

BOTANICAL ASSESSMENT OF THE  
DESTINATION ROCK INN  
RESORT DEVELOPMENT,  
GROBLERSHOOP  
(Portion 18 of Farm 387)



Dr N van Rooyen  
Prof MW van Rooyen

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# EXECUTIVE SUMMARY

The site is situated on Portion 18 of Farm 387, Gordonia RD, northeast of Groblershoop and east of the Orange River, with the entrance gate to the site at 28° 52' 37.13" S, 21° 59' 24.25" E. The topocadastral grid references are 2821 DD & 2822 CC. The site covers approximately 360 ha. The site is currently being developed and is located on the northern side of the N8, just after the Orange River bridge.

The mean annual precipitation is 234 mm, varying from 69 mm to 759 mm per annum. The mean annual temperature is 20.2°C while the extreme maximum and minimum temperatures measured were 43°C and -5.6°C. The geology of the site consists of quartz-muscovite schist, quartz-amphibole schist and quartz. A diabase dike occurs in the central part of the area. Aeolian sand and dunes are found in the southern parts of the study area, with alluvium soils along the Orange River in the southwest.

## Vegetation

This vegetation type covers the Orange River in the southwestern part of the site and is considered “**endangered**”, although 6% is conserved in the Richtersveld and Augrabies Falls National Parks. Some 50% is transformed for agricultural purposes or alluvial diamond mining.

Most of the site falls in the Bushmanland Arid Grassland vegetation type that covers large areas in the region and its status is “**least threatened**”. Little of this vegetation type is transformed and only small areas are conserved in the Augrabies Falls National Park.

Eleven associations (plant communities) were distinguished on the site covering riverine vegetation, dunes, rocky and gravelly hills and plains and ephemeral drainage lines. The species that dominate the site are the trees and shrubs *Senegalia mellifera*, *Boscia albitrunca* and *Phaeoptilum spinosum*, the dwarf shrubs *Rhigozum trichotomum*, *Tetraena rigida* and *Kleinia longiflora*, the succulent *Aloe claviflora*, as well as the grasses *Enneapogon desvauxii*, *Enneapogon scaber* and *Stipagrostis* spp. Along the Orange River, trees such as *Searsia viminalis*, *Ziziphus mucronata* and *Vachellia karroo* are dominant, although alien trees such as *Eucalyptus camaldulensis* and *Prosopis glandulosa* are abundant.

Some clearing of vegetation for the resort occurred in the riparian vegetation. A buffer zone of non-disturbance of at least 32 m from the edge of the Orange River and other drainage lines should be set aside. The riparian plant associations identified on site cover the banks of the Orange River in the southwest, with some ephemeral drainage lines more inland flowing towards the Orange River. Although some vegetation clearing and development in the riparian zone has already occurred, the river bank, channels and floodplains of the Orange River **should be excluded from any further development**. Two strips of riparian vegetation on the river bank have already been cleared for ESKOM power lines.

## Flora

The protected plant species of the site are listed in Table A.

Table A: Protected and endemic plant species of the Groblershoop site

Species	Endemic*	NCNCA*			NFA*	CITES* App. II	NEM:BA ToPS*	Red list*
		Sch 1*	Sch 2*	Sch 6*				
<i>Vachellia erioloba</i>					x			DEC*
<i>Aloe claviflora</i>	x		x			x		LC
<i>Argemone ochroleuca</i>				x				
<i>Avonia papyracea</i>	x		x			x		LC
<i>Boscia albitrunca</i>			x		x			LC
<i>Cynanchum viminalis</i>			x					LC
<i>Dinteranthus pole-evansii</i>	x		x					<b>VU</b>
<i>Euphorbia davyi</i>			x			x		LC
<i>Euphorbia rhombifolia</i>			x			x		LC
<i>Euphorbia gariiepina</i>			x			x		LC
<i>Prosopis glandulosa</i>				x				
<i>Mesembryanthemum coriarium</i>			x					LC
<i>Plinthus karooicus</i>			x					LC
<i>Plinthus sericeus</i>	x		x					LC
<i>Stipagrostis amabilis</i>	x							
<i>Titanopsis calcarea</i>	x		x					LC

\*Endemic: Kalahari/Griqualand West Endemic

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

\*Sch 1: NCNCA Schedule 1: Specially protected species

\*Sch 2: NCNCA Schedule 2: Protected species

\*Sch 6: NCNCA Schedule 6: Alien invasive plant species

\*NFA: Protected trees: National Forest Act (Act No. 84 of 1998).

\*CITES (checklist.CITES.org): Convention on the Trade in Endangered Species of Wild Fauna and Flora

\*NEM:BA (2013) - Draft ToPS list of Threatened or Protected Species

\*Red List of South African plants (Raimondo *et al.* 2009)

\*DEC: Declining

\*VU: Vulnerable

\*LC: Least Concern

### Alien invasive plant species

The following declared alien and invasive plant species were recorded on site: *Argemone ochroleuca* (Category 1b), *Eucalyptus camaldulensis* (Category 1b) and *Prosopis glandulosa* (Category 3).

### Critical Biodiversity Areas

The Orange River and its banks are classified as a CBA1 area, while the remainder of the study site is classified as a CBA2 category. CBAs are areas required to meet biodiversity targets for ecosystems, species or ecological processes and as such development in these areas is discouraged. The site falls in a CBA1 and CBA2 and therefore Activity 12 of Listing Notice 1 (NEMA 2014, 2017; GRN No. 327) is triggered.

### Sensitivity

The eleven plant communities that were distinguished on site were evaluated and ranked in terms of sensitivity (very low, low, moderate, high and very high sensitivity) (Table B).

Sensitivity rating:

**Very low** sensitivity is applicable to habitats that have been transformed previously, especially by human activities. **Low** sensitivity means the sensitivity is not significant enough and should not have an influence on the decision about the project. However, any protected species may not be removed/destroyed without a permit. **Moderate** means a sensitivity rating that is real and sufficiently important to require management, e.g. management or protection of the rare/threatened fauna and flora, protection of the specific habitat on the property and/or rehabilitation. **High** means a sensitivity rating where the habitat should be excluded from any development. **Very high** means a sensitivity rating that should influence the decision whether or not to proceed with the project.

Table B. Sensitivity of the plant communities of the Groblershoop site

Plant communities	1	2	3	4	5	6	7	8	9	10	11
Threatened status (x5)	5	5	5	5	5	5	5	5	5	15	15
% Red data species (x4)	8	0	0	8	0	0	8	8	8	0	0
Number protected trees (x3)	3	3	3	3	3	3	3	3	3	0	0
% NCNCA species (x4)	12	12	12	12	12	12	8	8	8	8	0
% Endemic species (x2)	6	4	4	4	4	4	0	6	4	0	0
Conservation value (x4)	12	12	4	8	4	8	4	12	8	8	12
Species richness (x2)	4	4	2	4	4	4	4	2	2	2	2
Connectivity (x2)	2	2	2	2	2	2	6	2	2	4	4
Erosion (x2)	2	2	2	2	2	2	2	2	2	6	6
Resilience (x3)	6	3	3	3	3	3	6	6	6	3	3
Sum:	60	47	37	51	39	43	46	54	48	46	42
Sensitivity rating:	H	M	L	H	L	M	M	H	M	M	M

### Significance of environmental Impacts

An assessment of the significance of the impacts on the terrestrial ecosystems, aquatic ecosystems and rare and protected plant species was done (Table C).

Table C. Significance assessment of impacts on the plant associations on site

	Plant associations										
	1	2	3	4	5	6	7	8	9	10	11
Intensity ( $\alpha$ )	1	1	1	1	3	1	1	2	1	3	2
Duration ( $\beta$ )	2	2	2	2	2	2	2	4	2	4	4
Scale ( $\delta$ )	1	1	1	1	1	1	1	1	1	1	3
Certainty ( $\epsilon$ )	1	1	1	1	4	1	1	4	1	5	5
<b>Significance (<math>\alpha+\beta+\delta</math>)*<math>\epsilon</math>:</b>	4	4	4	4	24	4	4	28	4	40	45
<b>Significance rating:</b>	L	L	L	L	L	L	L	L	L	M	M

The **significance rating** should influence the development project as follows:

- Low significance (significance rating <30): If the negative impacts have little real effects it should not have an influence on the decision to proceed with the project.
- Moderate significance (significance rating 30 - 60): Negative impact: it implies that the impact is real and sufficiently important to require mitigation and management measures before the proposed project can be approved.
- High significance (significance rating >60): Negative impact should weigh towards a decision to terminate the project, or mitigation should be formulated and performed to reduce significance to at least a

moderate significance rating. In these circumstances the environmental resources have mostly been destroyed and the capacity of the environmental resources in the area to respond to change and withstand further stress has been or is close to being exceeded. If mitigation cannot be effectively implemented, the proposed activity should be terminated.

### **Mitigation**

Mitigation is the actions undertaken to compensate for environmental damage. The following mitigation measures are proposed during the construction and operational phases of the project:

- Buffer zones in the riparian zones should be provided, i.e. a 32 m zone of undisturbed habitat measured from the water's edge. A buffer zone is a collar of land that filters out inappropriate influences from surrounding activities, also known as edge effects, including the effects of invasive plant and animal species, physical damage and soil compaction caused through trampling and harvesting, abiotic habitat alterations and pollution.
- Development should be contained within the approved development boundaries and unnecessary disturbance adjacent to the site should be avoided.
- Minimise further clearance of natural vegetation and disturbance along the Orange River. A permit has to be obtained from NCDENC and/or DAFF for the removal or transplanting of protected plant species.
- Dedicated roads should be used on site and random driving in the veld or on dunes should be prohibited.
- Dust control measures should be implemented during construction.
- Protected plant species such as *Vachellia erioloba* and *Boscia albitrunca* should be retained where possible because of their keystone role in the ecosystem, for example they bind the soil, prevent erosion and form important food sources and habitats for various fauna.
- Implement a monitoring program for the early detection of alien invasive plant species. The control program to combat declared alien invasive plant species should be continued during the operational phase.
- No alien invasive plant species should be used in landscaping or gardens on site.
- Any areas that will be denuded as a result of activities on site, should be re-vegetated (rehabilitated) as soon as possible to prevent soil erosion and establishment of alien invasive plant species.

## TERMS OF REFERENCE

- Summarise available literature on the vegetation of the area as well as the physical environment, e.g. climate, geology, land types, soil, topography and drainage.
- Stratify the area into relatively homogeneous units or habitats based on physiography and vegetation cover, using aerial images and topocadastral maps.
- Do a field survey of the stratified units to enable a classification, description and mapping of plant communities (habitats).
- Compile checklists of flora and identify rare plant species, protected species, endemic species as well as alien invaders. Investigate management of these plant species.
- Do a sensitivity analysis and produce a sensitivity map.
- Indicate the presence of unique habitats, ecologically sensitive areas and degraded areas that may need further investigation, protection or rehabilitation.
- Assess the possible impact of the development on the ecosystem, habitats, drainage and fauna and flora, and propose mitigation measures.

# GENERAL INFORMATION

**Study site:** Portion 18 of Farm 387, Groblershoop.

**Approximate size of property:** 360 ha

**Environmental Assessment Practitioner:**

EnviroAfrica cc  
Contact person: Clinton Geysler  
Unit 7, Pastorie Park, Reitz St,  
Somerset West, 7130  
P.O. Box 5367, Helderberg, 7135  
Tel. +27 21 851 1616  
Mobile: 083 600 8882  
e-mail: [clinton@enviroafrica.co.za](mailto:clinton@enviroafrica.co.za)  
[www.enviroafrica.co.za](http://www.enviroafrica.co.za)

**Botanical assessment by:**

Ekotrust cc  
Noel van Rooyen Pr.Sci.Nat; Reg. no. 401430/83 - Botanical Sciences  
Gretel van Rooyen Pr.Sci.Nat., Reg. no. 400509/14 - Ecology; LAKadSA, SAAB;  
7 St George Street  
Lionviam,  
Somerset West, 7130,  
Mobile: 082 882 0886  
e-mails: [noel@ekotrust.co.za](mailto:noel@ekotrust.co.za); [gretel@ekotrust.co.za](mailto:gretel@ekotrust.co.za)



# REGULATIONS GOVERNING THIS REPORT

This report has been prepared in terms of the EIA Regulations under the National Environmental Management Act (Act No. 107 of 1998) (NEMA 2014, 2017).

## **Appointment of specialist**

Ekotrust cc was commissioned by EnviroAfrica cc (Somerset West) to provide a botanical assessment for a NEMA and S24G Application for a resort development near Groblershoop, on the banks of the Orange River.

## **Company profile:**

Name of Company: Ekotrust cc  
(Registration number: CK90/05465/23)  
Sole Member: Dr Noel van Rooyen  
Founding date: 1990

Ekotrust cc specializes in habitat evaluation, vegetation classification and mapping, floristic diversity assessments, rare species assessments, alien plant assessments and management, wildlife management, wildlife production and economic assessments, veld condition assessment, bush encroachment, fire management, carrying capacity, wildlife numbers and ratios.

## **Declaration of independence**

I, Noel van Rooyen, declare that:

- I am a member of Ekotrust cc: (CK90/05465/23);
- I act as an independent specialist consultant in the fields of ecology and botany;
- I regard the information contained in the report to be objective, true and correct within the framework of assumptions and limitations;
- I undertake to disclose to the applicant and the competent authority all information in my possession that reasonably has or may have the potential of influencing any decision to be taken by the competent authority; and
- I do not have any business, financial, personal or other interest in the activity or application other than fair remuneration for work performed in connection with the activity or application.

## **Indemnity and conditions relating to this report**

The observations, findings, recommendations and conclusions provided in the current report are based on the compiler's best scientific and professional knowledge and other available information. If new information should become available Ekotrust cc reserves the right to modify aspects of the report. This report (hard copy and/or electronic) must not be amended or extended without the prior written consent of the author. Furthermore, any recommendations, statements or conclusions drawn from or based on this report must make

reference to the report. If these recommendations, statements or conclusions form part of a main report relating to the current investigation, this report must be included in its entirety (as an Appendix).

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**Scope and purpose of report**

The scope and purpose of the report are summarised in the “Terms of Reference” section of this report.



Dr Noel van Rooyen

Date: 23 August 2018

## LIMITATIONS, ASSUMPTIONS AND UNCERTAINTIES

The following assumptions, limitations or uncertainties are listed regarding the ecological assessment of the Groblershoop site:

- The survey was conducted during very dry conditions in mid August 2018 and the number of bulbous plant species and summer annual plant species is an underestimate of the potential number of species that could occur on site.
- Rare and threatened plant and animal species are generally uncommon and/or localised and the once-off survey may fail to locate such species, especially if the survey is outside the flowering season of such species.

### ACRONYMS:

AIS	Alien and Invasive species
CBA	Critical Biodiversity Area
CBD	Convention on Biodiversity
CITES	Convention on the International Trade in Endangered Species of Wild Fauna and Flora
DAFF	Department of Agriculture, Forestry and Fisheries
DEA	Department of Environmental Affairs
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EMPr	Environmental Management Plan Report
ESA	Ecological Support Area
IUCN	International Union for the Conservation of Nature
GIS	Geographical Information System
NC	Northern Cape province
NEMA	National Environmental Management Act
NEM:BA	National Environmental Management: Biodiversity Act
NCNCA	Northern Cape Nature Conservation Act
NPAES	National Protected Area Expansion Strategy
PA	Protected Area
SANBI	South African National Biodiversity Institute
ToPS	Threatened and Protected Species
ToR	Terms of Reference

# CHAPTER 1

## INTRODUCTION

A botanical assessment for a NEMA and S24G Application for a resort development near Groblershoop, on the banks of the Orange River, was commissioned by EnviroAfrica cc.

The site is located on Portion 18 of Farm 387, Gordonia RD, located approximately 1.7 km northeast of Groblershoop. Construction has commenced on the development of a holiday resort (called Destination Rock Inn). To date, tented units, mobile units and 2-bedroom masonry units (combined total of 27 beds) have been constructed, including a thatched roof entrance, restaurant, ablution facilities, swimming pool and laundry room. Infrastructure, including septic tanks, have been constructed and access and internal roads have been cleared.

Further infrastructure such as an amphitheatre, solid waste facility and additional accommodation is also proposed. A double story hotel is proposed on the eastern bank of the Orange River, to the northwest of the property. A quarter mile racing strip and spin track with a paved parking area is also proposed on the southeastern side of the property, with a separate access from the N8.

The harsh climate, rugged terrain and shallow soils of the grasslands, shrubland and thornveld of the areas away from the Orange River make it suitable for only limited livestock and wildlife farming, conservation and ecotourism. The availability of water and the extensive fertile floodplains locally along the Orange River makes the area suitable for the cultivation of crops such as grapes, citrus, lucern and various vegetables. Although the area has a relatively low biodiversity, a number of rare and endemic plant species are found in this region.

Loss of habitat is regarded as the foremost cause of loss of biodiversity. It is therefore essential that the impact of development on biodiversity in sensitive and irreplaceable habitats on the site is minimized through careful planning and avoidance of sensitive areas. The aims of the study were to assess the site in terms of sensitive plant communities/habitats and rare flora, and to determine the impact that already occurred and the potential impact of the proposed further development on the ecology of the area.

# CHAPTER 2

## METHODS

### 2.1 Approach

The study commenced as a desktop study, followed by field-based surveys and verification in July 2016. Hard copy and digital information from spatial databases, such as Daffarcgis, topocadastral maps (2821 DD & 2822 CC) and vegetation types (Mucina & Rutherford 2006), were sourced to provide information on topography, geology, land types and broad vegetation types of the study area. Information on the climate was sourced from the Weather Bureau (1988, 1998).

The study site was stratified into relatively homogeneous vegetation/terrain units on Google Earth satellite images based on physiography and vegetation cover. This stratification was used to determine the position and number of sample plots, and was the basis for identifying habitat types and to produce a vegetation map.

The vegetation survey consisted of visiting the mapping units and systematically recording all identifiable woody species, grasses, forbs and alien (exotic) plant species within each of the stratified units on site, and estimating their cover-abundance. Physical habitat features, e.g. geology, topography, soil colour and texture, and rock cover, were noted. A checklist of the plant species recorded during the site visit was compiled. During the site visit, digital photographs of the sample plots and some individual plant species were taken and representative photographs of the different plant communities are included in the report.

### 2.2 Data analyses

A classification of the vegetation data was done with the TURBOVEG and JUICE computer programmes (Hennekens & Schaminee 2001, Tichy *et al.* 2011), which includes the TWINSPAN divisive clustering technique. A differential table of the vegetation was compiled (Appendix C) and the different plant communities were described and mapped.

### 2.3 Plant species checklists

All plant species recorded in the sample plots (110 species) are listed in the checklist (see Appendix A). Rare species on site were identified. An additional plant species checklist of the 2821 DD & 2822 CC quarter degree grids was obtained from the NewPosa database of the South African National Biodiversity Institute (SANBI) and lists 98 taxa (Appendix B).

### 2.4 Red Data plant species

The site was systematically surveyed for rare, threatened and/or endemic plant species during August 2018. The Red Data status, conservation and protected status of plant species recorded on site were determined from available literature and Acts.

### 2.5 Sensitivity assessment

A sensitivity assessment of each plant community was done and a rating awarded. A sensitivity map was drawn

based on a number of criteria discussed.

## **2.6 Impact assessment**

An assessment of the ecological impacts and their significance on the terrestrial and aquatic systems, is discussed and mitigation measures proposed.

## **2.7 Rehabilitation**

Rehabilitation measures are proposed to mitigate the impact of the activities that occurred on the sites should the application for the establishment of a resort be unsuccessful.

## CHAPTER 3

### ENVIRONMENTAL DESCRIPTION

#### 3.1 Location

The site is situated near the town of Groblershoop, southwest of the Orange River, at approximately  $28^{\circ} 52' 37.13''$  S,  $21^{\circ} 59' 24.25''$  E (Figures 1 & 2). The topocadastral grid references are 2821 DD & 2822 CC. The site covers approximately 360 ha.

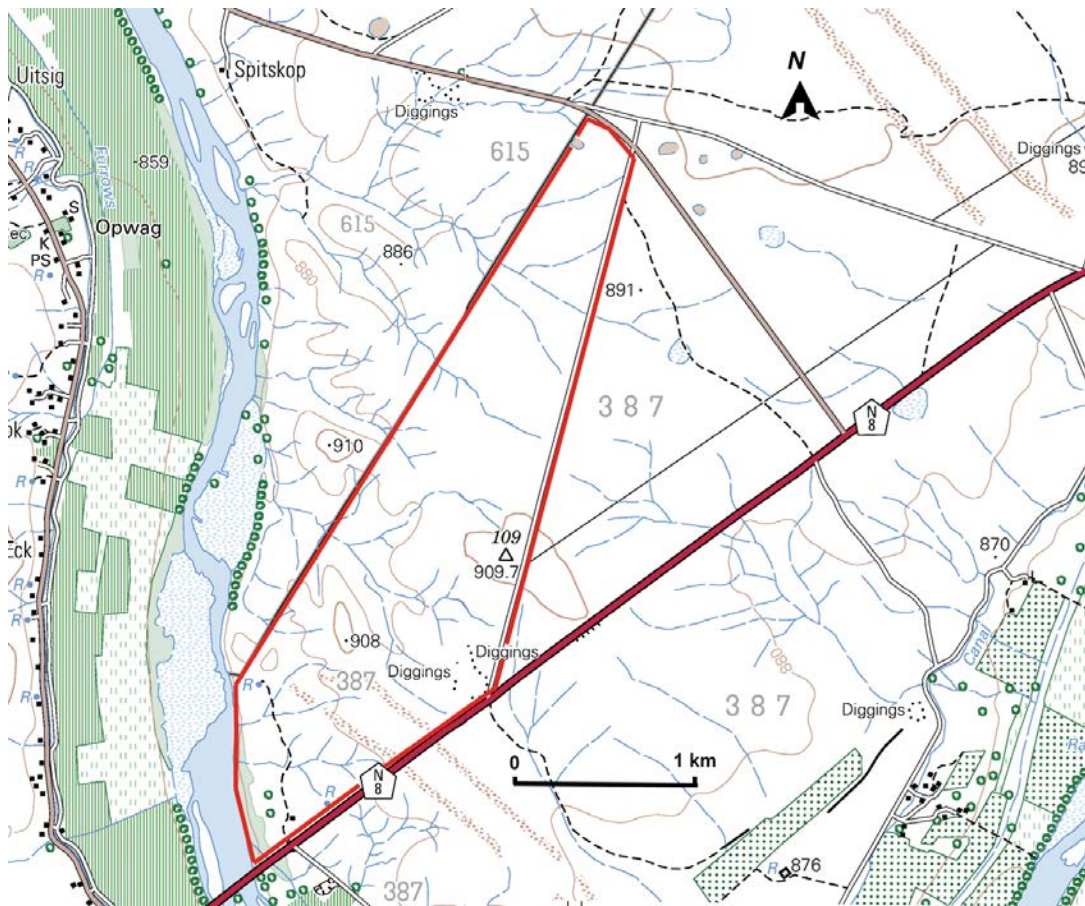


Figure 1. Topocadastral map of the Groblershoop resort property (red boundary line).



Figure 2 Aerial image of the general region of the Groblershoop site (red boundary line).

### 3.2 Terrain morphology and drainage

The site is bordered in the southwest by the Orange River and its riparian vegetation and floodplains, while most of the site occurs on the undulating plains and low hills northeast of the Orange River at altitudes ranging from 865 m to 880 m above sea level (Figures 1 & 2). The area is drained towards the Orange River in the southwest by a number of dry sandy and rocky drainage lines that flow only after significant amounts of rainfall have fallen.

### 3.3 Climate

#### 3.3.1 Regional climate

A summary of the broad climate of the area is provided by Mucina & Rutherford (2006). The site is situated in the Bushmanland Arid Grassland, which has a mean annual precipitation that ranges from 200 to 350 mm per annum and an annual precipitation coefficient of variation of 39%. The mean annual potential evaporation is 2771 mm, while the mean annual soil moisture stress is 86%. The mean annual temperature is 17.4°C, with extreme maximum and minimum temperatures of 43°C and -5°C respectively. Frost occurs on average on 20 days per annum.

#### 3.3.2 Rainfall

The mean annual precipitation measured at Boegoeberg Dam, about 20 km north of the farm is 234 mm, varying from 69 mm to 759 mm per annum (Tables 1 & 2; Weather Bureau 1998). This indicates a high variation in the annual rainfall and therefore a rainfall scenario that is highly unpredictable. The rainy season is predominantly from January to April when about 65% of the annual rainfall occurs. The wettest months are February and March and the driest period is from June to September, when less than 10 mm of rain is recorded



per month (Table 2, Figure 3). The maximum rainfall measured over a 24-hour period at Boegoeberg Dam was 89 mm in March, whereas the highest monthly rainfall was 261 mm, measured in January (Table 2).

Table 1. Rainfall at some weather stations in the vicinity of the development at Groblershoop

Month	Prieska	Douglas	Boegoeberg Dam	Van Wyksvlei	Upington
Jan	28	23	31	29	24
Feb	56	74	46	35	35
Mar	45	63	40	42	37
Apr	32	31	34	28	26
May	10	9	10	11	10
June	8	4	7	8	4
July	5	4	3	4	2
Aug	8	10	8	6	4
Sep	5	12	4	6	4
Oct	16	28	15	10	9
Nov	24	30	17	12	17
Dec	21	42	19	19	17
Year	258	330	234	210	189

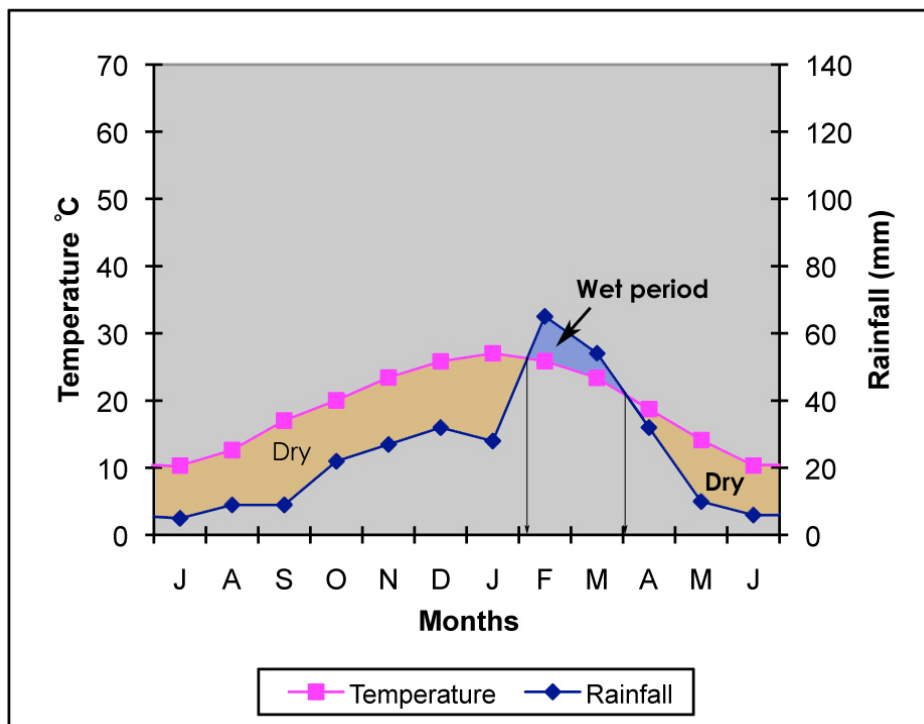


Figure 3. Climate diagram for Boegoeberg Dam, about 15 km to the south of Groblershoop.

Table 2. Rainfall statistics for Boegoeberg Dam weather station 0253363 X 29° 03' S; 22° 13' E; 891 m a.s.l.; Period 29 years

Month	Mean month	24 h max	Max per month	Min per month
Jan	31	78	261	0
Feb	46	82	168	0
Mar	40	89	148	0
Apr	34	72	135	1
May	10	33	52	0
June	7	20	29	0
July	3	16	24	0
Aug	8	45	52	0
Sep	4	22	22	0
Oct	15	30	46	0
Nov	17	35	82	0
Dec	19	47	129	0
Year	234	89	759	69

### 3.3.3 Temperature

The mean annual temperature for Boegoeberg Dam is 20.2°C (Table 3). The extreme maximum and minimum temperatures measured at Boegoeberg Dam over a 29 year period were 43°C and -5.6°C (Table 3). The mean daily maximum for January at Boegoeberg Dam is 35.4°C and for July it is 20.3°C. The mean daily minimum for January at Boegoeberg Dam is 20.0°C and for July it is 4.0°C. Frost may occur from May to September, a period of approximately 150 days.

Table 3 Temperature data (°C) for Boegoeberg Dam weather station 0253363 X; 29° 03' S; 22° 13' E; 891 m a.s.l.; Period 29 years

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Max	35.4	33.7	31.3	26.9	23.3	19.9	20.3	22.4	26.3	29.1	32.2	34.3	27.9
*Ext. Max	43.0	41.2	40.0	37.2	32.0	28.2	29.0	32.1	38.0	39.0	41.5	42.5	43.0
Min	20.0	19.5	17.6	13.1	7.9	4.6	4.0	5.6	9.5	12.9	16.4	18.7	12.5
*Ext. Min	10.5	10.5	4.8	1.0	-2.6	-4.0	-5.6	-5.5	-1.0	0.6	2.8	6.6	-5.6
Mean	27.8	26.7	24.5	20.1	15.6	12.2	12.2	14	17.9	21	24.3	26.5	20.2

Max = mean daily maximum temperature for the month

\*Ext. Max = extreme maximum temperature recorded per month

Min = mean daily minimum temperature for the month

\*Ext. Min = extreme minimum temperature recorded per month

Mean = mean monthly temperature for each month and for the year

### 3.3.4 Cloud cover and relative humidity

The cloud cover is highest from February to April when a mean cloud cover of two eighths or more occurs (Table 4). The percentage relative air humidity at 08:00 ranges from more than 80% from April to July, to less than 60% from October to January. The humidity at 14:00 ranges from 36% in June to 22% in December (Table 4).

Table 4 Cloud cover (in eights) at 14:00 and relative air humidity at 08:00, 14:00 and 20:00 at the Boegoeberg Dam weather station 0253363 X; 29° 03' S; 22° 13' E; 891 m a.s.l.; Period 29 years; and the percentage relative humidity measured at the Prieska weather station 0224430E2; 29° 40' S; 22° 45' E; 944 m a.s.l.; Period 29 years

	Cloud (0 - 8)	Relative % air humidity	
	14:00	08:00	14:00
Jan	1.9	52	23
Feb	2.3	63	29
Mar	2.5	72	32
Apr	2.1	82	34
May	1.5	87	35
June	1.4	87	36
July	1.0	82	32
Aug	1.0	75	28
Sept	1.5	64	23
Oct	1.8	57	23
Nov	1.7	51	23
Dec	1.6	49	22
Year	1.7	69	29

### 3.4 Geology

The geology of the site consists of quartz-muscovite schist, quartz-amphibole schist and quartz of the Groblershoop Formation, Brulsand Group. A diabase dike occurs in the central part of the area (Figure 4). Aeolian sand and dunes are found in the southern parts of the study area, with alluvium soils along the Orange River in the southwest.

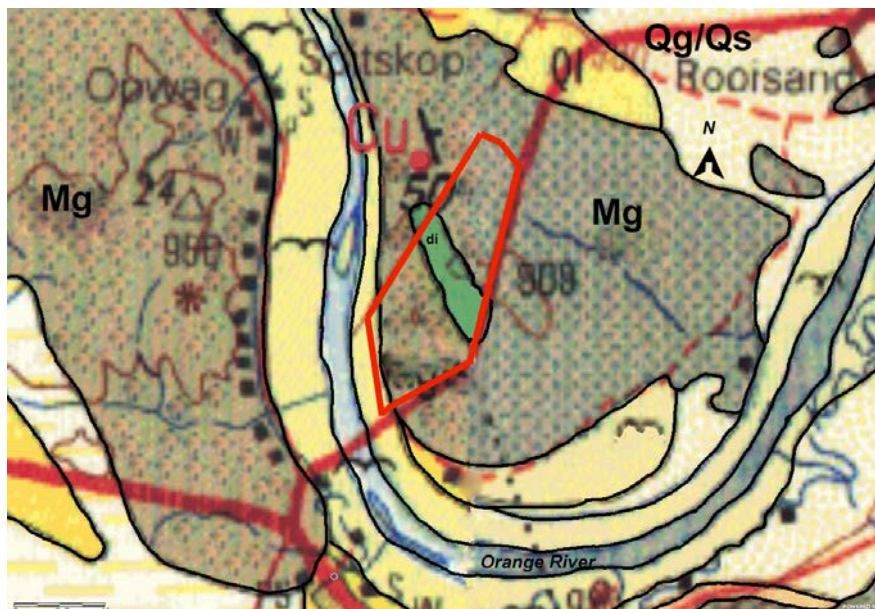


Figure 4. Geology of the Groblershoop region. Site boundary is indicated in red.

Legend (Figure 4):

Mg = quartz-muscovite schist

di = diabase

Qg/Qs = aeolian sand, sometimes with dunes

Along Orange River: alluvium

### 3.5 Land Types

Land Types denote areas that display a marked degree of uniformity with respect to terrain form, soil pattern and climate (Figure 5). A terrain unit within a Land Type is any part of the land surface with homogeneous form and slope. Terrain unit 1 represents a crest, 2 = scarp, 3 = midslope, 4 = footslope and 5 = valley bottom. Several land types occur in the region with the site occurring in the Ag4 Land Type.

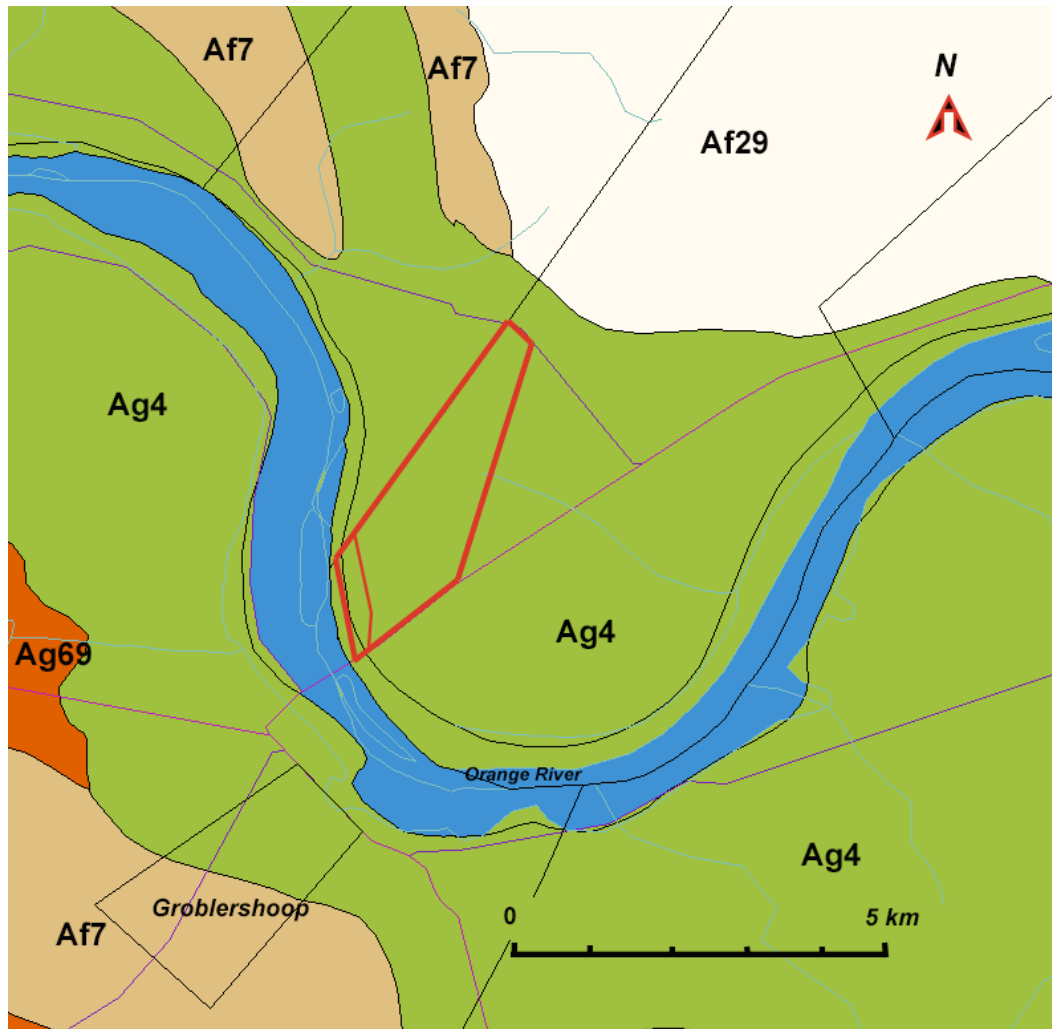


Figure 5. Land Types of the Groblershoop region with the site (indicated in red) occurring in the Ag4 Land Type.

The Ag Land Type is characterized by rocky areas with red to yellow apedal, freely drained soils with a high base status and less than 300 mm deep. Yellow soils occupy less than 10% of the area while high base status red-yellow apedal soils occupy a large area. The site occurs in the **Ag4 Land Type**, which covers a total of 76 400 ha in the general region. Terrain units 1, 3, 4 and 5 are distinguished in the Ag4 Land Type with terrain units 3 & 4 covering 28% and 40% of the landscape respectively. The slopes range from less than 3% in terrain units 1, 4 and 5, to 35% in terrain unit 3. Rocks cover up to 70% of terrain unit 1 and 35% of terrain unit 2. The fine, sand to sandy loam soils of the Mispah, Muden and Kalkbank soil forms dominate the area. The soils are usually less than 400 mm deep. Locally in terrain units 4 and 5 the soils may be up to 1200 mm deep. The percentage clay content of the soils ranges from 3% - 10% in the A- horizon and up to 18% in the B-horizon.

## CHAPTER 4

# ENVIRONMENTAL LEGISLATION

### 4.1 Introduction

The White Paper on the conservation and sustainable use of South Africa's biodiversity and the National Environmental Management Act (Act No. 107 of 1998) specify that due care must be taken to conserve and avoid negative impacts on biodiversity and that the sustainable, equitable and efficient use of biological resources must be promoted. Various Acts provide control over natural resources in terms of their conservation, the use of biological resources and avoidance of negative impacts on biodiversity. Some international conventions are also relevant to sustainable development. Unauthorised activities may however be rectified by means of an application in terms of Section 24G of NEMA.

### 4.2 Natural resources

Terrestrial and other ecosystems and their associated species are widely used for commercial, semi-commercial and subsistence purposes through both formal and informal markets. While some of this use is well managed and/or sustainable, much is thought to be unsustainable. "Use" in this case refers to direct use, such as collecting, harvesting, hunting and fishing for human consumption and production, as well as more indirect use such as ecotourism and wildlife ranching.

### 4.3 National Environmental Management Act (Act No. 107 of 1998) (NEMA)

This report has been prepared in terms of the EIA Regulations 2014, under the National Environmental Management Act, (Act No. 107 of 1998) (Government Notice R. 982, Government Gazette No. 38282 of 4 December 2014) (NEMA 2014).

NEMA requires that measures are taken that "prevent pollution and ecological degradation; promote conservation; and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development." In addition: (1) NEMA requires that the disturbance of ecosystems and loss of biological diversity are avoided, or where they cannot be altogether avoided, are minimised and remedied, (2) a risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions, and (3) sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands, and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure.

The activities listed below are some of the activities identified in terms of section 24(2) (a) of the Act as activities that may not commence without an environmental authorisation from the competent authority.

#### *Listing Notice 1 (GRN No. 327)*

- Activity 12 - The development of (*inter alia*)-
  - (ii) infrastructure or structures with a physical footprint of 100 m<sup>2</sup> or more; where such development occurs -

- (a) within a watercourse;
- (b) in front of a development setback; or
- (c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse.

- *Activity 27 – The clearance of an area of 1 ha or more, but less than 20 ha of indigenous vegetation, except where such clearance of indigenous vegetation is required for - (i) the undertaking of a linear activity; or (ii) maintenance purposes undertaken in accordance with a maintenance management plan.*

*Listing Notice 2 (GRN No 325)*

- *Activity 15 – The clearance of an area of 20 hectares or more of indigenous vegetation, excluding where such clearance of indigenous vegetation is required for - (i) the undertaking of a linear activity; or (ii) maintenance purposes undertaken in accordance with a maintenance management plan.*

“Indigenous vegetation” refers to vegetation consisting of indigenous plant species occurring naturally in an area, regardless of the level of alien infestation and where the topsoil has not been lawfully disturbed during the preceding 10 years.

*Listing Notice 3 (GRN No 324)*

- *Activity 12 – The clearance of an area of 300 m<sup>2</sup> or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan; (a) NORTHERN CAPE (i) within any critically endangered ecosystem or endangered ecosystem listed in terms of section 52 of NEM:BA or prior to the publication of such list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004; (ii) within Critical Biodiversity Areas (CBAs) identified in bioregional plans; (iii) within the littoral active zone or 100 m inland from the high water mark of the sea or an estuary, whichever distance is the greater, excluding where such removal will occur behind the development setback line on erven in urban areas; or; (iv) on land, where at the time of the coming into effect of this Notice or thereafter such land was zoned open space, conservation or had an equivalent zoning.*

#### **4.4 National Environmental Management: Biodiversity Act (Act No. 10 of 2004) (NEM:BA)**

As the principal national act regulating biodiversity protection, NEM:BA, which is administered by DEA, is concerned with the management and conservation of biological diversity, as well as the use of indigenous biological resources in a sustainable manner. The term biodiversity according to the Convention on Biodiversity (CBD) refers to the variability among living organisms from all sources including, *inter alia* terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity in genes, species and ecosystems.

NEM:BA places the responsibility on the developer in the:

- conservation of endangered ecosystems and restricts activities according to the categorisation of an area;
- promotes the appropriate use of environmental management tools to ensure that development is sustainable and protects biodiversity;
- limits further loss of biodiversity and conserves endangered ecosystems. Activities are restricted in terms of threatened and protected species while invasive species must be controlled and eradicated.

#### 4.4.1 Threatened ecosystems

Section 53 of NEM:BA lists the threatened status of **ecosystems**, i.e. critically endangered ecosystems, endangered ecosystems, and vulnerable ecosystems. The list of threatened ecosystems was published in 2011 (NEM:BA 2011). The Lower Gariep Alluvial Vegetation has a status of "**endangered**" and the Bushmanland Arid Grassland a status of "**least threatened**".

#### 4.4.2 Threatened or Protected Species (ToPS) Regulations

Section 56 of NEM:BA (2011) makes provision for the listing of **species** that are of such high conservation value, national importance or threatened that they need protection, i.e. critically endangered species, endangered species and vulnerable species.

Draft lists of species that are threatened or protected, and associated activities that are prohibited and/or exempted from restriction have been published in the Government Gazette Vol 574, No 36375 of 16 April 2013. Any proposed development involving one or more threatened or protected species and/or prohibited/restricted activities will require Environmental Authorisation in term of these Threatened or Protected Species (TOPS) Regulations of 2013, as read with NEM:BA.

#### 4.4.3 Alien and Invasive Species (AIS) Regulations

The Alien and Invasive Species (AIS) Regulations, in terms of Section 97(1) of NEM:BA, was published in Government Notice R598 in Government Gazette 37885 dated 1 August 2014. The Alien and Invasive Species (AIS) lists in terms of sections 66(1), 67(1), 70(1)(a), 71(3) and 71A of NEM:BA was subsequently published in Government Notice R 864 of 29 July 2016.

### 4.5. Critical Biodiversity Areas (CBAs)

Critical Biodiversity Areas are areas required to meet biodiversity targets for ecosystems, species or ecological processes. CBAs should be kept in a natural or near-natural state, with no further loss of habitat or land-use change permitted (biodiversityadvisor.sanbi.org; Namakwa Biodiversity Sector Plan 2016)

### 4.6 The National Environmental Management: Protected Areas Act (Act No. 57 of 2003) (NEM:PAA)

The Act provides for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes; for the establishment of a national register of all national, provincial and local protected areas; for the management of those areas in accordance with national norms and standards; for intergovernmental co-operation and public consultation in matters concerning protected areas; and for matters in connection therewith.

### 4.7 National Forests Act (Act No. 84 of 1998)(NFA)

The National Forest Act makes provision for the declaration of for example specially protected areas, forest nature reserves, forest wilderness areas and protected woodlands. A list of tree species declared protected in terms of the NFA was published in 2017. That means that in terms of section 15(1) of this act, no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree or any product derived from a protected tree, except under a license or exemption granted by the Minister to an applicant and subject to

such period and conditions as may be stipulated. The competent authority responsible for considering and issuing the license will be the national Department of Agriculture, Forestry and Fisheries (DAFF).

#### 4.8 Northern Cape Nature Conservation Act (Act No. 9 of 2009)(NCNCA)

The Northern Cape Nature Conservation Act (Act No. 9 of 2009) restricts activities involving specially protected, protected and indigenous plant species.

Section 50 deals with the restricted activities involving protected plants and states that no person may, without a permit, pick, import, export, transport, cultivate or trade in a specimen of a protected plant.

Section 51 involves the picking, receipt, possession, acquisition or handling of indigenous plants and states that no person may, without a permit, pick an indigenous plant – (a) on a public road; (b) on land next to a public road within a distance of 100 meters measured from the centre of the road; or (c) **within an area bordering a natural water course, whether wet or dry, up to and within a distance of 100 meters from the middle of a river on either side of the natural water course.**

The Act lists different categories of flora and fauna, so-called Schedules 1, 2, 3 and 6 for flora and Schedules 1, 2, 3, 4, 5 and 6 for fauna. The lists of flora in the Act were consulted and compared with lists of plant species recorded during the vegetation surveys of the sites.

#### 4.9 National Water Act (Act No. 36 of 1998)

The National Water Act places strong emphasis on sustainable use of water resources, and its purpose as per Subsection 2(g) of the NWA includes protecting aquatic and associated ecosystems and their biological diversity. A person may be authorised to use water:

- If the water use is permissible in terms of Schedule 1 of the NWA, or
- As a continuation of an existing lawful use, or
- If authorised by a General Authorisation (GA), or
- If licensed to do so in terms of the NWA i.e. Water Use License (WUL).

Wetlands, riparian zones and watercourses are defined as water resources by the Water Act and any contemplated activities that could affect these areas require authorisation. Any reference to a watercourse includes, where relevant, its bed and banks. All applications for a Water Use License should be done in terms of this Act.

A “watercourse” means –

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

“Riparian habitat” includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation with a composition and physical structure distinct from those of adjacent land areas.



#### 4.9.1 Schedule 1 of the NWA

Schedule 1 entitles a person to take water for reasonable domestic use in the person's household, for small gardening but not for commercial purposes, for watering of animals grazing on the land, or for firefighting. It also entitles a person to use water for recreational purposes. The schedule permits the storing and using of run-off from a roof i.e. rainwater harvesting. It also permits agreed discharge of waste or water containing waste into a conduit controlled by another person who is authorised to accept it and dispose of it e.g. local municipality.

#### 4.9.2 Existing lawful use

A person may continue an existing lawful water use – a water use that was lawfully exercised in the two years before the commencement of the NWA on 1 October 1998 – subject to the conditions under which it was exercised. The Minister may declare a water use that was not exercised in the qualifying two-year period to be an existing lawful water use. Scheduled irrigation under Irrigation Boards and from Government Water Schemes, which was not exercised in the qualifying period, but for which the rates have been fully paid, has been declared to be existing lawful use.

#### 4.9.3 General Authorisations (GA)

Two GAs have been issued for water uses, which describe the limits, conditions, and areas to which the GA applies.

#### 4.9.4 Water Use License (WUL)

Any person wishing to exercise a water use other than those defined in Schedule 1 of the NWA, or an existing lawful use, or a use promulgated by a GA, requires a water use license. A water use license may be issued to a natural person or legal entity and is attached to the property/ies on which the water is used. It includes descriptions of the license holder, the property/ies on which the water may be used, the nature of the water uses, the period for which the license will be valid, and license conditions.

Water use activities listed in terms of Section 21 of the NWA, which may require authorisation include the following:

- Section 21(a) Taking of water from a water resource (e.g. river, stream, dam, spring, aquifer (borehole), wetland, lake, and pan);
- Section 21(b) Storing water in dams (excluding reservoirs).

#### 4.10 National Environmental Management: Waste Act (Act No. 59 of 2008) (NEM:WA)

The relevant activities, listed in terms of Government Notice 718 in terms of Article 19 of the National Environmental Management: Waste Act (Act No. 59 of 2008) (NEM:WA), are applicable to all developments.

#### 4.11 Conservation of Agricultural Resources Act (Act No. 43 of 1983) (CARA)

The objectives of CARA are to provide for the conservation of the natural agricultural resources by the maintenance of the production potential of the land, by combating and preventing erosion and weakening or destruction of the water resources, and by protecting the vegetation and combating weeds and invader plants. In order to achieve the objectives, certain control measures are prescribed which shall be complied with by land users to whom they apply. The activities which are mentioned relate to (*inter alia*):

- the utilisation and protection of vleis, marshes, water sponges, water courses and water sources;
- the regulation of the flow pattern of run-off water;
- the control of weeds and invader plants;;
- the restoration or reclamation of eroded land or land which is otherwise disturbed or denuded;
- the construction, maintenance, alteration or removal of soil conservation works or other structures on land.

Lists of alien invasive plant species are provided with appropriate categories indicating the management of these problem species.

#### **4.12 National Heritage Resources Act (Act No. 25 of 1999) (NHRA)**

According to Section 27(18) of the National Heritage Resources Act, no person may destroy, damage, deface, excavate, alter, remove from its original position, subdivide or change the planning status of any heritage site without a permit issued by the relevant heritage resources authority responsible for the protection of such site. In terms of Section 38(1) of the NHRA, the South African Heritage Resource Agency (SAHRA) is to be notified of planned activities at the very earliest stages of the proposed development and furnished with details regarding the location, nature and extent of the proposed agricultural activities to be established at Ferndale farm.

#### **4.13 Convention on Biodiversity (CBD)**

South Africa became a signatory to the United Nations Convention on Biological Diversity (CBD) in 1993, which was ratified in 1995. The CBD requires signatory states to implement objectives of the Convention, which are the conservation of biodiversity; the sustainable use of biological resources and the fair and equitable sharing of benefits arising from the use of genetic resources. According to Article 14 (a) of the CBD, each Contracting Party, as far as possible and as appropriate, must introduce appropriate procedures, such as environmental impact assessments of its proposed projects that are likely to have significant adverse effects on biological diversity, to avoid or minimize these effects and, where appropriate, to allow for public participation in such procedures.

#### **4.14 Convention on the International Trade in Endangered Species of Wild Fauna and Flora (CITES)**

CITES is an international agreement to which countries adhere voluntarily. The aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. The species covered by CITES are listed in three appendices reflecting the degree of protection that the species needs. Appendix I includes species that are threatened with extinction and trade in these species is permitted only in exceptional circumstances. Appendix II lists species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled. Appendix III lists species that are protected in at least one country that has asked other CITES parties for assistance in controlling the trade (Website: [www.cites.org](http://www.cites.org)).

# CHAPTER 5

## VEGETATION

### 5.1 Introduction

Phytogeographically the site falls on the boundary of the Karoo-Namib Zone and the Kalahari-Highveld Transition Zone of White (1983). The Karoo-Namib Zone covers an extensive region in the western interior of southern Africa. Most of the vegetation types in the Orange River valley and surrounds fall in the Nama-Karoo Biome as described by Rutherford & Westfall (1986) and Mucina & Rutherford (2006). Acocks (1953), Mostert *et al.* (1971) and Gubb (1980) described the area as the Orange River Broken Veld. Low & Rebelo (1998) classified the area as part of the Orange River Nama Karoo and according to them, only 1.47% of the latter vegetation type is formally conserved, although little of the area is transformed, except along the Orange River.

### 5.2 Vegetation types

According to Mucina & Rutherford (2006), the vegetation types occurring in the Groblershoop region (see Figure 6) are the Bushmanland Arid Grassland (Nkb 3) and the Lower Gariep Alluvial Vegetation (AZa 3) along the Orange River. The site itself falls mainly in the Bushmanland Arid Grassland (Nkb 3), with a conservation status of “**least threatened**”. Part of the site in the southwest falls in the Lower Gariep Alluvial Vegetation, which is classified as “**endangered**” (Mucina & Rutherford 2006).

#### *Bushmanland Arid Grassland (Nkb 3)*

The Bushmanland Arid Grassland (Figure 6) covers 45 479 km<sup>2</sup> and occurs from the edge of the Namaqualand hills in the west to Prieska in the east. The northern border is more or less the Orange River and the southern border is formed by the edges of the Bushmanland Basin.

The Bushmanland Arid Grassland consists of extensive to irregular plains on a slightly sloping plateau sparsely vegetated by grasses, with *Stipagrostis* spp. the dominant grass species, and *Salsola* spp., *Tetraena* spp. and *Roepera* spp. the dominant dwarf shrub species. In years of abundant rain, flower displays of annual forbs can be expected.

A third of the area is covered by recent (Quaternary) alluvium and calcrete. Gneisses and metasediments of the Mokolian age outcrops occur in the area. The soils are mostly red-yellow apedal soils, freely drained, with high base status and <300 mm deep, with about one fifth of the area deeper than 300 mm, typical of Ag and Ae Land Types.

The most important grass species include *Stipagrostis uniplumis*, *Stipagrostis obtusa*, *Stipagrostis ciliata*, *Aristida congesta*, *Enneapogon desvauxii* and *Schmidtia kalahariensis*. Small trees and shrubs are sparsely distributed and include *Senegalia mellifera*, *Boscia foetida* subsp. *foetida*, *Lycium cinereum*, *Rhigozum trichotomum*, *Cadaba aphylla*, *Phaeoptilum spinosum* and *Parkinsonia africana*. Prominent dwarf shrubs such as *Aptosimum spinescens*, *Hermannia spinosa*, *Pentzia spinescens*, *Aptosimum elongatum*, *Barleria rigida*, *Blepharis mitrata*, *Justicia incana* and *Rosenia humilis* occur widespread. *Acanthopsis hoffmannseggiana*, *Barleria lichtensteiniana*, *Dicoma capensis*, *Sesamum capense*, *Mesembryanthemum coriarium* and *Tribulus terrestris* are some of the herbs in the area.

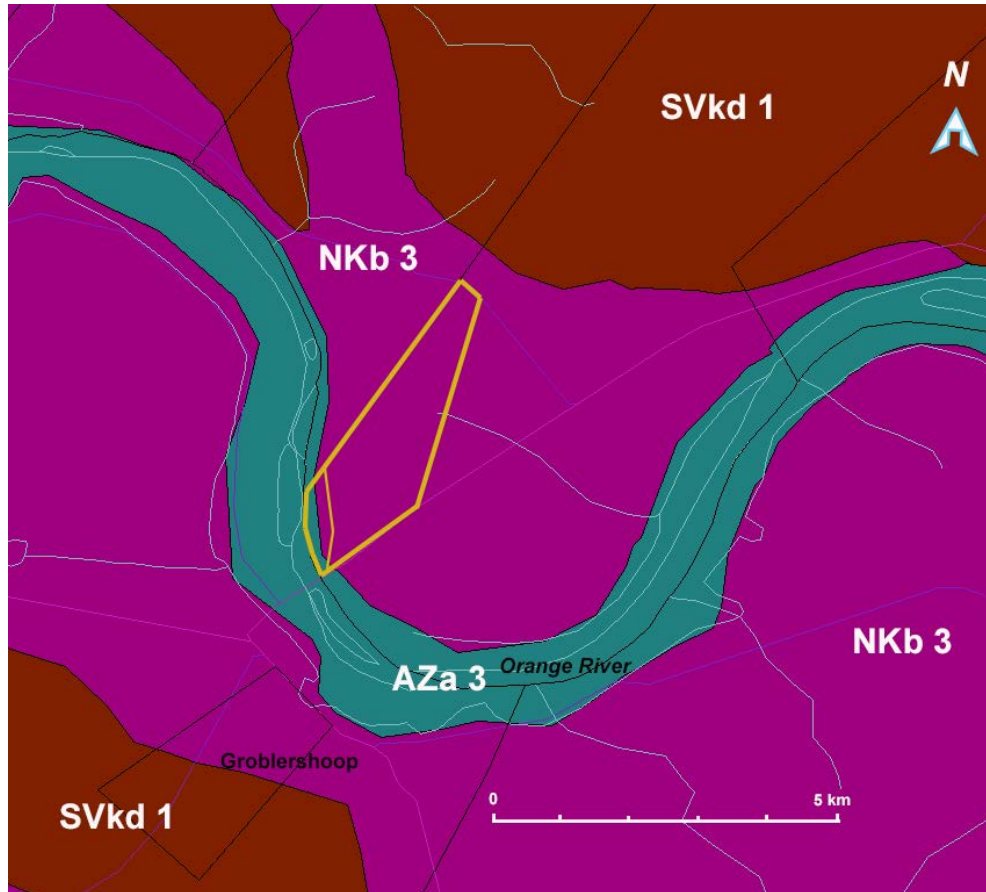


Figure 6. Vegetation types (Mucina & Rutherford 2006) of the Groblershoop region (site boundary indicated in orange).

Legend:

SVkd 1	=	Gordonia duneveld
NKb 3	=	Bushmanland Arid Grassland
AZa 3	=	Lower Gariep Alluvial Vegetation

#### *Lower Gariep Alluvial Vegetation (AZa 3)*

Apart of the site under evaluation occurs within this vegetation type, which includes the broad alluvial plains and islands of the Orange River from Groblershoop to the mouth of the Atlantic Ocean at Alexander Bay. Conspicuous species are *Searsia pendulina*, *Ziziphus mucronata*, *Euclea pseudebenus*, *Schotia afra* var. *angustifolia*, *Salix mucronata* and *Tamarix usneoides*, with beds of *Phragmites australis* occurring locally.

### 5.3 Vegetation associations of the site

Eleven associations (plant communities) were distinguished on the site covering riverine vegetation, dunes, rocky and gravelly hills and plains and ephemeral drainage lines (Appendix B; Figure 7). The species that dominate the site are the trees and shrubs *Senegalia mellifera*, *Boscia albitrunca* and *Phaeoptilum spinosum*, the dwarf shrubs *Rhigozum trichotomum*, *Tetraena rigida*, *Tetraena decumbens*, *Aizoon burchellii*, *Kleinia longiflora*, *Pentzia calcarea* and *Salsola tuberculata*, the succulent *Aloe claviflora*, as well as the grasses *Enneapogon desvauxii*, *Enneapogon scaber*, *Stipagrostis* spp. and *Schmidtia kalahariensis*. Along the Orange River, trees such as *Searsia viminale*, *Ziziphus mucronata* and *Vachellia karroo* are dominant, although alien trees such as *Eucalyptus camaldulensis* and *Prosopis glandulosa* are abundant.

Eleven plant associations or plant communities were distinguished on site (Appendix B, Figures 7 - 20):

1. *Aloe claviflora* - *Leucosphaera bainesii* - *Avonia papyracea* dwarf shrubveld
2. *Senegalia mellifera* - *Tetraena rigida* - *Ptychobium biflorum* shrubveld
3. *Senegalia mellifera* - *Aptosimum spinescens* - *Stipagrostis anomala* shrubveld
4. *Senegalia mellifera* - *Tetraena rigida* - *Enneapogon desvauxii* dwarf shrubveld
5. *Roepera lichtensteiniana* - *Tetraena decumbens* dwarf shrubland
6. *Senegalia mellifera* - *Ziziphus mucronata* - *Fingerhuthia africana* shrubveld
7. *Senegalia mellifera* - *Phaeoptilum spinosum* - *Cullen tomentosum* shrubveld
8. *Senegalia mellifera* - *Calobota linearifolia* - *Stipagrostis amabilis* shrubveld
9. *Senegalia mellifera* - *Vachellia erioloba* - *Justicia incana* bushveld
10. *Eucalyptus camaldulensis* - *Prosopis glandulosa* bushveld
11. *Vachellia karroo* - *Ziziphus mucronata* - *Searsia viminale* riparian forest

Description of the plant associations:

### 1. *Aloe claviflora* - *Leucosphaera bainesii* - *Avonia papyracea* dwarf shrubveld

This association was found on the plains in the northern part of the study area (Figures 7, 8 & 9). The shallow rocky soils are derived from quartz-muscovite schist, quartz-amphibole schist, with quartz outcrops (veins) and quartz gravel covering the landscape.

The diagnostic species included *Avonia papyracea*, *Titanopsis calcarea* and *Leucosphaera bainesii* (species groups 1 & 2, Appendix B). *Senegalia mellifera* and *Boscia albitrunca* were sparsely distributed in this habitat. The most important dwarf shrub species were *Tetraena rigida*, *Leucosphaera bainesii* (d = dominant), *Roepera lichtensteiniana*, *Aptosimum spinescens*, *Pentzia calcarea*, *Pteronia sordida*, *Aptosimum albomarginatum*, *Justicia australis* and *Hermannia spinosa*. The succulents were represented by *Aloe claviflora* (d), *Kleinia longiflora* and *Euphorbia rhombifolia* (d). The grass cover was very low, with *Enneapogon scaber*, *Enneapogon desvauxii* and *Oropetium capense* the most prominent species. The forb species recorded were *Dicoma capensis*, *Barleria lichtensteiniana* and *Acanthopsis hoffmanseggiana*.

Two subassociations were distinguished:

#### 1.1 *Aloe claviflora* - *Titanopsis calcarea* dwarf shrubland

This dwarf shrubland covered a relatively small area in the southern part of the Association 1 and was characterised by the local presence of *Titanopsis calcarea*.

#### 1.2 *Aloe claviflora* - *Leucosphaera bainesii* dwarf shrubland

This subassociation covered most of Association 1 with *Leucosphaera bainesii* the most conspicuous dwarf shrub.

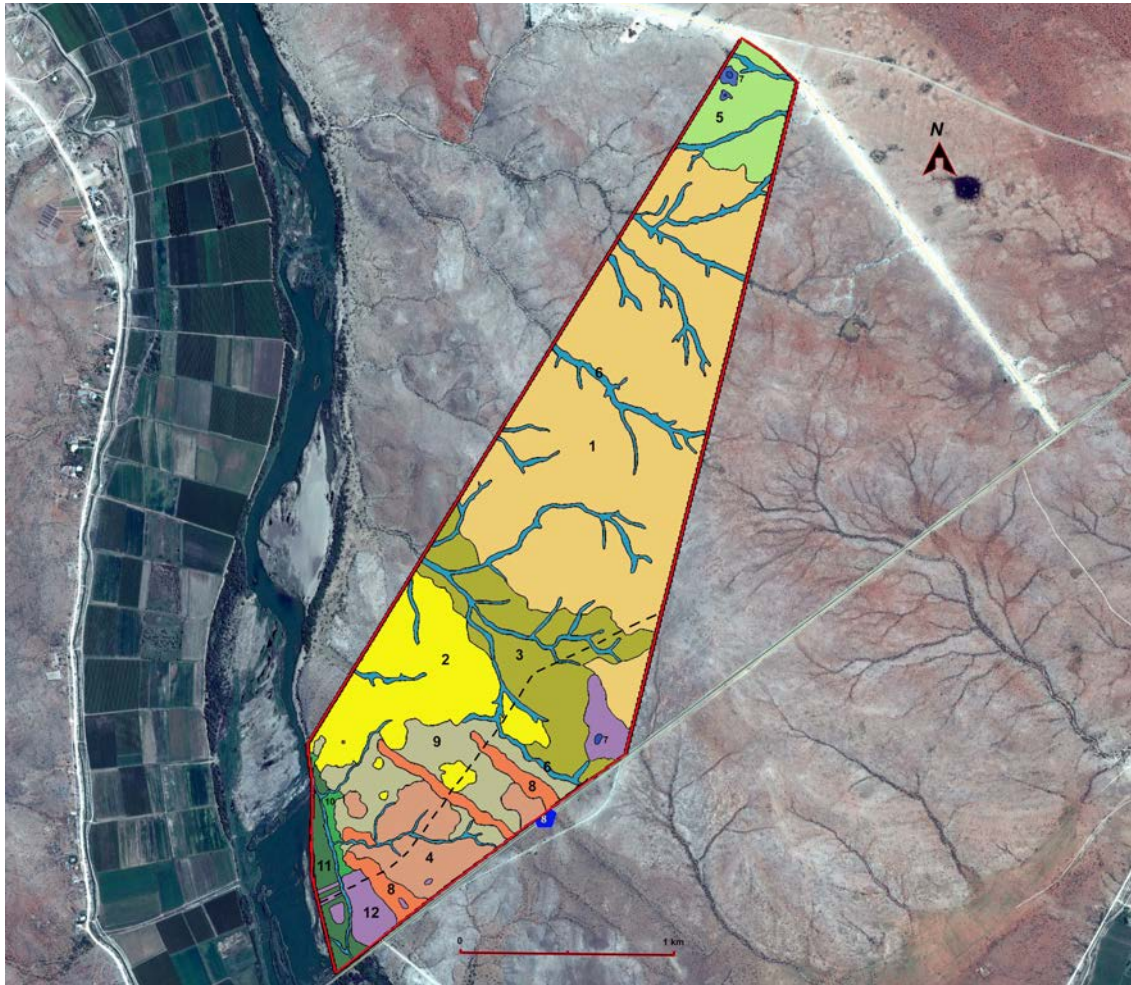


Figure 7 Vegetation map of the Groblershoop site.

Legend to Figure 7:

- |    |  |  |
|----|--|--|
| 1  |  | <i>Aloe claviflora</i> - <i>Leucosphaera bainesii</i> - <i>Avonia papyracea</i> dwarf shrubveld    |
| 2  |  | <i>Senegalia mellifera</i> - <i>Tetraena rigida</i> - <i>Ptychobium biflorum</i> dwarf shrubveld   |
| 3  |  | <i>Senegalia mellifera</i> - <i>Aptosimum spinescens</i> - <i>Stipagrostis amabilis</i> shrubveld  |
| 4  |  | <i>Senegalia mellifera</i> - <i>Tetraena rigida</i> - <i>Enneapogon desvauxii</i> dwarf shrubveld  |
| 5  |  | <i>Roepera lichtensteiniana</i> - <i>Tetraena decumbens</i> dwarf shrubveld                        |
| 6  |  | <i>Senegalia mellifera</i> - <i>Ziziphus mucronata</i> - <i>Fingerhuthia africana</i> shrubveld    |
| 7  |  | <i>Senegalia mellifera</i> - <i>Phaeoptilum spinosum</i> - <i>Cullen tomentosum</i> shrubveld      |
| 8  |  | <i>Senegalia mellifera</i> - <i>Calobota linearifolia</i> - <i>Stipagrostis amabilis</i> shrubveld |
| 9  |  | <i>Senegalia mellifera</i> - <i>Vachellia erioloba</i> - <i>Justicia incana</i> bushveld           |
| 10 |  | <i>Eucalyptus camaldulensis</i> - <i>Prosopis glandulosa</i> bushveld                              |
| 11 |  | <i>Vachellia karroo</i> - <i>Ziziphus mucronata</i> - <i>Searsia viminalis</i> riparian forest     |
|    |  | Infrastructure and disturbance   |



Figure 8. Subassociation 1.1: This subassociation was characterised by the protected species *Aloe claviflora*, *Avonia papyracea* and *Titanopsis calcarea*.



Figure 9. Subassociation 1.2: *Leucosphaera bainesii* was the dominant species in this subassociation.

## **2. *Senegalia mellifera* - *Tetraena rigida* - *Ptychlobium biflorum* shrubveld**

This association was found on the rocky hills in the southwestern part of the study area (Figures 7 & 10). The shallow rocky soils were derived from quartz-muscovite schist and quartz-amphibole schist, with quartz outcrops (veins) and quartz gravel covering the landscape.



Figure 10. Association 2: Dwarf shrub association on the ridges consisting of schist, quartz outcrops and quartz pebbles on the surface.

The diagnostic species included *Aristida diffusa*, *Ptychobium biflorum* and *Peliostomum leucorrhizum* (species group 3, Appendix B). *Senegalia mellifera* (d) and *Boscia albitrunca* were the tree and shrub species occurring in this habitat. The most important dwarf shrub species were *Rhigozum trichotomum* (d), *Tetraena rigida* (d), *Roepera lichtensteiniana*, *Aptosimum spinescens*, *Pteronia sordida*, *Salsola tuberculata*, *Thesium hystrix*, *Pegolettia retrofracta* and *Justicia australis*. The succulents were represented by *Aloe claviflora*, *Euphorbia gariiepina*, *Cynanchum viminalis* and *Kleinia longiflora*. The grass cover was very low, with *Enneapogon scaber*, *Enneapogon desvauxii*, *Stipagrostis anomala* and *Oropetium capense* the most prominent species. The forb species recorded were *Ptychobium biflorum*, *Peliostomum leucorrhizum*, *Barleria lichtensteiniana*, *Sericocoma avolans* and *Blepharis mitrata*.

### 3. *Senegalia mellifera* - *Aptosimum spinescens* - *Stipagrostis anomala* shrubveld

This association was found on the rocky hills in the southwestern part of the study area (Figure 7 & 11). The shallow rocky soils are derived from diabase.

There was no diagnostic species group but *Stipagrostis anomala* was the differential species in this association (Appendix B). *Senegalia mellifera* (d) and *Boscia albitrunca* were the tree and shrub species occurring in this habitat. The most important dwarf shrub species were *Tetraena rigida* (d), *Aptosimum spinescens* (d), *Rhigozum trichotomum* (d), *Aizoon burchellii*, *Leucosphaeria bainsii*, *Roepera lichtensteiniana*, *Pentzia calcarea* and *Justicia australis*. The succulents were represented by *Aloe claviflora* and *Kleinia longiflora*. The grass cover was low with *Stipagrostis anomala*, *Enneapogon scaber*, *Enneapogon desvauxii*, *Stipagrostis obtusa* and *Stipagrostis ciliata* the most prominent species. The forb species recorded were *Acanthopsis hoffmanseggiana* and *Tribulus cristatus*.





Figure 11. Association 3: Shrubveld on the diabase dike in the central part of the study site.

#### 4. *Senegalia mellifera* - *Tetraena rigida* - *Enneapogon desvauxii* dwarf shrubveld

This association was found on the undulating rocky terrain in the southern part of the study area (Figure 7 & 12). The shallow rocky soils were derived from quartz-muscovite schist and quartz-amphibole schist, with quartz outcrops (veins) and quartz gravel covering the landscape.



Figure 12. Association 4: Dwarf shrub association on shallow soils derived from schist, with quartz outcrops and gravel on the surface.

There was no diagnostic species group but the absence of species of species groups 1 - 6 and the prominence of *Senegalia mellifera* and *Tetraena rigida* differentiates this association (Appendix B). *Senegalia mellifera* (d) and *Boscia albitrunca* were the tree and shrub species occurring in this habitat. The most important dwarf shrub species were *Tetraena rigida* (d), *Leucosphaeria bainsii*, *Roepera lichtensteiniana*, *Aptosimum spinescens*, *Aizoon burchellii*, *Pteronia sordida*, *Aptosimum albomarginatum*, *Justicia australis*, *Pegolettia retrofracta*, *Plinthus karoocicus* and *Hermannia spinosa*. The succulents were represented by *Aloe claviflora*, *Kleinia longiflora* and *Euphorbia rhombifolia*. The grass cover was very low, with *Enneapogon scaber*, *Enneapogon*

*desvauxii* and *Stipagrostis obtusa* the most prominent species. The forb species recorded were *Dicoma capensis*, *Barleria lichtensteiniana* and *Acanthopsis hoffmanseggiana*.

#### 5. ***Roepera lichtensteiniana* - *Tetraena decumbens* dwarf shrubland**

This association was found on the plains in the far northern part of the study area (Figure 7 & 13). The shallow rocky and calcareous soils are derived from calcrete, quartz-muscovite schist and quartz-amphibole schist.

The diagnostic species was *Tetraena decumbens* (species group 8, Appendix B). Trees and shrubs were mostly absent with *Senegalia mellifera* and *Boscia albitrunca* sparsely distributed. The most important dwarf shrub species were *Roepera lichtensteiniana* (d), *Salsola tuberculata* (d), *Tetraena decumbens*, *Leucosphaeria bainesii*, *Pteronia sordida*, *Pentzia calcarea*, *Aptosimum spinescens* and *Justicia australis*. The succulents were represented by *Aloe claviflora*, *Kleinia longiflora* and *Euphorbia rhombifolia*. The grass cover was very low, with *Fingerhuthia africana*, *Eragrostis echinocloidea*, *Enneapogon desvauxii*, *Stipagrostis obtusa* and *Cenchrus ciliaris* the most prominent species. The only forb species recorded was *Barleria rigida*.



Figure 13. Association 5: Dwarf shrub association on the calcrete plains in the north of the site.

#### 6. ***Senegalia mellifera* - *Ziziphus mucronata* - *Fingerhuthia africana* shrubveld**

This shrubveld occurred along the rocky ephemeral drainage lines of the study area (Figures 7 & 14). A prominent feature of the drainage lines was the dominance of the shrub *Senegalia mellifera*.

The differential species included *Fingerhuthia africana*, *Lacomucinaea lineata* and *Cadaba aphylla* (Appendix B). *Senegalia mellifera* (d), *Boscia albitrunca*, *Ziziphus mucronata*, *Phaeoptilum spinosum*, *Cadaba aphylla*, *Lycium cinereum* and the alien *Prosopis glandulosa* were the tree and shrub species occurring in this habitat. The most important dwarf shrub species were *Leucosphaeria bainesii*, *Aptosimum spinescens*, *Pentzia calcarea*, *Salsola tuberculata* and *Justicia australis*. The succulents were represented by *Aloe claviflora* and *Kleinia longiflora*. The grass cover was very low, with *Fingerhuthia africana*, *Enneapogon scaber*, *Enneapogon desvauxii*, *Stipagrostis obtusa*, *Stipagrostis uniplumis* and *Cenchrus ciliaris* the most prominent species. The forb species recorded were *Barleria rigida*, *Sericocoma avolans* and *Blepharis mitrata*.



Figure 14. Association 6: Ephemeral drainage lines occur over most of the site away from the Orange River.

#### 7. *Senegalia mellifera* - *Phaeoptilum spinosum* - *Cullen tomentosum* shrubveld

Two small ephemeral pans or depressions were found in the north of the study area. The bare pans were surrounded by a dense tree and shrub layer (Figures 7 & 15). Another site occurred in an old borrow-pit next to the N8 in the southeast of the study area.



Figure 15. Association 7: Ephemeral pan in the northern part of the study site.

The diagnostic species include *Cullen tomentosum*, *Setaria verticillata* and *Justicia divaricata* (species group 12, Appendix B). *Senegalia mellifera* (d), *Phaeoptilum spinosum*, *Cadaba aphylla*, *Boscia albitrunca*, *Lycium cinereum* and the alien *Prosopis glandulosa* were the tree and shrub species occurring in this habitat. Few dwarf shrubs were recorded and included *Justicia divaricatum*, *Salsola tuberculata*, *Leucosphaera bainesii* and *Rhigozum trichotomum*. The only succulent present was *Kleinia longiflora*. The grass cover was very low, with *Setaria verticillata*, *Eragrostis echinochloidea*, *Enneapogon desvauxii* and *Stipagrostis ciliata* the most

prominent species. The forb species recorded were *Cullen tomentosum*, *Barleria rigida* and the alien *Argemone ochroleuca*.

#### 8. *Senegalia mellifera* - *Calobota linearifolia* - *Stipagrostis amabilis* shrubveld

This association was characteristic of the deep aeolian sand of the dunes in the south of the study area (Figures 7 & 16). The longitudinal dunes occurred in a northwest-southeast direction.

The diagnostic species included *Stipagrostis amabilis* (d), *Calobota linearifolia* (d) and *Brachiaria glomerata* (species group 16, Appendix B). *Senegalia mellifera* (d), *Boscia albitrunca*, *Phaeoptilum spinosum*, *Ehretia alba* and *Lycium bosciifolium* were the tree and shrub species occurring in this habitat. The most important dwarf shrub species were *Rhigozum trichotomum* and *Plinthus sericeus*. No succulents were recorded on the dunes. The grass cover was low to moderate, with *Stipagrostis amabilis* the most prominent species. Other grass species included *Stipagrostis obtusa*, *Stipagrostis ciliata*, *Stipagrostis uniplumis* and *Brachiaria glomerata*. Forb species were mostly absent.



Figure 16. Association 8: Dune habitat with *Stipagrostis amabilis* and *Calobota linearifolia*.

#### 9. *Senegalia mellifera* - *Vachellia erioloba* - *Justicia incana* bushveld

This association was located on relatively deep aeolian sandy soils in the valleys and plains to the east of the Orange River in the south of the study area (Figure 7 & 17).

The diagnostic species included *Justicia incana*, *Calobota spinescens* and *Schmidtia kalahariensis* (species group 18, Appendix B). *Vachellia erioloba*, *Senegalia mellifera*, *Boscia albitrunca*, *Phaeoptilum spinosum*, *Ziziphus mucronata* and the alien *Prosopis glandulosa* were the tree and shrub species occurring in this habitat. The most important dwarf shrub species were *Justicia incana*, *Calobota spinescens*, *Plinthus sericeus*, *Pegolettia retrofracta*, *Justicia australis* and *Justicia spartioides*. The only succulent recorded was *Mesembryanthemum coriarium*. The grass cover was moderate, with *Stipagrostis obtusa*, *Stipagrostis ciliata*, *Stipagrostis uniplumis*, *Cenchrus ciliaris* and *Schmidtia kalahariensis* the most prominent species.



Figure 17. Association 9: Plains with deep sand and individuals of *Vachellia erioloba*.

#### 10. *Eucalyptus camaldulensis* - *Prosopis glandulosa* bushveld

This small and relative degraded association was found in and along an ephemeral branch (side-stream) on relatively deep sandy and alluvial soils next to the main riverbank of the Orange River (Figure 7 & 18). This association is floristically related to the riparian forest along the Orange River (see Association 11).



Figure 18. Association 10: Degraded floodplains and drainage line alongside the riparian forest of the river bank.

The differential species included *Vachellia karroo*, *Eucalyptus camaldulensis* and *Pollichia campestris* (species group 22, Appendix B). The tree and shrub species include *Vachellia karroo*, *Eucalyptus camaldulensis*, *Lycium bosciifolium* and *Lycium cinereum*. The most important dwarf shrub species were the succulent *Mesembryanthemum coriarium* and *Pollichia campestris*. The grass cover was very low and the species included *Setaria verticillata*, *Eragrostis echinochloidea*, *Tragus berteronianus* and *Eragrostis porosa*. The forb species recorded were *Coronopus integrifolius* and *Tribulus zeyheri*.

**11. *Vachellia karroo* - *Ziziphus mucronata* - *Searsia viminalis* riparian forest**

This riparian forest occurred on the deep alluvial soils of the riverbank next to the Orange River in the southeast of the study area (Figure 7, 19 & 20).

The diagnostic species included the trees and shrubs *Vachellia karroo* (d), *Eucalyptus camaldulensis* (d), *Searsia viminalis* (d) and *Lycium hirsutum* (species group 23, Appendix B). Other woody species included *Ziziphus mucronata* (d), the alien *Prosopis glandulosa* (d) and *Lycium cinereum*. Very little dwarf shrubs were recorded, with *Asparagus cooperi* and *Pollichia campestris* occurring in places. The grass cover was very low in the riparian forest, with the reed *Phragmites australis* dominating the water's edge. The forb species recorded were *Senecio sisymbriifolius*, *Erucastrum austroafricanum* and the aliens *Chenopodium album*, *Argemone ochroleuca* and *Pergularia daemia*.



Figure 19. Association 11: Riparian forest on the banks of the Orange River.



Figure 20. Association 11: Degraded riparian forest on the banks of the Orange River.

# CHAPTER 6

## VEGETATION AND FLORA

### 6.1 Threats

Development (or change in land use) usually contributes to habitat loss and degradation in many biodiversity important areas. Much of the impact can be minimized through careful planning and avoidance of sensitive areas. In many areas it is not the direct use of biological resources such as subsistence harvesting (especially of medicinal plants) and illegal collection for commercial trade (particularly of groups such as succulents) that is threatening their sustainability, but rather indirect pressures such as changing of land use, land degradation, clearing of indigenous vegetation, overgrazing, invasion of land by alien species, informal settlements, urban development, industrial and agricultural pollution, mining, impoundments, cultivation, water abstraction and climate change. Loss of habitat is therefore regarded as the foremost cause of loss of biodiversity.

### 6.2 Vegetation types

#### 6.2.1 Bushmanland Arid Grassland

The site falls in the Bushmanland Arid Grassland, which covers a large area of the Northern Cape. Although only small patches of this vegetation type are conserved in statutory conservation areas such as the Augrabies Falls National Park and Gogap Nature Reserve, it is classified as "**least threatened**" because little of the area has been transformed (Mucina & Rutherford 2006; NEMA 2011). The biogeographically important taxon is the succulent herb *Tridentea dwequensis*, a Bushmanland endemic. Other endemic species are the succulents *Dinteranthus pole-evansii*, *Larryleachia dinteri*, *Larryleachia marlothii* and *Ruschia kenhardtensis*. Endemic herbs include *Lotononis oligocephala* and *Nemesia maxii*.

*Dinteranthus pole-evansii* was found on site.

#### 6.2.2 Lower Gariep Alluvial Vegetation

This vegetation type covers the Orange River to the southwest of the site and is considered "**endangered**", although 6% is conserved in the Richtersveld and Augrabies Falls National Parks. Some 50% is transformed for agricultural purposes or alluvial diamond mining.

### 6.3 Species richness

Species richness here refers to the number of species per association (or plant community).

Association 1	-	39
Association 2	-	46
Association 3	-	26
Association 4	-	33
Association 5	-	37
Association 6	-	44
Association 7	-	31

Association 8	-	25
Association 9	-	29
Association 10	-	13
Association 11	-	23

The mean species richness for the property is **32** species per plant association.

The mean species per association from a number of other sites along the Orange River is approximately **33 species**. The mean of **32 species** per community in the Groblershoop site is an indication of the relatively moderate species richness of the property, with up to 46 species per community recorded.

#### 6.4 Rare and protected plant species

Red Data species are threatened with extinction and therefore require protection from threatening factors. Species threatened by habitat destruction need to be conserved through mechanisms that conserve the entire ecosystem, where possible.

To determine the status of the flora in the study area the following sources of information were consulted (see Table 5):

- Species lists of the quarter degree grids falling in the study area were drawn from the South African Biodiversity Institute (SANBI) website from the new POSA database;
- Red lists of southern African plants (SANBI: [www.redlist.sanbi.org](http://www.redlist.sanbi.org)) together with the Red List of South African plants (Raimondo *et al.* 2009);
- National Forests Act (Act No 84 of 1998)(revised list 2017);
- National Environmental Management: Biodiversity Act, (Act No 10 of 2004) (ToPS lists) (NEM:BA 2013);
- CITES lists (2017) (Appendices I, II & III) (<https://www.cites.org>); and
- Lists of protected species of the Northern Cape Nature Conservation Act (Act No 9 of 2009) (NCNCA).

##### 6.4.1 Northern Cape Nature Conservation Act 2009 (Act No 9 of 2009)

Lists of Schedules 1 – 6 Flora were consulted and the following species occurring on site are listed (Table 5, Figures 21 - 23):

- Schedule 1 - Specially protected species:

None recorded.

- Schedule 2 - Protected species:

*Aizoon burchellii*  
*Aizoon schellenbergii*  
*Aloe claviflora*  
*Avonia papyracea*  
*Boscia albitrunca*  
*Cynanchum viminalis*  
*Dinteranthus pole-evansii*  
*Euphorbia davyi*  
*Euphorbia rhombifolia*  
*Euphorbia garipeensis*  
*Mesembryanthemum coriarium*



*Plinthus karoicus*  
*Plinthus sericeus*  
*Titanopsis calcarea*

Table 5. Protected and endemic plant species of the site, Groblershoop

Species	Endemic*	NCNCA*			NFA*	CITES* App. II	NEM:BA ToPS*	Red list*
		Sch 1*	Sch 2*	Sch 6*				
<i>Vachellia erioloba</i>					x			DEC*
<i>Aloe claviflora</i>	x		x			x		LC
<i>Argemone ochroleuca</i>				x				
<i>Avonia papyracea</i>	x		x			x		LC
<i>Boscia albitrunca</i>			x		x			LC
<i>Cynanchum viminale</i>			x					LC
<i>Dinteranthus pole-evansii</i>	x		x					<b>VU</b>
<i>Euphorbia davyi</i>			x			x		LC
<i>Euphorbia rhombifolia</i>			x			x		LC
<i>Euphorbia gariepina</i>			x			x		LC
<i>Prosopis glandulosa</i>				x				
<i>Mesembryanthemum coriarium</i>			x					LC
<i>Plinthus karoicus</i>			x					LC
<i>Plinthus sericeus</i>	x		x					LC
<i>Stipagrostis amabilis</i>	x							
<i>Titanopsis calcarea</i>	x		x					LC

\*Endemic: Kalahari/Griqualand West Endemic

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

\*Sch 1: NCNCA Schedule 1: Specially protected species

\*Sch 2: NCNCA Schedule 2: Protected species

\*Sch 6: NCNCA Schedule 6: Alien invasive plant species

\*NFA: Protected trees: National Forest Act (Act No. 84 of 1998).

\*CITES (checklist.CITES.org): Convention on the Trade in Endangered Species of Wild Fauna and Flora

\*NEM:BA (2013) - Draft ToPS list of Threatened or Protected Species

\*Red List of South African plants (Raimondo *et al.* 2009)

\*DEC: Declining

\*VU: Vulnerable

\*LC: Least Concern

- Schedule 3: Common indigenous plant species:

These are all indigenous species except those listed as Schedule 1 and 2 species.

- Schedule 6: Alien invasive plant species

*Prosopis glandulosa* and *Eucalyptus camaldulensis* was particularly dominant in the drainage lines and riparian forest (Associations 10 & 11). *Argemone ochroleuca* was recorded in the riparian forests and surrounding areas (Associations 10 & 11).



Figure 21. *Dinteranthus pole-evansii*, a NCNA protected and endemic species classified as "vulnerable".



Figure 22. *Titanopsis calcarea*, a NCNA protected species.



Figure 23. *Avonia papyracea*, a NCNA protected species and CITES listed species.

#### 6.4.2 Critical Biodiversity Areas (CBAs), Ecological Support Areas (ESAs) and Other Natural Areas (ONAs)

The Orange River and its banks are classified as a CBA1 area, while the remainder of the study site is classified as a CBA2 category (Figure 24). CBAs are areas required to meet biodiversity targets for ecosystems, species or ecological processes and as such development in these areas is discouraged. The site falls in a CBA1 and CBA2 and therefore Activity 12 of Listing Notice 1 (NEMA 2014, 2017; GRN No. 327) is triggered.

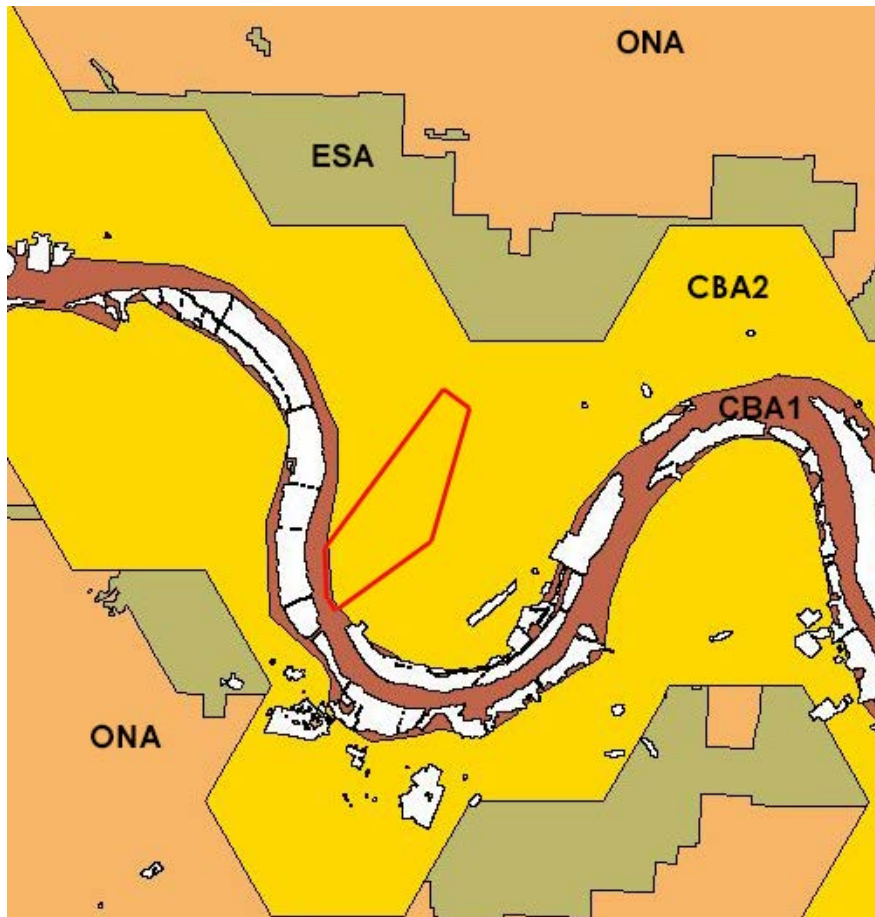


Figure 24. Critical Biodiversity Areas (CBA 1 & CBA2), Ecological Support Areas (ESAs) and Other Natural Areas (ONAs) (Namakwa Biodiversity Sector Plan 2016; biodiversityadvisor.sanbi.org; accessed August 2018). Site boundary indicated in red)

#### 6.4.3 National Environmental Management: Biodiversity Act, (Act 10 of 2004) (ToPS lists) (NEM:BA 2013)

Draft lists of critically endangered, endangered, vulnerable and protected plant species were published under the National Environmental Management, Biodiversity Act (No. 10 of 2004)(NEM:BA 2013). None of the plant species recorded on site are listed.

#### 6.4.4 NewPOSA (SANBI)

*Vachellia erioloba*: Declining (DEC)

All other plant species recorded on site are considered as 'Least Concern' (Table 5, Appendix B), with the exception of *Dinteranthus pole-evansii* that has a **vulnerable** status according to the IUCN Threatened Species criteria.

#### 6.4.5 CITES classification (2017 lists):

Appendix I lists species that are threatened with extinction and CITES prohibits international trade in specimens of these species except when the purpose of the import is not commercial, for instance for scientific research. Appendix II lists species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled. Appendix III is a list of species included at the request of a Party that already regulates trade in the species and that needs the cooperation of other countries to prevent unsustainable or illegal exploitation. Families and genera applicable to the study area are all in the Appendix II category (Table 5).

*Aloe claviflora*  
*Avonia papyracea*  
*Euphorbia davyii*  
*Euphorbia gariiepina*  
*Euphorbia rhombifolia*

#### 6.4.6 Centres of Endemism

The Groblershoop area lies on the southwestern boundary of the Griqualand West Centre of Endemism (GWC)(Van Wyk & Smith (1998). The term endemic refers to a species that is restricted in its distribution and therefore occurs only in a specific region.

In the GWC, the Asclepiadaceae, Euphorbiaceae and Mesembryanthemaceae are well-represented families. The GWC separates the Kalahari Basin from the sediments of the Karoo Supergroup further south. Hence most of the GWC endemics appear to have been derived from the Zambezian and Karoo-Namib Regional Centres of Endemism. Representative endemics include the succulents *Euphorbia bergii*, *Euphorbia rectirama*, *Lithops aucampiae* and *Aizoon asbestinum*, the grass *Digitaria polyphylla* and the shrubs *Searsia tridactyla* and *Tarchonanthus obovatus*.

The area also lies in the Central Upper Karoo area of the Karoo-Namib regional centre of endemism of White (1983). Genera with concentrations of endemic species in the Central Upper Karoo included *Eriocephalus*, *Hermannia*, *Pentzia*, *Phaeoptilum*, *Pteronia* and *Stipagrostis*.

#### 6.4.7 Biogeographically important endemic taxa

The flora of the southern Kalahari is generally species-poor. Less than 2.5% of the total species list of the southern Kalahari is regarded as endemic (Van Rooyen & Van Rooyen 1998). The plant species that have been listed as endemic and/or near-endemic to the southern Kalahari (Van Rooyen & Van Rooyen 1998; Lubbinge 1999; Smit 2000; Mucina & Rutherford 2006) include the trees *Vachellia haematoxylon* and *Acacia luederitzii* var. *luederitzii*, the dwarf shrub *Plinthus sericeus*, the grasses *Antheophora argentea*, *Megaloprotacne albescens*, *Stipagrostis amabilis* and *Panicum kalaharensis*, and the forbs *Helichrysum arenicola*, *Kohautia ramossissima*, *Neuradopsis austro-africana* and *Neuradopsis bechuanicus*.

*Plinthus sericeus* and *Stipagrostis amabilis* were the Kalahari endemic species found on site.

#### 6.4.8 Protected trees (National Forest Act, Act 84 of 1998) (NFA 2017)

*Vachellia erioloba* and *Boscia albitrunca* are the nationally protected tree species on site (Table 5, Figure 25).

The criteria used to select tree species for inclusion in the protected tree list are:

- Red List Status (i.e. rare or threatened species);
- keystone species playing a dominant role in an ecosystem's functioning;
- unsustainability of use;
- cultural or spiritual importance; and
- whether a species is already adequately protected by other legislation.

Permits are required for the utilisation, e.g. harvesting for wood, and medicinal purposes of declared protected trees. The effect of the Act is that no person may cut, disturb, damage or destroy any indigenous, living protected tree in a natural forest; or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, or any forest product derived from a protected tree, except in terms of a license granted by the Minister (or a delegated authority) to an applicant and subject to a period and conditions as may be stipulated. Certain exemptions are also described in the Act. The listing of a tree species as protected does not mean it cannot be used, but the objective is to ensure sustainable use through licensing control measures.

*Vachellia erioloba* is considered as endangered in parts of its range because of over-use (firewood). It is a protected species because of its role as a keystone species in its natural environment, because of its spiritual value and because it is not adequately protected by legislation. It is slow-growing and is estimated to live to about 300 years of age. It increases habitat heterogeneity, increases species richness by providing habitats and services such as nesting for birds, lizards, rodents and other small mammals. It also provides shade, enriches the soil underneath it, and provides suitable microhabitat for shade-tolerant and fleshy-fruited plants. A diverse invertebrate community exists within these trees. Disturbances that fundamentally change the population or size structure of this species are likely to have detrimental effects on both biodiversity pattern and process.



Figure 25. *Vachellia erioloba* usually occurs in deep sand in Associations 4, 7, 8 & 9.

*Boscia albitrunca* is a slow-growing species with non-dormant, endozoochorous seeds with a short life-expectancy (Alias *et al.* 2003). It is a valuable source of shade in arid areas such as the Kalahari where trees are

not always abundant. It is regarded as one of the keystone species in the Kalahari providing habitat for a multitude of other species (Bothma 1982). Furthermore, *Boscia albitrunca* is of great cultural importance, forming an inseparable part of the cultural history of many groups (Bothma 1982). The most important threat to the species is the high browsing pressure and the fact that in times of drought branches are cut as livestock feed.

#### 6.4.9 Disjunct distributions (Van Wyk & Smith 2001)

An intriguing aspect of some taxa is their links with other Gondwana fragments (notably South America) and/or the arid areas in northeast Africa. Examples of genera that occur on site are *Rhigozum* and *Zygophyllum*.

#### 6.4.10 Localities of some of the protected plant species

<i>Aizoon burchellii</i>	-	common in Associations 1 - 6
<i>Aizoon schellenbergii</i>	-	present in Associations 1, 5, 6 & 7
<i>Aloe claviflora</i>	-	widespread in Associations 1- 6
<i>Avonia papyracea</i>	-	S28 51 46.8 E22 00 04.2
<i>Avonia papyracea</i>	-	S28 51 10.9 E22 00 19.9
<i>Avonia papyracea</i>	-	S28 51 43.9 E22 00 05.6
<i>Avonia papyracea</i>	-	S28 50 49.8 E22 00 28.5
<i>Avonia papyracea</i>	-	S28 50 53.3 E22 00 13.9
<i>Avonia papyracea</i>	-	S28 52 05.3 E21 59 44.3
<i>Boscia albitrunca</i>	-	widespread in Associations 1 - 8
<i>Cynanchum viminalis</i>	-	S28 51 44.4 E22 00 01.8
<i>Dinteranthus pole-evansii</i>	-	S28 50 53.3 E22 00 13.9
<i>Euphorbia davyii</i>	-	S28 52 16.6 E21 59 29.1
<i>Euphorbia gariepina</i>	-	present in Associations 1, 2 & 4
<i>Euphorbia rhombifolia</i>	-	common in Associations 1, 2, 4 & 5
<i>Mesembryanthemum coriarium</i>	-	present in Associations 6, 9 & 10
<i>Plinthus karoocicus</i>	-	present in Associations 3 - 6
<i>Plinthus sericeus</i>	-	present in Associations 8 & 9
<i>Titanopsis calcarea</i>	-	S28 51 47.7 E22 00 08.8
<i>Titanopsis calcarea</i>	-	S28 51 46.9 E22 00 08.8
<i>Vachellia erioloba</i> - 7 m, 5 m		S28 52 13.4 E21 59 16.2
<i>Vachellia erioloba</i> - 6 m, 6 m		S28 52 30.0 E21 59 27.9
<i>Vachellia erioloba</i> - 5 m		S28 52 20.5 E21 59 20.6
<i>Vachellia erioloba</i> - 6.5 m, 8 m, 7.5 m		S28 52 20.9 E21 59 17.3
<i>Vachellia erioloba</i> - 8 m, 6.5 m, 6 m, 5 m, 6 m, 7 m		S28 52 15.9 E21 59 38.3
<i>Vachellia erioloba</i> - 6 m, 7 m		S28 52 10.6 E21 59 40.6

# CHAPTER 7

## ALIEN AND INVASIVE PLANT SPECIES

### 7.1 Alien and Invasive Species (AIS) Regulations

Chapter 5 of NEM:BA provides for the protection of biodiversity from alien and invasive species. The act defines alien species and contemplates the listing of invasive species in regulations. As for ToPS, the act defines certain activities that are restricted in connection with declared listed alien or invasive species which include, among others, importing, exporting, growing, breeding, transporting and selling those species, and would therefore require Environmental Authorisation.

The Alien and Invasive Species (AIS) Regulations, in terms of Section 97(1) of NEM:BA, was published in Government Notice R598 in Government Gazette 37885 dated 1 August 2014. The Alien and Invasive Species (AIS) lists in terms of sections 66(1), 67(1), 70(1)(a), 71(3) and 71A of NEM:BA was subsequently published in Government Notice R 864 of 29 July 2016.

### 7.2 Categories

In terms of the aforementioned legislation, the following categories of declared alien and invasive plants are recognised in South Africa:

1. **Exempted Alien Species** means an alien species that is not regulated in terms of this statutory framework - as defined in Notice 2 of the AIS List.
2. **Prohibited Alien Species** mean an alien species listed by notice by the Minister, in respect of which a permit may not be issued as contemplated in section 67(1) of the act. These species are contained in Notice 4 of the AIS List, which is referred to as the List of Prohibited Alien Species (with freshwater fish in List 7 of Notice 4).
3. **Category 1a Listed Invasive Species** mean a species listed as such by notice in terms of section 70(1)(a) of the act, as a species that must be combatted or eradicated. These species are contained in Notice 3 of the AIS List, which is referred to as the National Lists of Invasive Species. Landowners are obliged to take immediate steps to control Category 1a species.
4. **Category 1b Listed Invasive Species** mean species listed as such by notice in terms of section 70(1)(a) of the act, as species that must be controlled or 'contained'. These species are contained in Notice 3 of the AIS List, which is referred to as the National Lists of Invasive Species. However, where an Invasive Species Management Programme has been developed for a Category 1b species, then landowners are obliged to "control" the species in accordance with the requirements of that programme. Therefore, Category 1a triggers an immediate obligation to control, whereas that obligation only comes into effect for Category 1b species when an Invasive Species Management Programme is implemented for that species in the specific area.
5. **Category 2 Listed Invasive Species** mean species listed by notice in terms of section 70(1)(a) of the act, as species that require a permit to carry out a restricted activity e.g. cultivation within an area specified in the Notice or an area specified in the permit, as the case may be. Category 2 includes plant species that have economic, recreational, aesthetic or other valued properties, notwithstanding their invasiveness. It is important to note that a Category 2 species that falls outside the demarcated area specified in the permit,

becomes a Category 1b invasive species. Permit-holders must take all the necessary steps to prevent the escape and spread of the species.

6. **Category 3 Listed Invasive Species** mean species listed by notice in terms of section 70(1)(a) of the act, as species that are subject to exemptions in terms of section 71(3) and prohibitions in terms of section 71A of act, as specified in the notice. Category 3 species are less-transforming invasive species which are regulated by activity. The principal focus with these species is to ensure that they are not introduced, sold or transported. However, Category 3 plant species are automatically Category 1b species within riparian and wetland areas.

The following is a preliminary list of declared alien and invasive plant species recorded on site:

<i>Argemone ochroleuca</i>	Category 1b
<i>Eucalyptus camaldulensis</i>	Category 1b
<i>Prosopis glandulosa</i>	Category 3

Alien invaders should be controlled by mechanical and/or chemical means. Mechanical means include ringbarking (girdling), uprooting, chopping, slashing and felling. An axe or chain saw or brush cutter can be used. Stumps or ring-barked stems should be treated immediately with a chemical weedkiller. Follow-up treatment is usually needed.



## CHAPTER 8

# ECOLOGICAL SENSITIVITY ANALYSIS

### 8.1 Introduction

Sensitivity is the vulnerability of a habitat to any impact, for example a dune, wetland or ridge system would be more vulnerable to development than would a sandy plain. Several features of a site can be identified and assessed to derive a sensitivity score, e.g.:

- threatened status of the regional vegetation type wherein the proposed site is situated;
- percentage of red list plant species per association or site;
- number of protected tree species per association or site;
- percentage of provincially protected plant species;
- percentage of endemic plant species per association or site (endemic to vegetation type);
- conservation value of association (habitat) or site;
- species richness per plant association or per sample plot (number of plant species);
- degree of connectivity and/or fragmentation of the habitat, i.e. high connectivity and low fragmentation infers a low rating;
- soil erosion potential; and
- resilience (this is a measure of the ability of a particular habitat/plant community to recover after an impact, i.e. high resilience infers low rating).

An **overall sensitivity model** (Table 7) is developed for each plant community on site. This is achieved by weighting each criterion and calculating the sum for the association, which reflects the sensitivity and sensitivity ranking

The parameters that were used to allocate the different categories of sensitivity (very low, low, moderate, high and very high) were the following:

1. Threatened status of the ecosystem (depends on the percentage area intact, or degree of transformation) (Driver *et al.* 2005, Mucina & Rutherford 2006, NEM:BA 2011).

The ecosystems are classified into the following categories:

**Low sensitivity:** If “Least Threatened”, the vegetation type has most of its habitat intact, i.e. more than 80%; or the vegetation type is adequately statutory or formally conserved in parks and reserves.

**Moderate sensitivity:** If “Vulnerable”, the vegetation type has from 60% to 80% of the ecosystem intact; less than 40% has been transformed which could result in some ecosystem functioning being altered, and/or the ecosystem is statutory poorly conserved. For example, the vegetation type is rich in plant species but is not a pristine example of a vegetation type, therefore some transformation or disturbance occurred, such as human structures and degraded veld due to overgrazing and/or bush encroachment.

High sensitivity: If “Endangered”, the vegetation type has from 40% to 60% of the ecosystem intact; or 40% to 60% transformed due to disturbance, cultivation or alien species; or the ecosystem is statutory poorly conserved e.g. less than about 3% conserved.

Very high sensitivity: If “Critically Endangered”, the vegetation type has only 16% to 36% of the ecosystem intact. The richer the ecosystem is in terms of species, the higher the percentage threshold.

*Category rating:*

Low	(LT)	= 1
Moderate	(VU)	= 2
High	(EN)	= 3
Very high	(CE)	= 4

- Percentage of red list plant species (listed higher than ‘least concern’, LC)(Raimondo *et al.* 2009).

The sensitivity scale ranges from none, low, moderate to high and the rating is determined by the presence of rare flora in a plant community (calculated as percentage of the mean number of species per association).

*Category rating:*

None	(0%)	= 0
Low	(>0 – 2%)	= 1
Moderate	(>2 – 5%)	= 2
High	(>5%)	= 3

- Presence of protected tree species (National Forests Act, Act No. 84 of 1998; NFA 2015)

The presence of protected tree species in a vegetation type is rated as low, moderate or high. This rating depends on the availability of habitat in the community and the protection and management guidelines for these species and guidelines for biodiversity offsets of the Department of Agriculture, Forestry and Fisheries, DAFF).

*Category rating:*

None	(0 species)	= 0
Low	(1 - 2 species)	= 1
Moderate	(3 – 4 species)	= 2
High	(>4 species)	= 3

- Presence of Northern Cape protected plant species (Northern Cape Nature Conservation Act, Act No. 9 of 2009):

The presence of protected species in a vegetation type is rated as low, moderate or high depending on the number of protected species as percentage of the total plant species per association.

*Category rating:*

None	(0%)	= 0
Low	(>0 - 5%)	= 1
Moderate	(>5 – 10%)	= 2
High	(>10%)	= 3

5. Percentage of plant species endemic to the regional vegetation types (Van Wyk & Smith 2001; Mucina & Rutherford 2006).

The presence of endemic species should be considered as low, moderate to high, depending on the availability of habitat in the community. The number of species is expressed as a percentage of the number of species per association. *Aloe claviflora*, *Avonia papyracea*, *Dinteranthus pole-evansii*, *Plinthus sericeus*, *Stipagrostis amabilis* and *Titanopsis calcarea* are the endemic species in the region.

*Category rating:*

None	(0%)	= 0
Low	(>0 - 2%)	= 1
Moderate	(2–5%)	= 2
High	(>5%)	= 3

6. Conservation value of the terrain type and/or habitat.

The criteria are low, moderate and high. The presence of e.g. quartzitic outcrops, ridges, wetlands and dunes should be considered to have a moderate to high conservation value. However, this should be seen in the context of the presence of representative habitat in the broader region or in conservation areas.

*Category rating:*

Low		= 1
Moderate		= 2
High		= 3

7. Species richness per association

The species-richness (number of species per association) will depend on the region, climate, topography, ecosystem and degree of transformation. The scale ranges from low, moderate to high.

*Category rating:*

Low	(<30)	= 1
Moderate	(30 – 50)	= 2
High	(>50)	= 3

8. Degree of connectivity and/or fragmentation of the ecosystem

The degree of connectivity with surrounding or adjacent natural areas and/or fragmentation of plant communities, is indicated as low, moderate or high, e.g. high connectivity with surrounding similar habitat, or low fragmentation of habitat is considered as having a low value (1).

*Category rating (note reverse order):*

Low		= 3
Moderate		= 2
High		= 1

9. Erosion potential of the soil

The erosion potential of the soil is indicated as low, moderate or high, e.g. coarse sandy soils on plains have a low erosion potential.

*Category rating:*

- Low = 1
- Moderate = 2
- High = 3

10. Resilience is a measure of the ability of a particular habitat/plant community to recover after an impact, i.e. high resilience infers low value (1).

*Category rating (note reverse order):*

- Low = 3
- Moderate = 2
- High = 1

**8.2 Weighting of sensitivity criteria**

- Threatened status of the vegetation type = x5
- Percentage of red list plant species = x4
- Number of NFA protected tree species = x3
- Percentage of NCNCA protected species = x4
- Percentage of endemic species = x2
- Conservation value (habitat) = x4
- Plant community species richness = x2
- Degree of connectivity/fragmentation of habitat = x2
- Erosion = x2
- Resilience = x3

**8.3 Sensitivity rating**

- ≤30 = very low (VL) (rating scale = 1)
- 31 – 40 = low (L) (rating scale = 2)
- 41 – 50 = moderate (M) (rating scale = 3)
- 51 – 65 = high (H) (rating scale = 4)
- >65 = very high (VH) (rating scale = 5)

Table 7. Sensitivity of the plant communities of the Groblershoop site (see Figure 26)

Plant communities	1	2	3	4	5	6	7	8	9	10	11
Threatened status (x5)	5	5	5	5	5	5	5	5	5	15	15
% Red data species (x4)	8	0	0	8	0	0	8	8	8	0	0
Number protected trees (x3)	3	3	3	3	3	3	3	3	3	0	0
% NCNCA species (x4)	12	12	12	12	12	12	8	8	8	8	0
% Endemic species (x2)	6	4	4	4	4	4	0	6	4	0	0
Conservation value (x4)	12	12	4	8	4	8	4	12	8	8	12
Species richness (x2)	4	4	2	4	4	4	4	2	2	2	2
Connectivity (x2)	2	2	2	2	2	2	6	2	2	4	4
Erosion (x2)	2	2	2	2	2	2	2	2	2	6	6
Resilience (x3)	6	3	3	3	3	3	6	6	6	3	3
Sum:	60	47	37	51	39	43	46	54	48	46	42
Sensitivity rating:	H	M	L	H	L	M	M	H	M	M	M

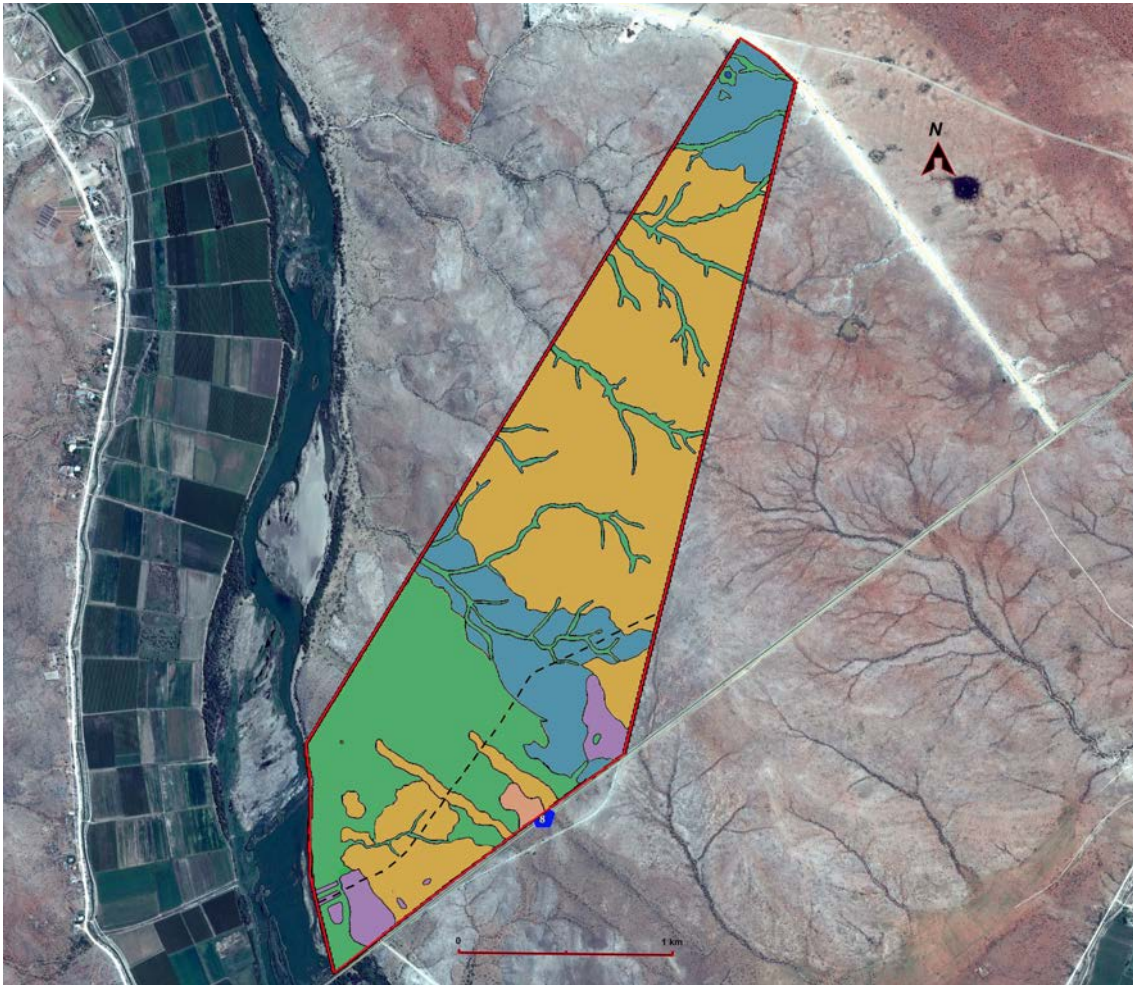
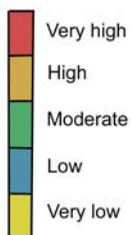


Figure 26. Sensitivity map of the Groblershoop site based on the plant associations identified for the site (see Figure 7). The purple units indicate infrastructure and/or disturbed areas.

**Legend:**



Overall, the sensitivity rating of the associations on site ranged from low (L), through moderate (M) to high (H). The associations with a high sensitivity were associations 1, 4 and 8.

#### 8.4 Sensitivity rating

**Very low** sensitivity is applicable to habitats that have been transformed previously, especially by human activities. **Low** sensitivity means the sensitivity is not significant enough and should not have an influence on the decision about the project. However, any protected species may not be removed/destroyed without a permit. **Moderate** means a sensitivity rating that is real and sufficiently important to require management, e.g. management or protection of the rare/threatened fauna and flora, protection of the specific habitat on the

property and/or rehabilitation. **High** means a sensitivity rating where the habitat should be excluded from any development. **Very high** means a sensitivity rating that should influence the decision whether or not to proceed with the project.

# CHAPTER 9

## ASSESSMENT OF SIGNIFICANCE OF ENVIRONMENTAL IMPACTS

### 9.1 Introduction

As with all land-uses, there are environmental impacts associated with the resort development, road building and clearance of indigenous vegetation. These include the following:

- Streamflow is often interrupted and an uninterrupted streamflow is crucial for the maintenance of riparian habitats and wetlands.
- Roads may potentially increase sediment loads and disrupt water flow patterns.
- Physical disturbance of soils and removal of natural vegetation cover, result in erosion and in many instances invasion by alien plant species.
- Removal, transplanting or destruction of rare and protected plant species may not proceed without authorisation.

### 9.2 Impacts

Construction phase

#### 9.2.1 Direct impacts of the resort development

- Major clearing of vegetation in Association 10 occurred on the site of the resort development.
- Some clearing was done in Association 11 (Riparian forest on the banks of the Orange River) for entertainment infrastructure and total clearing for ESKOM power lines.
- Minimal disturbance occurred during the upgrading of parts of the fence around the property.
- Wind and water erosion may occur along access roads and the development site because of the removal of vegetation and exposure of the soil surface. The road along the ephemeral branch of the Orange River (Association 10), may present major problems during flooding events.
- Increased dust levels during construction.
- Loss of faunal habitat, especially along the Orange River.

#### 9.2.2 Indirect impacts

- Loss of biodiversity.
- Alien plant species might invade the disturbed areas, especially along the Orange River.
- Increased dust levels might negatively affect the plant growth.

#### 9.2.3 Cumulative impacts

- Further infrastructure development e.g. resort (lodge), water pumps, water pipe lines, power lines and access roads would increase the impact in the Critical Biodiversity Area;
- the spread of weedy and alien invasive plant species due to disturbance at the site; and

- potential increases in water runoff leading to erosion will contribute to negative impacts on the riparian ecosystem and may lead to a further loss of habitat for indigenous fauna and flora.

#### 9.2.4 Residual impacts

Residual impacts should be low if the mitigation and rehabilitation measures are applied and alien invasive species are controlled.

### 9.3 Significance of impacts

The significance of environmental impacts is assessed by means of the criteria of **intensity** and **duration** (severity), **certainty** (probability) and **scale** (extent) (Table 8).

**Severity** is calculated from the ratings given to intensity and duration of the impact. Reversibility should be evaluated along with intensity and is the ability of the impacted environment to return to its pre-impacted state once the cause of the impact has been removed.

An **intensity** ( $\alpha$ ) (magnitude) rating is awarded to each impact as follows:

- Low intensity – the ecosystem pattern, process and functioning are minimally affected and a minor impact may occur.  
Rating = 1
- Moderate intensity – valued, important, sensitive or vulnerable systems or communities are negatively affected but ecosystem pattern, process and functions can continue albeit in a slightly modified way.  
Rating = 2
- High intensity – environment affected to the extent that the ecosystem pattern, process and functions are altered and may even temporarily or permanently cease. Valued, important, sensitive or vulnerable systems, communities or species are substantially affected.  
Rating = 4

The **duration** rating ( $\beta$ ) is awarded as follows:

- Short term – up to 5 years  
Rating = 2
- Moderate term - >5 – 15 years  
Rating = 3
- Long term – >15 – 30 years: The impact will occur during the operational life of the activity, and recovery may occur with mitigation (restoration and rehabilitation).  
Rating = 4
- Permanent – the impact will destroy the ecosystem functioning and mitigation (restoration and rehabilitation) will not contribute in such a way or in such a time span that the impact can be considered transient.  
Rating = 5



**Scale rating ( $\delta$ ):**

Site specific	= 1
Local (surrounding areas)	= 3
Regional (provincial)	= 5

**Certainty ( $\epsilon$ )** describes the probability or likelihood of the impact actually occurring, and is rated as follows:

- **Improbable** – where the impact is unlikely to occur, either because of design, mitigation or historic experience.  
Rating = 1
- **Probable** - there is a good probability that the impact will occur (<50% chance of occurring).  
Rating = 3
- **Highly probable** - most likely that the impact will occur (50 – 90% chance of occurring).  
Rating = 4
- **Definite** – the impact will occur regardless of any prevention or mitigating measures (>90% chance of occurring).  
Rating = 5

The **significance rating** is determined through a synthesis of the characteristics described above where:

$$S = (\alpha + \beta + \delta) * \epsilon$$

Table 8. Significance assessment of impacts on the plant associations on site

	Plant associations										
	1	2	3	4	5	6	7	8	9	10	11
Intensity ( $\alpha$ )	1	1	1	1	3	1	1	2	1	3	2
Duration ( $\beta$ )	2	2	2	2	2	2	2	4	2	4	4
Scale ( $\delta$ )	1	1	1	1	1	1	1	1	1	1	3
Certainty ( $\epsilon$ )	1	1	1	1	4	1	1	4	1	5	5
<b>Significance (<math>\alpha+\beta+\delta</math>)*<math>\epsilon</math>:</b>	4	4	4	4	24	4	4	28	4	40	45
<b>Significance rating:</b>	L	L	L	L	L	L	L	L	L	M	M

The significance of the impact ranges from Low to Moderate for the site. The associations that will bear the brunt of the development are 10 and 11, and partially in 8. The significance rating for Associations 8 was considered to be low, with the significance rating for Associations 10 and 11 being moderate. Since the latter associations are part of an endangered vegetation type and located within a CBA, mitigation measures should be strictly followed to avoid harmful impacts.

The **significance rating** should influence the development project as follows:

- **Low significance** (significance rating <30)  
  
If the negative impacts have little real effects it should not have an influence on the decision to proceed with the project.
- **Moderate significance** (significance rating 30 - 60)

Negative impact: it implies that the impact is real and sufficiently important to require mitigation and management measures before the proposed project can be approved.

- High significance (significance rating >60)

Negative impact: this should weigh towards a decision to terminate the project, or mitigation should be formulated and performed to reduce significance to at least a moderate significance rating. In these circumstances the environmental resources have mostly been destroyed and the capacity of the environmental resources in the area to respond to change and withstand further stress has been or is close to being exceeded. If mitigation cannot be effectively implemented, the proposed activity should be terminated.

#### 9.4 SUMMARY OF IMPACTS:

##### 9.4.1 CONSTRUCTION PHASE: CURRENT DEVELOPMENT

Development of the resort already started and the impacts of the constructions are summarised below (Tables 9 - 13).

Table 9: Impact of current development on **natural vegetation** during the construction phase

	Without mitigation	With mitigation
<b>Scale (<math>\delta</math>)</b>	Site specific (1)	Site specific (1)
<b>Duration (<math>\beta</math>)</b>	Long-term (4)	Long-term (4)
<b>Intensity (<math>\alpha</math>)</b>	Moderate (2)	Moderate (2)
<b>Certainty (<math>\epsilon</math>)</b>	Definite (5)	Definite (5)
<b>Significance (<math>\alpha+\beta+\delta</math>)*<math>\epsilon</math></b>	<b>Moderate (35)</b>	<b>Moderate (35)</b>
<b>Status (positive, neutral or negative)</b>	Negative	Negative
<b>Reversibility</b>	Partially reversible	Partially reversible
<b>Irreplaceable loss of resources?</b>	Partially replaceable	Replaceable
<b>Can impacts be mitigated?</b>	Low degree	
<b>Mitigation:</b>		
<ul style="list-style-type: none"> <li>• Vegetation clearing for the current infrastructure has already been done.</li> <li>• No alien invasive plant species may be used for landscaping and gardening and indigenous species should be used wherever possible.</li> <li>• The denuded and disturbed areas should be re-vegetated or rehabilitated.</li> </ul>		
<b>Direct impacts:</b>		
<ul style="list-style-type: none"> <li>• <b>It should be noted that the 32 m buffer zone from the water's edge was not always observed (Figure 32). Furthermore, a road was constructed in a water course (Figure 31).</b></li> <li>• Loss of indigenous vegetation on the footprint of the development.</li> <li>• Loss of faunal habitat.</li> </ul>		
<b>Indirect impacts:</b>		
<ul style="list-style-type: none"> <li>• Loss of biodiversity.</li> <li>• Development in a Critical Biodiversity Area.</li> </ul>		

<ul style="list-style-type: none"> <li>• Replacement of indigenous vegetation with cultivated lawns.</li> <li>• Increased human presence that will negatively affect animal behaviour.</li> </ul>
<p><b>Cumulative impacts:</b></p> <p>Additional infrastructure development and the spread of alien invaders due to loss of natural vegetation will exacerbate the negative impact of the development on the vegetation and will lead to a loss of habitat for indigenous fauna and flora.</p> <p>The Lower Gariep Alluvial Vegetation has a national conservation status of 'endangered'. Only 6% of the vegetation type is statutorily conserved and some 50% of this vegetation type has already been transformed.</p>
<p><b>Residual impacts:</b></p> <ul style="list-style-type: none"> <li>• Loss of indigenous vegetation has already occurred.</li> </ul>

#### 9.4.2 CONSTRUCTION PHASE: FUTURE DEVELOPMENT

Table 10: Impact of future development on **natural vegetation** during the construction phase

	Without mitigation	With mitigation
<b>Scale (<math>\delta</math>)</b>	Site specific (1)	Site specific (1)
<b>Duration (<math>\beta</math>)</b>	Long-term (4)	Long-term (4)
<b>Intensity (<math>\alpha</math>)</b>	Moderate (2)	Low (1)
<b>Certainty (<math>\epsilon</math>)</b>	Definite (5)	Definite (5)
<b>Significance (<math>\alpha+\beta+\delta</math>)*<math>\epsilon</math></b>	<b>Moderate (35)</b>	<b>Moderate (30)</b>
<b>Status (positive, neutral or negative)</b>	Negative	Negative
<b>Reversibility</b>	Partially reversible	Partially reversible
<b>Irreplaceable loss of resources?</b>	Partially replaceable	Replaceable
<b>Can impacts be mitigated?</b>	Low degree	
<p><b>Mitigation:</b></p> <ul style="list-style-type: none"> <li>• Development should be contained within the proposed footprint of the development and unnecessary disturbance adjacent to the site should be avoided.</li> <li>• Minimise further clearance of natural vegetation and disturbance along the Orange River and its tributaries. A permit has to be obtained from NCDENC and/or DAFF for the removal or transplanting of protected plant species.</li> <li>• The indigenous vegetation, and especially the indigenous trees, should be retained as far as possible and buildings should be placed between trees. Protected trees should be conserved and not destroyed. The denuded and disturbed areas should be re-vegetated with indigenous species as soon as possible.</li> <li>• No firewood collection may be allowed.</li> <li>• No protected trees may be damaged or cut without a permit.</li> <li>• No alien invasive plant species may be used for landscaping and gardening.</li> <li>• Existing and dedicated roads should be marked and utilised by vehicles and random driving in the veld or on dunes should be prohibited.</li> </ul>		

<ul style="list-style-type: none"> <li>• Implement a monitoring program for the early detection of alien invasive plant species. The control program to combat declared alien invasive plant species should be continued during the operational phase.</li> <li>• Any areas that will be denuded as a result of activities on site, should be re-vegetated (rehabilitated) as soon as possible to prevent soil erosion and establishment of alien invasive plant species.</li> </ul>
<p><b>Direct impacts:</b></p> <ul style="list-style-type: none"> <li>• Major loss of indigenous vegetation on the footprint of the development.</li> <li>• Increased dust levels.</li> <li>• Loss of faunal habitat.</li> </ul>
<p><b>Indirect impacts:</b></p> <ul style="list-style-type: none"> <li>• Loss of biodiversity.</li> <li>• Some disturbance will inevitably occur in the direct surroundings of the site.</li> <li>• As a result of the loss of vegetation seed production and propagation of indigenous plants will be reduced.</li> <li>• Increased dust levels during construction might negatively affect the plant growth.</li> </ul>
<p><b>Cumulative impacts:</b></p> <p>Additional infrastructure development and the spread of alien invaders due to loss of natural vegetation will exacerbate the negative impact of the development on the vegetation and will lead to a loss of habitat for indigenous fauna and flora.</p> <p>The Lower Gariep Alluvial Vegetation has a national conservation status of ‘endangered’. Only 6% of the vegetation type is statutorily conserved and some 50% of this vegetation type has already been transformed. The proposed development lies in a Critical Biodiversity Area and development in these areas is generally discouraged.</p>
<p><b>Residual impacts:</b></p> <ul style="list-style-type: none"> <li>• Despite mitigation measures some loss of the vegetation will occur.</li> </ul>

Table 11: Impact of future development on **alien vegetation** during the construction phase

	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Scale (<math>\delta</math>)</b>	Local (3)	Site specific (1)
<b>Duration (<math>\beta</math>)</b>	Long-term (4)	Long-term (4)
<b>Intensity (<math>\alpha</math>)</b>	Moderate (2)	Low (1)
<b>Certainty (<math>\epsilon</math>)</b>	Highly probable (4)	Probable (3)
<b>Significance (<math>\alpha+\beta+\delta</math>)*<math>\epsilon</math></b>	<b>Moderate (36)</b>	<b>Low (18)</b>
<b>Status (positive, neutral or negative)</b>	Negative	Positive
<b>Reversibility</b>	Partially reversible	Partially reversible
<b>Irreplaceable loss of resources?</b>	n.a.	
<b>Can impacts be mitigated?</b>	Yes	

<p><b>Mitigation:</b></p> <ul style="list-style-type: none"> <li>• Development should be restricted to the proposed development site and the disturbance to the surrounding natural or indigenous vegetation be kept to a minimum.</li> <li>• Establish a monitoring program for the early detection and control of alien invasive plant species.</li> <li>• No alien invasive species should be used in landscaping or gardens on the site.</li> </ul>
<p><b>Direct impacts:</b></p> <ul style="list-style-type: none"> <li>• As a result of the loss of indigenous vegetation and resulting disturbance, declared alien species might invade the area. Removal of alien invasive plant species should be encouraged.</li> </ul>
<p><b>Indirect impacts:</b></p> <ul style="list-style-type: none"> <li>• Disturbance will favour alien species and without follow-up control, alien species may spread through the area.</li> <li>• Removal of alien species and the rehabilitation of the habitat may favour indigenous plant species.</li> </ul>
<p><b>Cumulative impacts:</b></p> <ul style="list-style-type: none"> <li>• The establishment of declared weedy and alien invasive plant species on the disturbed site could lead to their spread into the surrounding natural vegetation and onto neighbouring properties. Their presence may also slow down the recovery of the natural vegetation.</li> </ul>
<p><b>Residual impacts:</b></p> <p>Low residual impact if the declared weedy and alien invasive species are controlled.</p>

#### 9.4.3 SUMMARY OF IMPACTS: OPERATIONAL PHASE

Table 12: Impact of development of **natural vegetation** during the operational phase

	Without mitigation	With mitigation
<b>Scale (<math>\delta</math>)</b>	Site specific (1)	Site specific (1)
<b>Duration (<math>\beta</math>)</b>	Long-term (4)	Long-term (4)
<b>Intensity (<math>\alpha</math>)</b>	Low (2)	Low (1)
<b>Certainty (<math>\epsilon</math>)</b>	Highly probable (4)	Probable (3)
<b>Significance (<math>\alpha+\beta+\delta</math>)*<math>\epsilon</math></b>	<b>Low (28)</b>	<b>Low (18)</b>
<b>Status (positive, neutral or negative)</b>	Negative	Negative
<b>Reversibility</b>	Partially reversible	Partially reversible
<b>Irreplaceable loss of resources?</b>	Replaceable	Replaceable
<b>Can impacts be mitigated?</b>	Low degree	
<p><b>Mitigation:</b></p> <ul style="list-style-type: none"> <li>• The indigenous vegetation, and especially the trees, should be retained as far as possible and buildings should be placed between trees. Protected trees should be conserved and not destroyed. The denuded and disturbed areas should be re-vegetated with indigenous species as soon as possible.</li> </ul>		

<ul style="list-style-type: none"> <li>• No collection of firewood may be allowed.</li> <li>• No protected trees may be damaged or cut.</li> <li>• No invasive alien plant species should be used for landscaping and gardening.</li> <li>• Environmental code of conduct for all staff and visitors should be developed.</li> <li>• Existing and dedicated roads should be marked and utilised by vehicles and random driving in the veld or on dunes should be prohibited.</li> <li>• Any areas that will be denuded as a result of activities on site, should be re-vegetated (rehabilitated) as soon as possible to prevent soil erosion and establishment of alien invasive plant species.</li> </ul>
<p><b>Direct impacts:</b></p> <ul style="list-style-type: none"> <li>• Major loss of indigenous vegetation has occurred during the construction phase and loss of indigenous vegetation during the operational phase should be avoided.</li> <li>• Loss of faunal habitat.</li> <li>• Development in a Critical Biodiversity Area.</li> <li>• Replacement of indigenous vegetation with cultivated lawns.</li> <li>• Increased human presence that will negatively affect animal behaviour.</li> </ul>
<p><b>Indirect impacts:</b></p> <ul style="list-style-type: none"> <li>• Loss of biodiversity.</li> <li>• Some disturbance will inevitably occur in the direct surroundings of the site.</li> </ul>
<p><b>Cumulative impacts:</b></p> <p>Additional infrastructure development and the spread of alien invaders due to loss of natural vegetation will exacerbate the negative impact of the development on the vegetation and will lead to a loss of habitat for indigenous fauna and flora.</p> <p>The Lower Gariep Alluvial Vegetation has a national conservation status of 'endangered'. Only 6% of the vegetation type is statutorily conserved and some 50% of this vegetation type has already been transformed. The proposed development lies in a Critical Biodiversity Area and development in these areas is generally discouraged.</p>
<p><b>Residual impacts:</b></p> <p>None, if mitigation is successful in avoiding all further disturbance to the natural vegetation.</p>

**Table 13.** Impact of development on **alien vegetation** during the operational phase

	<b>Without mitigation</b>	<b>With mitigation</b>
<b>Scale (<math>\delta</math>)</b>	Local (3)	Site specific (1)
<b>Duration (<math>\beta</math>)</b>	Long-term (4)	Long-term (4)
<b>Intensity (<math>\alpha</math>)</b>	Moderate (2)	Low (1)
<b>Certainty (<math>\epsilon</math>)</b>	Probable (3)	Probable (3)
<b>Significance (<math>\alpha+\beta+\delta</math>)*<math>\epsilon</math></b>	<b>Low (27)</b>	<b>Low (18)</b>
<b>Status (positive, neutral or negative)</b>	Negative	Positive
<b>Reversibility</b>	Partially reversible	Partially reversible
<b>Irreplaceable loss of resources?</b>	n.a.	

<b>Can impacts be mitigated?</b>	Yes	
<b>Mitigation:</b>		
<ul style="list-style-type: none"> <li>• Establish a monitoring program for the early detection and control of alien invasive plant species.</li> <li>• No alien invasive species should be used in landscaping or gardens on the site.</li> </ul>		
<b>Direct impacts:</b>		
<ul style="list-style-type: none"> <li>• As a result of the loss of indigenous vegetation and resulting disturbance, declared alien species might invade the area. Removal of alien invasive plant species should be encouraged.</li> </ul>		
<b>Indirect impacts:</b>		
<ul style="list-style-type: none"> <li>• Disturbance will favour alien species and without follow-up control, alien species may spread through the area.</li> <li>• Removal of alien species and the rehabilitation of the habitat may favour indigenous plant species.</li> </ul>		
<b>Cumulative impacts:</b>		
<ul style="list-style-type: none"> <li>• The establishment of declared weedy and alien invasive plant species on the disturbed site could lead to their spread into the surrounding natural vegetation and onto neighbouring properties. Their presence may also slow down the recovery of the natural vegetation.</li> <li>•</li> </ul>		
<b>Residual impacts:</b>		
Low residual impact if the declared weedy and alien invasive species are controlled.		

## CHAPTER 10

### DISCUSSION

#### 10.1 Vegetation type (regional)

The property falls in the Lower Gariep Alluvial Vegetation and Bushmanland Arid Grassland. The Lower Gariep Alluvial Vegetation is classified as "**endangered**" (NEMA (2011). About 6% is statutorily conserved in the Richtersveld and Augrabies Falls National Parks and about 50% transformed for agricultural purposes and alluvial diamond mining. Some clearing of vegetation for the resort occurred in the riparian vegetation (Figure 27). Two strips of riparian vegetation on the river bank have already been cleared for power lines (Figures 28 & 29). Therefore, further development in the riparian habitat must be discouraged or limited to the minimum.



Figure 27. Development in the riparian habitat of the Orange River.

Although only small patches of the Bushmanland Arid Grassland is conserved in statutory conservation areas such as the Augrabies Falls National Park, it is classified as '**least threatened**' because little of the area has been transformed and covers large areas of the Northern Cape (NEMA 2011). Most of this vegetation type on the property is undisturbed at present besides the clearance of vegetation underneath ESKOM power lines that dissect the site. The proposed racetrack and other associated development in the central parts of the site should be concentrated in the already disturbed areas (borrow-pit terrain) (Figure 30).





Figure 28. Clearing of the riparian habitat for first ESKOM power line.



Figure 29. Clearing of the riparian habitat for second ESKOM power line.



Figure 30. Borrow-pit disturbed area where the racetrack and associated infrastructure is to be developed.

## 10.2 Terrestrial plant associations on site

Most of the site consists of low hills and ridges with quartz outcrops in the central area, changing to undulating plains in the north. A high cover of quartz pebbles occurs in places. Some of the protected plant species occur in low numbers, e.g. *Vachellia erioloba*, although *Boscia albitrunca* and *Aloe claviflora* are more widespread. There is a small area in the north in Association 1 where a small population of *Titanopsis calcarea* is found along with *Avonia papyracea* that is more widespread (see GPS locations). *Dinteranthus pole-evansii*, a "vulnerable" species, was found on one location in the northern plains in Association 1. Association 1 is classified with a "high" sensitivity" where the habitat should be excluded from any development. Protected tree species and other Northern Cape protected species may not be removed or damaged without permits issued by the relevant authorities (NCNCA and DAFF).

## 10.3 Aquatic associations on site

A buffer zone of non-disturbance of at least 32 m from the edge of the Orange River and other drainage lines should be set aside. The riparian plant associations identified on site cover the banks of the Orange River in the southwest, with some ephemeral drainage lines more inland flowing towards the Orange River. Although some vegetation clearing and development in the riparian zone has already occurred, the river bank, channels and floodplains of the Orange River **should be excluded from any further development.**

The alluvial vegetation along the Orange River and along ephemeral drainage lines should be conserved because of their role in binding soil, preventing erosion of the riverbanks and because it constitutes important food sources and habitats for various fauna, e.g. nesting for bird species. The underbrush normally associated with these species also forms an important micro-habitat for a number of animal species.

There is currently a road following the ephemeral branch of the Orange River towards the picnic site on the banks of the river (Figures 31 & 32). Some ephemeral streams from the east join this branch in at least two places. In times of flood this terrain will most probably be under water. Access to the resort terrain on the river

bank will be cut off from the main resort unless a bridge is provided for access. A PES and EIS may be required by DWS for the crossing and construction of a bridge.



Figure 31. Road along the branch of the Orange River.



Figure 32. Picnic site on the water's edge accessed by the road shown in Figure 31.

Well-defined ephemeral drainage lines that dissect the site **should be excluded from any development**. The drainage lines are dry for most of the year and flow for short periods after relatively heavy rains. These seasonal drainage lines are not considered to be wetlands in the strict sense of the word but the flow of water should not be impeded, and prevention of erosion should be a high priority if the area is to be developed, e.g. erection of gabions (see section 10.6)

It is important to have undisturbed areas of at least the same size and of similar habitat than the area used for the resort development to allow for natural movement and re-colonization of displaced fauna. No further disturbance of the riparian habitat should be allowed.

#### 10.4 Alien plant species

The presence of the woody invaders *Eucalyptus camaldulensis* and *Prosopis glandulosa* is of concern and these species should be eradicated as part of the management measures of the riverine habitat. Removal of alien species and the rehabilitation of the habitat may favour indigenous plant species. The use of alien species in landscaping or gardens around the resort development should be discouraged.

#### 10.5 Mitigation

Mitigation is the actions undertaken to compensate for environmental damage. The following mitigation measures are proposed during the construction and operational phases of the project:

- Buffer zones in the riparian zones should be provided, i.e. a 32 m zone of undisturbed habitat measured from the water's edge. A buffer zone is a collar of land that filters out inappropriate influences from surrounding activities, also known as edge effects, including the effects of invasive plant and animal species, physical damage and soil compaction caused through trampling and harvesting, abiotic habitat alterations and pollution.
- Development should be contained within the approved development boundaries and unnecessary disturbance adjacent to the site should be avoided.
- Minimise further clearance of natural vegetation and disturbance along the Orange River. A permit has to be obtained from NCDENC and/or DAFF for the removal or transplanting of protected plant species.
- Dedicated roads should be used on site and random driving in the veld or on dunes should be prohibited.
- Dust control measures should be implemented during construction.
- Protected plant species such as *Vachellia erioloba* and *Boscia albitrunca* should be retained where possible because of their keystone role in the ecosystem, for example they bind the soil, prevent erosion and form important food sources and habitats for various fauna.
- Implement a monitoring program for the early detection of alien invasive plant species. The control program to combat declared alien invasive plant species should be continued during the operational phase.
- No alien invasive plant species should be used in landscaping or gardens on site.
- Any areas that will be denuded as a result of activities on site, should be re-vegetated (rehabilitated) as soon as possible to prevent soil erosion and establishment of alien invasive plant species.

#### 10.6 Rehabilitation plan

It is proposed that a rehabilitation plan is designed to accelerate the natural succession process where vegetation clearing took place and the soil surface exposed. The suggested method of rehabilitation is the landscaping of the disturbed areas and spreading of indigenous grass seed mixtures mixed with mulch or topsoil. The grass and other plant species recommended should be adapted to the specific habitat conditions and if possible originate from the region. The selected species should be annual and perennial species in order to try to establish some form of cover and bring organic matter into the soil that will aid in water retention and germination of seeds.

- Use machinery and labour to landscape the site and prepare the surface for further rehabilitation.
- Active restoration such as oversowing with grass seed mixtures and brush packing/mulching, as well as irrigation, should be applied.

- Disturbed stream banks may be stabilised with stones, netting and logs.
- The control of soil erosion should take place continuously.
- Monitor the area regularly to assess the rehabilitation progress.
- Monitoring and control of declared weeds and alien invasive species should be conducted regularly. Only where manual techniques have failed may herbicides be considered. The contamination of soil and water should not occur.

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## APPENDIX A

Plant species list of the Destination Rock Inn near  
Groblershoop, Northern Cape

Trees	7
Shrubs	11
Dwarf shrubs	31
Grasses	27
Forbs	21
Succulents	11
Parasites	3
Sedges	1
Fern	1
Aliens	6
<b>Total</b>	<b>119</b>

**Trees**

*Boscia albitrunca*  
*Salix mucronata*  
*Searsia lancea*  
*Searsia viminalis*  
*Vachellia erioloba*  
*Vachellia karroo*  
*Ziziphus mucronata*

**Shrubs**

*Cadaba aphylla*  
*Calobota linearifolia*  
*Ehretia alba*  
*Grewia flava*  
*Lycium bosciifolium*  
*Lycium cinereum*  
*Lycium hirsutum*  
*Lycium oxycarpum*  
*Phaeoptilum spinosum*  
*Searsia burchellii*  
*Senegalia mellifera*

**Dwarf shrubs**

*Aizoon burchellii*  
*Aizoon schellenbergii*  
*Aptosimum albomarginatum*  
*Aptosimum cf. marlothii*  
*Aptosimum lineare*  
*Aptosimum spinescens*  
*Asparagus cooperi*  
*Barleria rigida*  
*Calobota spinescens*  
*Erioccephalus ericoides*  
*Erioccephalus sp.*  
*Hermannia spinosa*  
*Justicia divaricatum*  
*Justicia australis*  
*Justicia incana*  
*Justicia spartioides*  
*Leucosphaera bainesii*  
*Pegolettia retrofracta*  
*Pentzia calcarea*  
*Pentzia spinescens*

*Plinthus karooticus*  
*Plinthus sericeus*  
*Pollichia campestris*  
*Pteronia sordida*  
*Pteronia* sp.  
*Rhigozum trichotomum*  
*Roepera lichtensteiniana*  
*Salsola aphylla*  
*Salsola tuberculata*  
*Tetraena decumbens*  
*Tetraena rigida*

**Forbs**

*Acanthopsis hoffmannseggiana*  
*Barleria lichtensteiniana*  
*Blepharis mitrata*  
*Coronopus integrifolius*  
*Cullen tomentosum*  
*Dicoma capensis*  
*Erucastrum austroafricanum*  
*Geigeria ornativa*  
*Indigofera alternans*  
*Lepidium africanum*  
*Limeum* cf. *aethiopicum*  
*Lophiocarpus polystachyus*  
*Nolletia* cf. *chrysocomoides*  
*Peliostomum leucorrhizum*  
*Phyllanthus* sp.  
*Ptychlobium biflorum*  
*Senecio sisymbriifolius*  
*Sericocoma avolans*  
*Sesamum triphyllum*  
*Tribulus cristatus*  
*Tribulus zeyheri*

**Grasses**

*Antheophora pubescens*  
*Aristida adscensionis*  
*Aristida diffusa*  
*Brachiaria glomerata*  
*Cenchrus ciliaris*  
*Cynodon dactylon*  
*Enneapogon cenchroides*  
*Enneapogon desvauxii*  
*Enneapogon scaber*  
*Eragrostis annulata*  
*Eragrostis echinochloidea*  
*Eragrostis lehmanniana*  
*Eragrostis nindensis*  
*Eragrostis obtusa*  
*Eragrostis porosa*  
*Fingerhuthia africana*  
*Oropetium capense*  
*Phragmites australis*  
*Schmidtia kalahariensis*  
*Setaria verticillata*  
*Sporobolus fimbriatus*  
*Stipagrostis amabilis*  
*Stipagrostis anomala*  
*Stipagrostis ciliata*  
*Stipagrostis obtusa*  
*Stipagrostis uniplumis*  
*Tragus berteronianus*

**Parasites**

*Lacomucinaea lineata*  
*Tapinanthus oleifolius*  
*Thesium hystrix*

**Succulents**

*Aloe claviflora*  
*Avonia papyracea*  
*Cynanchum viminale*  
*Dinteranthus pole-evansii*  
*Euphorbia davyi*  
*Euphorbia gariepina*  
*Euphorbia rhombifolia*  
*Kleinia longiflora*  
*Mesembryanthemum coriarium*  
*Monsonia crassicaule*  
*Titanopsis calcarea*

**Sedges**

*Cyperus cf. laevigatus*

**Fern**

*Equisetum ramosissimum*

**Alien (exotic) plants**

*Argemone ochroleuca*  
*Bidens bipinnata*  
*Chenopodium album*  
*Eucalyptus camaldulensis*  
*Pergularia daemia*  
*Prosopis glandulosa*

## APPENDIX B

Plant species list according to the 2821 DD & 2822 CC  
quarter degree grids: NewPosa (SANBI)

<i>Adenium oleifolium</i> Stapf	LC
<i>Alternanthera pungens</i> Kunth	Naturalised
<i>Aptosimum albomarginatum</i> Marloth & Engl.	LC
<i>Arctotis leiocarpa</i> Harv.	LC
<i>Aristida adscensionis</i> L.	LC
<i>Aristida congesta</i> Roem. & Schult. subsp. <i>congesta</i>	LC
<i>Aristida diffusa</i> Trin. subsp. <i>burkei</i> (Stapf) Melderis	LC
<i>Aristida stipitata</i> Hack. subsp. <i>spicata</i> (De Winter) Melderis	LC
<i>Berkheya spinosissima</i> (Thunb.) Willd. subsp. <i>spinosissima</i>	LC
<i>Boerhavia cordobensis</i> Kuntze	Naturalised
<i>Brachiaria glomerata</i> (Hack.) A.Camus	LC
<i>Cenchrus ciliaris</i> L.	LC
<i>Centropodia glauca</i> (Nees) Cope	LC
<i>Chascanum pinnatifidum</i> (L.f.) E.Mey. var. <i>pinnatifidum</i>	LC
<i>Cheilanthes deltoidea</i> Kunze subsp. <i>deltoidea</i>	LC
<i>Chloris virgata</i> Sw.	LC
<i>Cleome angustifolia</i> Forssk. subsp. <i>diandra</i> (Burch.) Kers	LC
<i>Combretum erythrophyllum</i> (Burch.) Sond.	LC
<i>Corchorus asplenifolius</i> Burch.	LC
<i>Cucumis africanus</i> L.f.	LC
<i>Cullen tomentosum</i> (Thunb.) J.W.Grimes	LC
<i>Digitaria eriantha</i> Steud.	LC
<i>Dyerophytum africanum</i> (Lam.) Kuntze	LC
<i>Enneapogon cenchroides</i> (Licht. ex Roem. & Schult.) C.E.Hubb.	LC
<i>Enneapogon scaber</i> Lehm.	LC
<i>Eragrostis echinochloidea</i> Stapf	LC
<i>Eragrostis lehmanniana</i> Nees var. <i>lehmanniana</i>	LC
<i>Eragrostis pallens</i> Hack.	LC
<i>Eragrostis porosa</i> Nees	LC
<i>Felicia hirsuta</i> DC.	LC
<i>Ficus cordata</i> Thunb. subsp. <i>cordata</i>	LC
<i>Forsskaolea candida</i> L.f.	LC
<i>Geigeria pectidea</i> (DC.) Harv.	LC
<i>Gisekia africana</i> (Lour.) Kuntze var. <i>africana</i>	LC
<i>Gisekia pharnacioides</i> L. var. <i>pharnacioides</i>	LC
<i>Heliophila minima</i> (Stephens) Marais	LC
<i>Heliophila trifurca</i> Burch. ex DC.	LC
<i>Heliotropium ciliatum</i> Kaplan	LC
<i>Hermannia burkei</i> Burt Davy	LC
<i>Hermannia eenii</i> Baker f.	LC
<i>Hermannia spinosa</i> E.Mey. ex Harv.	LC
<i>Hermstaedtia fleckii</i> (Schinz) Baker & C.B.Clarke	LC
<i>Hibiscus elliotiae</i> Harv.	LC
<i>Indigofera alternans</i> DC. var. <i>alternans</i>	LC
<i>Jamesbrittenia integerrima</i> (Benth.) Hilliard	LC
<i>Jamesbrittenia tysonii</i> (Hiern) Hilliard	LC
<i>Justicia divaricata</i> Licht. ex Roem. & Schult.	LC
<i>Justicia puberula</i> Immelman	LC
<i>Justicia spartioides</i> T.Anderson	LC
<i>Kohautia caespitosa</i> Schnizl. subsp. <i>brachyloba</i> (Sond.) D.Mantell	LC
<i>Kohautia cynanchica</i> DC.	LC
<i>Lacomucinaea lineata</i> (L.f.) Nickrent & M.A.Garcia	LC
<i>Leobordea platycarpa</i> (Viv.) B.-E.van Wyk & Boatwr.	LC
<i>Lessertia frutescens</i> (L.) Goldblatt & J.C.Manning subsp. <i>frutescens</i>	LC
<i>Leucosphaera bainesii</i> (Hook.f.) Gilg	LC
<i>Limeum aethiopicum</i> Burm.f. var. <i>lanceolatum</i> Friedrich	NE
<i>Limeum argute-carinatum</i> Wawra ex Wawra & Peyr. var. <i>argute-carinatum</i>	LC
<i>Limeum fenestratum</i> (Fenzl) Heimerl var. <i>fenestratum</i>	LC
<i>Limeum myosotis</i> H.Walter var. <i>myosotis</i>	LC
<i>Lophiocarpus polystachyus</i> Turcz.	LC
<i>Lycium cinereum</i> Thunb.	LC

<i>Manulea schaeferi</i> Pilg.	LC
<i>Melinis nerviglumis</i> (Franch.) Zizka	LC
<i>Melinis repens</i> (Willd.) Zizka subsp. <i>grandiflora</i> (Hochst.) Zizka	LC
<i>Microlooma longitubum</i> Schltr.	LC
<i>Nemesia</i> sp.	
<i>Nymania capensis</i> (Thunb.) Lindb.	LC
<i>Ocimum americanum</i> L. var. <i>americanum</i>	LC
<i>Panicum lanipes</i> Mez	LC
<i>Pentzia pinnatisecta</i> Hutch.	LC
<i>Polygala leptophylla</i> Burch. var. <i>leptophylla</i>	LC
<i>Prosopis glandulosa</i> Torr. var. <i>glandulosa</i>	NE, Naturalised
<i>Prosopis velutina</i> Wooton	NE, Naturalised, Invasive
<i>Ptychobium biflorum</i> (E.Mey.) Brummitt subsp. <i>biflorum</i>	LC
<i>Roepera lichtensteiniana</i> (Cham.) Beier & Thulin	LC
<i>Ruschia</i> sp.	
<i>Salsola kali</i> L.	Naturalised, Invasive
<i>Salsola tuberculatiformis</i> Botsch.	LC
<i>Schmidtia kalahariensis</i> Stent	LC
<i>Schmidtia pappophoroides</i> Steud.	LC
<i>Senecio consanguineus</i> DC.	LC
<i>Sericocoma avolans</i> Fenzl	LC
<i>Sesamum capense</i> Burm.f.	LC
<i>Sisymbrium burchellii</i> DC. var. <i>burchellii</i>	LC
<i>Solanum capense</i> L.	LC
<i>Sporobolus ioclados</i> (Trin.) Nees	LC
<i>Stipagrostis namaquensis</i> (Nees) De Winter	LC
<i>Stipagrostis obtusa</i> (Delile) Nees	LC
<i>Stipagrostis uniplumis</i> (Licht.) De Winter var. <i>uniplumis</i>	LC
<i>Striga gesnerioides</i> (Willd.) Vatke	LC
<i>Tapinanthus oleifolius</i> (J.C.Wendl.) Danser	LC
<i>Tephrosia dregeana</i> E.Mey. var. <i>dregeana</i>	LC
<i>Tragus berteronianus</i> Schult.	LC
<i>Tragus racemosus</i> (L.) All.	LC
<i>Tribulus zeyheri</i> Sond. subsp. <i>zeyheri</i>	LC
<i>Triraphis</i> sp.	
<i>Tulbaghia tenuior</i> K.Krause & Dinter	LC
<i>Vachellia haematoxylon</i> (Willd.) Seigler & Ebinger	LC

## APPENDIX C

### Differential table of the vegetation of the Destination Rock Inn site near Groblershoop, Northern Cape

Plant association	1	2	3	4	5	6	7	8	9	10	11
Sample plot no.	1 1   1 1 2 3   3 3 3   1 1 2   3   2 2 2 2   1 2 2 3   1 2 2   1 3   1 3 3 3     4 4 9   6 7 8 0   7 2 3 6   2 3 0   8 9 7   1 4 7 6   4 8 5 9 1   5 2 3   3 5 0 4   1 5 8 9   2   1 6 0										
<b>Species group 1</b>											
<i>Titanopsis calcarea</i>	+	.	.	.	.	.	.	.	.	.	.
<i>Dicoma capensis</i>	+	.	.	.	.	.	.	.	.	.	.
<b>Species group 2</b>											
<i>Avonia papyracea</i>	+	.	.	.	.	.	.	.	.	.	.
<i>Hermannia spinosa</i>	+	.	.	.	.	.	.	.	.	.	.
<b>Species group 3</b>											
<i>Aristida diffusa</i>	.	.	.	.	.	.	.	.	.	.	.
<i>Ptycholobium biflorum</i>	.	.	.	.	.	.	.	.	.	.	.
<i>Peliostomum leucorrhizum</i>	.	.	.	.	.	.	.	.	.	.	.
<i>Limeum</i> sp.	.	.	.	.	.	.	.	.	.	.	.
<b>Species group 4</b>											
<i>Barleria lichtensteiniana</i>	+	.	.	.	.	.	.	.	.	.	.
<i>Oropetium capense</i>	+	.	.	.	.	.	.	.	.	.	.
<i>Cynanchum viminalis</i>	+	.	.	.	.	.	.	.	.	.	.
<b>Species group 5</b>											
<i>Stipagrostis anomala</i>	.	.	.	.	.	.	.	.	.	.	.
<b>Species group 6</b>											
<i>Acanthopsis hoffmannseggiana</i>	+	.	.	.	.	.	.	.	.	.	.
<b>Species group 7</b>											
<i>Tetraena rigida</i>	1	.	.	.	.	.	.	.	.	.	.
<i>Thesium hystrix</i>	+	.	.	.	.	.	.	.	.	.	.
<i>Euphorbia garipeina</i>	.	.	.	.	.	.	.	.	.	.	.
<b>Species group 8</b>											
<i>Tetraena decumbens</i>	.	.	.	.	.	.	.	.	.	.	.
<i>Eragrostis obtusa</i>	.	.	.	.	.	.	.	.	.	.	.
<b>Species group 9</b>											
<i>Euphorbia rhombifolia</i>	+	.	.	.	.	.	.	.	.	.	.
<i>Aizoon burchellii</i>	.	.	.	.	.	.	.	.	.	.	.
<b>Species group 10</b>											
<i>Fingerhuthia africana</i>	.	.	.	.	.	.	.	.	.	.	.
<i>Plinthus karoocicus</i>	.	.	.	.	.	.	.	.	.	.	.
<i>Lacomucinaea lineata</i>	.	.	.	.	.	.	.	.	.	.	.
<b>Species group 11</b>											
<i>Aptosimum cf. marlothii</i>	+	.	.	.	.	.	.	.	.	.	.
<i>Aptosimum spinescens</i>	+	.	.	.	.	.	.	.	.	.	.
<i>Enneapogon scaber</i>	1	.	.	.	.	.	.	.	.	.	.
<i>Blepharis mitrata</i>	.	.	.	.	.	.	.	.	.	.	.
<i>Pentzia calcarea</i>	+	.	.	.	.	.	.	.	.	.	.
<i>Aloe claviflora</i>	a	.	.	.	.	.	.	.	.	.	.
<i>Pteronia sordida</i>	+	.	.	.	.	.	.	.	.	.	.
<b>Species group 12</b>											
<i>Cullen tomentosum</i>	.	.	.	.	.	.	.	.	.	.	.
<i>Argemone ochroleuca</i>	.	.	.	.	.	.	.	.	.	.	.
<i>Setaria verticillata</i>	.	.	.	.	.	.	.	.	.	.	.
<i>Justicia divaricata</i>	.	.	.	.	.	.	.	.	.	.	.
<b>Species group 13</b>											
<i>Cadaba aphylla</i>	.	.	.	.	.	.	.	.	.	.	.
<i>Eragrostis echinochloidea</i>	.	.	.	.	.	.	.	.	.	.	.
<b>Species group 14</b>											
<i>Leucosphaera bainesii</i>	.	.	.	.	.	.	.	.	.	.	.
<i>Salsola tuberculata</i>	.	.	.	.	.	.	.	.	.	.	.
<i>Sericocoma avolans</i>	.	.	.	.	.	.	.	.	.	.	.
<i>Aizoon schellenbergii</i>	.	.	.	.	.	.	.	.	.	.	.
<b>Species group 15</b>											
<i>Enneapogon desvauxii</i>	+	.	.	.	.	.	.	.	.	.	.
<i>Kleinia longiflora</i>	.	.	.	.	.	.	.	.	.	.	.
<i>Roepera lichtensteiniana</i>	+	.	.	.	.	.	.	.	.	.	.
<i>Aptosimum albomarginatum</i>	1	.	.	.	.	.	.	.	.	.	.
<i>Barleria rigida</i>	+	.	.	.	.	.	.	.	.	.	.
<b>Species group 16</b>											







## APPENDIX D

**Curriculum vitae: DR NOEL VAN ROOYEN****1. Biographical information**

Surname	<b>Van Rooyen</b>
First names	<b>Noel</b>
ID number	<b>501225 5034 084</b>
Citizenship	<b>South African</b>
Business address	<b>Ekotrust CC 7 St George Street Lionviham 7130 Somerset West South Africa</b>
Mobile	<b>082 882 0886</b>
e-mail	<a href="mailto:noel@ekotrust.co.za">noel@ekotrust.co.za</a>
Current position	<b>Member of Ekotrust cc</b>
Professional registration	<b>Botanical Scientist : Pr.Sci.Nat; Reg no. 401430/83</b>

Academic qualifications include BSc (Agric), BSc (Honours), MSc (1978) and DSc degrees (1984) in Plant Ecology at the University of Pretoria, South Africa. Until 1999 I was Professor in Plant Ecology at the University of Pretoria and at present I am a member of Ekotrust cc.

**2. Publications**

I am the author/co-author of 123 peer reviewed research publications in national and international scientific journals and was supervisor or co-supervisor of 9 PhD and 33 MSc students. More than 300 projects were undertaken by Ekotrust cc over a period of more than 28 years.

**Books**

VAN ROOYEN, N. 2001. *Flowering plants of the Kalahari dunes*. Ekotrust CC, Pretoria. (In collaboration with H. Bezuidenhout & E. de Kock).

Author / co-author of various chapters on the Savanna and Grassland Biomes in:

LOW, B. & REBELO, A.R. 1996. *Vegetation types of South Africa, Lesotho and Swaziland*, Department of Environmental Affairs and Tourism, Pretoria.

KNOBEL, J. (Ed.) 1999, 2006. *The Magnificent Natural Heritage of South Africa*. (Chapters on the Kalahari and Lowveld).

VAN DER WALT, P.T. 2010. **Bushveld**. Briza, Pretoria. (Chapter on Sour Bushveld).

Contributed to chapters on vegetation, habitat evaluation and veld management in the book:

BOTHMA, J. du P. & DU TOIT, J.G. (Eds). 2016. **Game Ranch Management**. 5th edition. Van Schaik, Pretoria.

Co-editor of the book:

BOTHMA, J. du P. & VAN ROOYEN, N. (eds). 2005. **Intensive wildlife production in southern Africa**. Van Schaik, Pretoria.

### 3. Ekotrust CC: Core Services

Ekotrust CC specializes in vegetation surveys, classification and mapping, wildlife management, wildlife production and economic assessments, vegetation ecology, veld condition assessment, carrying capacity, biodiversity assessments, rare species assessments, carbon pool assessments and alien plant management.

### 4. Examples of projects

Numerous vegetation surveys and vegetation impact assessments for Baseline, Scoping and Environmental Impact Assessments (EIA's) were made both locally and internationally.

Numerous projects have been undertaken in game ranches and conservation areas covering aspects such as vegetation surveys, range condition assessments and wildlife management. Of note is the Kgalagadi Transfrontier Park; iSimangaliso Wetland Park, Ithala Game Reserve, Phinda Private Game Reserve, Mabula Game Reserve, Tswalu Kalahari Desert Reserve, Maremani Nature Reserve and Associate Private Nature Reserve (previously Timbavati, Klaserie & Umbabat Private Game Reserve).

Involvement in various research programmes: vegetation of the northern Kruger National Park, Savanna Ecosystem Project at Nylsvley, Limpopo; Kuiseb River Project (Namibia); Grassland Biome Project; Namaqualand and Kruger Park Rivers Ecosystem research programme.

### 5. Selected references of projects done by Ekotrust CC

VAN ROOYEN, N., THERON, G.K., BREDENKAMP, G.J., VAN ROOYEN, M.W., DEUTSCHLÄNDER, M. & STEYN, H.M. 1996. *Phytosociology, vegetation dynamics and conservation of the southern Kalahari*. Department of Environmental Affairs & Tourism, Pretoria.

VAN ROOYEN, N. 1999 & 2017. The vegetation types, veld condition and game of Tswalu Kalahari Desert Reserve.

VAN ROOYEN, N. 2000. Vegetation survey and mapping of the Kgalagadi Transfrontier Park. Peace Parks Foundation, Stellenbosch.

VAN ROOYEN, N, VAN ROOYEN, M.W. & GROBLER, A. 2004. Habitat evaluation and stocking rates for wildlife and livestock - PAN TRUST Ranch, Ghanzi, Botswana.

VAN ROOYEN, N. 2004. Vegetation and wildlife of the Greater St Lucia Wetland Park, KZN.

- VAN ROOYEN, N. & VAN ROOYEN, M.W. 2008. Vegetation classification, habitat evaluation and wildlife management of the proposed Royal Big Six Nsubane-Pongola Transfrontier Park, Swaziland. Ekotrust cc.
- VAN ROOYEN, N. & VAN ROOYEN, M.W. 2011. Habitat evaluation and wildlife management on the Meletse Wildlife Reserve, Limpopo. Ekotrust cc.
- VAN ROOYEN, M.W. & VAN ROOYEN, N. 2013. Carbon in the woody vegetation in the Mayoko area, Republic of Congo. Report to Flora, Fauna & Man Ecological Consultants.
- VAN ROOYEN, M.W. & VAN ROOYEN, N. 2013. Resource assessment of *Elephantorrhiza elephantina* on farms (or portions) of Abbey, Tweed, Concordia and Bellville, Northern Cape. Report to CSIR.
- VAN ROOYEN, N. & VAN ROOYEN, M.W. 2014. Ecological evaluation and wildlife management on Ndzalama Nature Reserve and adjacent farms, Gravelotte, Limpopo province.
- VAN ROOYEN, M.W. & VAN ROOYEN, N. & VAN DEN BERG, H. 2016. Kathu Bushveld study: Research offset for first development phase of Adams Solar Energy Facility. Project conducted for Department of Environment and Nature Conservation Northern Cape (DENC) and the Department of Agriculture, Forestry and Fisheries (DAFF).
- VAN ROOYEN, N. & VAN ROOYEN, M.W. 2016. Ecological evaluation of the farm Springbokoog in the Van Wyksvlei region of Northern Cape, including a habitat assessment for the introduction of black rhinoceros. Ekotrust cc.
- VAN ROOYEN, N. & VAN ROOYEN, M.W. 2018. Ecological evaluation and wildlife management of the farm Twin Oaks, Limpopo.

## 6. Selected publications

- VAN ROOYEN, N. 1978. A supplementary list of plant species for the Kruger National Park from the Pafuri area. *Koedoe* 21: 37 - 46.
- VAN ROOYEN, N., THERON, G.K. & GROBBELAAR, N. 1981. A floristic description and structural analysis of the plant communities of the Punda Milia - Pafuri - Wambiya area in the Kruger National Park, Republic of South Africa. 2. The sandveld communities. *Jl S. Afr. Bot.* 47: 405 - 449.
- VAN ROOYEN, N., THERON, G.K. & GROBBELAAR, N. 1986. The vegetation of the Roodeplaat Dam Nature Reserve. 4. Phenology and climate. *S. Afr. J. Bot.* 52: 159 - 166.
- VAN ROOYEN, N. 1989. Phenology and water relations of two savanna tree species. *S. Afr. J. Sci.* 85: 736 - 740.
- VAN ROOYEN, N., BREDENKAMP, G.J. & THERON, G.K. 1991. Kalahari vegetation: Veld condition trends and ecological status of species. *Koedoe* 34: 61 - 72.
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## Curriculum vitae: Gretel van Rooyen

### 1. Biographical information

Surname	Van Rooyen	Maiden name	Rösch
First names	Margaretha Wilhelmine		
ID number	5004130033084	Citizenship	South African
Home address	7 St George Street Lionviham 7130 Somerset West	Work address	Department of Botany University of Pretoria Pretoria 0002 South Africa
Mobile	072 0253386		
e-mail	gretel@ekotrust.co.za		
Current position	Honorary Professor in Plant Ecology Scientific advisor - Ekotrust		
Academic qualifications	BSc; BSc (Hons), HNOD, MSc (Botany), PhD (Plant ecology)		

### 2. Publications

I am author / co-author of more than 100 peer reviewed research publications and have presented / co-presented more than 100 posters or papers at international and national conferences. Five PhD-students and 29 Masters students have completed their studies under my supervision / co-supervision. I have co-authored a book as part of a series on the Adaptations of Desert Organisms by Springer Verlag (Van Rheede van Oudtshoorn, K. & Van Rooyen, M.W. 1999. *Dispersal biology of desert plants*. Springer Verlag, Berlin) and two wildflower guides (Van Rooyen, G., Steyn, H. & De Villiers, R. 1999. *Cederberg, Clanwilliam and Biedouw Valley*. Wild Flower Guide of South Africa no 10. Botanical Society of South Africa, Kirstenbosch, and Van der Merwe, H. & Van Rooyen, G. *Wild flowers of the Roggeveld and Tanqua*). I have also contributed to six chapters in the following books: (i) Dean, W.R.J. & Milton, S.J. (Eds) *The Karoo: Ecological patterns and processes*. Cambridge University Press, Cambridge. pp. 107-122; (ii) Knobel, J. (ed.) *The magnificent heritage of South Africa*. Sunbird Publishing, Llandudno. pp. 94-107; (iii) Hoffman, M.T., Schmiedel, U., Jürgens, N. [Eds]: *Biodiversity in southern Africa. Vol. 3: Implications for landuse and management*: pp. 109–150, Klaus Hess Publishers, Göttingen & Windhoek; (iv) Schmiedel, U., Jürgens, N. [Eds]: *Biodiversity in southern Africa. Vol. 2: Patterns and processes at regional scale*: pp. 222-232, Klaus Hess Publishers, Göttingen & Windhoek; (v) Stoffberg, H., Hindes, C. & Muller, L. *South African Landscape Architecture: A Compendium and A Reader*. Chapter 10, pp. 129 – 140; and (vi) Stoffberg, H., Hindes, C. & Muller, L. *South African Landscape Architecture: A Compendium and A Reader*. Chapter 11, pp. 141 – 146.

### 3. Research interests

My primary research interests lie in population biology and vegetation dynamics. The main aim of the research is to gain an understanding of ecosystem dynamics and to use this understanding to develop strategies to conserve, manage, use sustainably or restore ecosystems. Geographically the focus of the studies has been primarily in Namaqualand (Northern Cape Province, South Africa; classified as Succulent Karoo) and the Kalahari although several studies were conducted in Maputaland (Northern KwaZulu-Natal) and Namibia.

### 4. Projects and selected project references

Over the past 40 years my research has centred around the population biology, vegetation dynamics and classification of the vegetation in the Succulent Karoo (Namaqualand, Tanqua, Hantam, Roggeveld), Kalahari (arid grassland) and Namib Desert in Namibia.

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- VAN ROOYEN, N., VAN ROOYEN, M.W. & VAN DER MERWE, H. 2012. The vegetation of Ratelkraal, Northern Cape. Report to Northern Cape Nature Conservation.
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## 5. Selected research publications

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