint within each watercourse and tis catchment.
- Employ sound rehabilitation measures to restore characteristics of all affected watercourses.

4.4.2. Contamination of surface water

Source of the impact

Use of vehicles, mining machinery and equipment.

Description of the impact

Accidental spills of petrochemical substances may contaminate the watercourses. If any of these substances build up on the ground surface it can be carried away through surface runoff during rainfall events to the ephemeral stream or seep wetland.

Mitigation and monitoring

- Vehicles and machinery should be regularly serviced and maintained.

- Refuelling and vehicle maintenance must take place in well demarcated areas and over suitable drip trays to prevent soil pollution.
- Drip trays must be available on site and installed under all stationary vehicles.
- Spill kits to clean up accidental spills from any accidental spillages must be well-marked and available on site. Workers must undergo induction to ensure that they are prepared for rapid clean-up procedures.
- Any soil or area that is contaminated must be cleaned immediately by removing the soil and disposing it as hazardous waste in the correct manner.
- Any areas storing hazardous fluids or waste should have a berm constructed around it, to prevent any contaminated water running off from these areas.

4.4.3. Siltation of surface water

Source of the impact

During clearing of an area for the excavation or stripping of ore, construction of infrastructure and roads, stockpiling, natural events.

Description of the impact

Vegetation will be stripped in preparation for the mining areas and associated infrastructure. These bare areas will be very susceptible to water erosion without plants to stabilise the soil, creating potential sediment source zones. High runoff events could potentially cause the ephemeral stream and seep wetland to be filled with silt from mining areas if the sediment source zones lie along the drainage paths towards these watercourses. This may lead to a change in hydrologic regime or character of the ephemeral stream and seep wetland.

Mitigation and monitoring

- Bare ground exposure should be minimised at all times in terms of the surface area and duration.
- Re-establishment of plant cover on disturbed areas must take place as soon as possible, once activities in the area have ceased.
- No new roads, infrastructure or mining areas should be developed over watercourses.
- Disturbances during the rainy season (November to March) should be monitored and controlled.
- Any potential run-off from exposed ground should be controlled with flow retarding barriers.

- Regular monitoring during the mining operation should be carried out to identify areas where erosion is occurring; followed by appropriate remedial actions.

4.4.4. Contamination of groundwater

Source of the impact

Mining activities, use of vehicles, mining machinery and equipment.

Description of the impact

The karst aquifers that occur in the underlying dolomite and lime stone rocks in the western parts of Glosam represent a major strategic water resource, which is sensitive both in respect to the abstraction and potential pollution of groundwater. Alterations to the geomorphological character of the watercourses will affect the groundwater/surface water interactions, which may have detrimental effects to the important aquifer underlying the study site. There is also a possibility that vehicles and equipment might leak oil and fuel may be spilled. Hazardous surface spillages will seep into the underlying aquifers and contaminate ground water.

Mitigation and monitoring

- Vehicles and machinery should be regularly serviced and maintained.
- Refuelling and vehicle maintenance must take place in well demarcated areas and over suitable drip trays to prevent soil pollution.
- Drip trays must be available on site and installed under all stationary vehicles.
- Spill kits to clean up accidental spills from any accidental spillages must be well-marked and available on site. Workers must undergo induction to ensure that they are prepared for rapid clean-up procedures.
- Any soil or area that is contaminated must be cleaned immediately by removing the soil and disposing it as hazardous waste in the correct manner.
- Any areas storing hazardous fluids or waste should have a berm constructed around it, to prevent any contaminated water running off from these areas.
- No mining should take place in the ephemeral stream or in the vicinity of the seep wetland. If this is unavoidable, a water use license to alter the beds and banks of each earmarked watercourse should be obtained from DWS prior to such activities.

4.5. Broad-scale ecological processes

Source of the impact

Clearing of vegetation and disturbance during the construction of roads and mining activities; alterations to watercourse habitat characteristics.

Description of the impact

Transformation of intact habitat on a cumulative basis would contribute to the fragmentation of the landscape and would potentially disrupt the connectivity of the landscape for fauna and flora and impair their ability to respond to environmental fluctuations. The ore rich hills and seep wetland are the most vulnerable habitats on site in terms of cumulative disturbances. The fragmentation of these habitats through loss of specialised species due to habitat alterations will destroy connectivity of vital ecological corridors and it will disrupt the terrestrial and aquatic food web, which might have cascading effects on a landscape level.

Mitigation and monitoring

- Implement best practise principles to minimise the footprint of transformation, by keeping to existing roads and earmarked areas where possible.
- No new roads should be created across a watercourse.
- No mining should take place in the ephemeral stream or in the vicinity of the seep wetland. If this is unavoidable, a water use license to alter the beds and banks of each earmarked watercourse should be obtained from DWS prior to such activities.
- After such a licence has been obtained, care should still be taken to minimise the footprint within each watercourse.
- Employ sound rehabilitation measures to restore characteristics of all affected habitats.
- For restoration of the affected areas without topsoil, soils can be sourced from other sustainable areas and chemically changed to match with the surrounding environment.
- To restore areas where compacted soil occur, a ripper blade or deep plow can be pulled across the affected area to alleviate compaction.
- Encourage the growth of natural plant species in all affected areas by sowing indigenous seeds or by planting seedlings. Seeds can be acquired from renukaroo@gmail.com or can be harvested from plants in the adjacent pristine habitat.

5. CONCLUSION, RECOMMENDATIONS AND OPINION REGARDING AUTHORISATION

Seven plant communities were identified on site of which the thornveld on historic mine footprint, shrubland on manganese ridges and woodland along the ephemeral stream are associated with the core mining area. These areas are considered to be of high and very high sensitivity respectively. The most profound impacts are expected to be related to alterations and the possible destruction of the ephemeral stream, alteration to soil character as well as loss of soil fertility, loss of plant species of conservation concern and contribution to the cumulative effects of other mining activities in the region.

A number of species of conservation concern is found in the earmarked habitats and will most certainly be damaged or removed. The most severe effect will be on the protected *Boscia albitrunca,* which is widespread across the study area. A licence application regarding protected trees should be lodged with Department of Agriculture, Forestry and Fisheries prior to any potential disturbances to these trees. *Boscia albitrunca* is also protected in terms of the NCNCA, along with species like *Gymnosporia buxifolia, Olea europaea* subsp*. africana* and *Pelargonium minimum*, which also occur in the earmarked area. A permit application regarding protected flora as well as the harvesting of indigenous vegetation need to be lodged with the Northern Cape Department of Environment and Nature Conservation prior to any clearance of vegetation.

To conclude, the proposed mining activities will impact the ecological integrity of Glosam, with associated impacts mainly considered to be moderately high. If the mining operation is managed with best environmental practise in mind, followed by effective rehabilitation efforts, these impacts can be reduced. Therefore, environmental authorisation should only be granted on condition that the applicant commits to the adherence of effective avoidance, management, mitigation and rehabilitation measures.

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Boscia
ECOLOGICAL CONSULTING

APPENDICES

APPENDIX 1

Plant species list

Family	Scientific Name	Status	NFA	NCNCA
ACANTHACEAE	*Barleria irritans*	LC		
	Barleria rigida	LC		
	Blepharis marginata	LC		
	Justicia divaricata	LC		
	Justicia puberula	LC		
	Justicia thymifolia	LC		
AIZOACEAE	*Plinthus sericeus*	LC		
AIZOACEAE (MESEM)	*Hereroa wilmaniae*	**DDT**		**S2**
AMARANTHACEAE	*Sericocoma avolans*	LC		
	Sericorema remotiflora	LC		
AMARYLLIDACEAE	*Boophone disticha*	LC		**S2**
ANACARDIACEAE	***Schinus molle***	**Nat. Exot.**		
	Searsia burchellii	LC		
	Searsia ciliata	LC		
	Searsia lancea	LC		
	Searsia pyroides	LC		
	Searsia tridactyla	LC		
APOCYNACEAE	*Stapelia* sp.	-		**S2**
ASPARAGACEAE	*Asparagus bechuanicus*	LC		
	Asparagus sp.	-		
ASTERACEAE	*Arctotheca calendula*	LC		
	Chrysocoma ciliata	LC		
	Cichorium intybus* subsp. *intybus	**Nat. Exot.**		
	Dicoma capensis	LC		
	Dimorphotheca polyptera	LC		
	Eriocephalus ericoides	LC		
	Felicia fascicularis	LC		
	Felicia filifolia subsp. *filifolia*	LC		
	Geigeria sp.	-		
	Helichrysum melanacme	LC		
	Helichrysum zeyheri	LC		
	Hirpicium echinus	LC		
	Kleinia longiflora	LC		
	Lopholaena cneorifolia	LC		
	Osteospermum oppositifolium	LC		
	Pegolettia retrofracta	LC		
	Pentzia calcarea	LC		
	Pentzia globosa	LC		
	Pentzia incana	LC		
	Pteronia undulata	LC		
	Senecio consanguineus	LC		
	Tagetes minuta	**Nat. Exot.**		
	Tarchonanthus camphoratus	**Bush Encr.**		
	Tarchonanthus obovatus	LC		
BIGNONIACEAE	*Rhigozum obovatum*	LC		
	Rhigozum trichotomum	**Bush Encr.**		
BORAGINACEAE	*Ehretia alba*	LC		

Family	Scientific Name	Status	NFA	NCNCA
BRASSICACEAE	*Capsella bursa-pastoris*	Nat. Exot.		
	Lepidium africanum subsp. *divaricatum*	LC		
CACTACEAE	*Opuntia ficus-indica*	Decl. Inv.		
	Opuntia lindheimeri	Decl. Inv.		
CAPPARACEAE	*Boscia albitrunca*	LC	X	S2
	Cadaba aphylla	LC		
	Cleome rubella	LC		
CARYOPHYLLACEAE	*Pollichia campestris*	LC		
CELASTRACEAE	*Gymnosporia buxifolia*	LC		S2
	Putterlickia saxatilis	LC		
CHENOPODIACEAE	*Chenopodium carinatum*	Nat. Exot.		
	Chenopodium schraderianum	Nat. Exot.		
	Salsola geminiflora	LC		
	Salsola kali	Decl. Inv.		
CLEOMACEAE	*Cleome rubella*	LC		
COMMELINACEAE	*Commelina africana* var. *krebsiana*	LC		
CONVOLVULACEAE	*Convolvulus multifidus*	LC		
CRASSULACEAE	*Crassula capitella* subsp. *nodulosa*	LC		S2
	Crassula setulosa	LC		S2
	Kalanchoe rotundifolia	LC		S2
CUCURBITACEAE	*Acanthosicyos naudinianus*	LC		
	Peponium caledonicum	LC		
CYPERACEAE	*Bulbostylis humilis*	LC		
EBENACEAE	*Euclea crispa*	Bush Encr.		
	Euclea undulata	Bush Encr.		
EUPHORBIACEAE	*Acalypha indica*	LC		
	Croton gratissimus var. *gratissimus*	LC		
	Euphorbia mauritanica	LC		S2
FABACEAE	*Calobota cuspidosa*	LC		
	Chamaecrista biensis	LC		
	Indigofera vicioides var. *vicioides*	LC		
	Lessertia frutescens	LC		S1
	Lotononis parviflora	LC		
	Melolobium candicans	LC		
	Melolobium exudans	LC		
	Melolobium humile	LC		
	Parkinsonia africana	LC		
	Prosopis glandulosa	Decl. Inv.		
	Ptycholobium biflorum subsp. *biflorum*	LC		
	Requienia sphaerosperma	LC		
	Rhynchosia totta var. *totta*	LC		
	Senegalia mellifera	Bush Encr.		
	Senna italica subsp. *arachoides*	LC		
	Tephrosia burchellii	LC		
	Vachellia erioloba	LC	X	
	Vachellia haematoxylon	LC	X	
	Vachellia tortilis	Decl. Inv.		
GERANIACEAE	*Pelargonium minimum*	LC		S1

Family	Scientific Name	Status	NFA	NCNCA
HYACINTHACEAE	*Albuca* cf. *virens* subsp. *virens*	LC		
	Dipcadi gracillimum	LC		
	Massonia sp.	-		
IRIDACEAE	*Freesia andersoniae*	LC		S2
JUNCACEAE	*Juncus dregeanus* subsp. *dregeanus*	LC		
LAMIACEAE	*Leonotis pentadentata*	LC		
	Salvia verbenaca	LC		
	Stachys burchelliana	LC		
LOBELIACEAE	*Lobelia erinus*	LC		
MALVACEAE	*Grewia flava*	Bush Encr.		
	Hermannia affinis	LC		
	Hermannia bryoniifolia	LC		
	Hermannia burchellii	LC		
	Hermannia comosa	LC		
	Hermannia glabrata	LC		
	Hermannia linearifolia	LC		
	Hermannia tomentosa	LC		
	Hermannia vestita	LC		
MOLLUGINACEAE	*Pharnaceum viride*	LC		
MORACEAE	*Ficus cordata* subsp. *cordata*	LC		
MYRTACEAE	*Eucalyptus* sp.	Decl. Inv.		
NYCTAGINACEAE	*Phaeoptilum spinosum*	LC		
OLEACEAE	*Olea europaea* subsp. *africana*	LC		S2
OXALIDACEAE	*Oxalis* sp.	-		S2
PEDALIACEAE	*Sesamum triphyllum*	LC		
PHYLLANTHACEAE	*Phyllanthus parvulus*	LC		
PLUMBAGINACEAE	*Dyerophytum africanum*	LC		
POACEAE	*Andropogon schirensis*	LC		
	Anthephora pubescens	LC		
	Aristida adscensionis	LC		
	Aristida congesta subsp. *barbicollis*	LC		
	Aristida congesta subsp. *congesta*	LC		
	Aristida diffusa	LC		
	Aristida engleri var. *ramosissima*	LC		
	Aristida meridionalis	LC		
	Aristida stipitata	LC		
	Brachiaria serrata	LC		
	Cenchrus ciliaris	LC		
	Centropodia glauca	LC		
	Chrysopogon serrulatus	LC		
	Cymbopogon caesius	LC		
	Cymbopogon pospischilii	LC		
	Digitaria eriantha	LC		
	Enneapogon cenchroides	LC		
	Enneapogon desvauxii	LC		
	Enneapogon scaber	LC		
	Enneapogon scoparius	LC		
	Eragrostis brizantha	LC		

Family	Scientific Name	Status	NFA	NCNCA
POACEAE	*Eragrostis chloromelas*	LC		
	Eragrostis curvula	LC		
	Eragrostis cylindriflora	LC		
	Eragrostis echinochloidea	LC		
	Eragrostis lehmanniana	LC		
	Eragrostis nindensis	LC		
	Eragrostis obtusa	LC		
	Eragrostis rigidior	LC		
	Eragrostis rotifer	LC		
	Eragrostis trichophora	LC		
	Eustachys paspaloides	LC		
	Fingerhuthia africana	LC		
	Heteropogon contortus	LC		
	Melinis repens	LC		
	Microchloa caffra	LC		
	Panicum arbusculum	LC		
	Panicum maximum	LC		
	Pogonarthria squarrosa	LC		
	Schmidtia kalahariensis	LC		
	Schmidtia pappophoroides	LC		
	Setaria verticillata	LC		
	Sporobolus fimbriatus	LC		
	Stipagrostis obtusa	LC		
	Stipagrostis uniplumis	LC		
	Themeda triandra	LC		
	Tragus sp.	-		
POLYGALACEAE	*Polygala leptophylla* var. *armata*	LC		
PTERIDACEAE	*Cheilanthes eckloniana*	LC		
	Cheilanthes hirta var. hirta	LC		
	Pellaea calomelanos	LC		
RHAMNACEAE	*Ziziphus mucronata*	LC		
SANTALACEAE	*Thesium lineatum*	LC		
	Viscum rotundifolium	LC		
SAPINDACEAE	*Dodonaea viscosa* var. *angustifolia*	LC		
SCROPHULARIACEAE	*Aptosimum albomarginatum*	LC		
	Aptosimum marlothii	LC		
	Jamesbrittenia sp.	-		**S2**
	Peliostomum origanoides	LC		
	Selago sp.	-		
	Sutera griquensis	LC		
SOLANACEAE	*Lycium* sp.	-		
	Solanum sp.	-		
VERBENACEAE	*Chascanum garipense*	LC		

APPENDIX 2

Faunal species list

LIST OF MAMMALS

Mammals protected according to NCNCA are indicated with their respective Schedule no. in superscript

	Scientific name	Common name	IUCN	SA RDB	Habitat	Potential of occurrence
CHIROPTERA	[2]*Eidolon helvum*	African Straw-coloured Fruit-bat	**NT**	Not listed	Wide habitat tolerance.	High
	[2]*Tadarida aegyptiaca*	Egyptian Free-tailed Bat	LC	LC	Wide habitat tolerance.	High
	[2]*Cistugo lesueuri*	Lesueur's Hairy Bat	LC	Not listed	Broken country with koppies and cliffs.	High
	[2]*Neoromicia capensis*	Cape Bat	LC	LC	Wide habitat tolerance, but often found in arid areas, grassland, bushveld and *Acacia* woodland. Animals roost under the bark of trees and similar vegetation.	High
	[2]*Nycteris thebaica*	Common Slit-faced Bat	LC	LC	Savanna species with wide habitat tolerance. Roosts in caves, mine adits, aardvark holes, rock crevices and hollow trees in open savanna woodland.	High
	[2]*Rhinolophus clivosus*	Geoffroy's Horseshoe Bat	LC	**NT**	Wide habitat tolerance.	High
	[2]*Rhinolophus denti*	Dent's Horseshoe Bat	LC	**NT**	Savanna habitats.	High

LIST OF MAMMALS (continued)

Mammals protected according to NCNCA are indicated with their respective Schedule no. in superscript

	Scientific name	Common name	IUCN	RDB	Habitat	Potential occurrence
CROSCELIDIDAE	[2]*Macroscelides proboscideus*	Karoo Round-eared Sengi	LC	LC	Species of open country, with preference for shrub bush and sparse grass cover, also occur on hard gravel plains with sparse boulders for shelter, and on loose sandy soil provided there is some bush cover.	High
	[2]*Elephantulus myurus*	Eastern Rock Sengi	LC	LC	Savanna and grassland on rocky outcrops or koppies that provide sufficient cracks and holes for shelter.	High
	[2]*Elephantulus rupestris*	Western Rock Sengi	LC	LC	Rocky koppies, rocky outcrops or piles of boulders where these offer sufficient holes and crannies for refuge.	High
TUBULENTATA	[1]*Orycteropus afer*	Aardvark	LC	LC	Wide habitat tolerance, being found in open woodland, scrub and grassland, especially associated with sandy soil.	High

LIST OF MAMMALS (continued)

Mammals protected according to NCNCA are indicated with their respective Schedule no. in superscript

	Scientific name	Common name	IUCN	RDB	Habitat	Potential occurrence
HYRACOIDEA	[2]*Procavia capensis*	Rock Hyrax	LC	LC	Outcrops of rocks, especially granite formations and dolomite intrusions in the Karoo. Also erosion gullies.	Confirmed
LAGOMORPHA	[2]*Lepus capensis*	Cape Hare	LC	LC	Dry, open regions, with palatable bush and grass.	Confirmed
	[2]*Lepus saxatilis*	Scrub Hare	LC	LC	Common in agriculturally developed areas, especially in crop-growing areas or in fallow lands where there is some bush development.	Moderate
	[2]*Pronolagus rupestris*	Smith's Red Rock Rabbit	LC	LC	Rocky slopes and the tops of rocky outcrops of mountains and hills, where grass or scrub vegetation occurs.	High
PHOLIDOTA	[1]*Manis temminckii*	Ground Pangolin	**VU**	**VU**	Prefers savanna woodland in low-lying regions with moderate to dense scrub; average annual rainfall of 250 to 1,400 mm.	Moderate

LIST OF MAMMALS (continued)

Mammals protected according to NCNCA are indicated with their respective Schedule no. in superscript

	Scientific name	Common name	IUCN	RDB	Habitat	Potential occurrence
RODENTIA	[2]*Cryptomys hottentotus*	African Mole Rat	LC	LC	Wide substrate tolerance; sandy soils to heavier compact substrates, e.g. decomposed schists and stony soils.	High
	[2]*Hystrix africaeaustralis*	Cape Porcupine	LC	LC	Catholic in habitat requirements.	High
	[2]*Xerus inauris*	South African Ground Squirrel	LC	LC	Open terrain with a sparse bush cover and hard substrate.	High
	[2]*Pedetes capensis*	Springhare	LC	LC	Occurs widespread: open sandy ground, sandy scrub, overgrazed grassland, edges of vleis and dry river beds.	High
	[2]*Graphiurus ocularis*	Spectacled Dormouse	LC	LC	Rocky habitats, but also trees.	High
	[2]*Rhabdomys pumilio*	Four-striped Grass Mouse	LC	LC	Essentially a grassland species, occurs in wide variety of habitats where there is good grass cover.	High
	[2]*Mus minutoides*	Pygmy Mouse	LC	LC	Wide habitat tolerance.	High

LIST OF MAMMALS (continued)

Mammals protected according to NCNCA are indicated with their respective Schedule no. in superscript

	Scientific name	Common name	IUCN	RDB	Habitat	Potential occurrence
RODENTIA	[3]*Mus musculus*	House Mouse	LC	Not listed	Wide habitat tolerance.	High
	[2]*Mastomys coucha*	Southern Multimammate Mouse	LC	LC	Wide habitat tolerance.	High
	[2]*Aethomys chrysophilus*	Red Rock Rat	LC	LC	Savanna habitats	High
	[2]*Aethomys namaquensis*	Namaqua Rock Rat	LC	LC	Catholic habitat requirements, but prefer rocky hills, outcrops or boulder-strewn hillsides.	High
	[2]*Parotomys brantsii*	Brants' Whistling Rat	LC	LC	Associated with a dry sandy substrate in more arid parts of the Nama-karoo and Succulent Karoo. Species selects areas of low percentage of plant cover and areas with deep sands.	Low
	[2]*Parotomys littledalei*	Littledale's Whistling Rat	LC	**NT**	Riverine associations or associated with *Lycium* bushes or *Psilocaulon absimile*.	Medium

LIST OF MAMMALS (continued)

Mammals protected according to NCNCA are indicated with their respective Schedule no. in superscript

	Scientific name	Common name	IUCN	RDB	Habitat	Potential occurrence
RODENTIA	[2]*Otomys unisulcatus*	Karoo Bush Rat	LC	LC	Shrub and fynbos associations in areas with rocky outcrops Tend to avoid damp situations but exploit the semi-arid Karoo through behavioural adaptation.	High
	[3]*Rattus rattus*	House Rat	LC	Not listed	Primarily commensal, but also found in a variety of natural and semi-natural habitats	High
	[2]*Saccostomus campestris*	Pouched Mouse	LC	LC	Savanna woodland.	Medium
	[2]*Desmodillus auricularis*	Cape Short-eared Gerbil	LC	LC	Tend to occur on hard ground, unlike other gerbil species, with some cover of grass or karroid bush.	High
	[2]*Gerbillurus paeba*	Hairy-footed Gerbil	LC	LC	Gerbils associated with Nama and Succulent Karoo preferring sandy soil or sandy alluvium with a grass, scrub or light woodland cover.	Low

LIST OF MAMMALS (continued)

Mammals protected according to NCNCA are indicated with their respective Schedule no. in superscript

	Scientific name	Common name	IUCN	RDB	Habitat	Potential occurrence
RODENTIA	[2]*Gerbilliscus leucogaster*	Bushveld Gerbil	LC	**DD**	Predominantly associated with light sandy soils or sandy alluvium.	High
	[2]*Gerbilliscus brantsii*	Highveld Gerbil	LC	LC	Sandy soils or sandy alluvium with some cover of grass, scrub or open woodland.	High
	[2]*Malacothrix typica*	Gerbil Mouse	LC	LC	Found predominantly in Nama and Succulent Karoo biomes, in areas with a mean annual rainfall of 150-500 mm.	Low
PRIMATES	[4]*Cercopithecus pygerythrus*	Vervet Monkey	LC	LC	Savanna and open woodland, but is extremely adaptable and versatile species able to persist in secondary and/or highly fragmented vegetation.	High
	[4]*Papio ursinus*	Chacma Baboon	LC	LC	Can exploit fynbos, montane grasslands, riverine courses in deserts, and simply need water and access to refuges.	Confirmed

LIST OF MAMMALS (continued)

Mammals protected according to NCNCA are indicated with their respective Schedule no. in superscript

	Scientific name	Common name	IUCN	RDB	Habitat	Potential occurrence
EULIPOTYPHLA	[2]*Crocidura cyanea*	Reddish-Grey Musk Shrew	LC	DD	Occurs in relatively dry terrain, with a mean annual rainfall of less than 500 mm. Occur in karroid scrub and in fynbos often in association with rocks.	High
ERINACEOMORPHA	[1]*Atelerix frontalis*	South African Hedgehog	LC	**NT**	Generally found in semi-arid and subtemperate environments with ample ground cover.	Moderate
CARNIVORA	[1]*Proteles cristata*	Aardwolf	LC	LC	Common in the 100-600mm rainfall range of country, Nama-Karoo, Succulent Karoo Grassland and Savanna biomes.	High
	[4]*Caracal caracal*	Caracal	LC	LC	Caracals tolerate arid regions, occur in semi-desert and karroid conditions.	High
	[1]*Felis silvestris*	Wild Cat	LC	LC	Wide habitat tolerance.	High

LIST OF MAMMALS (continued)

Mammals protected according to NCNCA are indicated with their respective Schedule no. in superscript

	Scientific name	Common name	IUCN	RDB	Habitat	Potential occurrence
CARNIVORA	[1]*Felis nigripes*	Black-footed cat	**VU**	LC	Associated with arid country, particularly areas with open habitat that provides some cover in the form of tall stands of grass or scrub.	Moderate
	[2]*Genetta genetta*	Common Genet	LC	LC	Occur in open arid habitats.	High
	[2]*Suricata suricatta*	Suricate	LC	LC	Open arid country with hard and stony substrate. Occur in Nama- and Succulent Karoo but also fynbos.	High
	[2]*Cynictis penicillata*	Yellow Mongoose	LC	LC	Semi-arid country on a sandy substrate.	High
	[2]*Herpestes sanguineus*	Slender mongoose	LC	LC	Wide habitat tolerance.	High
	[2]*Herpestes pulverulentus*	Cape Grey Mongoose	LC	LC	Wide habitat tolerance.	High
	[2]*Atilax paludinosus*	Marsh mongoose	LC	LC	Mainly restricted to riparian habitats, wherever there is suitable vegetation cover and water in close proximity.	Low

LIST OF MAMMALS (continued)

Mammals protected according to NCNCA are indicated with their respective Schedule no. in superscript

	Scientific name	Common name	IUCN	RDB	Habitat	Potential occurrence
CARNIVORA	[1]*Vulpes chama*	Cape Fox	LC	LC	Associated with open country, open grassland, grassland with scattered thickets and coastal or semi-desert scrub.	High
	[4]*Canis mesomelas*	Black-backed Jackal	LC	LC	Wide habitat tolerance.	High
	[1]*Hyaena brunnea*	Brown Hyena	**NT**	**NT**	Found in dry areas, generally with annual rainfall of 100 - 700 mm, particularly along the coast, semi-desert, open scrub and open woodland savanna.	Low
	[1]*Otocyon megalotis*	Bat-eared Fox	LC	LC	Open country with mean annual rainfall of 100-600 mm.	High
	[1]*Ictonyx striatus*	Striped Polecat	LC	LC	Widely distributed throughout the sub-region.	High
	[1]*Mellivora capensis*	Honey Badger	LC	**NT**	Wide habitat tolerance.	High

LIST OF MAMMALS (continued)

Mammals protected according to NCNCA are indicated with their respective Schedule no. in superscript

	Scientific name	Common name	IUCN	RDB	Habitat	Potential occurrence
CETARTIODACTYLA	[2]*Oreotragus oreotragus*	Klipspringer	LC	LC	Rocky and mountainous terrain	High
	[2]*Raphicerus campestris*	Steenbok	LC	LC	Inhabits open country.	High
	[2]*Sylvicapra grimmia*	Common Duiker	LC	LC	Presence of bushes are important.	Confirmed
	[2]*Thagelaphus strepciceros*	Greater Kudu	LC	LC	Mixed scrub woodland on lowlands, hills, and mountains.	High

LIST OF REPTILES

Reptiles protected according to NCNCA are indicated with their respective Schedule no. in superscript.

Family	Scientific name	Common name	Status
AGAMIDAE	[3]*Agama aculeata aculeata*	Western Ground Agama	LC
	[3]*Agama atra*	Southern Rock Agama	LC
AMPHISBAENIDAE	[3]*Monopeltis capensis*	Cape Worm Lizard	LC
	[3]*Monopeltis infuscata*	Dusky Worm Lizard	LC
	[3]*Zygaspis quadrifrons*	Kalahari Dwarf Lizard	LC
CHAMAELEONIDAE	[1]*Chamaeleo dilepis*	Flap-necked Chamaeleon	LC
COLUBRIDAE	[3]*Dispholidus typus*	Boomslang	LC
	[2]*Philothamnus semivariegatus*	Spotted Bush Snake	LC
CORDYLIDAE	[1]*Karusasaurus polyzonus*	Southern Karusa Lizard	LC
ELAPIDAE	[3]*Naja nivea*	Cape Cobra	LC
GEKKONIDAE	[3]*Chondrodactylus bibronii*	Bibron's Gecko	LC
	[3]*Pachydactylus capensis*	Cape Gecko	LC
	[3]*Pachydactylus mariquensis*	Common Banded Gecko	LC
	[3]*Ptenopus garrulus garrulus*	Common Barking Gecko	LC
GERRHOSAURIDAE	[3]*Gerrhosaurus flavigularis*	Yellow-throated Plated Lizard	LC
LACERTIDAE	[2]*Heliobolus lugubris*	Bushveld Lizard	LC
	[2]*Nucras intertexta*	Spotted Sandveld Lizard	LC
	[2]*Pedioplanis lineoocellata lineoocellata*	Spotted Sand Lizard	LC
	[2]*Pedioplanis namaquensis*	Namaqua Sand Lizard	LC
LAMPROPHIIDAE	[2]*Boaedon capensis*	Common House Snake	LC
	[2]*Lamprophis aurora*	Aurora House Snake	LC
	[3]*Psammophis trinasalis*	Fork-marked Sand Snake	LC
	[3]*Psammophylax tritaeniatus*	Striped Grass Snake	LC
	[2]*Pseudaspis cana*	Mole Snake	LC
LEPTOTYPHLOPIDAE	[3]*Leptotyphlops scutifrons scutifrons*	Peters' Thread Snake	LC
PELOMEDUSIDAE	[3]*Pelomedusa subrufa*	Marsh Terrapin	LC
SCINCIDAE	[3]*Trachylepis capensis*	Cape Skink	LC
	[3]*Trachylepis sulcata sulcata*	Western Rock Skink	LC
	[3]*Trachylepis variegata*	Variegated Skink	LC
TESTUDINIDAE	[2]*Homopus femoralis*	Greater Dwarf Tortoise	LC
	[2]*Psammobates oculifer*	Serrated Tent Tortoise	LC
	[2]*Psammobates tentorius*	Tent Tortoise	LC
	[2]*Stigmochelys pardalis*	Leopard Tortoise	LC
TYPHLOPIDAE	[3]*Rhinotyphlops lalandei*	Delalande's Beaked Blind Snake	LC
VARANIDAE	[2]*Varanus albigularis albigularis*	Southern Rock Monitor	LC
VIPERIDAE	[3]*Bitis arietans arietans*	Puff Adder	LC

LIST OF AMPHIBIANS

Amphibians protected according to NCNCA are indicated with their respective Schedule no. in superscript

Family	Scientific name	Common name	IUCN status
BUFONIDAE	[2]*Amietophrynus garmani*	Eastern Olive Toad	LC
	[2]*Amietophrynus gutturalis*	Guttural Toad	LC
	[2]*Amietophrynus poweri*	Western Olive Toad	LC
	[2]*Bufo gariepensis*	Karoo Toad	LC
HYPEROLIIDAE	[2]*Kassina senegalensis*	Bubbling Kassina	LC
MICROHYLIDAE	[2]*Breviceps adspersus*	Bushveld Rain Frog	LC
PIPIDAE	[2]*Xenopus laevis*	Common Platanna	LC
PYXICEPHALIDAE	[2]*Amietia quecketti*	Common River Frog	LC
	[2]*Cacosternum boettgeri*	Boettger's Caco	LC
	[1]*Pyxicephalus adspersus*	Giant Bullfrog	**NT**
	[2] *Tomopterna cryptotis*	Tremolo Sand Frog	LC
	[2]*Tomopterna tandyi*	Tandy's Sand Frog	LC

LIST OF BIRDS

Birds protected according to NCNCA are indicated with their respective Schedule no. in superscript

Scientific name	Common name	IUCN status	SA Bird Atlas
[1]*Accipiter badius*	Shikra	LC	LC
[2]*Acrocephalus baeticatus*	African Reed-Warbler	Not listed	LC
[2]*Actitis hypoleucos*	Common Sandpiper	LC	LC
[2]*Alcedo cristata*	Malachite Kingfisher	LC	LC
[2]*Alopochen aegyptiacus*	Egyptian Goose	LC	LC
[2]*Amadina erythrocephala*	Red-headed Finch	LC	LC
[2]*Amaurornis flavirostris*	Black Crake	LC	LC
[2]*Anas capensis*	Cape Teal	LC	LC
[2]*Anas erythrorhyncha*	Red-billed Teal	LC	LC
[2]*Anas smithii*	Cape Shoveller	LC	LC
[2]*Anas sparsa*	African Black Duck	LC	LC
[2]*Anas undulata*	Yellow-billed Duck	LC	LC
[2]*Anhinga rufa*	African Darter	LC	LC
[2]*Anthoscopus minutus*	Cape Penduline-Tit	LC	LC
[2]*Anthropoides paradiseus*	Blue Crane	**VU**	**NT**
[2]*Anthus cinnamomeus*	African Pipit	Not listed	LC
[2]*Anthus crenatus*	African Rock Pipit	LC	**NT**
[2]*Anthus vaalensis*	Buffy Pipit	LC	LC
[2]*Apus affinis*	Little Swift	LC	LC
[2]*Apus apus*	Common Swift	LC	LC
[2]*Apus bradfieldi*	Bradfield's Swift	LC	LC
[2]*Apus caffer*	White-rumped Swift	LC	LC
[2]*Apus horus*	Horus Swift	LC	LC
[2]*Aquila rapax*	Tawny Eagle	LC	**EN**
[2]*Aquila verreauxii*	Verreaux's Eagle	LC	**VU**
[2]*Ardea cinerea*	Grey Heron	LC	LC
[2]*Ardea melanocephala*	Black-headed Heron	LC	LC
[2]*Ardea purpurea*	Purple Heron	LC	LC
[2]*Ardeotis kori*	Kori Bustard	**NT**	**NT**
[2]*Batis pririt*	Pririt Batis	LC	LC
[2]*Bostrychia hagedash*	Hadeda Ibis	LC	LC
[2]*Bradornis infuscatus*	Chat Flycatcher	LC	LC
[2]*Bradornis mariquensis*	Marico Flycatcher	LC	LC
[2]*Bubalornis niger*	Red-billed Buffalo-Weaver	LC	LC
[1]*Bubo africanus*	Spotted Eagle-Owl	LC	LC
[1]*Bubo lacteus*	Verreaux's Eagle Owl	LC	LC
[2]*Bubulcus ibis*	Cattle Egret	LC	LC
[2]*Burhinus capensis*	Spotted Thick-knee	LC	LC
[1]*Buteo rufofuscus*	Jackal Buzzard	LC	LC
[1]*Buteo vulpinus*	Steppe Buzzard	Not listed	LC
[2]*Calandrella cinerea*	Red-capped Lark	LC	LC
[2]*Calendulauda africanoides*	Fawn-coloured Lark	LC	LC

LIST OF BIRDS (continued)

Birds protected according to NCNCA are indicated with their respective Schedule no. in superscript

Scientific name	Common name	IUCN status	SA Bird Atlas
[2]*Calendulauda bradfieldi*	Bradfield's Lark	Not listed	LC
[2]*Calendulauda sabota*	Sabota Lark	LC	LC
[2]*Calidris alba*	Sanderling	LC	LC
[2]*Calidris ferruginea*	Curlew Sandpiper	LC	LC
[2]*Calidris minuta*	Little Stint	LC	LC
[2]*Campethera abingoni*	Golden-tailed Woodpecker	LC	LC
[1]*Caprimulgus europaeus*	European Nightjar	LC	LC
[1]*Caprimulgus rufigena*	Rufous-cheeked Nightjar	LC	LC
[1]*Caprimulgus tristigma*	Freckled Nightjar	LC	LC
[2]*Cercomela familiaris*	Familiar Chat	LC	LC
[2]*Cercotrichas coryphoeus*	Karoo Scrub-Robin	Not listed	LC
[2]*Cercotrichas paena*	Kalahari Scrub-Robin	LC	LC
[2]*Ceryle rudis*	Pied Kingfisher	LC	LC
[2]*Charadrius asiaticus*	Caspian Plover	LC	LC
[2]*Charadrius pallidus*	Chestnut-banded Plover	**NT**	**NT**
[2]*Charadrius pecuarius*	Kittlitz's Plover	LC	LC
[2]*Charadrius tricollaris*	Three-banded Plover	LC	LC
[2]*Chersomanes albofasciata*	Spike-heeled Lark	LC	LC
[2]*Chlidonias hybridus*	Whiskered Tern	LC	LC
[2]*Chlidonias leucopterus*	White-winged Tern	LC	LC
[2]*Chrysococcyx caprius*	Diderick Cuckoo	LC	LC
[2]*Ciconia abdimii*	Abdim's Stork	LC	**NT**
[2]*Ciconia ciconia*	White Stork	LC	LC
[1]*Ciconia nigra*	Black Stork	LC	**VU**
[2]*Cinnyris fusca*	Dusky Sunbird	LC	LC
[2]*Cinnyris mariquensis*	Marico Sunbird	LC	LC
[1]*Circaetus pectoralis*	Black-chested Snake-Eagle	LC	LC
[1]*Circus maurus*	Black Harrier	**VU**	**NT**
[1]*Circus pygargus*	Montagu's Harrier	LC	LC
[1]*Circus ranivorus*	African Marsh-Harrier	LC	**EN**
[2]*Cisticola aridulus*	Desert Cisticola	LC	LC
[2]*Cisticola fulvicapillus*	Neddicky	LC	LC
[2]*Cisticola juncidis*	Zitting Cisticola	LC	LC
[2]*Cisticola subruficapillus*	Grey-backed Cisticola	LC	LC
[2]*Cisticola tinniens*	Levaillant's Cisticola	LC	LC
[2]*Clamator glandarius*	Great Spotted Cuckoo	LC	LC
[2]*Clamator jacobinus*	Jacobin Cuckoo	LC	LC
[3]*Colius colius*	White-backed Mousebird	LC	LC
[2]*Columba guinea*	Speckled Pigeon	LC	LC
[2]*Columba livia*	Rock Pigeon	LC	LC
[2]*Coracias caudata*	Lilac-breasted Roller	LC	LC
[2]*Coracias garrulus*	European Roller	**NT**	**NT**
[2]*Coracias naevia*	Purple Roller	LC	LC

LIST OF BIRDS (continued)

Birds protected according to NCNCA are indicated with their respective Schedule no. in superscript

Scientific name	Common name	IUCN status	SA Bird Atlas
[3]*Corvus albus*	Pied Crow	LC	LC
[3]*Corvus capensis*	Black Crow	LC	LC
[2]*Cossypha caffra*	Cape Robin-Chat	LC	LC
[2]*Coturnix coturnix*	Common Quail	LC	LC
[2]*Creatophora cinerea*	Wattled Starling	LC	LC
[2]*Cuculus clamosus*	Black Cuckoo	LC	LC
[2]*Cuculus gularis*	African Cuckoo	LC	LC
[2]*Cursorius rufus*	Burchell's Courser	LC	**VU**
[2]*Cursorius temminckii*	Temminck's Courser	LC	LC
[2]*Cypsiurus parvus*	African Palm-Swift	LC	LC
[2]*Dendrocygna viduata*	White-faced Duck	LC	LC
[2]*Dendropicos fuscescens*	Cardinal Woodpecker	LC	LC
[2]*Dicrurus adsimilis*	Fork-tailed Drongo	LC	LC
[2]*Egretta alba*	Great Egret	LC	LC
[2]*Egretta garzetta*	Little Egret	LC	LC
[2]*Egretta intermedia*	Yellow-billed Egret	LC	LC
[1]*Elanus caeruleus*	Black-shouldered Kite	LC	LC
[2]*Emberiza capensis*	Cape Bunting	LC	LC
[2]*Emberiza flaviventris*	Golden-breasted Bunting	LC	LC
[2]*Emberiza impetuani*	Lark-like Bunting	LC	LC
[2]*Emberiza tahapisi*	Cinnamon-breasted Bunting	LC	LC
[2]*Eremomela icteropygialis*	Yellow-bellied Eremomela	LC	LC
[2]*Eremopterix verticalis*	Grey-backed Sparrowlark	LC	LC
[2]*Estrilda astrild*	Common Waxbill	LC	LC
[2]*Estrilda erythronotos*	Black-faced Waxbill	LC	LC
[3]*Euplectes afer*	Yellow-crowned Bishop	LC	LC
[3]*Euplectes orix*	Southern Red Bishop	LC	LC
[2]*Eupodotis afraoides*	Northern Black Korhaan	LC	LC
[2]*Eupodotis ruficrista*	Red-crested Korhaan	LC	LC
[1]*Falco biarmicus*	Lanner Falcon	LC	**VU**
[1]*Falco chicquera*	Red-necked Falcon	**NT**	LC
[1]*Falco naumanni*	Lesser Kestrel	LC	LC
[1]*Falco peregrinus*	Peregrine Falcon	LC	LC
[1]*Falco rupicolis*	Rock Kestrel	Not listed	LC
[1]*Falco rupicoloides*	Greater Kestrel	LC	LC
[2]*Fulica cristata*	Red-knobbed Coot	LC	LC
[2]*Gallinago nigripennis*	African Snipe	LC	LC
[1]*Gallinula chloropus*	Common Moorhen	LC	LC
[1]*Glareola nordmanni*	Black-winged Pratincole	**NT**	**NT**
[1]*Glaucidium perlatum*	Pearl-spotted Owlet	LC	LC
[2]*Granatina granatina*	Violet-eared Waxbill	LC	LC
[1]*Gyps africanus*	White-backed Vulture	**CR**	**CR**
[1]*Gyps coprotheres*	Cape Vulture	**EN**	**EN**

LIST OF BIRDS (continued)

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Scientific name	Common name	IUCN status	SA Bird Atlas
[2]*Halcyon chelicuti*	Striped Kingfisher	LC	LC
[1]*Haliaeetus vocifer*	African Fish-Eagle	LC	LC
[2]*Hieraaetus pennatus*	Booted Eagle	LC	LC
[2]*Himantopus himantopus*	Black-winged Stilt	LC	LC
[2]*Hippolais icterina*	Icterine Warbler	LC	LC
[2]*Hirundo albigularis*	White-throated Swallow	LC	LC
[2]*Hirundo cucullata*	Greater Striped Swallow	LC	LC
[2]*Hirundo dimidiata*	Pearl-breasted Swallow	LC	LC
[2]*Hirundo fuligula*	Rock Martin	LC	LC
[2]*Hirundo rustica*	Barn Swallow	LC	LC
[2]*Hirundo semirufa*	Red-breasted Swallow	LC	LC
[2]*Hirundo spilodera*	South African Cliff-Swallow	LC	LC
[2]*Indicator indicator*	Greater Honeyguide	LC	LC
[2]*Ixobrychus minutus*	Little Bittern	LC	LC
[2]*Lagonosticta senegala*	Red-billed Firefinch	LC	LC
[2]*Lamprotornis nitens*	Cape Glossy-starling	LC	LC
[2]*Laniarius atrococcineus*	Crimson-breasted Shrike	LC	LC
[2]*Lanius collaris*	Common Fiscal	LC	LC
[2]*Lanius collurio*	Red-backed Shrike	LC	LC
[2]*Lanius minor*	Lesser Grey Shrike	LC	LC
[2]*Larus cirrocephalus*	Grey-headed Gull	LC	LC
[1]*Leptoptilos crumeniferus*	Marabou Stork	LC	**NT**
[2]*Malcorus pectoralis*	Rufous-eared Warbler	LC	LC
[2]*Megaceryle maxima*	Giant Kingfisher	LC	LC
[1]*Melierax canorus*	Southern Pale Chanting Goshawk	LC	LC
[1]*Melierax gabar*	Gabar Goshawk	LC	LC
[2]*Merops apiaster*	European Bee-eater	LC	LC
[2]*Merops hirundineus*	Swallow-tailed Bee-eater	LC	LC
[2]*Milvus aegyptius*	Yellow-billed Kite	Not listed	LC
[1]*Milvus migrans*	Black Kite	LC	LC
[2]*Mirafra fasciolata*	Eastern Clapper Lark	Not listed	LC
[2]*Mirafra passerina*	Monotonous Lark	LC	LC
[2]*Monticola brevipes*	Short-toed Rock-Thrush	LC	LC
[2]*Motacilla capensis*	Cape Wagtail	LC	LC
[2]*Muscicapa striata*	Spotted Flycatcher	LC	LC
[2]*Myrmecocichla formicivora*	Anteating Chat	LC	LC
[1]*Neotis ludwigii*	Ludwig's Bustard	**EN**	**EN**
[2]*Netta erythrophthalma*	Southern Pochard	LC	LC
[2]*Nilaus afer*	Brubru	LC	LC
[2]*Numenius phaeopus*	Common Whimbrel	LC	LC
[2]*Numida meleagris*	Helmeted Guineafowl	LC	LC
[2]*Nycticorax nycticorax*	Black-crowned Night-Heron	LC	LC
[2]*Oena capensis*	Namaqua Dove	LC	LC
[2]*Oenanthe monticola*	Mountain Wheatear	LC	LC

LIST OF BIRDS (continued)

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Scientific name	Common name	IUCN status	SA Bird Atlas
[2]*Oenanthe pileata*	Capped Wheatear	LC	LC
[2]*Onychognathus nabouroup*	Pale-winged Starling	LC	LC
[2]*Oriolus oriolus*	Eurasian Golden Oriole	LC	LC
[2]*Ortygospiza atricollis*	African Quailfinch	LC	LC
[2]*Oxyura maccoa*	Maccoa Duck	**NT**	**NT**
[2]*Parisoma layardi*	Layard's Tit-Babbler	LC	LC
[2]*Parisoma subcaeruleum*	Chestnut-vented Tit-Babbler	LC	LC
[2]*Parus cinerascens*	Ashy Tit	LC	LC
[2]*Passer diffusus*	Southern Grey-headed Sparrow	LC	LC
[3]*Passer domesticus*	House Sparrow	LC	LC
[3]*Passer melanurus*	Cape Sparrow	LC	LC
[2]*Passer motitensis*	Great Sparrow	LC	LC
[2]*Phalacrocorax africanus*	Reed Cormorant	LC	LC
[2]*Phalacrocorax lucidus*	White-breasted Cormorant	LC	LC
[2]*Philetairus socius*	Sociable Weaver	LC	LC
[2]*Philomachus pugnax*	Ruff	LC	LC
[1]*Phoenicopterus minor*	Lesser Flamingo	**NT**	**NT**
[1]*Phoenicopterus ruber*	Greater Flamingo	LC	**NT**
[2]*Phylloscopus trochilus*	Willow Warbler	LC	LC
[2]*Platalea alba*	African Spoonbill	LC	LC
[2]*Plectropterus gambensis*	Spur-winged Goose	LC	LC
[2]*Plegadis falcinellus*	Glossy Ibis	LC	LC
[2]*Plocepasser mahali*	White-browed Sparrow-Weaver	LC	LC
[3]*Ploceus velatus*	Southern Masked-Weaver	LC	LC
[2]*Podiceps cristatus*	Great Crested Grebe	LC	LC
[2]*Podiceps nigricollis*	Black-necked Grebe	LC	LC
[1]*Polemaetus bellicosus*	Martial Eagle	**VU**	**EN**
[1]*Polihierax semitorquatus*	Pygmy Falcon	LC	LC
[1]*Polyboroides typus*	African Harrier-Hawk	LC	LC
[2]*Porphyrio madagascariensis*	African Purple Swamphen	LC	LC
[2]*Prinia flavicans*	Black-chested Prinia	LC	LC
[2]*Psophocichla litsipsirupa*	Groundscraper Thrush	LC	LC
[2]*Pternistis adspersus*	Red-billed Francolin	LC	LC
[2]*Pterocles bicinctus*	Double-banded Sandgrouse	LC	LC
[2]*Pterocles burchelli*	Burchell's Sandgrouse	LC	LC
[2]*Pterocles namaqua*	Namaqua Sandgrouse	LC	LC
[1]*Ptilopsis granti*	Southern White-faced Scops-Owl	LC	LC
[3]*Pycnonotus nigricans*	African Red-eyed Bulbul	LC	LC
[2]*Pytilia melba*	Green-winged Pytilia	LC	LC
[3]*Quelea quelea*	Red-billed Quelea	LC	LC
[2]*Rallus caerulescens*	African Rail	LC	LC
[2]*Recurvirostra avosetta*	Pied Avocet	LC	LC
[2]*Rhinopomastus cyanomelas*	Common Scimitarbill	LC	LC
[2]*Rhinoptilus africanus*	Double-banded Courser	LC	LC

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Scientific name	Common name	IUCN status	SA Bird Atlas
[2]*Riparia paludicola*	Brown-throated Martin	LC	LC
[2]*Riparia riparia*	Sand Martin	LC	LC
[1]*Sagittarius serpentarius*	Secretarybird	**VU**	**VU**
[2]*Scleroptila gutturalis*	Orange River Francolin	LC	LC
[2]*Scopus umbretta*	Hamerkop	LC	LC
[2]*Serinus albogularis*	White-throated Canary	LC	LC
[2]*Serinus atrogularis*	Black-throated Canary	LC	LC
[2]*Serinus flaviventris*	Yellow Canary	LC	LC
[2]*Sigelus silens*	Fiscal Flycatcher	LC	LC
[2]*Spizocorys conirostris*	Pink-billed Lark	LC	LC
[2]*Sporopipes squamifrons*	Scaly-feathered Finch	LC	LC
[2]*Spreo bicolor*	Pied Starling	LC	LC
[2]*Stenostira scita*	Fairy Flycatcher	LC	LC
[2]*Streptopelia capicola*	Cape Turtle-Dove	LC	LC
[2]*Streptopelia semitorquata*	Red-eyed Dove	LC	LC
[2]*Streptopelia senegalensis*	Laughing Dove	LC	LC
[2]*Struthio camelus*	Common Ostrich	LC	LC
[2]*Sylvia borin*	Garden Warbler	LC	LC
[2]*Sylvietta rufescens*	Longbilled Crombec	LC	LC
[2]*Tachybaptus ruficollis*	Little Grebe	LC	LC
[2]*Tachymarptis melba*	Alpine Swift	LC	LC
[2]*Tadorna cana*	South African Shelduck	LC	LC
[2]*Tchagra australis*	Brown-crowned Tchagra	LC	LC
[2]*Telophorus zeylonus*	Bokmakierie	LC	LC
[2]*Threskiornis aethiopicus*	African Sacred Ibis	LC	LC
[2]*Tockus leucomelas*	Southern Yellow-billed Hornbill	LC	LC
[2]*Tockus nasutus*	African Grey Hornbill	LC	LC
[1]*Torgos tracheliotus*	Lappet-faced Vulture	**EN**	**EN**
[2]*Tricholaema leucomelas*	Acacia Pied Barbet	LC	LC
[2]*Tringa glareola*	Wood Sandpiper	LC	LC
[2]*Tringa nebularia*	Common Greenshank	LC	LC
[2]*Tringa stagnatilis*	Marsh Sandpiper	LC	LC
[2]*Turdus smithi*	Karoo Thrush	Not listed	LC
[2]*Turnix sylvatica*	Small Buttonquail	LC	LC
[1]*Tyto alba*	Barn Owl	LC	LC
[2]*Upupa epops*	African Hoopoe	LC	LC
[3]*Urocolius indicus*	Red-faced Mousebird	LC	LC
[2]*Vanellus armatus*	Blacksmith Lapwing	LC	LC
[2]*Vanellus coronatus*	Crowned Lapwing	LC	LC
[2]*Vidua chalybeata*	Village Indigobird	LC	LC
[2]*Vidua macroura*	Pin-tailed Whydah	LC	LC
[2]*Vidua regia*	Shaft-tailed Whydah	LC	LC
[2]*Zosterops pallidus*	Orange River White-eye	LC	LC

APPENDIX 3

A photographic guide for species of conservation concern known to occur on site

Hereroa wilmaniae

Data Deficient – Taxonomically Problematic

Lessertia frutescens

All *Lessertia* spp. are protected under Schedule 1 of NCNCA

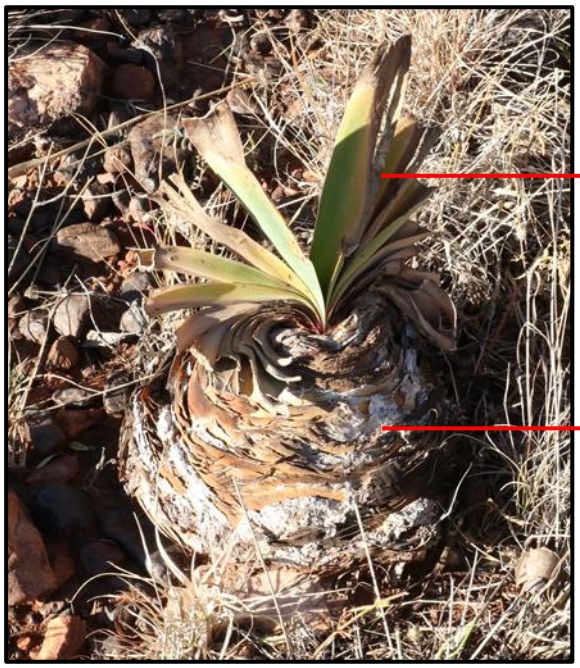
- Small shrublet with leaves being:
  - Hairy
  - Imparipinnate; i.e. leaflets arranged on either side of the stem, typically in pairs opposite each other, with a single leaflet at the apex.
- Pods are membranous, slightly inflated or compressed
- Typical pea flowers

Pelargonium minimum

***Pelargonium* spp. are protected under Schedule 1 of NCNCA**

Boophone disticha

Protected under Schedule 2 of NCNCA



Fan-shape leaves

Bulb protruding from the ground.

Stapelia sp.

APOCYNACEAE spp. are protected under Schedule 2 of NCNCA

Freesia andersoniae

IRIDACEAE spp. are protected under Schedule 2 of NCNCA

Crassula setulosa

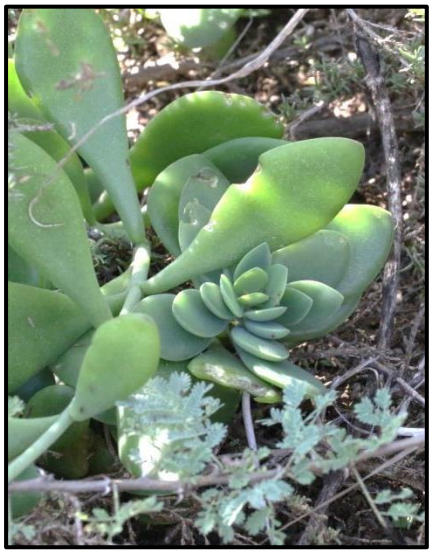
CRASSULACEAE spp. are protected under Schedule 2 of NCNCA

Kalanchoe rotundifolia

CRASSULACEAE spp. are protected under Schedule 2 of NCNCA

Orange-Pink tubular flowers on a long and slender stem

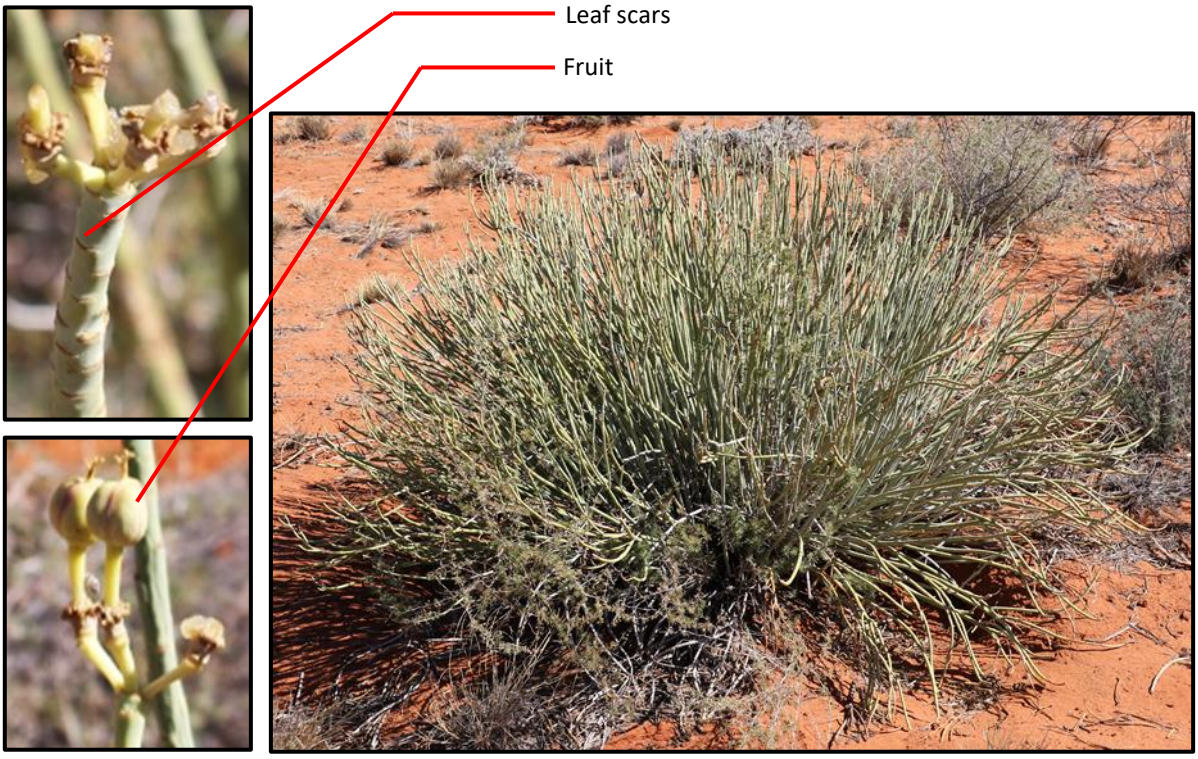
Dry flower heads



Small, rounded/lobed, brittle fleshy leaves

Euphorbia mauritanica

***Euphorbia* spp. are protected under Schedule 2 of the NCNCA**



Jamesbrittenia sp.

***Jamesbrittenia* spp. are protected under Schedule 2 of the NCNCA**

Gymnosporia buxifolia

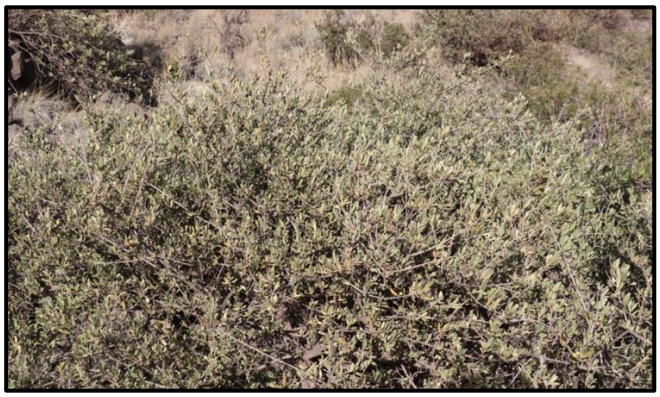
Gymnosporia spp. are protected under Schedule 2 of the NCNCA

Spiny shrub or small tree. Leaves in tufts, obovate, toothed above. Highly ariable

Many white flowers with an unpleasant smell in axillary cymes.

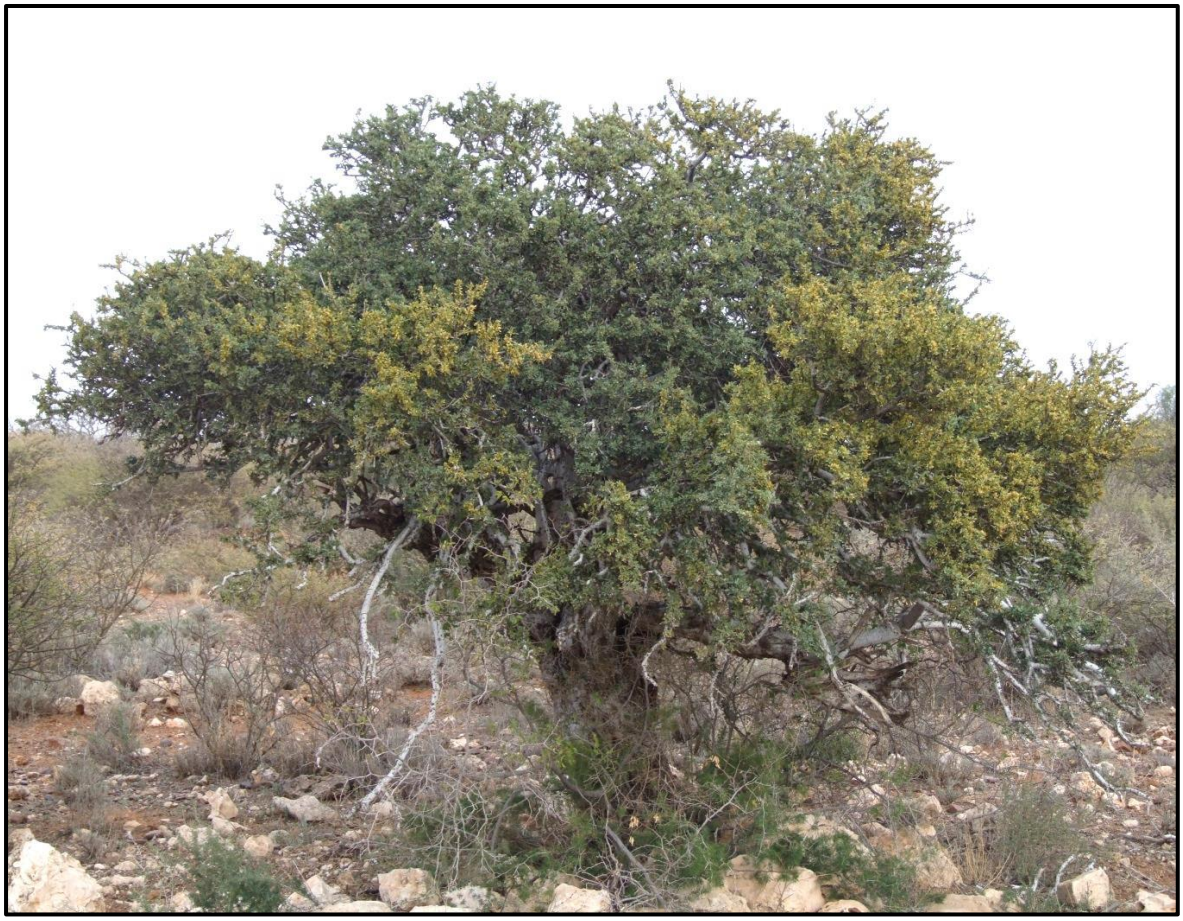
Olea europaea subsp. *africana*

Protected under Schedule 2 of the NCNCA



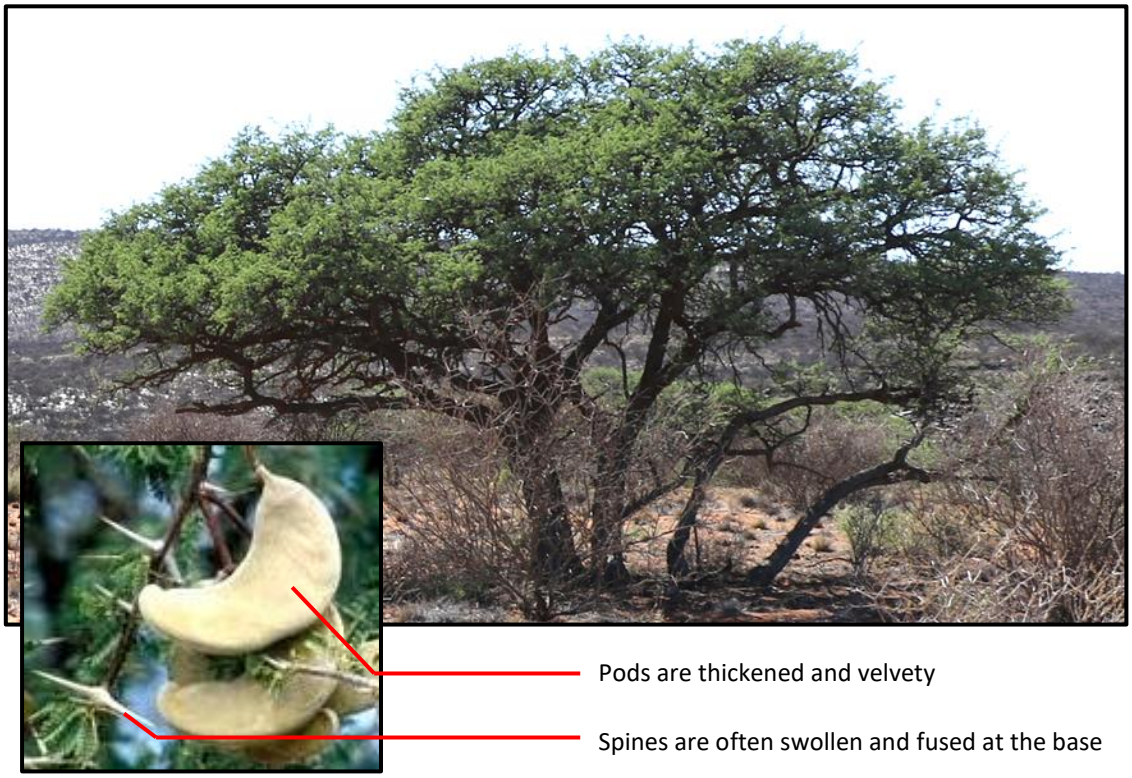
Boscia albitrunca

Protected under the NFA and Schedule 2 of the NCNCA



Vachellia erioloba

Protected under the NFA



Pods are thickened and velvety

Spines are often swollen and fused at the base