NC 10141 MR

Boscia
ECOLOGICAL CONSULTING

ECOLOGICAL & WETLAND ASSESSMENT REPORT

Annesley Salt (Pty) Ltd

Remainder of the Farm Annesley 338

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Annesley Salt (Pty) Ltd

Remainder of the Farm Annesley 338

District of Gordonia

Northern Cape Province

Ecological & Wetland Assessment Report in application for Environmental Authorisation related to a Mining Right Application (Ref: NC 10141MR) that was lodged with the Department of Mineral Resources

January 2019

EXECUTIVE SUMMARY

Annesley (Pty) Ltd is proposing the mining of salt on The Remainder of the Farm Annesley 338. The mining right area is located within the Gordonia District Municipality of the Northern Cape Province. This ecological and wetland assessment report describes the characteristics of terrestrial, aquatic and wetland habitats in the proposed mining area, identifies the source of impacts from the mining operation and assesses these impacts, as well as the residual impacts after closure.

A desktop study and field investigation was performed to obtain ecological information for the proposed study area and identify the ecological characteristics and sensitivity of the site. Two plant communities were identified on site of which all are included in the earmarked area to be affected by mining activities. Of these two, the ephemeral pan is considered to be the most sensitive, with a Very High Sensitivity to mining activities due to its vital ecological functionality and significance. The wetland itself is regarded to be moderately modified, with moderate Ecological Importance and Sensitivity. The most profound impacts are expected to be related to the further destruction of the pan, as well as the associated alteration of aquatic habitats for specialised fauna; which in turn will cause fragmentation of important ecological corridors in the region.

Species of conservation concern that are found in these earmarked habitats will most likely also be lost locally. This includes the plant *Harpagophytum procumbens*, if it is present in the grassland where infrastructure will be placed. Similarly, the mining operation could result in the large-scale clearance of indigenous vegetation. Additionally, any disturbances to the Aardvark burrows in the grassland as well as any protected baboon spiders will displace these protected species locally. Permit applications regarding protected fauna and 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, destruction of Aardvark burrows or the imminent death of protected invertebrates.

The significance of the impacts will be affected by the success of the mitigation and rehabilitation measures implemented. Therefore, authorisation can only be granted if the applicant commits to the adherence of effective avoidance, management, mitigation and rehabilitation measures.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

1. INTRODUCTION

1.1. Background information

Annesley Salt (Pty) Ltd is proposing the mining of salt on the Remainder of the Farm Annesley 338 (from heron referred to as Annesley salt mine). The mining right area is located within the Gordonia District Municipality of the Northern Cape Province and lies 130 km north-west of the town Upington on a gravel road that turns from the R360 (Figure 1). The total extent of the mining right area is 100.3481 ha and comprises a wetland, known as an ephemeral pan.

An ecological and wetland assessment is required in order to consider the impacts that the proposed activities might have on the ecosystems of Annesley and therefore Boscia Ecological Consulting has been appointed by the applicant to conduct an assessment and provide an ecological and wetland assessment report.

This assessment report describes the characteristics of terrestrial, aquatic and wetland habitats in 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 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.

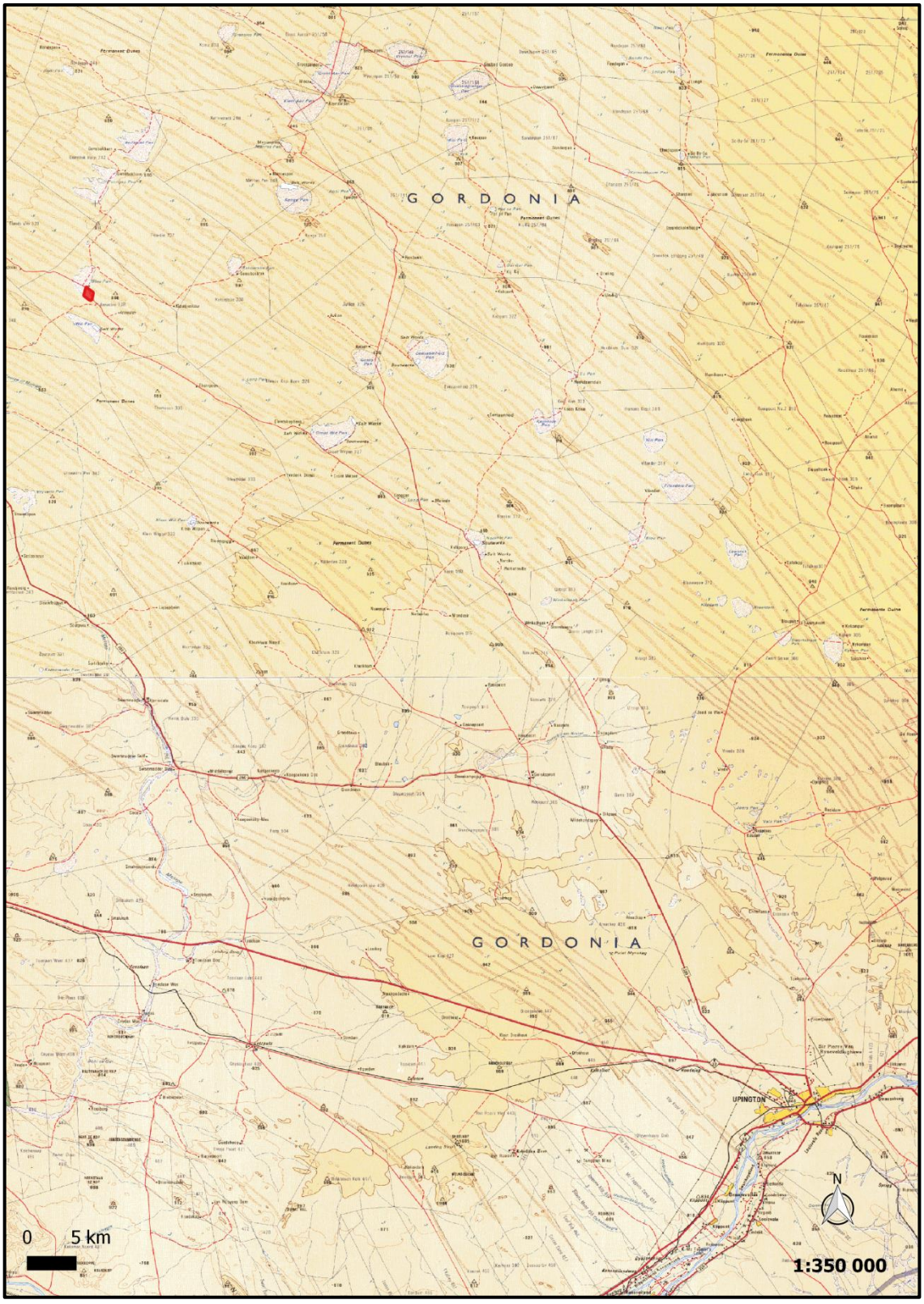


Figure 1. The location of the Annesley mining area is indicated in red.

1.2. Scope of study

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

- conduct a desktop study and field investigation in order to identify and describe different ecological habitats (terrestrial, aquatic and wetland) and provide an inventory of communities/species/taxa 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 ecological assessment report that:
  - indicates identified habitats and fauna and flora species,
  - delineates and classifies wetlands,
  - indicates the ecological sensitivity of habitats and conservation values of species, including Wetland Health Assessment (PES), Wetland Ecological Importance and Sensitivity (EIS) and Wetland Functional Assessment (Eco-Services)
  - determines the potential impacts of the project on the ecological integrity,
  - 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

The mining operation is based on salt resources that are confined to the natural underground brines. Groundwater will be abstracted from boreholes and pumped consecutively into a series of shallow evaporation ponds where crystallisation of salt will occur spontaneously as the water dries up. Ten evaporation ponds will be created by excavating the pan surface to clay level (± 30 cm). After crystallisation, coarse salt will be collected and stock piled before being hauled to Upington for final processing. An estimated total volume of 12 000 tons of grade 1 salt will be produced annually over 10 years.

Mining activities will primarily make use of existing public road that crosses the property to gain access to the mining right area, but additional roads will be created in order to access work and residential areas. Apart from the evaporation ponds and stock pile area, other planned infrastructure includes workshop facilities, wash bay area, dedicated generator site, three borehole pumps with associated pipe network, ablutions, diesel depot and two pre-fabricated housing units (Figure 2).

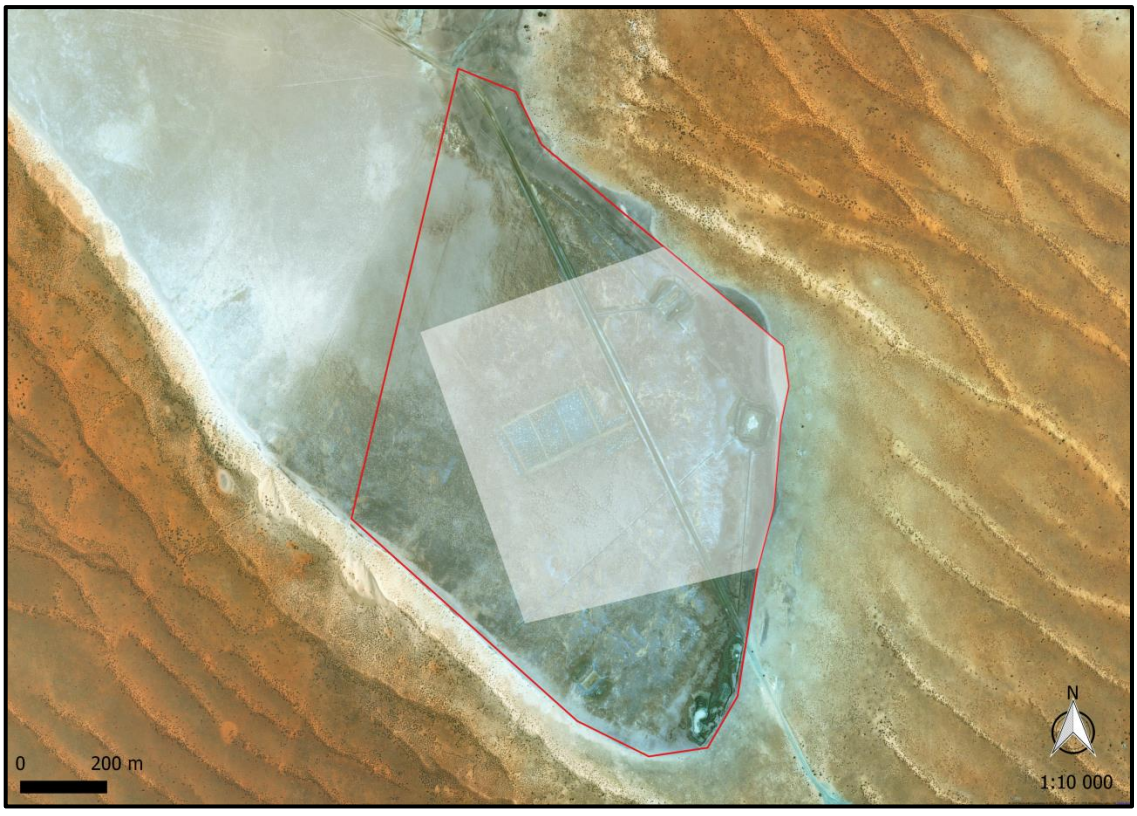


Figure 2. The locality of the core footprint for the mining operation is indicated in white, while the border of the proposed mining right area is indicated in red.

2. METHODOLOGY

2.1. Data collection

The study comprised a combination of field and desktop surveys for data collection on fauna, flora and wetland habitats in order to obtain the most comprehensive data set for the assessment. The fieldwork component was conducted on 26 October 2018 and most data for the desktop component was obtained from the quarter degree square that includes the study area (2720 CB).

2.2. Flora

2.2.1. 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.

2.2.2. Desktop survey

For the desktop component, the South African National Vegetation Map (Mucina and Rutherford 2006) was used to obtain data on broad scale vegetation types and their conservation status.

The South African National Biodiversity Institute's (SANBI) BGIS database was also consulted to obtain information on biodiversity information for the Siyanda District Municipality (NC08), 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 include the study area. 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 2017).

2.3. Fauna

2.3.1. Desktop survey

A desktop survey was undertaken to obtain lists of mammals, reptiles, amphibians, birds and invertebrates 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) and Griffiths et al. (2015) for invertebrates.

Additional information on faunal distribution was extracted from the various databases hosted by the ADU web portal, http://adu.org.za. 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; 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 2015) and/or the various red data books for the respective taxa.

2.3.2. 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 Data species. The presence of faunal species was determined using the following methods:

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

2.4. Wetlands

2.4.1. Information collection

a) Desktop survey

A desktop survey was undertaken to obtain general information regarding the significance and ecological functioning of wetlands. Maps delineating wetland boundaries were generated using 1:50 000 topographic maps, satellite images and other geographic information systems. The National Freshwater Ecosystem Priority Areas (Nel et al. 2011) was inspected and the geological wetland descriptors were also determined using desktop information. Guidelines, including (Ollis et al. 2013), (DWAF 2007), (Macfarlane et al. 2007) and (Kotze et al. 2007a) were consulted in order to classify and assess wetlands on Annesley.

b) Field survey

The wetland survey was conducted concurrent with the vegetation and fauna survey to assess and delineate the wetlands on Annesley. The following elements were assessed:

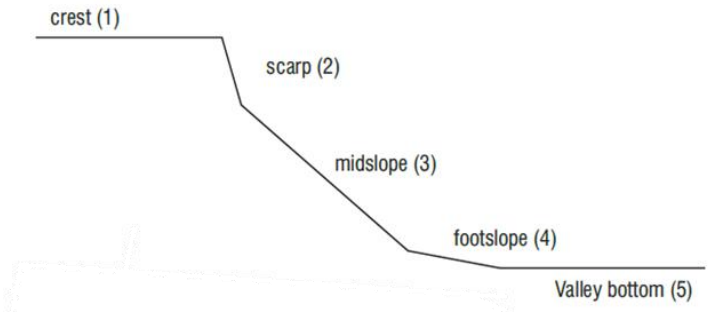
- Wetland descriptors
- Present ecological state
- Features of ecological importance and functionality
- Current impacts

2.4.2. Wetland assessment procedures

a) Wetland Delineation

Wetlands were delineated according to the delineation procedure as set out by DWAF (2005). The delineation procedure considered the following four attributes to determine the limitations of the wetland:

- **Terrain Unit Indicator** helps identifying those parts of the landscape where wetlands are most likely to occur. Typical terrain units are depicted below:



- **Soil Form Indicator** identifies the soil forms, as defined by SCWG (1991). A hydromorphic soil displays unique characteristics resulting from its prolonged and repeated saturation.

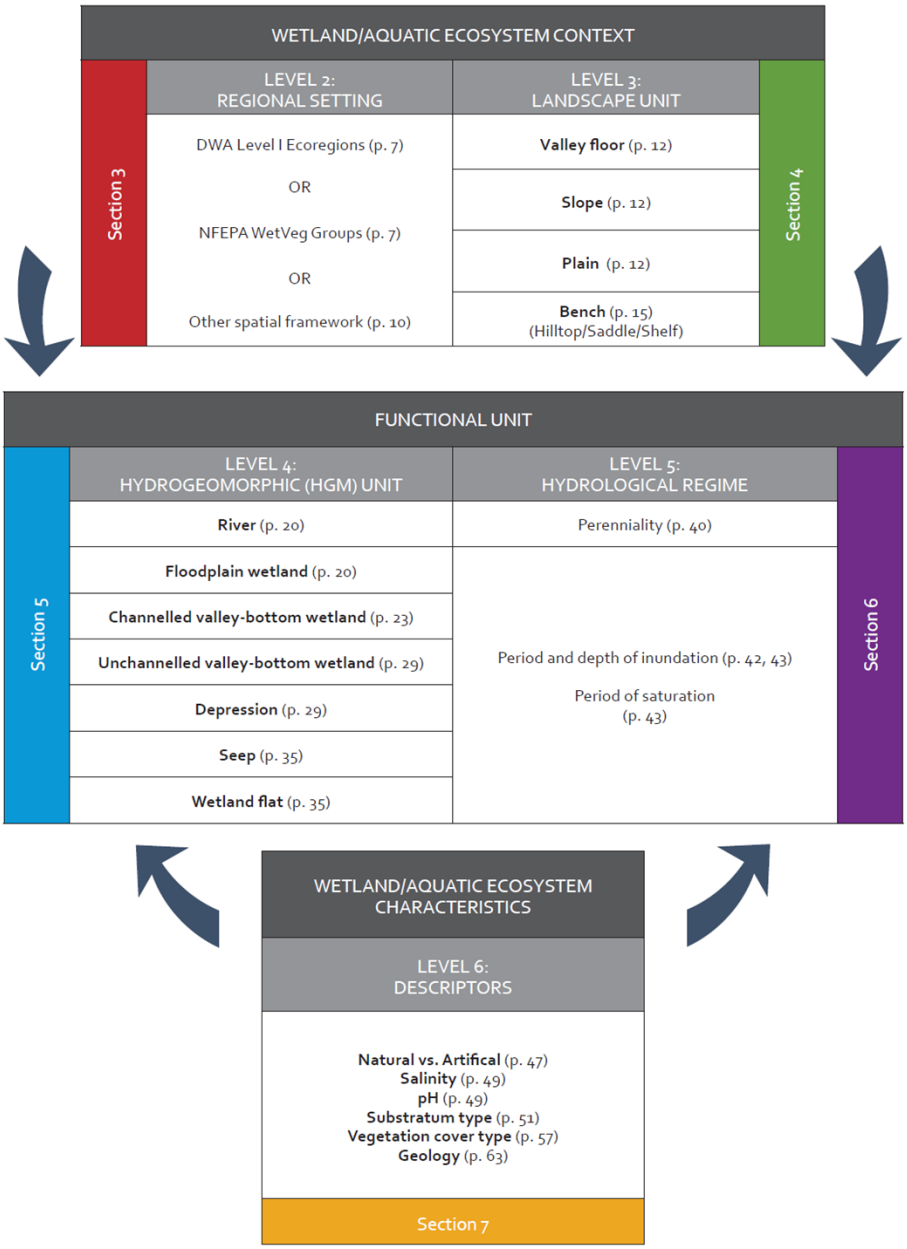
- **Soil Wetness Indicator** identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation. In practice, this indicator is used as the primary indicator.

- **Vegetation Indicator** identifies hydrophilic vegetation associated with frequently saturated soils. Plant communities undergo distinct changes in species composition along the wetness gradient.

The presence of all indicators provides a logical, defensible, and technical basis for identifying an area as wetland, but an area should display a minimum of either soil wetness or vegetation indicators in order to be classified as a wetland. Verification of the terrain unit and soil form indicators increases the level of confidence in deciding the boundary. In other words, the more indicators present, the higher the confidence in the delineation.

b) Wetland Classification

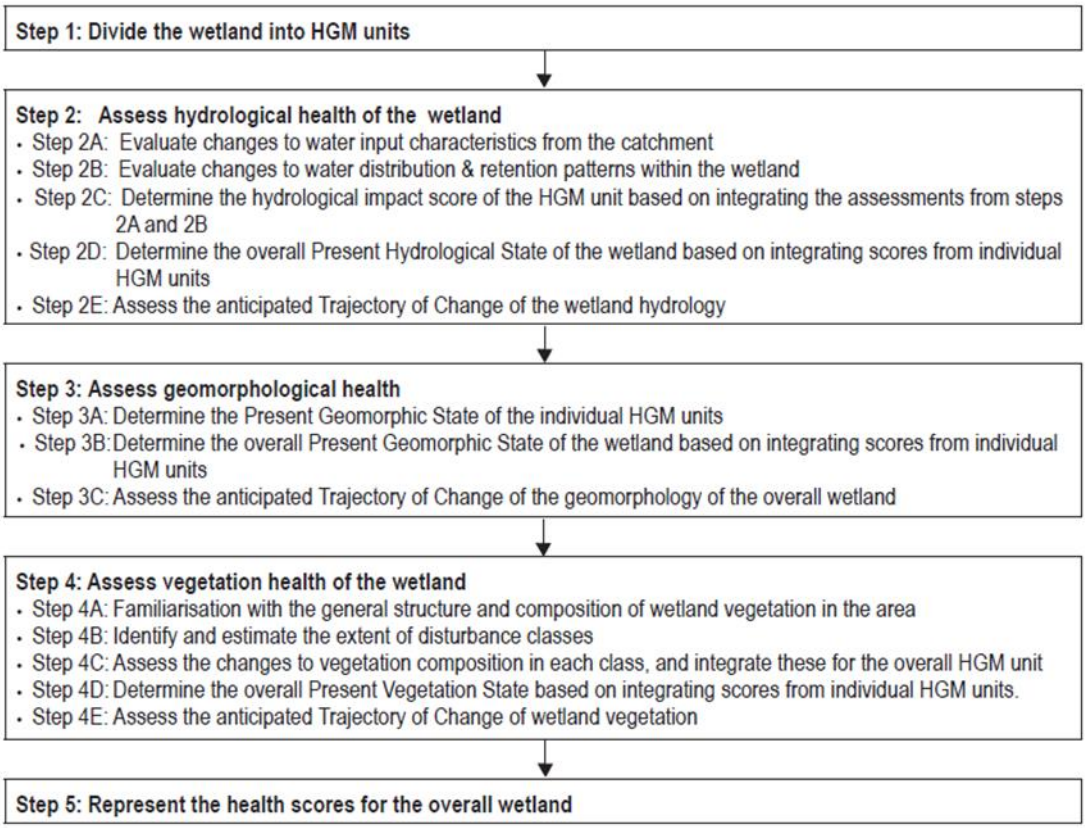
The wetlands were subsequently classified according to the classification procedure for inland systems (Level 2) developed by Ollis et al. (2013). The inland component of the Classification System has a tiered structure (see below diagram), which progresses from Regional Setting (Level 2) and Landscape Units (Level 3), to Hydrogeomorphic (HGM) Units at the finest spatial scale (Level 4). At Level 5, Inland Systems are distinguished from each other based on the hydrological regime and, in the case of open waterbodies, the inundation depth class. At Level 6, six 'descriptors' have been incorporated into the Classification System. These descriptors allow you to distinguish between aquatic ecosystems with different structural, chemical, and/or biological characteristics.



c) Wetland Health Assessment

A Present Ecological State (PES) assessment was conducted to establish baseline health for the wetlands, based on WET-Health (Macfarlane et al. 2007). WET-Health requires the identification of hydrogeomorphic (HGM) units and then assists in assessing the health of the identified HGM units using indicators based on geomorphology, hydrology and vegetation. A Wet-Health level 1 assessment was conducted to determine the PES of the wetlands on Annesley.

The PES assessment is conducted by following a 5 step process:



The overall PES is then calculated using the following formula, to give a score ranging from 0 (pristine) to 10 (critically impacted in all respects):

$$\frac{((\text{Hydrology score}) \times 3) + ((\text{Geomorphology score}) \times 2) + ((\text{Vegetation score}) \times 2)}{7}$$

The PES categories used by WET-Health to describe the integrity of the wetlands are:

Description	Combined impact score	PES Category
Unmodified, natural.	0 – 0.9	**A**
Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1 – 1.9	**B**
Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact.	2 – 3.9	**C**
Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4 – 5.9	**D**
The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6 – 7.9	**E**
Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8 - 10	**F**

Trajectory of Change classes, scores and symbols used to describe the predicted nature of change in the state of a wetland from its present state given threats and vulnerability, are:

Trajectory class	Description	Change score	Class Range	Symbol
Improve markedly	Condition is likely to improve substantially over the next five years	2	1.1 to 2.0	↑↑
Improve	Condition is likely to improve over the next 5 years	1	0.3 to 1.0	↑
Remain stable	Condition is likely to remain stable over the next 5 years	0	-0.2 to 0.2	→
Deterioration slight	Condition is likely to deteriorate slightly over the next 5 years	-1	-0.3 to -1.0	↓
Deterioration substantial	Condition is likely to deteriorate substantially over the next 5 years	-2	-1.1 to -2.0	↓↓

d) Wetland Ecological Importance and Sensitivity

An Ecological Importance and Sensitivity (EIS) assessment was conducted by using methodology adapted from Duthie (1999). For this assessment procedure, a series of determinants are considered using a ranking scale of 0 to 4, i.e. Very high = 4; High = 3, Moderate = 2; Marginal/Low = 1; None = 0:

Determinant
PRIMARY DETERMINANTS
1. Rare & Endangered Species
2. Populations of Unique Species
3. Species/taxon Richness
4. Diversity of Habitat Types or Features
5 Migration route/breeding and feeding site for wetland species
6. Sensitivity to Changes in the Natural Hydrological Regime
7. Sensitivity to Water Quality Changes
8. Flood Storage, Energy Dissipation & Particulate/Element Removal
MODIFYING DETERMINANTS
9. Protected Status
10. Ecological Integrity

The median of the determinants is used to allocate an Ecological Management Class (EMC):

EIS Category	Mean range	EMC
Very high Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications.	> 3 and <= 4	A
High Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications.	> 2 and <= 3	B
Moderate Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications.	> 1 and <= 2	C
Low/marginal Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications.	> 0 and <= 1	D

a) Wetland Functional Assessment

To assessment of the ecosystem services supplied by the wetlands on Annesley was conducted according to guidelines provided for a Level 2 assessment in WET-EcoServices (Kotze et al. 2007b). This assessment examines and rates the following services according to their degree of importance and the degree to which the service is provided:

Ecosystem services supplied by wetlands	**Indirect benefits**	**Regulating and supporting benefits**	Flood attenuation		The spreading out and slowing down of floodwaters in the wetland, thereby reducing the severity of floods downstream
			Streamflow regulation		Sustaining streamflow during low flow periods
			Water quality enhancement benefits	Sediment trapping	The trapping and retention in the wetland of sediment carried by runoff waters
				Phosphate assimilation	Removal by the wetland of phosphates carried by runoff waters
				Nitrate assimilation	Removal by the wetland of nitrates carried by runoff waters
				Toxicant assimilation	Removal by the wetland of toxicants (e.g. metals, biocides and salts) carried by runoff waters
				Erosion control	Controlling of erosion at the wetland site, principally through the protection provided by vegetation
			Carbon storage		The trapping of carbon by the wetland, principally as soil organic matter
	Direct benefits	**Biodiversity maintenance**			Through the provision of habitat and maintenance of natural process by the wetland, a contribution is made to maintaining biodiversity
		Provisioning benefits	Provision of water for human use		The provision of water extracted directly from the wetland for domestic, agriculture or other purposes
			Provision of harvestable resources		The provision of natural resources from the wetland, including livestock grazing, craft plants, fish etc.
			Provision of cultivated foods		The provision of areas in the wetland favourable for the cultivation of foods
		Cultural benefits	Cultural heritage		Places of special cultural significance in the wetland, e.g. for baptisms or gathering of culturally significant plants
			Tourism and recreation		Sites of value for tourism and recreation in the wetland, often associated with scenic beauty and abundant birdlife
			Education and research		Sites of value in the wetland for education or research

Score	**< 0.5**	**0.5 – 1.2**	**1.3 – 2.0**	**2.1 – 2.8**	**> 2.8**
Rating of the likely extent to which a benefit is being supplied	Low	Moderately low	Intermediate	Moderately high	High

2.5. 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 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.

2.6. 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:

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

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 the impacts.

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

2.7. Assumptions and limitations

Due to the brief duration of the survey and the lack of seasonal coverage, the species list obtained during the site visit cannot be regarded as comprehensive. Ideally, a site should be visited several times during different seasons to ensure that the full complement of plant and animal species present is captured. However, this is rarely possible due to time and cost constraints. The survey was nevertheless conducted in such a manner to ensure all representative communities are included.

The site visit for the study took place during early summer, which is generally not a favourable time of the year for vegetation surveys; unless some early spring rain occurred. The best time to evaluate vegetation in the study area is after at least some summer rain when the vegetation has responded and is in an actively growing state. This was however not the case during this survey. Although the majority of the study site is situated on an ephemeral pan, which is naturally void of vegetation due to the high clay and salt content of the soil, most grasses, annuals and other flowering plants in the terrestrial portion of the site were not in the most suitable condition for the survey. The results presented here can therefore only reflect the condition of the vegetation. It is expected that some species of conservation concern were not visible during the time of sampling. Nevertheless, most of the common and significant species encountered were identifiable. Similarly, the aquatic element of the pan is best represented when inundated after good rainfall events. The pan was dry during the survey and consequently, the timing of the site visit is considered to be a limiting factor. The aridity and patchy rainfall of the region however rarely provides ideal conditions for these urgent types of surveys and therefore the field investigation was supplemented by desktop surveys to obtain comprehensive understanding of the overall ecology on site.

The methodology used to assess the wetlands on site were mainly developed for- and best applied to the more temperate wetlands of South Africa. The suite of methodologies available to date do not provide for a comprehensive assessment of the pans in the Northern Cape. This is mainly due to the fact that they are rarely wet and do not display those indicators typically used for wetland assessments in other parts of South Africa. Until recently, these systems have also received little attention in terms of scientific research. Therefore, the nature of the pans on site and the lack of fully applicable methodologies are regarded as a limiting factor to justify the impacts to- and sensitivity of these systems on site.

3. DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1. Current and historic land use

The major land uses in the region are livestock farming and salt mining. The site is classified as non-arable land with low potential for grazing. The main agricultural enterprise in the region is sheep, with a proposed stocking rate of 23 Ha per large stock unit. The area is not suited for cultivation.

Apart from the current mining application by Annesley, there are no other activities currently taking place on site. A public gravel road to Noenieput does however traverse the property. Evidence of historic salt mining activities and excavations are still clearly visible (Figure 3).

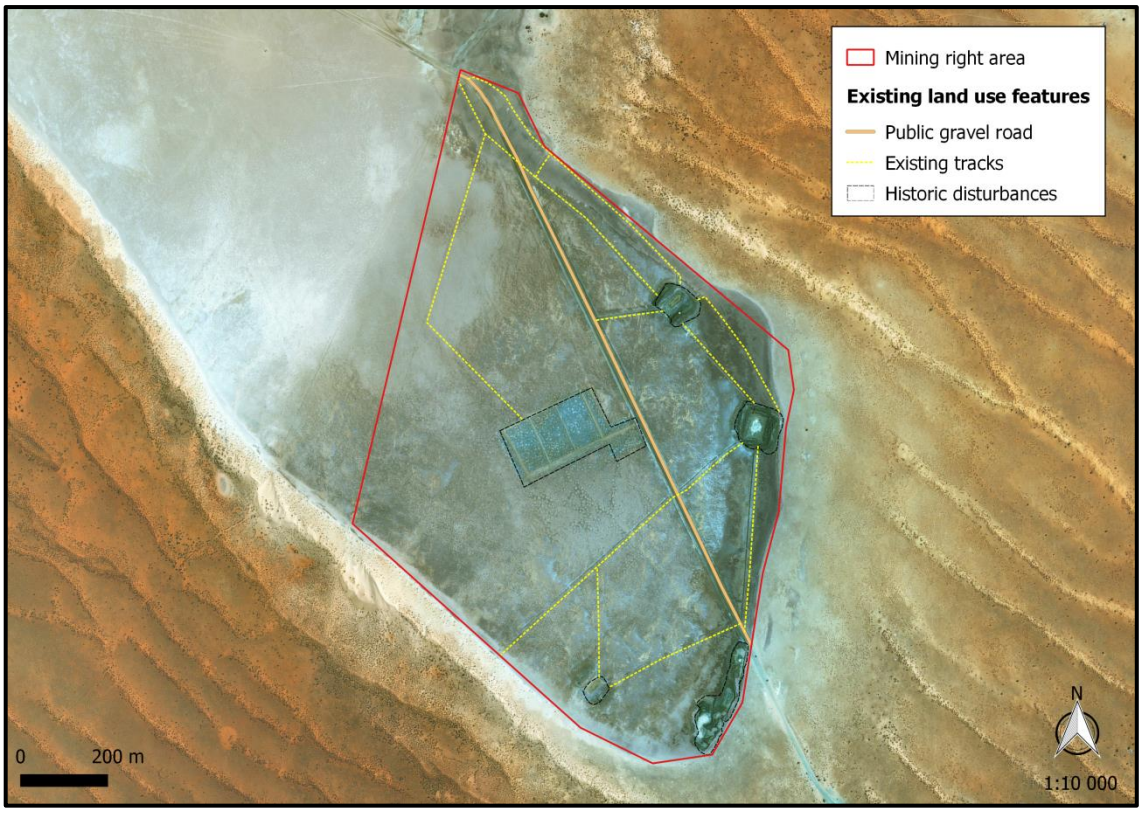


Figure 3. Evidence of the land use history on Annesley.

3.2. Drainage and Quaternary Catchment

The study area falls within the Nossob-Molopo quaternary catchments D42D of the Lower Orange Water Management Area (Figure 4). The quaternary catchment has been allocated a Present Ecological State (PES) of 'Moderately Modified' (C) by (Smook et al. 2002) and information regarding mean annual rainfall, evaporation potential and runoff for the quaternary catchment is provided in Table 2. Watercourses on the study site that have been formally mapped include an ephemeral pan, known as Bloupan (Figure 5).

Table 2. Catchment characteristics for the Nossob-Molopo quaternary catchments, as presented by Smook et al. (2002).

Quaternary catchment	Catchment Area (km^2)	Mean Annual Rainfall (mm)	Mean Annual Evaporation (mm)	Mean Annual Runoff (10^6 m^3)
D42D	16 210	151	2 750	1.21

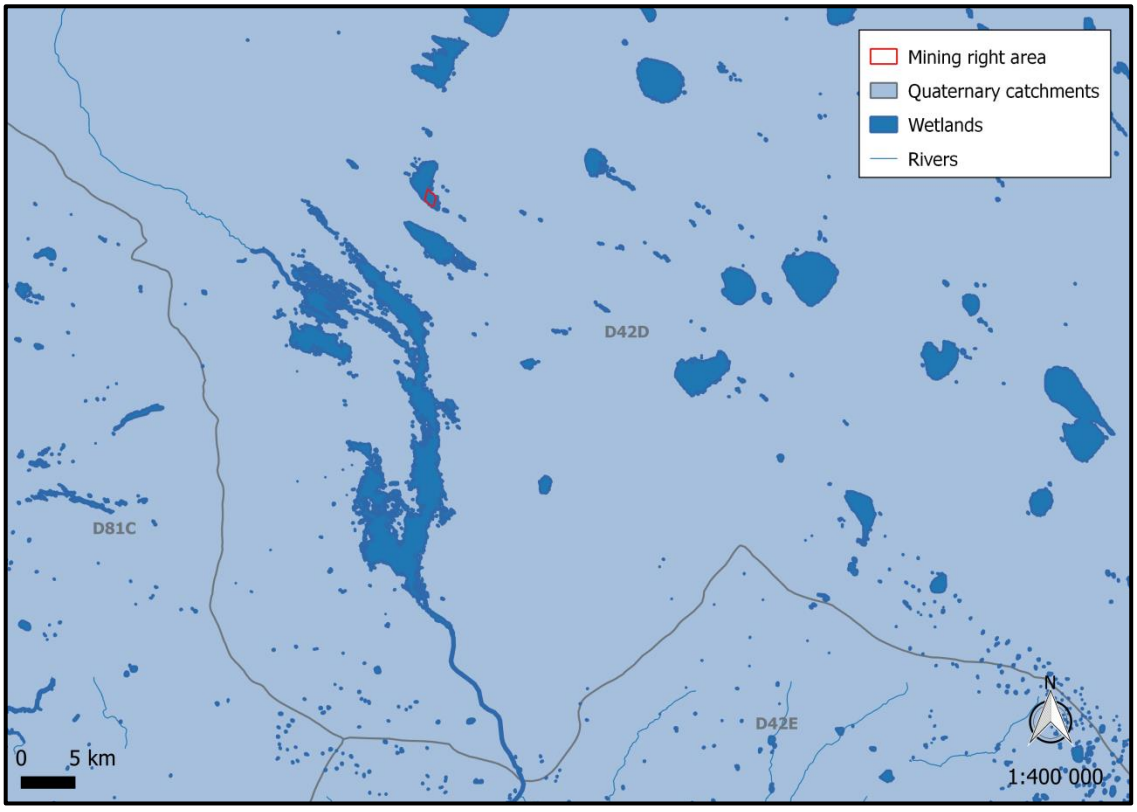


Figure 4. The locality of the proposed mining area in relation to the quaternary catchments of the Lower Orange Water Management Area.

Figure 5. The location of formally mapped watercourses on the proposed mining right area.

3.3. Geology, soils and topography

According to (Heinz 1988) the geological features on Annesley mainly comprise quaternary and carboniferous deposits. Bloupan is primarily associated with pan sediments, along with tillite, shale, brown grit and conglomerate with impure limestone and calcarenite from the Dwyka Formation of the Ecca Group, Karoo Supergroup. The pan is surrounded by dunes comprising red sand from the Gordonia Formation of the Kalahari Group (Figure 6). It is important to note that the delineation of the features on this geological map does not accurately reflect how it occurs on site, because it was not drawn at a very fine scale. The salt resource is naturally found in the groundwater, which is derived from the weathered fractured-rock aquifers of the Dwyka Group tillite and shale.

The region is characterised by dune hills (parallel crests) and lowlands, with altitudes ranging between 860 m above sea level on dune crests and 820 m around the pan. Almost the entire study area is situated on a pan. Here, the terrain is flat indicated by a slope of 0.1 % running west. The slope that runs south-west from the small terrestrial section in the north-eastern corner of the site towards the pan is indicated by a very gentle slope of 1 %.

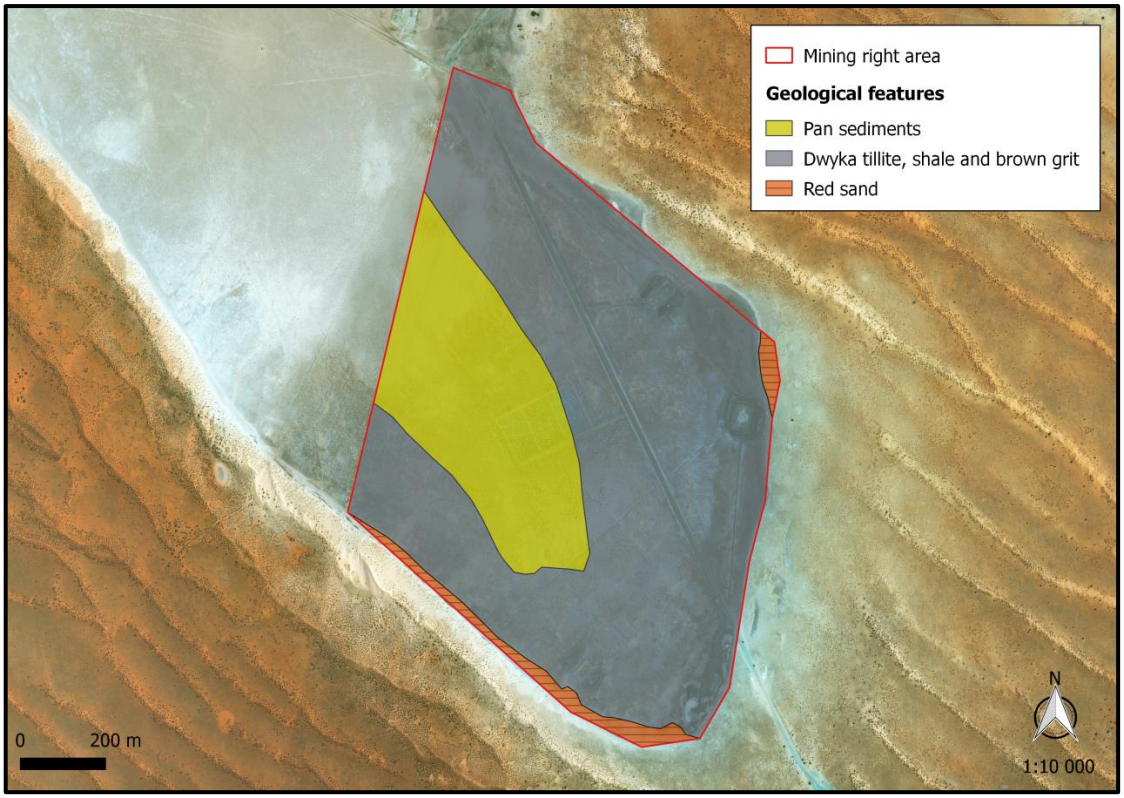


Figure 6. The distribution of geological features in the study area according to Heinz (1988).

The site is closely associated with the Af5a landtype (**Error! Reference source not found.**). Here, red-yellow apedal, freely drained soils, as well as red with a high base status and a depth of more than 300 mm are found. This landtype however only describes the sand dunes surrounding the pan and does not relate to the pan itself.

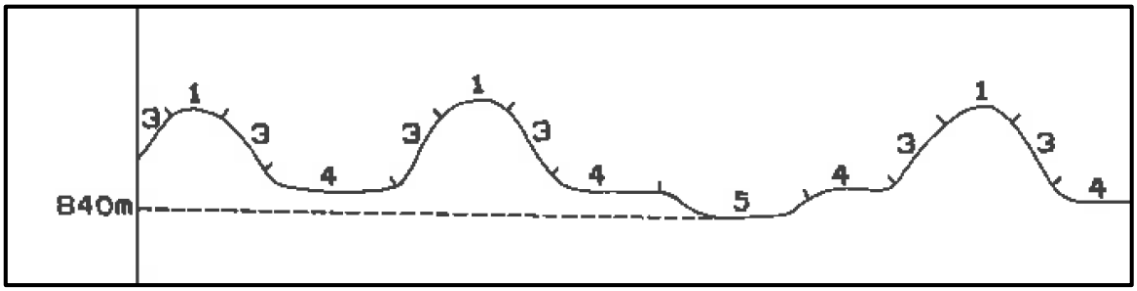


Figure 7. The terrain form sketch for the Af5 landtype, which the study site is associated with.

3.4. Vegetation

3.4.1. Broad-scale vegetation patterns

The study area falls within the Savanna and Azonal Vegetation biomes (Mucina and Rutherford 2006). According to the vegetation map of Mucina and Rutherford (2012), two broad-scale vegetation units are present on site (Figure 8), i.e. Gordonia Duneveld and Southern Kalahari Salt Pans. This vegetation map however does not reflect the true character of the site, because it has not been mapped at a very fine scale.

Gordonia Duneveld is found in the Northern Cape at altitudes between 800 and 1 200 m. It comprises the largest part of the South African side of the Kgalagadi Transfrontier Park, is found south of the Molopo River border with Botswana (west of Van Zylsrus), interleaving the Kalahari Karroid Shrubland in the west (south of Rietfontein to the Orange River) and in the south (around Upington and north of Groblershoop). It also occurs as a number of loose dune cordons south of the Orange River near Keimoes and between Upington and Putsonderwater. The topography typically comprises parallel dunes about 3 – 8 m above the plains. The vegetation occurs mainly as open shrubland with ridges of grassland dominated by *Stipagrostis amabilis* on the dune crests, *Vachellia haematoxylon* on the dune slopes, *Senegalia mellifera* on lower slopes and *Rhigozum trichotomum* in the interdune straaten. The geology and soil comprise aeolian sand underlain by superficial silcretes and calcretes of the Cenozoic Kalahari Group. The unit is classified as least threatened, with 14% being conserved in the Kgalagadi Transfrontier Park. Very little of this unit has been transformed and erosion is generally low. However, the destabilisation of normally vegetated dunes does occur in some areas due to local overstocking. Important taxa include those endemic to the Kalahari region, but none are limited to this unit.

Southern Kalahari Salt Pans are distributed in the Northern Cape and North-West Provinces as well as neighbouring Kalahari regions of Botswana and Namibia at altitudes between 800 and 1 500 m. The largest concentration of these pans in South Africa is found near Groot-Mier in western Gordonia. Although many of the pans are devoid of vegetation, the vegetation is typically presented as low grasslands on pan bottoms, dominated by *Sporobolus* sp. A mixture of dwarf shrubs dominated by *Lycium* and/or *Rhigozum* usually forms the outer belt in the salt pan zonation system.

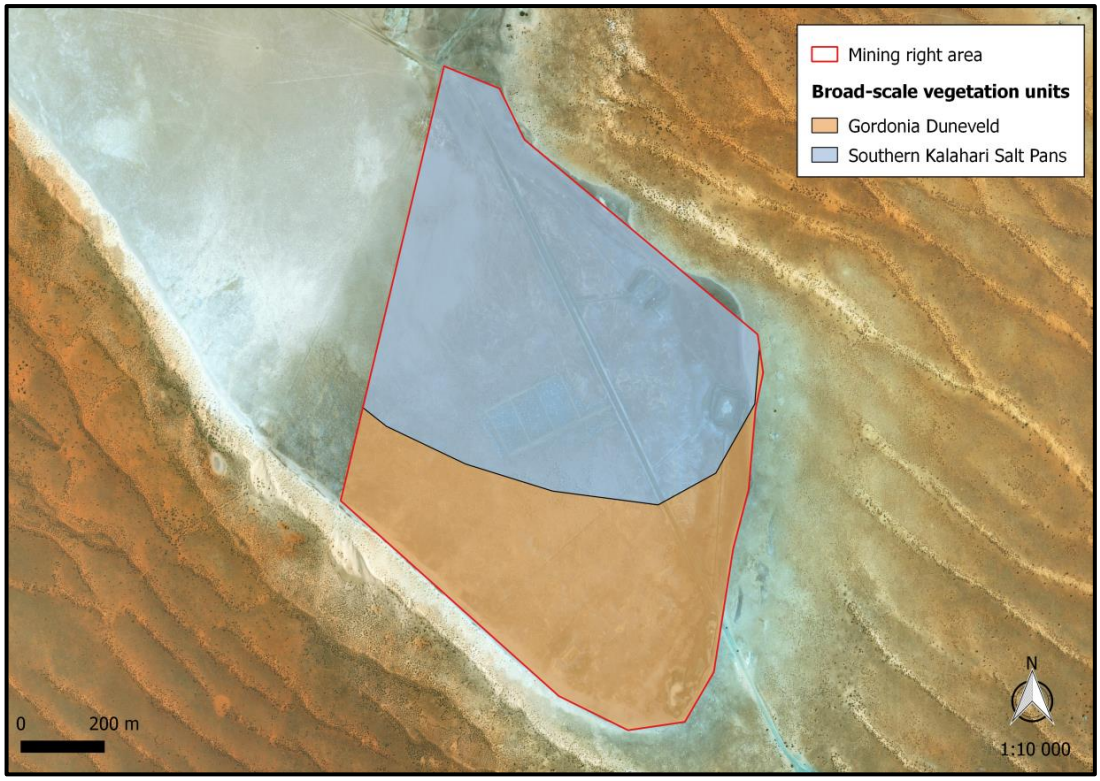


Figure 8. The broad-scale vegetation units (Mucina and Rutherford 2012) present in the study area.

Most of the pans formed on the sandy sediments of the Cenozoic Kalahari Group, but in the south-east some formed on the dolomites of the Campbell Group (Vaalian-age Griqualand Wes Supergroup) and in the west some formed on diamictites of the Dwyka Group (Karoo Supergroup). The pan soil consist of white (washed) sand in shallow pans, rocky soils on calcrete outcrops and most typically of clays and sandy clays rich in Na, K and Mg. These soils are usually characterised by a high pH of 9. The pan bottoms are exposed for most of the year and carry shallow pools for a short time only after very good rains. The unit is classified as being least threatened, with about 8 % being statutorily conserved in the Kgalagadi Transfrontier Park. The vegetation on the pans is subject to natural degradation controlled by concentration of grazing animals. No endemic species are known from this unit.

3.4.2. 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 two distinct units (Figure 9) and are described below. A complete plant species list, including those species likely to occur in the area is presented in Appendix 1.

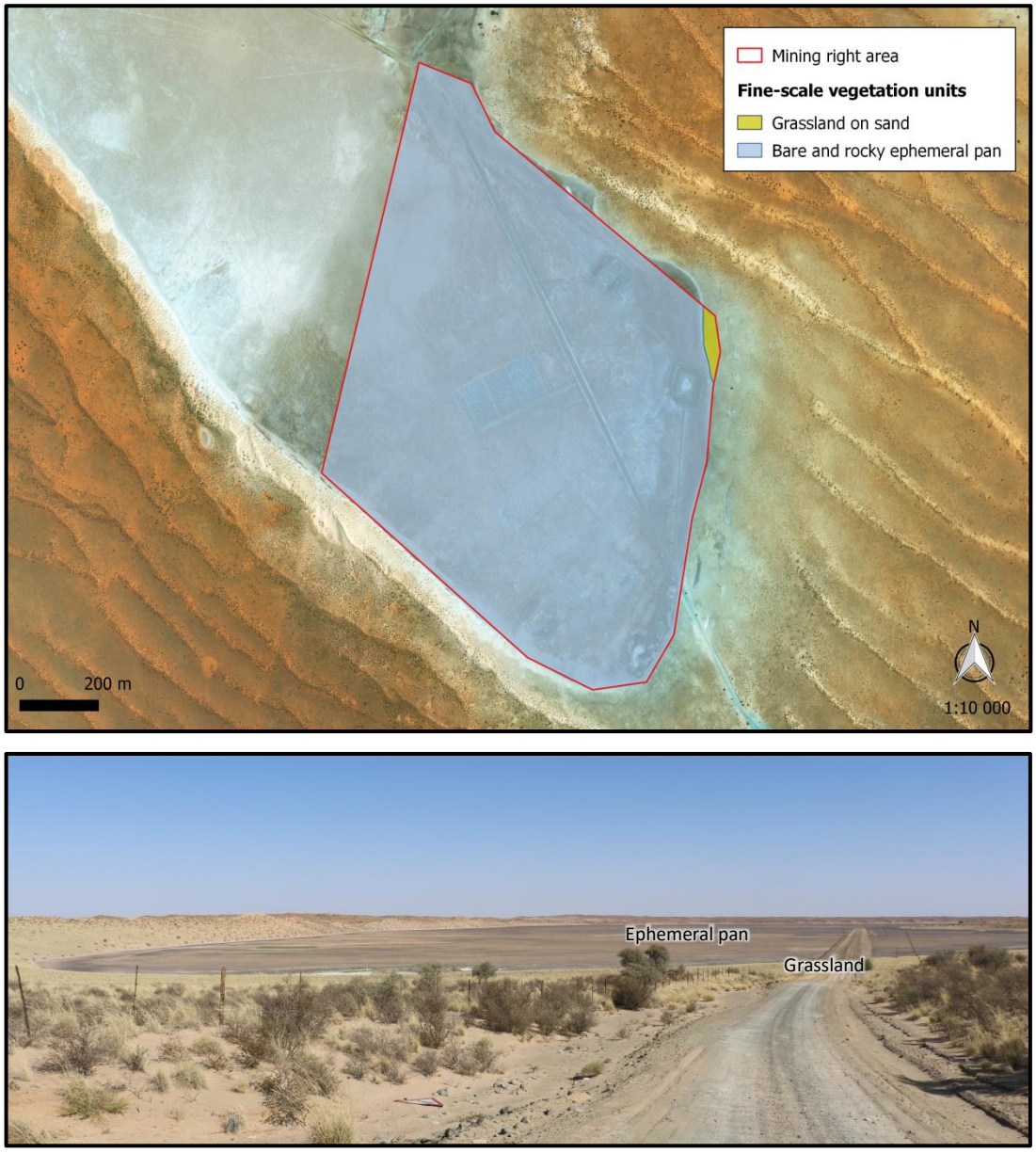


Figure 9. The distribution of fine-scale plant communities in the study area.

i) *Stipagrostis ciliata* grassland on sand

This community comprises a very small terrestrial section in the north-eastern corner of the study area (Figure 9). It is found on a sandy terrace that links the red dunes in the east, with the pan in the west. Light-coloured sand constitute about 10 % of the ground cover. It is typically represented as a grassland with *Stipagrostis ciliata* constituting about 70 % of the vegetation cover (Figure 10). Other grasses found here include *Schmidtia kalahariensis*. Shrub species, such as *Rhigozum trichotomum* and *Lycium pumilum* are sparsely scattered among the grassland.

Figure 10. The grassland on light-coloured sand is dominated by *Stipagrostis ciliata* and links the red dunes in the east (background) with the pan.

ii) Bare and rocky ephemeral pan

The ephemeral pan comprises the majority of the study area (Figure 9). The ground surface comprises a hard clayey crust that is devoid of vegetation and densely rock-strewn (Figure 11). The only plants encountered in this unit were restricted to a dilapidated concrete base (Figure 12), and included *Tetraena simplex* and *Galenia papulosa*.

Figure 11. The ephemeral pan is bare, rocky and devoid of vegetation.

Figure 12. The only vegetation encountered on the ephemeral pan was restricted to a dilapidated concrete base.

3.4.3. 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.

All species recorded in the area are classified as least concern; a category which includes widespread and abundant taxa; and none of the species from the study area are protected in terms of the National Forests (NFA) Act No 84 of 1998.

Specially protected species in terms of Schedule 1 of the Northern Cape Nature Conservation (NCNCA) Act No. 9 of 2009 (Table 3) that are known from the study area include *Harpagophytum procumbens* subsp*. procumbens.* Those protected in terms of Schedule 2 of the NCNCA are *Oxalis lawsonii* and *Manulea burchellii*. These species were historically recorded in the region but was not encountered on site. Nevertheless, it is possible that it might occur in the grassland habitat, especially after some summer rain, particularly *Harpagophytum procumbens* subsp*. procumbens*. Its annual stems are not always present and therefore it could easily be overlooked. A photographic guide to these species is attached as Appendix 3.

Table 3. Plant species found in the study region that are of conservation concern.

FAMILY	Scientific name	Status	NFA	NCNCA
OXALIDACEAE	*Oxalis lawsonii*	LC		S2
PEDALIACEAE	*Harpagophytum procumbens* subsp. *procumbens*	LC		S1
SCROPHULARIACEAE	*Manulea burchellii*	LC		S2

In addition to those protected species listed above; according to Section 51(2) of NCNCA, a permit is required from the Northern Cape, Department of Environment and Nature Conservation (DENC) for any large-scale (> 1 Ha) clearance of all indigenous (Schedule 3) vegetation, before such activities commence.

3.4.4. 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).

However, no declared weeds or invasive species were recorded in and around the study area.

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	

3.4.5. 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 the study area, are listed in Table 5.

Table 5. A list of declared indicators of bush encroachment in the Northern Cape recorded in the study area.

Scientific name	Common name
Rhigozum trichotomum	Three-thorn rhigozum

3.5. 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 or specially protected 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. The landscape features on Annesley does not provide a particularly diverse habitat opportunity to faunal communities, but those likely to be found in the study area are discussed in their respective faunal groups below.

3.5.1. Mammals

As many as 59 terrestrial mammals and five bat species have been recorded in the region (see Appendix 2), of which signs of Aardvark activity were encountered during the site visit.

Virtually all mammals of the study area are protected; either according to Schedule 1, 2 or 3 of NCNCA (see Appendix 2). Twenty one mammal species of conservation concern potentially occur in the area (Table 6), of which fifteen are listed either in the IUCN or South African Red Data Book and an additional six species are specially protected according to Schedule 1 of NCNCA (Table 6).

Of these, Aardvark activities were evident on site, especially in the grassland on light-coloured sand, where many burrows occur (Figure 13). Apart from these burrows being utilised by the aforementioned protected species, they also serve as refuge for many other small mammals and lizards (Figure 14). Furthermore, the Anteating Chat is known to nest in the roof of these- and porcupine burrows (Figure 14).

The Bushveld Gerbil, Bushveld Sengi, Lesser Red Musk Shrew, Aardwolf, African Wild Cat, Cape Fox, Bat-eared Fox, African Striped Weasel, Honey Badger and Striped Polecat all have a high chance of occurring in the north-eastern corner of the site, given their wide habitat tolerances or preference for the grassland habitat found here.

Table 6. Mammal species of conservation concern that are likely to occur in the region Conservation values are indicated in terms of the international (IUCN) Red List, the South African Red Data Book (SA RDB) and Schedule 1 of the Northern Cape Nature Conservation Act (NCNCA).

Scientific name	Common name	IUCN	SA RDB	NCNCA
Rhinolophus denti	Dent's Horseshoe Bat		NT	
Rhinolophus darlingi	Darling's Horseshoe Bat		NT	
Elephantulus intufi	Bushveld Sengi		DD	
Orycteropus afer	Aardvark			X
Parotomys littledalei	Littledale's Whistling Rat		NT	
Gerbilliscus leucogaster	Bushveld Gerbil		DD	
Manis temminckii	Ground Pangolin	VU	VU	X
Crocidura hirta	Lesser Red Musk Shrew	LC	DD	
Atelerix frontalis	South African Hedgehog		NT	X
Proteles cristata	Aardwolf			X
Felis silvestris	African Wild Cat			X
Felis nigripes	Black-footed Cat	VU		X
Acinonyx jubatus	Cheetah	VU	VU	X
Panthera pardus	Leopard	VU		X
Vulpes chama	Cape Fox			X
Crocuta crocuta	Spotted Hyaena		NT	X
Hyaena brunnea	Brown Hyena	NT		X
Otocyon megalotis	Bat-eared Fox			X
Poecilogale albinucha	African Striped Weasel		DD	X
Ictonyx striatus	Striped Polecat			X
Mellivora capensis	Honey Badger		NT	X

Ground Pangolin, South African Hedgehog and Black-footed cat may potentially occur on site on account of their preferences for arid areas. They are however rather skittish and therefore they will most likely occur very seldomly. The Brown Hyaena might be present, but has a low potential to be found on site mainly based on the fact that farm fences are restricting their occurrences across their natural distribution range. The protected bat species as well as Littledale's Whistling Rat also have a low potential to be found on site due to their preference for savanna or shrubland habitats.

Cheetah, Leopard and Spotted Hyaena have a very low chance to be found on site. Although they all have a wide habitat tolerance and the site occurs within their current known distribution range, these species are very seldomly seen outside nature reserves or national parks.

Figure 13. Aardvark and Cape Porcupine burrows that were encountered on site.

In general, impacts on mammals arising from the salt mining activities will primarily be restricted to the grassland, where most of the supporting infrastructure is planned.

Figure 14. A western ground agama took refuge in an aardvark burrow, before being disturbed by our field work activities (top); and an Anteating Chat's nesting burrow in the roof of a porcupine burrow (bottom).

3.5.2. Reptiles

The Annesley mining area lies within the distribution range of at least 30 reptile species (see Appendix 2) of which the western ground agama was encountered during the field survey. None of these reptiles are known to be associated with aquatic habitats and therefore are expected to be found on site when the pan is dry as well as in the grassland habitat on site.

No listed species are known to occur in the area, but most reptiles of the study area are protected either according to Schedule 2 or 3 of NCNCA (see Appendix 2). Impacts on reptiles from the salt mining activities will primarily be restricted to the grassland.

3.5.3. Amphibians

Eight amphibian species are known from 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 on site that would represent suitable breeding habitats for most of these species, but the ephemeral pan will be important during periods of inundation. 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 Bloupan could therefore potentially provide the ideal habitat for it. Its presence will however only be confirmed after a good rainfall event causes inundation of the pan. All other amphibians of the study area are protected according to Schedule 2 of NCNCA (see Appendix 2).

In general, impacts on amphibians arising from the salt mining activities will primarily be restricted to the ephemeral pan.

3.5.4. Avifauna

The study site does not fall within or near; i.e. within 100 km, of any of the Important Bird Areas (IBA) defined by Birdlife South Africa. A total number of 176 bird species have been recorded from the region and all of these species are protected either according to Schedule 1, 2 or 3 of NCNCA (see Appendix 2).

As many as 18 listed bird species are known from the region, all of which are classified as Vulnerable, Near Threatened, Endangered or Critically Endangered (Table 7). 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 7. The ephemeral pan will potentially attract protected water birds, such as Chestnut-banded Plover, Black Stork, Marabou Stork, Lesser Flamingo and Greater Flamingo when inundated. The remaining species of conservation concern are expected to occur in the grassland section by occasionally passing over the area, but are not expected to reside on site.

Table 7. Bird of conservation concern that are likely to occur on site. Species are indicated in terms of the IUCN, SA Bird Atlas and Schedule 1 of the Northern Cape Nature Conservation Act (NCNCA).

Scientific name	Common name	IUCN	SA Bird Atlas	NCNCA
Aquila rapax	Tawny Eagle		**EN**	X
Aquila verreauxii	Verreaux's Eagle		**VU**	X
Ardeotis kori	Kori Bustard	**NT**	**NT**	
Bubo africanus	Spotted Eagle-Owl			X
Bubo lacteus	Verreaux's Eagle-Owl			X
Buteo rufofuscus	Jackal Buzzard			X
Buteo vulpinus	Steppe Buzzard			X
Caprimulgus rufigena	Rufous-cheeked Nightjar			X
Charadrius pallidus	Chestnut-banded Plover	**NT**	**NT**	X
Ciconia nigra	Black Stork		**VU**	X
Circaetus pectoralis	Black-chested Snake-Eagle			X
Circus maurus	Black Harrier	**EN**	**EN**	X
Cursorius rufus	Burchell's Courser		**VU**	
Elanus caeruleus	Black-shouldered Kite			X
Eupodotis vigorsii	Karoo Korhaan		**NT**	
Falco biarmicus	Lanner Falcon		**VU**	X
Falco chicquera	Red-necked Falcon	**NT**		X
Falco naumanni	Lesser Kestrel			X
Falco peregrinus	Peregrine Falcon			X
Falco rupicolis	Rock Kestrel			X
Falco rupicoloides	Greater Kestrel			X
Gyps africanus	White-backed Vulture	**CR**	**CR**	X
Haliaeetus vocifer	African Fish-Eagle			X
Hieraaetus pennatus	Booted Eagle			X
Leptoptilos crumeniferus	Marabou Stork		**NT**	X
Melierax gabar	Gabar Goshawk			X
Milvus migrans	Black Kite			X
Neotis ludwigii	Ludwig's Bustard	**EN**	**EN**	X
Phoenicopterus minor	Lesser Flamingo	**NT**	**NT**	X
Phoenicopterus ruber	Greater Flamingo		**NT**	X
Polemaetus bellicosus	Martial Eagle	**VU**	**EN**	X
Polihierax semitorquatus	Pygmy Falcon			X
Polyboroides typus	African Harrier-Hawk			X
Ptilopsus granti	Southern White-faced Scops-Owl			X
Sagittarius serpentarius	Secretarybird	**VU**	**VU**	X
Spizocorys sclateri	Sclater's Lark	**NT**	**NT**	X
Tyto alba	Barn Owl			X

3.5.1. 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 8, along with species that are specially protected according to Schedule 1 of the NCNCA. All other invertebrates from the class Insecta and Arachnida are protected either according to Schedule 2 or 3 of the NCNCA.

Table 8. 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
INSECTA	COLEOPTERA	*Circellium bacchus*	Cape Dung Beetle	S1
		Colophon spp.	All Stag Beetles	S1
	LEPIDOPTERA	*Lepidochrysops penningtoni*	Pennington's Blue	**DD**
	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			Velvet worms	S1

Two major habitats delimit possible invertebrate communities on site, i.e. the ephemeral pan and the small portion of terrestrial habitat classified as Bushveld vegetation for insect preference, according to Picker et al. (2004). Furthermore, the pan's surface can also primarily be classified as a terrestrial habitat when it is not inundated.

i. Ephemeral pan

Ephemeral pans host species specifically adapted to ephemerality. Crustaceans in particular are specialists of these pans and dominate them. Their eggs lie dormant in the soil until the pans are inundated. Not much is known about the species distribution or conservation status of species in the Northern Cape, but typical taxa to be expected in Bloupan include Notostraca, Anostraca, Cladocera, Copepoda, Ostracoda and Conchostraca. Within a few days after the pan is wet these species will hatch out and attract a number of wetland birds. Therefore, these pans also act as important breeding and feeding links to birds in terms of connectivity, by providing stepping-stone corridors in an arid landscape. Of all invertebrates on Bloupan, the crustaceans are expected to be most affected, because the core activities will take place here. The disturbance or destruction of these pans will not only impact the specialised pan invertebrate communities locally, but is expected to also have a regional and landscape-level effect.

ii. Terrestrial habitats

Bushveld vegetation

The small portion of grassland on sand located in the eastern section of the study site is included in the bushveld vegetation for insect preference. Invertebrate communities associated with this habitat are widely distributed and extremely diverse. Therefore, it is not possible to list specialised communities that occur here. However, those species of conservation concern listed in Table 8 are most likely to be associated with this habitat. They are not likely to be much affected however, because the core activities will not take place here. Limited impacts will be in the form of habitat loss and the inevitable death of those that occur in the path of project activities. These impacts are however expected to be largely local.

Terrestrial invertebrates found on the pan surface

Invertebrate communities associated with the pan surface primarily include those that find refuge under the numerous rocks on the pan's surface. These rocks retain moisture and provide ample suitable microhabitats for invertebrates, especially spiders (Figure 15). Some of the spider species of conservation concern listed in Table 10 could potentially occur on Bloupan and will inevitably be affected by the removal of rocks from the surface.

Figure 15. The numerous rocks on Bloupan provide ample suitable microhabitat for invertebrates, especially spiders.

3.6. Wetlands

The National Water Act (36 of 1998) (NWA) provides a framework to protect water resources. According to this Act, 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.

3.6.1. Wetland delineation and classification

One wetland was identified on site. The wetland has a total area of ± 635 ha of which 127 ha falls within the study site. The wetland, knowns as Bloupan, is indicated in Figure 16, along with its buffer zone. This 100 m buffer is required by the NWA to be assigned to all watercourses that fall within an area earmarked for development, to minimise anthropogenic impacts. However, the proposed salt mine will inevitably be developed within the wetland and associated activities will take place within the buffer zone.

Bloupan has a flat terrain on soils underlain by Dwyka tillites and classified as a natural endorheic depression (Figure 17 and Table 9). Water enters the depression primarily through direct precipitation and overland inflow, but it is intermittently (rarely) inundated. This unique hydrological regime limits practitioners to produce quantitative baseline information, however it is expected that, once filled, the water in Bloupan will be brackish to saline and alkaline.

The depression floor is devoid of vegetation (see section 3.4.2). The substratum is classified as shallow, sandy clay soil intermixed with an abundance of pebbles (Figure 18), as well as a patchy distribution of cobbles and thin salt crusts on the surface (Figure 19).

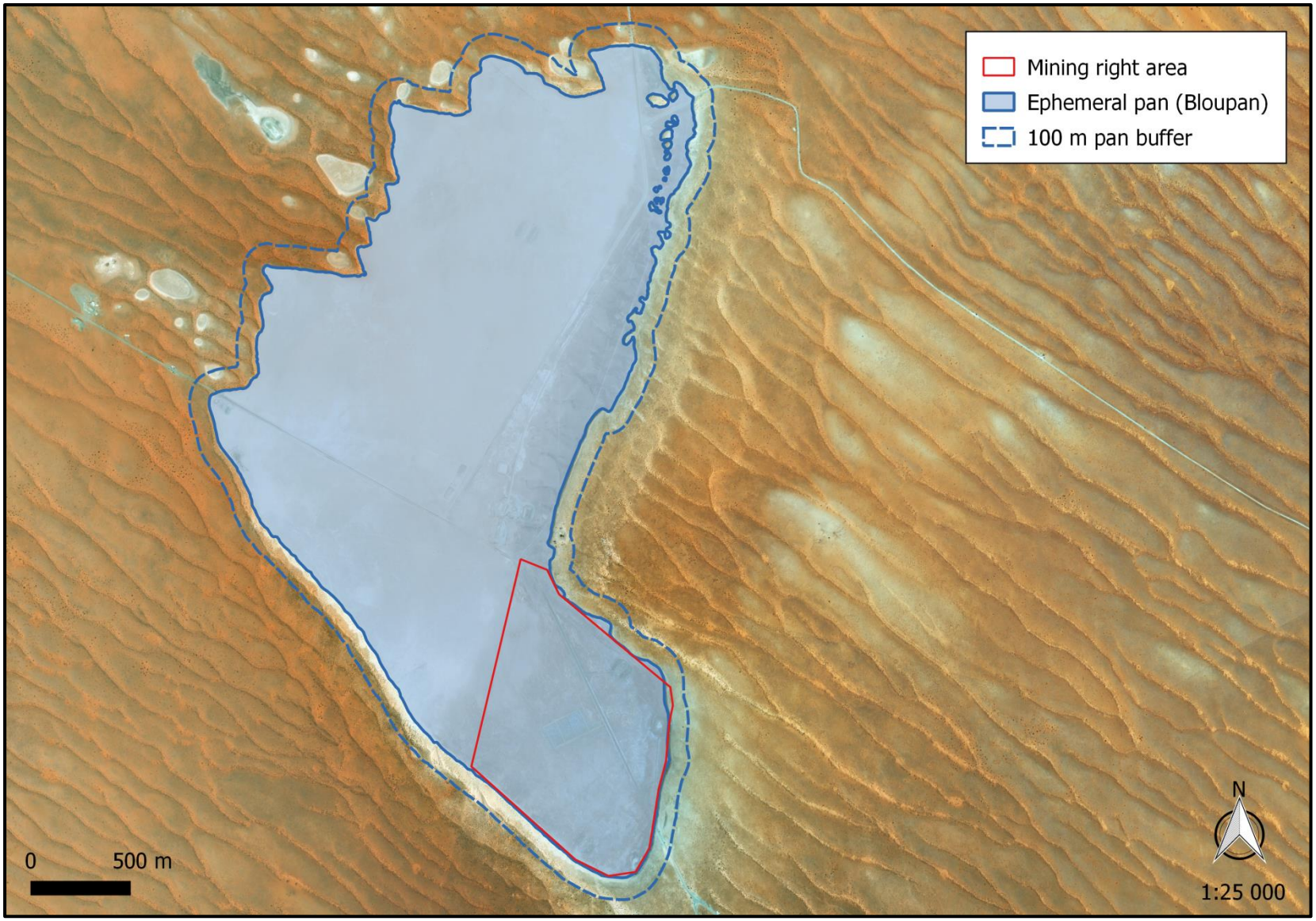


Figure 16. The delineation of Bloupan, along with its buffer zone.

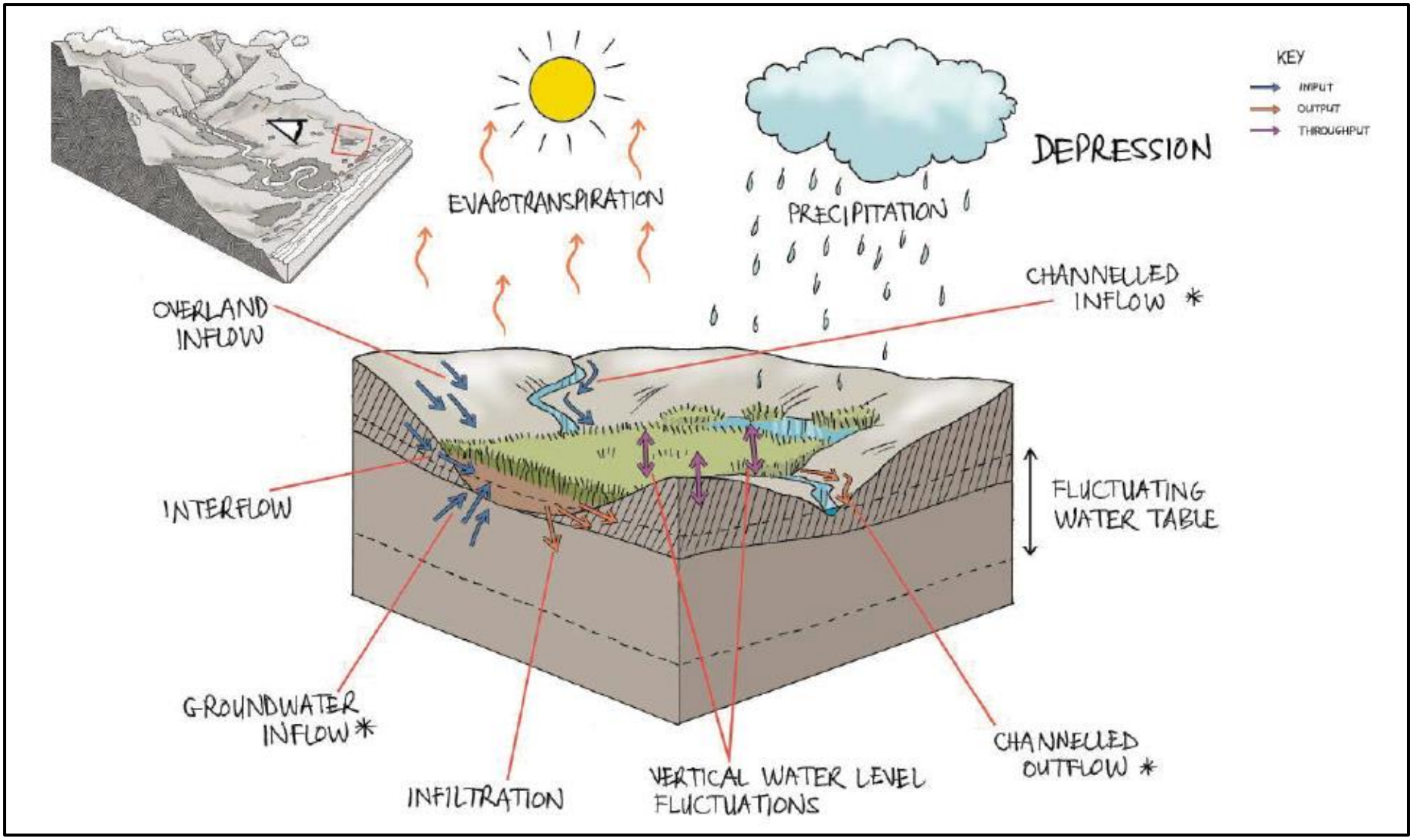


Figure 17. Conceptual illustration of a depression, showing the typical landscape setting and the dominant inputs, throughputs and outputs of water (Ollis et al. 2013).

Table 9. Summary of the results for the application of Levels 1 to 4 of the Classification System (Ollis et al. 2013), to Bloupan. The confidence rating of classification at each level is given in brackets.

	Level 1	Level 2		Level 3	Level 4: HGM Unit		
	System type	**DWA Ecoregion**	**NFEPA WetVeg Group**	**Landscape Unit**	**4A**	**4B**	**4C**
BLOUPAN	INLAND (high)	Southern Kalahari (high)	Kalahari Duneveld (high)	Valley floor (medium)	Depression (high)	Endorheic (high)	Without channelled inflow (high)

Figure 18. The substratum of Bloupan is characterised by shallow, sandy clay soil intermixed with an abundance of pebbles.

Figure 19. A patchy distribution of cobbles and thin salt crusts are also present on Bloupan's surface.

3.6.2. Wetland Health Assessment (PES)

Bloupan is regarded as moderately modified (PES C, Table 10). A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact. The endorheic nature of Bloupan is characterised by a localised catchment area which includes the surrounding dunes. Therefore, impacts on the hydrology and geomorphic health of the pan have primarily been produced by activities within the wetland itself rather than the catchment area. The large size of the pan however moderates these impacts. Although Bloupan is primarily devoid of vegetation, impacts on the vegetation health were nevertheless assessed to measure the deviation from natural conditions. The locations of all identified disturbances are indicated in Figure 20, while key impacts identified are shown in Table 11.

Table 10. Summarised results of Wet-Health level 1 assessment (Macfarlane et al. 2007) to Bloupan.

Ha	HGM Extent (%)	Hydrology		Geomorphology		Vegetation	
		Impact score	Change score	Impact score	Change score	Impact score	Change score
635	100	3.5	0	2.5	-1	0	0
Present State Categories		C	→	C	↓	A	→
						Overall PES	**2 (C)**

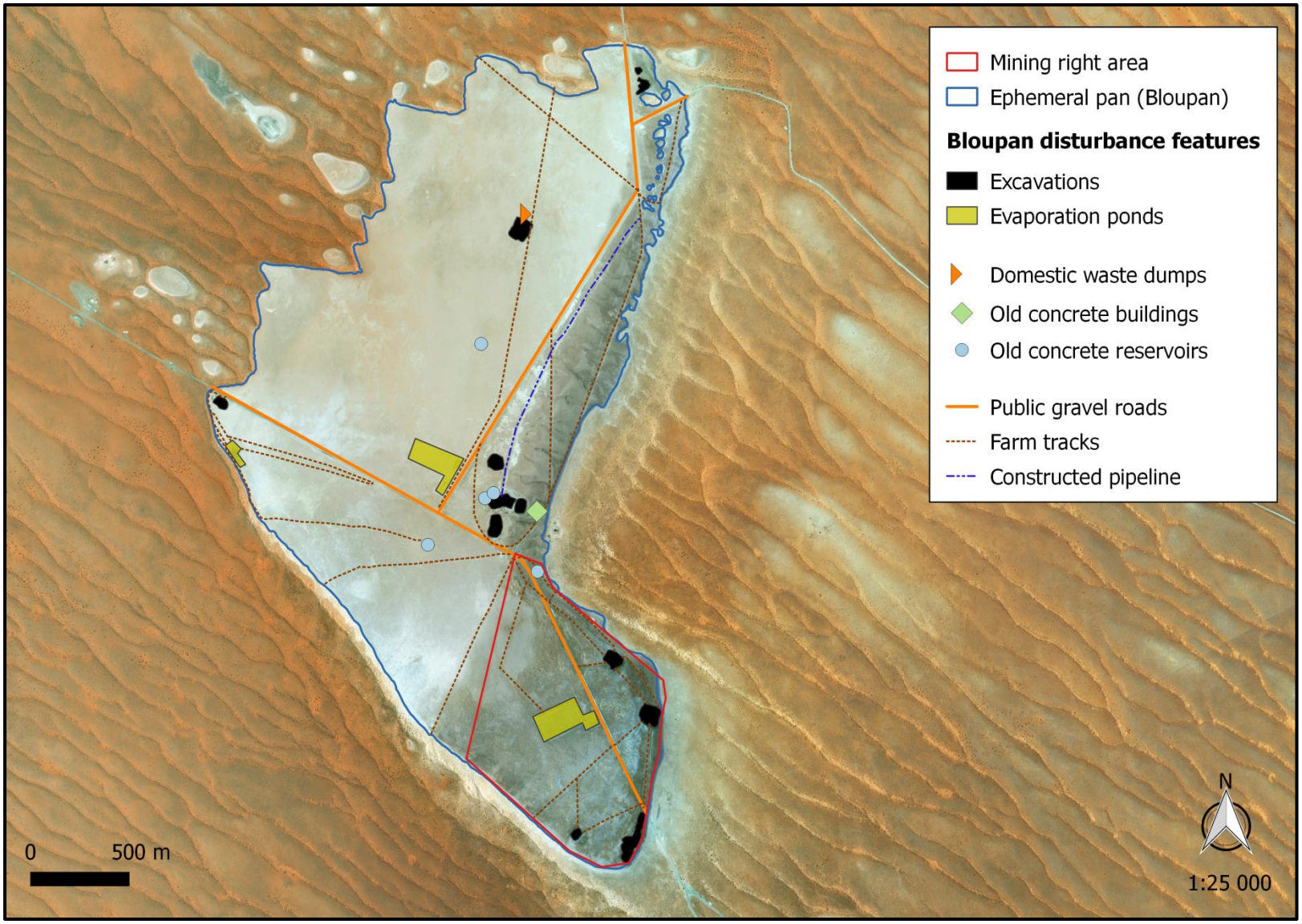


Figure 20. The locations of disturbance features impacting on Bloupan.

Table 11. Features directly impacting Bloupan.

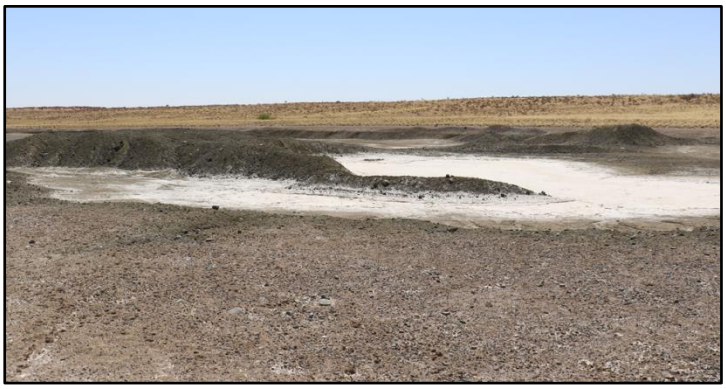
	**Roads** A number of public roads traverse the pan. They are slightly raised from the natural pan's surface and consist of gravel material that has been deposited on the pan to allow for easy crossing. **Extent:** ± 7 km **Proportion:** 0.5 % **Associated impacts:** - Modification to pan surface. - Impeding the natural flow of water. - Infilling effects on geomorphology.
	**Old evaporation ponds** A number of shallow evaporation pond complexes occur on the pan. These ponds consist of slightly excavated bottoms, surrounded by compacted earth walls. **Extent:** ± 9 Ha **Proportion:** 1.4 % **Associated impacts:** - Modifications to pan surface. - Impeding the natural flow of water. - Infilling effects on geomorphology. - Erosional effects on geomorphology.
	**Excavations** Numerous deeper excavations occur in the pan. These were presumably created to access and extract materials to build the public roads, while others were created to store water or function as deeper evaporation ponds for salt mining. **Extent: ±** 10 Ha **Proportion:** 1.6 % **Associated impacts:** - Modification to pan surface. - Impeding the natural flow of water. - Infilling effects on geomorphology - Erosional effects on geomorphology.

Table 11 (cont.). Features directly impacting Bloupan, arranged in order of severity of impacts.

 	**Concrete infrastructure** A few old dilapidated structures occur on the pan, including buildings and reservoirs that were built onto the pan's surface. **Extent:** ± 0.2 Ha **Proportion:** 0.03 % **Associated impacts:** - Modification to pan surface. - Impeding the natural flow of water. - Infilling effects on geomorphology.
 	**Pipelines** A network of pipelines exists on Bloupan. Most have been buried underneath the pan's surface, but one line has been constructed within an earth wall. The pipes seem to have been transporting groundwater to the old evaporation ponds and reservoirs. There is also evidence of pipe leakages in some locations on the pan. **Extent:** ± 2 km **Proportion:** 0.06 % **Associated impacts:** - Modification to pan surface. - Impeding the natural flow of water. - Artificial increase of water. - Infilling effects on geomorphology.

Table 11 (cont.). Features directly impacting Bloupan, arranged in order of severity of impacts.

	**Fence lines** Numerous fence lines traverse the pan. These are constructed from wire and mesh connected to wooden poles that have been buried into the pans surface. **Extent:** *Undetermined* **Proportion:** *Undetermined* **Associated impacts:** - Modification to pan surface. - Infilling effects on geomorphology.
	**Domestic waste** In some areas domestic waste has been dumped and burnt on the pan's surface, including glass bottles, cans, plastic items and crockery. **Extent: ±** 0.01 Ha **Proportion:** 0.002 % **Associated impacts:** - Modification to pan surface. - Infilling effects on geomorphology.
	**Farm tracks** Numerous farm tracks occur on the pan. These are indicated by two tracks where rocks have been displaced due to vehicular movement. **Extent:** *Undetermined* **Proportion:** *Undetermined* **Associated impacts:** - Slight modification to pan surface.

3.6.3. Wetland Ecological Importance and Sensitivity

The EIS of Bloupan was rated to have a Medium EIS (Table 12) and are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these pans may be sensitive to flow and habitat modifications.

The assessment was mainly based on a “wet scenario” and related information from similar wetlands in the region, because their ecological importance will primarily only manifest during times of inundation. A number of red listed water birds are expected to occur in the pans when they are inundated. These include the Chestnut-banded Plover, Black Stork, Marabou Stork, Lesser Flamingo and Greater Flamingo; which are either classified as Near-Threatened or vulnerable. Unfortunately, the pans of the Northern Cape have not yet been comprehensively surveyed for invertebrates and therefore it is difficult to state with confidence which species are present. However, it is known that Branchiopod species are populations uniquely associated with these wetlands. The egg-banks of these organisms are also found in the top soil layers of these pans.

The pan hosts fairly low species richness and habitat diversity compared to perennial wetlands, but it is considered to be moderately important breeding and feeding links in terms of connectivity, especially for the survival of wetland birds in South Africa during wet periods by providing stepping-stone corridors in an arid landscape.

The pan is also considered to have a low sensitivity to changes in hydrology and water quality, because it floods infrequently (< annually). However, if it is inundated anthropogenically and for a prolonged period of time, it will lose its ability to sustain the unique aquatic communities, which are adapted for ephemerality, e.g. Branchiopod eggs require periods of desiccation for their life cycles to complete. The pan has a moderate food storage, energy dissipation and element removal ability, mainly based on its large size. The pan does not fall within any category of protected status that reflects its importance for conservation of ecological diversity at any scale and therefore it has been considered to have a low protected status. Furthermore, the reference flood regime and habitat has been moderately affected by human activity, which causes Bloupan to be rated with a moderate ecological integrity.

Table 12. Summary of the results for the application of an EIS assessment (Duthie 1999) to Bloupan.

DETERMINANT	SCORE	CONFIDENCE
PRIMARY DETERMINANTS		
1. Rare & Endangered Species	4	4
2. Populations of Unique Species	4	3
3. Species/taxon Richness	1	4
4. Diversity of Habitat Types or Features	1	4
5 Migration route/breeding and feeding site for wetland species	2	3
6. Sensitivity to Changes in the Natural Hydrological Regime	1	4
7. Sensitivity to Water Quality Changes	1	4
8. Flood Storage, Energy Dissipation & Particulate/Element Removal	2	3
MODIFYING DETERMINANTS		
9. Protected Status	0	3
10. Ecological Integrity	2	3
TOTAL	**18**	
MEDIAN	**1.5**	
OVERALL ECOLOGICAL SENSITIVITY AND IMPORTANCE	**Moderate**	

3.6.4. Wetland Functional Assessment

The functionality of Bloupan scored high in the provision of harvestable natural resources and moderately high in the maintenance of biodiversity and flood attenuation (Figure 21).

The provision of natural resources is significant, mainly due to the salt mining activities associated with it. The significance of this benefit increases due to the fact that the study site is located in a rural area, where the poverty level is moderately high. The maintenance of biodiversity is attributable to the suitable habitat the pan provides for Red Data water birds and the moderate significance of the occurrence of special (Branchiopod) species as well as the fact that Bloupan is in a moderately pristine condition. The pan also contributes to flood attenuation mainly due to it naturally being a large ephemeral depression.

The current state and functionality of Bloupan is not likely to change significantly as a result of the planned mining activities. Nevertheless, the most profound threats are in the form of additional geomorphological and hydrological alterations if the planned activities extend beyond the footprint of the reported disturbances. Related impacts also include erosion, as well as changes in the sediment input and hydrologic regime. These secondary threats are however inconsequential due to the low frequency of rainfall and subsequent flooding in the area.

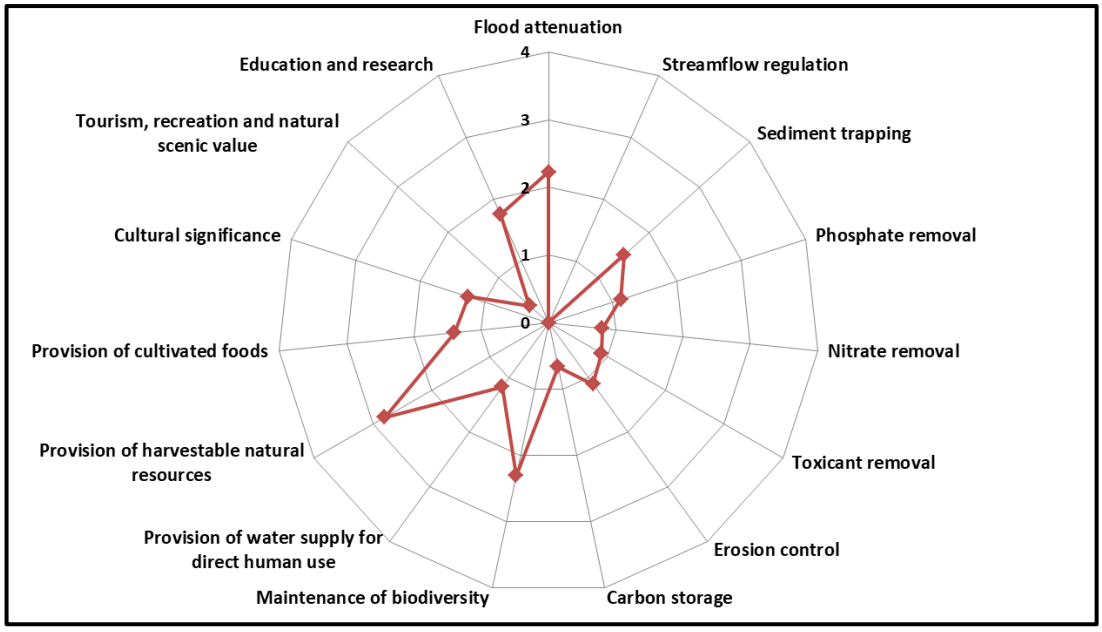


Figure 21. A spider diagram representing different ecosystem services provided by Bloupan. Ecosystem services are scored form 0 (no importance) to 4 (very important).

3.6.5. Wetland cumulative impact evaluation

According to the Wetland Freshwater Priority Areas project most wetlands (89%) which occur in the Kalahari Duneveld vegetation group have been classified to have a Present Ecological State (PES) of "AB", which means that the pans are in a Natural or Good condition, while 6% have been moderately transformed and 5% have been critically transformed. Within the direct vicinity of the proposed mining operation almost all wetlands have been rated to be in good condition (Figure 22).

3.7. Critical biodiversity areas and broad-scale processes

The proposed mining site does not fall within any formally protected area or within a National Protected Areas Expansion Strategy Focus Area. Furthermore, the broad-scale vegetation units of the study area are all classified as least threatened and therefore no formal fine-scale conservation planning has been conducted. The Mining and Biodiversity Guidelines (DENC et al. 2013) also does not classify the site to be of any Biodiversity Importance.

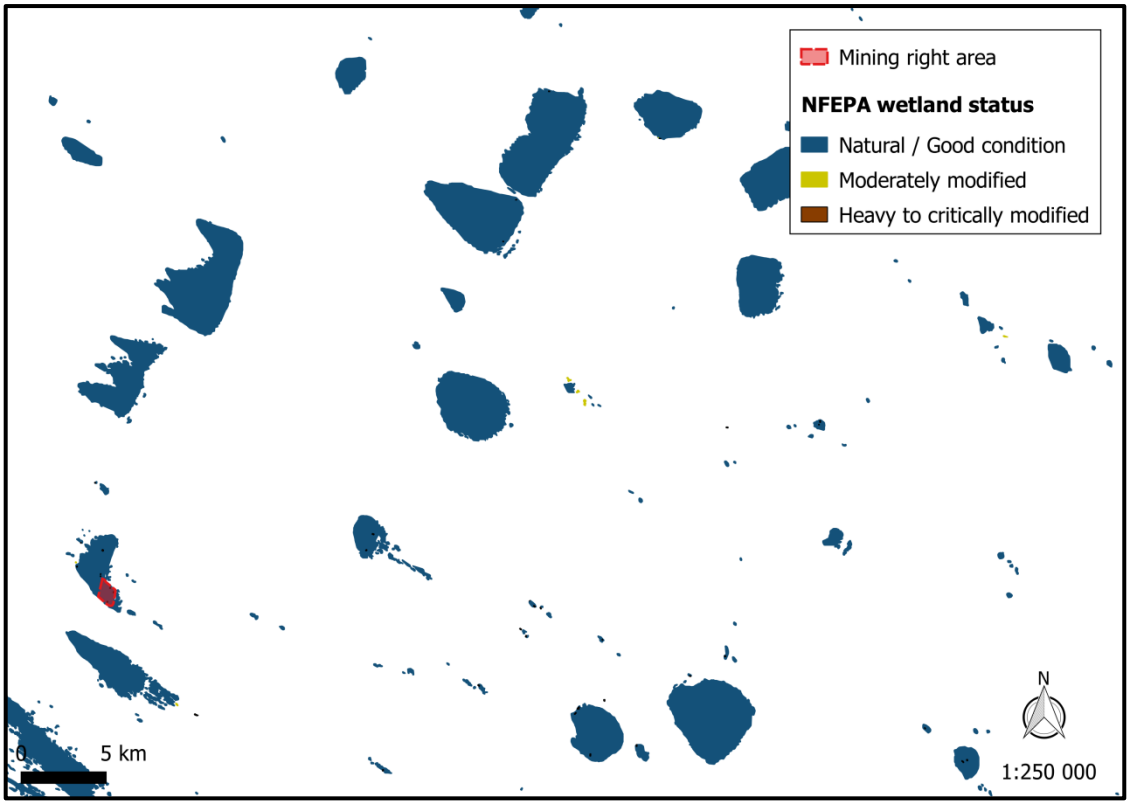


Figure 22. The status of wetlands occurring in the vicinity of the proposed mining right area.

The Siyanda Environmental Management Framework Report (2008) regards Southern Kalahari Salt Pans only to be of medium conservation importance/urgency, but it is considered an Ecological Support Area in relation to the Northern Cape Critical Biodiversity Areas Map (Figure 23).

The site itself encompasses a wetland which is a unique habitat protected in terms of the National Water Act (Act No 36 of 1998), but as previously mentioned the pans in the region have been classified to be in good condition and none of them have been identified as significant wetlands in terms of Ramsar sites, IUCN Frog localities, threatened water bird localities or Crane breeding grounds.

The mining operation itself is expected to cause slight habitat transformation of the aquatic environment on Bloupan, but is not expected to contribute significantly to cumulative habitat loss and the disruption of the broad-scale landscape connectivity in the region.

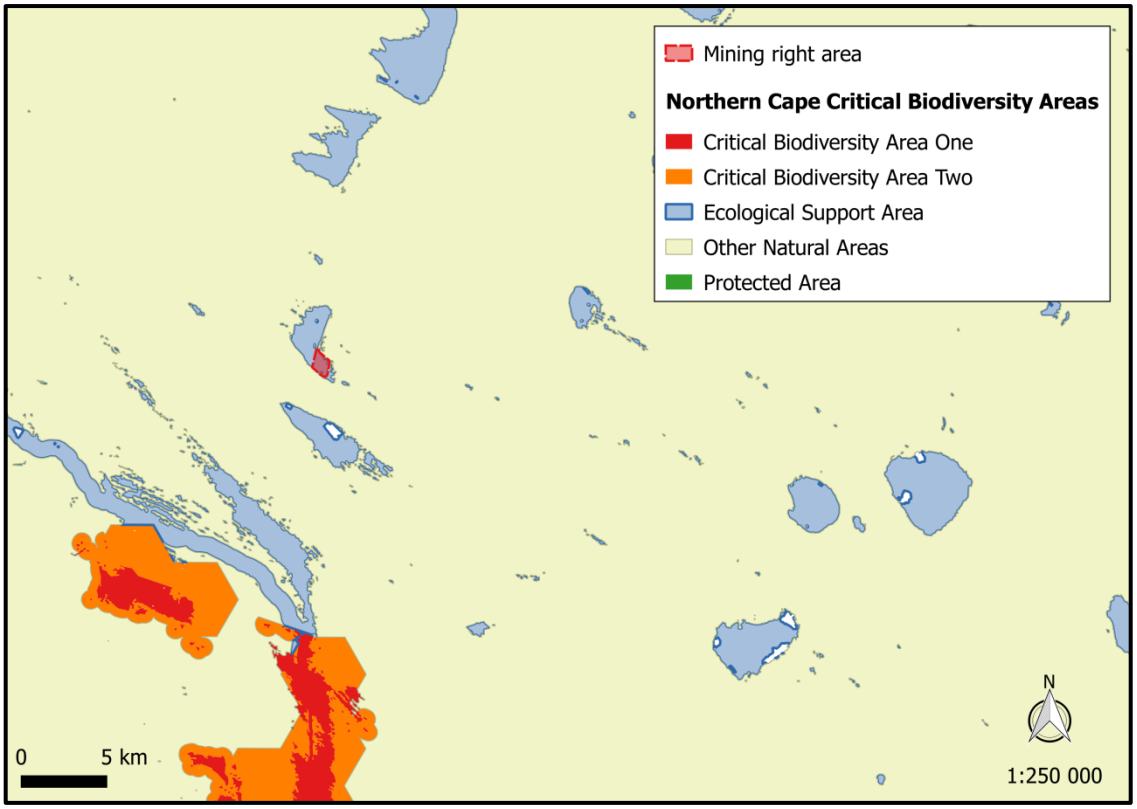


Figure 23. The study area in relation to the Northern Cape Critical Biodiversity areas.

3.8. Site sensitivity

The sensitivity map for the Annesley mining operation is illustrated in Figure 24. The ephemeral pan is considered to be of **very high** sensitivity due to its vital ecological and hydrological functionality and significance. It is also a unique habitats protected in terms of the National Water Act (Act No 36 of 1998). This unit is essentially a no-go area, but the nature of activities related to salt mining inevitably requires the proposed operation to continue within the wetland.

The grassland on sand is considered to be of **medium** sensitivity. This section is also earmarked for mining activities, but only relates to the establishment of supporting infrastructure. No significant plant species of conservation is expected to occur here and although a high number of Aardvark burrows were encountered in this section, it only represents a very small portion within the adjacent larger grassland. Therefore, impacts are expected to be largely local.

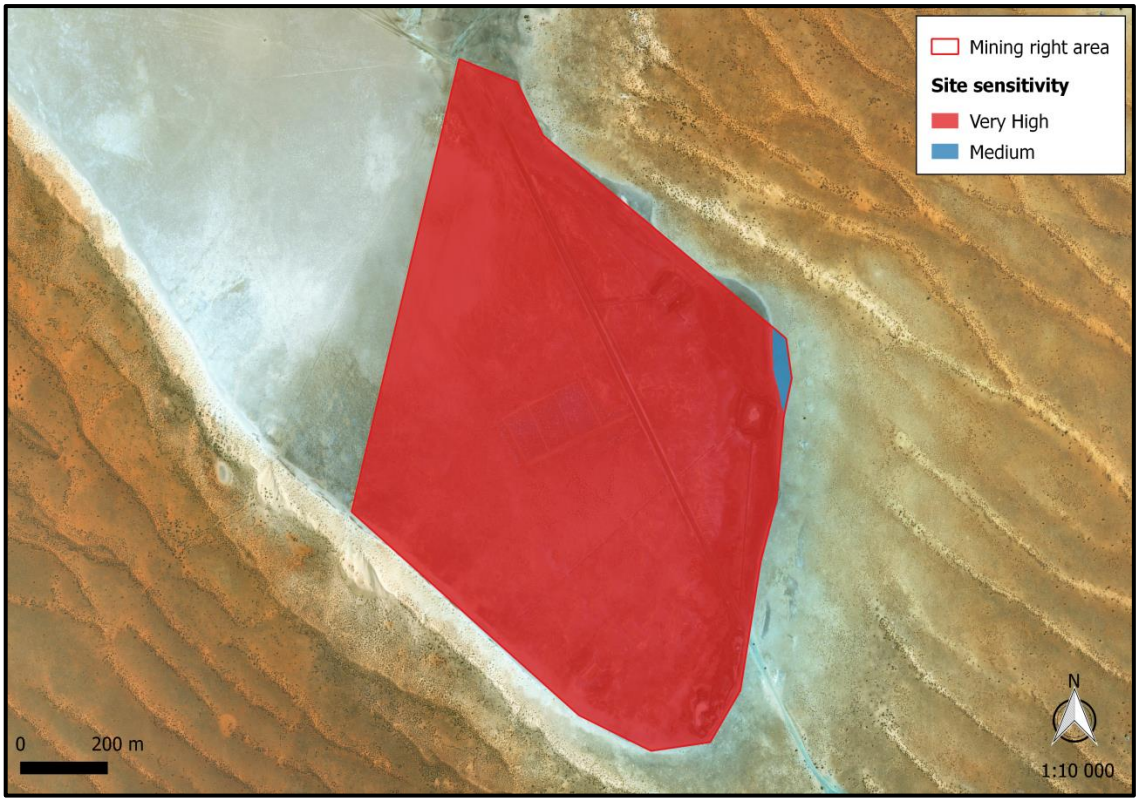


Figure 24. A sensitivity map for the Annesley mining area.

4. ECOLOGICAL IMPACT ASSESSMENT

In this section, the potential impacts and associated risk factors that may be generated by the Annesley mining operation are identified and described. A detailed analysis of each impact is provided in Table 13. The impacts are assessed in terms of the relevant ecological aspects and each impact is associated with an outline of specific mitigation measures, which with proper implementation, monitoring and auditing, will serve to reduce the significance of the impact. In order to ensure that the impacts identified are broadly applicable and inclusive, all the likely or potential impacts that may be associated with the mining activities are listed.

4.1. Topography, soil erosion and associated degradation of landscapes

4.1.1. Loss of soil fertility

Source of the impact

During the removal of topsoil. This impact is mainly associated with the establishment of supporting infrastructure in the grassland on sand.

Description of the impact

Improper stockpiling and soil compaction can result in soil sterilisation. Leaching can also occur, resulting in the loss of nutrients.

Mitigation and monitoring

- 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 in order 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 be kept separate from 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.

Table 13. A detailed analysis of ecological impacts identified for the Annesley mining operation.

	IMPACT	Phase			Extent	Duration	Severity	Probability	Significance	Significance after Mitigation
		C	O	D						
Landscape	Loss of soil fertility	✓	✓	✓	Activity specific (0)	Short term (1)	Medium (2)	Possible, temporarily (6)	Very Low (18)	Very Low
	Increase in soil erosion	✓	✓	✓	Local (2)	Decommissioning (3)	High (3)	Possible during life of operation (9)	Low-Medium (72)	Low
Flora	Loss of indigenous vegetation	✓	✓	✓	On-site (1)	Short term (1)	Minimal (1)	Certain, temporarily (7)	Very Low (21)	Very Low
	Loss of Red data and/or protected floral species	✓	✓		On-site (1)	Life of operation (2)	High (3)	Possible, infrequently (7)	Low (42)	Very Low
	Introduction or spread of alien species	✓	✓	✓	Local (2)	Decommissioning (3)	Medium (2)	Remotely possible during life of operation (8)	Low-Medium (56)	Very low/Positive
	Bush encroachment			✓	On-site (1)	Decommissioning (3)	Medium (2)	Remotely possible, temporarily (5)	Low (30)	Very low/Positive

	IMPACT	Phase			Extent	Duration	Severity	Probability	Significance	Significance after Mitigation
		C	O	D						
Fauna	Habitat fragmentation	✓	✓	✓	Regional (3)	Decommissioning (3)	High (3)	Possible for life of operation (9)	Medium-High (81)	Low-Medium
	Disturbance, displacement and killing of fauna	✓	✓	✓	Local (2)	Life of operation (2)	High (3)	Possible for life of operation (9)	Low-Medium (63)	Low
Ecological Processes	Compromise of ecological processes	✓	✓	✓	Regional (3)	Residual (4)	High (3)	Possible for life of operation (9)	Medium-High (90)	Low-Medium

4.1.2. Soil erosion

Source of the impact

Infrastructure development on the grassland on sand; alterations of the pan's surface through evaporation pond development and associated disturbances.

Description of the impact

In the grassland, vegetation will be stripped in preparation for placement of infrastructure and therefore the areas will be bare and susceptible to erosion, particularly wind erosion. Topsoil and overburden that is stripped and piled on surrounding areas can also be eroded by wind, rain and flooding. The soil/sediments will be carried away during runoff. The affected areas will be rehabilitated, but full restoration might only occur over a number of years, subsequent to the re-establishment of vegetation. In the pans, any earth walls developed onto the pan surface during the operation will be susceptible to erosion, particularly through rain. This will affect the geomorphological and hydrological character of the pan.

Mitigation and monitoring

- Re-establishment of plant cover on disturbed areas in the grassland must take place as soon as possible, once activities in the area have ceased.
- Ground exposure should be minimised in terms of the surface area and duration.
- The operation must co-ordinate different activities in order to optimise the footprint on the pan's surface and thereby prevent unnecessary activities on adjacent pristine areas of the pan.
- Construction of infrastructure and evaporation ponds during the rainy season (November to March) should be monitored and controlled.
- Run-off from exposed ground should be controlled with flow retarding barriers.
- All stockpiles and earth walls must be kept as small as possible, with gentle slopes (18 degrees) in order to avoid excessive erosional induced losses.
- Stockpiled soil material are to be stored on the higher lying areas of the footprint area and not in any storm water run-off channels or any other areas where it is likely to cause erosion, or where water would naturally accumulate.
- Regular audits carried out to identify areas where erosion is occurring (incl. linear activities such as roads and pipelines); followed by appropriate remedial actions.

4.2. Vegetation and floristics

4.2.1. Loss of indigenous vegetation

Source of the impact

Construction of supporting infrastructure in the grassland; the placement of stockpiles; and the clearing of vegetation for materials storage and topsoil stockpiles; vehicular movement.

Description of the impact

Construction and mining activities on site will reduce the natural habitat for ecological functioning.

Mitigation and monitoring

- Minimise the footprint of transformation.
- Encourage proper rehabilitation of disturbed areas.
- Encourage the growth of natural plant species by sowing indigenous seeds or by planting seedlings.

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

Source of the impact

Removal of listed or protected plant species; during the construction of supporting infrastructure; the placement of stockpiles; and the clearing of vegetation in the grassland.

Description of the impact

No protected species were encountered during the field visit, but *Harpagophytum procumbens* subsp. *procumbens* could potentially occur here and might be damaged or removed during the operation. Any 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 this species. It is however very unlikely that mining activities will have a significant impact on plant species of conservation concern.

Mitigation and monitoring

- Footprint areas of the mining activities must be scanned for Red Listed and protected plant species prior to any disturbances.
- It is recommended that these plants are identified and marked prior to intended activity.
- These plants should, where possible, be incorporated into the design layout and left in situ.
- However, if threatened by destruction, these plants should be removed (with the relevant permits from DAFF and/or DENC) and relocated if possible.
- 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 appointment of an ECO must 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.

4.2.3. Introduction or spread of alien species

Source of the impact

Clearing of vegetation; mining activities in the grassland; potentially increasing suitable habitats for halophytic invasive species in the pan.

Description of the impact

No alien invasive species were encountered in the area, which reflects the pristine nature of the vegetation on site. However, it is always possible that plants can invade an area after disturbances of the pristine conditions of the pan and grassland, for example, when the soil chemistry of the pan is altered through the addition of salt water it could provide suitable habitat to halophytic invaders such as *Salsola kali.* Any new alien invasive species should be controlled to prevent their propagation into new areas.

Mitigation and monitoring

- Minimise the footprint of transformation.
- Encourage proper rehabilitation of excavated areas.
- Encourage the growth of natural plant species.
- Mechanical methods of control to be implemented extensively.
- Annual follow-up operations to be implemented.

4.2.4. Encouraging bush encroachment

Source of the impact

Clearing of vegetation; disturbances through mining activities in the grassland.

Description of the impact

The small extent of bush encroaching species on site shows the low level of past disturbance interference in the natural ecosystem. While general clearing of the area and mining activities destroy natural vegetation, bush encroaching plants can increase due to their opportunistic nature in disturbed areas. If encroaching plants establish in disturbed areas, it may the lower potential for future land use and decrease biodiversity. With proper mitigation, the impacts can be substantially reduced.

Mitigation and monitoring

- Minimise the footprint of transformation.
- Encourage proper rehabilitation of disturbed areas.
- Encourage the growth of a diverse selection of natural plant species.
- Mechanical methods of control to be implemented selectively.
- Annual follow-up monitoring to be implemented.

4.3. Fauna

4.3.1. Habitat fragmentation

Source of the impact

Clearance of vegetation in the grassland; removal of rocks and alteration of pan crust in the pan.

Description of the impact

Disturbances related to construction of associated infrastructure in the grassland as well as the transformation of pan habitat will result in the loss of connectivity and fragmentation of natural habitats. Fragmentation of habitats will lead to the loss of migration corridors, in turn resulting in degeneration of the affected population's genetic make-up. This 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. This impact will be most profound in the pan and is associated with the possible loss of habitat for specialised crustacean fauna found here as well as the spiders residing under rocks.

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.
- Employ sound rehabilitation measures to restore the characteristics of the affected aquatic habitats wherever possible.

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 habitat, affecting individual species and ecological processes. This will result in the displacement of faunal species that depend on such habitats. This impact is likely to impact the resident (and protected) Aardvark population as well as killing of spiders during preparation of pan surface. Increased noise and vibration will also disturb and possibly displace birds and other 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 the 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.
- A full-time ECO must render guidance to the staff and contractors with respect to suitable areas for all related disturbance.
- Everyone on site must undergo environmental induction for awareness on not harming or collecting species that are often persecuted out of superstition and to be educated about the conservation importance of the fauna occurring on site.
- Reptiles, amphibians and any of the protected baboon spiders that are exposed during the clearing operations should be captured for later release or translocation by a qualified expert.
- Permit applications regarding protected fauna need to be lodged with Northern Cape DENC prior to any destruction of Aardvark burrows.
- Employ measures that ensure adherence to the speed limit.

4.4. Broad-scale ecological processes

Source of the impact

The construction of roads, supporting infrastructure and the clearing of vegetation in the grassland; alterations to the pan's surface.

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 fragmentation of the pans will destroy connectivity of vital ecological and aquatic linkages. However, due to the healthy condition of pans in the region, the cumulative impact of the proposed mining operation is low.

Mitigation and monitoring

- Minimise the footprint of transformation.
- Encourage proper rehabilitation of affected areas where possible.
- Encourage the growth of natural plant species in the grassland.
- Employ sound rehabilitation measures to restore the characteristics of the affected hydrological- and geomorphological regime of the pan.

5. CONCLUSION, RECOMMENDATIONS AND OPINION REGARDING AUTHORISATION

Two plant communities were identified on site of which all are included in the earmarked area to be affected by mining activities. Of these two, the ephemeral pan is considered to be the most sensitive, with a Very High Sensitivity to mining activities due to its vital ecological functionality and significance. The wetland itself is regarded to be moderately modified, with moderate Ecological Importance and Sensitivity. The most profound impacts are expected to be related to the further destruction of the pan, as well as the associated alteration of aquatic habitats for specialised fauna; which in turn will cause fragmentation of important ecological corridors in the region.

Species of conservation concern that are found in these earmarked habitats will most likely also be lost locally. This includes the plant *Harpagophytum procumbens*, if it is present in the grassland where infrastructure will be placed. Similarly, the mining operation could result in the large-scale clearance of indigenous vegetation. Additionally, any disturbances to the Aardvark burrows in the grassland as well as any protected baboon spiders will displace these protected species locally. Permit applications regarding protected fauna and 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, destruction of Aardvark burrows or the imminent death of protected invertebrates.

To conclude, the destruction of the natural habitats within the study area is inevitable. The significance of the impacts will be affected by the success of the mitigation measures implemented and the rehabilitation programme for the mining area. The majority of the site has been moderately modified and are expected to be further affected. In my opinion, authorisation can be granted as long as the applicant commits to the adherence of effective avoidance, management, mitigation and rehabilitation measures.

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Boscia
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APPENDICES

APPENDIX 1

Plant species list

Family	Scientific name	Status	NFA	NCNCA
AIZOACEAE	*Galenia papulosa*	LC		
AMARANTHACEAE	*Salsola barbata*	LC		
	Sericorema remotiflora	LC		
ANACAMPSEROTACEAE	*Talinum caffrum*	LC		
ASTERACEAE	*Eriocephalus ambiguus*	LC		
	Felicia clavipilosa subsp. *clavipilosa*	LC		
	Gazania jurineifolia subsp. *jurineifolia*	LC		
	Geigeria brevifolia	LC		
	Geigeria pectidea	LC		
CARYOPHYLLACEAE	*Silene bellidioides*	LC		
CONVOLVULACEAE	*Ipomoea bolusiana*	LC		
FABACEAE	*Calobota linearifolia*	LC		
	Calobota spinescens	LC		
	Indigofera sp.	-		
	Otoptera burchellii	LC		
	Tephrosia purpurea subsp. *Leptostachya*	-		
	Vigna unguiculata subsp. *stenophylla*	LC		
GERANIACEAE	*Monsonia luederitziana*	LC		
LOASACEAE	*Kissenia capensis*	LC		
MALVACEAE	*Hermannia tomentosa*	LC		
	Melhania burchellii	LC		
NEURADACEAE	*Neuradopsis austro-africana*	LC		
OXALIDACEAE	*Oxalis lawsonii*	LC		S2
PEDALIACEAE	*Harpagophytum procumbens* subsp. *procumbens*	LC		S1
POACEAE	*Eragrostis annulata*	LC		
	Megaloprotachne albescens	LC		
POLYGONACEAE	*Oxygonum alatum* var. *alatum*	LC		
RHAMNACEAE	*Helinus spartioides*	LC		
RUSCACEAE	*Eriospermum roseum*	LC		
SCROPHULARIACEAE	*Manulea burchellii*	LC		S2
	Peliostomum junceum	LC		
ZYGOPHYLLACEAE	*Tetraena clavata*	LC		
	Tetraena simplex	-		

APPENDIX 2

Fauna species list

LIST OF MAMMALS

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

	Scientific name	Common name	IUCN	RDB	Habitat	Potential occurrence
CHIROPTERA	[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 denti*	Dent's Horseshoe Bat	LC	**NT**	Savanna habitats.	Low
	[2]*Rhinolophus darlingi*	Darling's Horseshoe Bat	LC	**NT**	Savanna habitats.	Low
	[2]*Tadarida aegyptiaca*	Egyptian Free-tailed Bat	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
MACROSCELIDIDAE	[2]*Macroscelides proboscideus*	Round-eared Sengi	LC	LC	A habitat specialist occupying gravel plains associated with alluvial plains and relatively flat areas between higher elevation areas such as outcrops, scarps, hills, and mountains.	Low
	[2]*Elephantulus intufi*	Bushveld Sengi	LC	**DD**	Arid terrain, including dry savanna woodlands, grassland, and semi-deserts	High
	[2]*Elephantulus rupestris*	Western Rock Sengi	LC	LC	Arid habitats, including deserts, dry savannas, and dry shrublands. Typically associated with rocky ridges, outcrops or koppies (rocky hills), and boulder fields at the bases of mountains.	Low
TUBULENTATA	[1]*Orycteropus afer*	Aardvark	LC	LC	Wide habitat tolerance, being found in open woodland, scrub and grassland, especially associated with sandy soil.	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
LAGOMORPHA	[2]*Lepus capensis*	Cape Hare	LC	LC	Dry, open regions, with palatable bush and grass.	High
	[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.	Low
RODENTIA	[2]*Hystrix africaeaustralis*	Cape Porcupine	LC	LC	Catholic in habitat requirements.	Confirmed
	[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]*Fukomys damarensis*	Damara Mole-rat	LC	LC	It is found in semi-arid thorn scrub, woodland, savanna, grassland habitats associated with red Kalahari sands and sandy soils.	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	[2]*Zelotomys woosnami*	Woosnam's Desert Mouse	LC	LC	It is found in dry savanna on Kalahari sands. This species has very specific micro-habitat requirements, it occurs along river beds and around pans.	High
	[2]*Saccostomus campestris*	Pouched Mouse	LC	LC	Wide habitat tolerance but prefers soft, particularly sandy soils; can be found in open and dense vegetation and in rocky areas; annual rainfall of 250 - 1 200 mm.	High
	[2]*Dendromus melanotis*	Grey Climbing Mouse	LC	LC	Inhabits grasslands and savanna.	High
	[2]*Malacothrix typica*	Large-eared (Gerbil) Mouse	LC	LC	Short grass habitats over hard soil.	Low
	[2]*Rhabdomys dilectus*	Mesic Four-striped Grass Mouse	LC	*Not listed*	Wide habitat tolerance, from desert fringe to high-rainfall montane areas with grass cover.	High
	[2]*Mus indutus*	Desert Pygmy Mouse	LC	LC	Wide habitat tolerance in semi-arid savannas.	High
	[6]*Mus musculus*	House Mouse	LC	*Not listed*	Wide habitat tolerance.	High
	[2]*Thallomys nigricauda*	Black-tailed Tree Rat	LC	LC	Arboreal species generally associated with *Acacia* bushland habitats.	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]*Mastomys coucha*	Southern Multimammate Mouse	LC	LC	Wide habitat tolerance.	High
	[2]*Parotomys brantsii*	Brants's Whistling Rat	LC	LC	Restricted to consolidated sands in semi-desert.	High
	[2]*Parotomys littledalei*	Littledale's Whistling Rat	LC	**NT**	Occurs in shrublands and is not known to persist in disturbed or modified habitats.	Low
	[2]*Micaelamys namaquensis*	Namaqua Rock Mouse	LC	LC	Catholic habitat requirements but prefer rocky hills, outcrops or boulder-strewn hillsides.	Low
	[2]*Aethomys chrysophilus*	Red Veld Rat	LC	LC	Typically a savanna species, but it is also found in cropland and secondary forests.	Low
	[2]*Desmodillus auricularis*	Cape Short-tailed Gerbil	LC	LC	Tend to occur on hard ground, unlike other gerbil species, with some cover of grass or karroid bush.	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]*Gerbillurus paeba*	Pygmy Hairy-footed Gerbil	LC	LC	Associated with Nama and Succulent Karoo preferring sandy soil or sandy alluvium with a grass, scrub or light woodland cover.	Medium
	[2]*Gerbillurus vallinus*	Brush-tailed Hairy-footed Gerbil	LC	LC	Associated with gravel plains, consolidated sand and dry river beds	High
	[2]*Gerbilliscus leucogaster*	Bushveld Gerbil	LC	**DD**	Sandy soils; wooded and more open grassland; areas of cultivation.	High
	[2]*Gerbilliscus brantsii*	Highveld Gerbil	LC	LC	Sandy soils; wooded and more open grassland; areas of cultivation.	High
PRIMATES	[4]*Papio ursinus*	Chacma Baboon	LC	LC	Can exploit fynbos, montane grasslands, riverine courses in deserts, and simply need water and access to refuges.	Low
PHOLIDOTA	[1]*Smutsia temminckii*	Ground Pangolin	**VU**	**VU**	Low to high rainfall areas, including open grassland, woodland and rocky hills, but excluding forest and true desert; nevertheless present throughout the Kalahari sand country.	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
EULIPOTYPHLA	[2]*Crocidura hirta*	Lesser Red Musk Shrew	LC	**DD**	Found in grassland, savanna and bush savanna.	High
	[1]*Atelerix frontalis*	South African Hedgehog	LC	**NT**	Generally found in semi-arid and sub-temperate environments with ample ground cover.	Medium
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*	African Wild Cat	LC	LC	Wide habitat tolerance.	High
	[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.	Medium
	[1]*Acinonyx jubatus*	Cheetah	**VU**	**VU**	Wide range of habitats.	Very Low
	[1]*Panthera pardus*	Leopard	**VU**	LC	Wide range of habitats.	Very Low
	[2]*Genetta genetta*	Common (Small-spotted) Genet	LC	LC	Occur in open arid 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
CARNIVORA	[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, but areas with adequate cover.	High
	[1]*Vulpes chama*	Cape Fox	LC	LC	Associated with open country, open grassland, grassland with scattered thickets and coastal or semi-desert scrub.	High
	[1]*Crocuta crocuta*	Spotted Hyaena	LC	**NT**	Wide habitat tolerance.	Very Low
	[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
	[4]*Canis mesomelas*	Black-backed Jackal	LC	LC	Wide habitat tolerance.	High
	[1]*Otocyon megalotis*	Bat-eared Fox	LC	LC	Open country with mean annual rainfall of 100-600 mm.	High
	[1]*Poecilogale albinucha*	African Striped Weasel	LC	**DD**	Wide habitat tolerance, but most common in grassland areas.	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]*Ictonyx striatus*	Striped Polecat	LC	LC	Widely distributed throughout the sub-region.	High
	[1]*Mellivora capensis*	Honey Badger	LC	**NT**	Wide habitat tolerance.	High
SUIFORMES	[2]*Phacochoerus africanus*	Common Warthog	LC	LC	Confined to savanna grasslands, open bushlands, and woodlands	Low
CETARTIODACTYLA	[2]*Taurotragus oryx*	Common Eland	LC	LC	Wide habitat tolerance.	Low
	[2]*Oryx gazella*	Gemsbok	LC	LC	Semi-arid and arid bushland and grassland of the Kalahari and Karoo and adjoining regions of Southern Africa.	Low
	[2]*Tragelaphus strepsiceros*	Greater Kudu	LC	LC	Wooded savanna	Low
	[2]*Connochaetes taurinus*	Blue Wildebeest	LC	LC	Occurs in short-grass plains, and bordering Acacia savanna open bushland and woodland in drier areas.	Low
	[2]*Alcelaphus caama*	Red Hartebeest	LC	LC	Prefer the edge to the middle of open plains	Low
	[2]*Antidorcas marsupialis*	Springbok	LC	LC	Open arid plains with short vegetation	Low
	[2]*Raphicerus campestris*	Steenbok	LC	LC	Inhabits open country.	High
	[2]*Sylvicapra grimmia*	Common Duiker	LC	LC	Presence of bushes is important.	Low

LIST OF REPTILES

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

Family	Scientific name	Common name	IUCN status
AGAMIDAE	[3]*Agama aculeata aculeata*	Western Ground Agama	LC
	[3]*Agama anchietae*	Anchieta's Agama	LC
AMPHISBAENIDAE	[3]*Monopeltis mauricei*	Maurice's Worm Lizard	LC
	[3]*Zygaspis quadrifrons*	Kalahari Dwarf Worm Lizard	LC
COLUBRIDAE	[2]*Telescopus beetzii*	Beetz's Tiger Snake	LC
CORDYLIDAE	[2]*Platysaurus broadleyi*	Augrabies Flat Lizard	LC
ELAPIDAE	[3]*Naja nivea*	Cape Cobra	LC
GEKKONIDAE	[3]*Chondrodactylus angulifer angulifer*	Common Giant Gecko	LC
	[3]*Chondrodactylus bibronii*	Bibron's Gecko	LC
	[3]*Chondrodactylus turneri*	Turner's Gecko	LC
	[3]*Colopus wahlbergii furcifer*	Striped Ground Gecko	LC
	[3]*Lygodactylus bradfieldi*	Bradfield's Dwarf Gecko	LC
	[3]*Pachydactylus capensis*	Cape Gecko	LC
	[3]*Pachydactylus punctatus*	Speckled Gecko	LC
	[3]*Ptenopus garrulus garrulus*	Common Barking Gecko	LC
LACERTIDAE	[2]*Heliobolus lugubris*	Bushveld Lizard	LC
	[2]*Meroles suborbitalis*	Spotted Desert Lizard	LC
	[2]*Nucras tessellata*	Western Sandveld Lizard	LC
	[2]*Pedioplanis inornata*	Plain Sand Lizard	LC
	[2]*Pedioplanis lineoocellata lineoocellata*	Spotted Sand Lizard	LC
	[2]*Pedioplanis namaquensis*	Namaqua Sand Lizard	LC
LAMPROPHIIDAE	[2]*Dipsina multimauculata*	Dwarf Beaked Snake	LC
	[3]*Psammophis trinasalis*	Fork-marked Sand Snake	LC
SCINCIDAE	[3]*Acontias gariepensis*	Mier Kalahari Legless Skink	LC
	[3]*Acontias kgalagadi kgalagadi*	Kgalagadi Legless Skink	LC
	[3]*Trachylepis occidentalis*	Western Three-Striped Skink	LC
	[3]*Trachylepis punctulata*	Speckled Sand Skink	LC
	[3]*Trachylepis sparsa*	Karasburg Tree Skink	LC
	[3]*Trachylepis sulcata sulcata*	Western Rock Skink	LC
TESTUDINIDAE	[3]*Psammobates oculifer*	Serrated Tent Tortoise	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 poweri*	Western Olive Toad	LC
	[2]*Bufo gariepensis*	Karoo Toad	LC
HYPEROLIIDAE	[2]*Kassina senegalensis*	Bubbling Kassina	LC
PIPIDAE	[2]*Xenopus laevis*	Common Platanna	LC
PYXICEPHALIDAE	[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 RDB
2	*Acrocephalus baeticatus*	African Reed-Warbler		
2	*Actitis hypoleucos*	Common Sandpiper		
2	*Alario alario*	Black-headed Canary		
-	*Alario leucolaema*	Damara Canary		
2	*Alopochen aegyptiacus*	Egyptian Goose		
2	*Amadina erythrocephala*	Red-headed Finch		
2	*Anas capensis*	Cape Teal		
2	*Anas erythrorhyncha*	Red-billed Teal		
2	*Anas sparsa*	African Black Duck		
2	*Anas undulata*	Yellow-billed Duck		
2	*Anthoscopus minutus*	Cape Penduline-Tit		
2	*Anthus cinnamomeus*	African Pipit		
2	*Apus affinis*	Little Swift		
2	*Apus apus*	Common Swift		
2	*Apus bradfieldi*	Bradfield's Swift		
2	*Apus caffer*	White-rumped Swift		
1	*Aquila rapax*	Tawny Eagle		**EN**
1	*Aquila verreauxii*	Verreaux's Eagle		**VU**
2	*Ardea cinerea*	Grey Heron		
2	*Ardea melanocephala*	Black-headed Heron		
2	*Ardeotis kori*	Kori Bustard	**NT**	**NT**
2	*Batis pririt*	Pririt Batis		
2	*Bradornis infuscatus*	Chat Flycatcher		
2	*Bradornis mariquensis*	Marico Flycatcher		
1	*Bubo africanus*	Spotted Eagle-Owl		
1	*Bubo lacteus*	Verreaux's Eagle-Owl		
2	*Bubulcus ibis*	Cattle Egret		
2	*Burhinus capensis*	Spotted Thick-knee		
1	*Buteo rufofuscus*	Jackal Buzzard		
1	*Buteo vulpinus*	Steppe Buzzard		
2	*Calandrella cinerea*	Red-capped Lark		
2	*Calendulauda africanoides*	Fawn-coloured Lark		
2	*Calendulauda bradfieldi*	Bradfield's Lark		
2	*Calidris alba*	Sanderling		
2	*Calidris ferruginea*	Curlew Sandpiper		
2	*Calidris minuta*	Little Stint		
1	*Caprimulgus rufigena*	Rufous-cheeked Nightjar		
2	*Cercomela familiaris*	Familiar Chat		
2	*Cercomela tractrac*	Tractrac Chat		
2	*Cercotrichas coryphoeus*	Karoo Scrub-Robin		

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 RDB
2	*Cercotrichas paena*	Kalahari Scrub-Robin		
1	*Charadrius pallidus*	Chestnut-banded Plover	NT	NT
2	*Charadrius pecuarius*	Kittlitz's Plover		
2	*Charadrius tricollaris*	Three-banded Plover		
2	*Chersomanes albofasciata*	Spike-heeled Lark		
2	*Chrysococcyx caprius*	Diderick Cuckoo		
2	*Ciconia ciconia*	White Stork		
1	*Ciconia nigra*	Black Stork		VU
2	*Cinnyris fusca*	Dusky Sunbird		
1	*Circaetus pectoralis*	Black-chested Snake-Eagle		
1	*Circus maurus*	Black Harrier	EN	EN
2	*Cisticola aridulus*	Desert Cisticola		
2	*Clamator jacobinus*	Jacobin Cuckoo		
2	*Colius colius*	White-backed Mousebird		
2	*Columba guinea*	Speckled Pigeon		
2	*Columba livia*	Rock Dove		
2	*Corvus capensis*	Cape Crow		
2	*Coturnix coturnix*	Common Quail		
2	*Creatophora cinerea*	Wattled Starling		
2	*Cursorius rufus*	Burchell's Courser		VU
2	*Dendropicos fuscescens*	Cardinal Woodpecker		
2	*Dicrurus adsimilis*	Fork-tailed Drongo		
1	*Elanus caeruleus*	Black-shouldered Kite		
2	*Emberiza impetuani*	Lark-like Bunting		
2	*Eremomela icteropygialis*	Yellow-bellied Eremomela		
2	*Eremopterix australis*	Black-eared Sparrowlark		
2	*Eremopterix verticalis*	Grey-backed Sparrowlark		
2	*Estrilda astrild*	Common Waxbill		
2	*Euplectes orix*	Southern Red Bishop		
2	*Eupodotis afraoides*	Northern Black Korhaan		
2	*Eupodotis ruficrista*	Red-crested Korhaan		
2	*Eupodotis vigorsii*	Karoo Korhaan		NT
1	*Falco biarmicus*	Lanner Falcon		VU
1	*Falco chicquera*	Red-necked Falcon	NT	
1	*Falco naumanni*	Lesser Kestrel		
1	*Falco peregrinus*	Peregrine Falcon		
1	*Falco rupicolis*	Rock Kestrel		
1	*Falco rupicoloides*	Greater Kestrel		
2	*Fulica cristata*	Red-knobbed Coot		
1	*Gyps africanus*	White-backed Vulture	CR	CR

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 RDB
1	*Haliaeetus vocifer*	African Fish-Eagle		
1	*Hieraaetus pennatus*	Booted Eagle		
2	*Himantopus himantopus*	Black-winged Stilt		
2	*Hippolais icterina*	Icterine Warbler		
2	*Hirundo albigularis*	White-throated Swallow		
2	*Hirundo cucullata*	Greater Striped Swallow		
2	*Hirundo dimidiata*	Pearl-breasted Swallow		
2	*Hirundo fuligula*	Rock Martin		
2	*Hirundo rustica*	Barn Swallow		
2	*Hirundo spilodera*	South African Cliff-Swallow		
2	*Lamprotornis nitens*	Cape Glossy Starling		
2	*Laniarius atrococcineus*	Crimson-breasted Shrike		
2	*Lanius collaris*	Common Fiscal		
2	*Lanius collurio*	Red-backed Shrike		
2	*Lanius minor*	Lesser Grey Shrike		
1	*Leptoptilos crumeniferus*	Marabou Stork		**NT**
2	*Malcorus pectoralis*	Rufous-eared Warbler		
2	*Melierax canorus*	Southern Pale Chanting		
1	*Melierax gabar*	Gabar Goshawk		
2	*Merops apiaster*	European Bee-eater		
2	*Merops hirundineus*	Swallow-tailed Bee-eater		
1	*Milvus migrans*	Black Kite		
2	*Mirafra fasciolata*	Eastern Clapper Lark		
2	*Monticola brevipes*	Short-toed Rock-Thrush		
2	*Motacilla capensis*	Cape Wagtail		
2	*Muscicapa striata*	Spotted Flycatcher		
2	*Myrmecocichla formicivora*	Anteating Chat		
1	*Neotis ludwigii*	Ludwig's Bustard	**EN**	**EN**
2	*Nilaus afer*	Brubru		
2	*Numenius phaeopus*	Common Whimbrel		
2	*Numida meleagris*	Helmeted Guineafowl		
2	*Oena capensis*	Namaqua Dove		
2	*Oenanthe monticola*	Mountain Wheatear		
2	*Oenanthe pileata*	Capped Wheatear		
2	*Onychognathus nabouroup*	Pale-winged Starling		
2	*Oriolus oriolus*	Eurasian Golden Oriole		
2	*Parisoma subcaeruleum*	Chestnut-vented Tit-Babbler		
2	*Parus cinerascens*	Ashy Tit		
2	*Passer diffusus*	Southern Grey-headed Sparrow		
2	*Passer domesticus*	House Sparrow		

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 RDB
2	*Passer melanurus*	Cape Sparrow		
2	*Passer motitensis*	Great Sparrow		
2	*Philetairus socius*	Sociable Weaver		
2	*Philomachus pugnax*	Ruff		
1	*Phoenicopterus minor*	Lesser Flamingo	NT	NT
1	*Phoenicopterus ruber*	Greater Flamingo		NT
2	*Phylloscopus trochilus*	Willow Warbler		
2	*Plectropterus gambensis*	Spur-winged Goose		
2	*Plocepasser mahali*	White-browed Sparrow-Weaver		
2	*Ploceus velatus*	Southern Masked-Weaver		
1	*Polemaetus bellicosus*	Martial Eagle	VU	EN
1	*Polihierax semitorquatus*	Pygmy Falcon		
1	*Polyboroides typus*	African Harrier-Hawk		
2	*Prinia flavicans*	Black-chested Prinia		
2	*Pterocles bicinctus*	Double-banded Sandgrouse		
2	*Pterocles burchelli*	Burchell's Sandgrouse		
2	*Pterocles namaqua*	Namaqua Sandgrouse		
1	*Ptilopsus granti*	Southern White-faced Scops-Owl		
2	*Pycnonotus nigricans*	African Red-eyed Bulbul		
2	*Pytilia melba*	Green-winged Pytilia		
2	*Quelea quelea*	Red-billed Quelea		
2	*Recurvirostra avosetta*	Pied Avocet		
2	*Rhinopomastus cyanomelas*	Common Scimitarbill		
2	*Rhinoptilus africanus*	Double-banded Courser		
2	*Riparia paludicola*	Brown-throated Martin		
2	*Riparia riparia*	Sand Martin		
1	*Sagittarius serpentarius*	Secretarybird	VU	VU
2	*Scopus umbretta*	Hamerkop		
2	*Serinus albogularis*	White-throated Canary		
2	*Serinus atrogularis*	Black-throated Canary		
2	*Serinus flaviventris*	Yellow Canary		
2	*Spizocorys conirostris*	Pink-billed Lark		
1	*Spizocorys sclateri*	Sclater's Lark	NT	NT
2	*Spizocorys starki*	Stark's Lark		
2	*Sporopipes squamifrons*	Scaly-feathered Finch		
2	*Streptopelia capicola*	Cape Turtle-Dove		
2	*Streptopelia senegalensis*	Laughing Dove		
2	*Struthio camelus*	Common Ostrich		
2	*Sylvia borin*	Garden Warbler		
2	*Sylvietta rufescens*	Long-billed Crombec		

LIST OF BIRDS (continued)

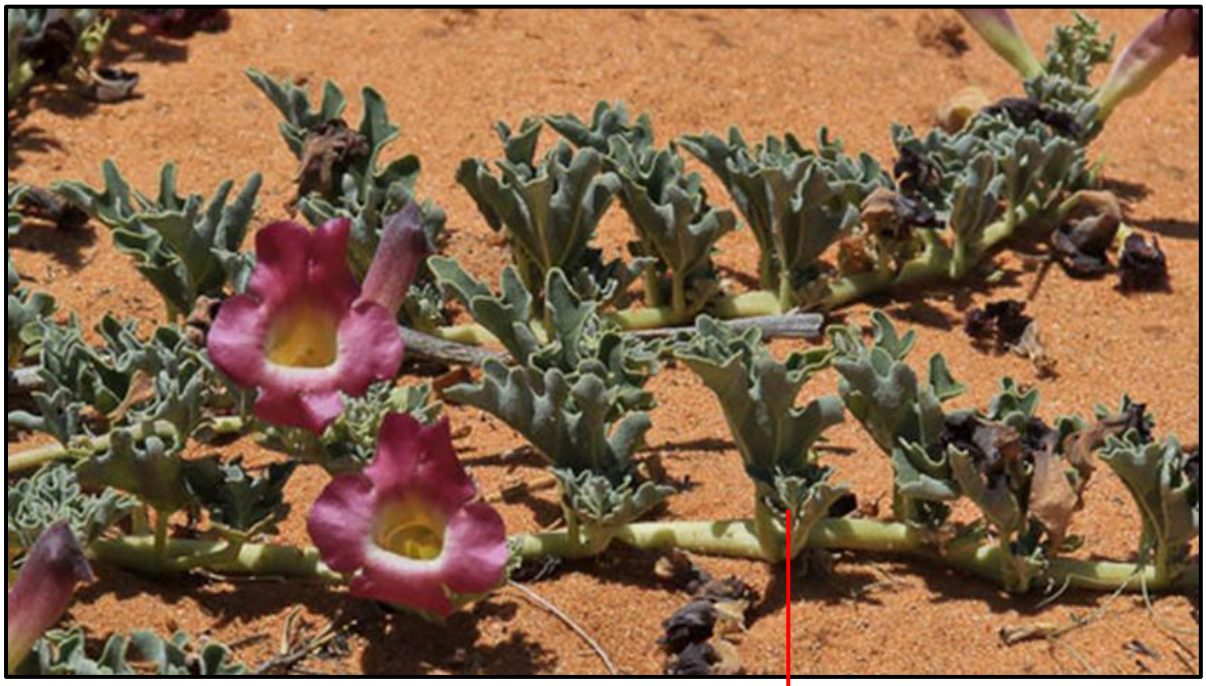
Birds protected according to NCNCA are indicated with their respective Schedule no. in superscript.

	Scientific name	Common name	IUCN status	SA RDB
[2]	*Tachybaptus ruficollis*	Little Grebe		
[2]	*Tachymarptis melba*	Alpine Swift		
[2]	*Tadorna cana*	South African Shelduck		
[2]	*Telophorus zeylonus*	Bokmakierie		
[2]	*Threskiornis aethiopicus*	African Sacred Ibis		
[2]	*Tockus leucomelas*	Southern Yellow-billed Hornbill		
[2]	*Tricholaema leucomelas*	Acacia Pied Barbet		
[2]	*Tringa glareola*	Wood Sandpiper		
[2]	*Tringa nebularia*	Common Greenshank		
[2]	*Tringa stagnatilis*	Marsh Sandpiper		
[1]	*Tyto alba*	Barn Owl		
[2]	*Upupa africana*	African Hoopoe		
[2]	*Urocolius indicus*	Red-faced Mousebird		
[2]	*Vanellus armatus*	Blacksmith Lapwing		
[2]	*Vanellus coronatus*	Crowned Lapwing		
[2]	*Zosterops pallidus*	Orange River White-eye		

APPENDIX 3

A photographic guide for species of conservation concern that potentially occur on site

Harpagophytum procumbens subsp. *procumbens*
(Protected in terms of Schedule 1 of the NCNCA)



A perennial, prostrate creeper with annual stems

Rough, shallowly-lobed leaves

Dry seed head (Devil's claw)