

Ecology Scoping Study

Greater Karoo Renewable Energy project near Richmond, Northern Cape Province



David Hoare Consulting (Pty) Ltd



David Hoare
Consulting (Pty) Ltd

Address:
Postnet Suite #116
Private Bag X025
Lynnwood Ridge
0040

41 Soetdoring Avenue
Lynnwood Manor
Pretoria

Telephone: 087 701 7629
Cell: 083 284 5111
Fax: 086 550 2053
Email: dhoare@lantic.net

Ecological Impact Assessment study on the potential impacts of the proposed Greater Karoo Renewable Energy wind and solar projects near Richmond, Northern Cape Province.

Location:
Ubuntu Local Municipality within the Pixley Ka Seme District
Municipality

for

Great Karoo Renewable Energy (Pty) Ltd.

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Details of specialist consultant

Company name	David Hoare Consulting (Pty) Ltd
Registration no.:	CK2017/308639/07
Address	Postnet Suite #116 Private Bag X025 Lynnwood Ridge 0040
Contact person	Dr David Hoare
Contact details	Cell: 083 284 5111 Email: dhoare@lantic.net
Qualifications	PhD Botany (Nelson Mandela Metropolitan University) MSc Botany (University of Pretoria) BSc (Hons) Botany (Rhodes University) BSc Botany, Zoology (Rhodes University)

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EXECUTIVE SUMMARY

Great Karoo Renewable Energy (Pty) Ltd is planning to construct five renewable energy projects within the boundaries of the study area, three solar PV projects, and two wind energy projects. Great Karoo Renewable Energy (Pty) Ltd appointed David Hoare Consulting (Pty) Ltd to provide specialist biodiversity consulting services for the EIA for the proposed projects. The consulting services comprise an assessment of potential impacts on the general ecology in the study area by the proposed project. The study excludes Avifauna, Aquatic Ecology and Bats. This report provides details of the results of the ecology Scoping study, based on a desktop assessment of the study area, mapping from aerial imagery, and detailed site visits of the footprint of the proposed project. The study area is located approximately 30km south-west of Richmond along the N1 within the Northern Cape Province.

The first section of the report provides an outline of the Terms of Reference for the study, Limitations, Assumptions and Uncertainties, a list of acronyms, abbreviations and a short glossary. This is followed by an introduction to the project.

The following section provides an outline of the methodology used to undertake the ecology assessment. This includes the approach taken to assess the sensitivity of the site and a summary of the background information used to undertake the assessment. Background information includes electronic databases with species information, Red Data Lists, published field guides and National and Provincial legislation, specifically regulations with published lists of species and/or ecosystems.

The next section of the report provides details on legislation that applies to development of the site with respect to the ecological receiving environment. There are various acts that limit development or require permits before development can proceed. The most important of these are permits required in terms of protected species that could potentially occur on site, including the National Environmental Management: Biodiversity Act, the Northern Cape Nature Conservation Act and the National Forests Act.

The next section provides a description of the ecological receiving environment, including details on the location of the site, the regional vegetation patterns, local habitat patterns occurring on site, lists of plant and animal species of concern that are likely to occur there and a list of species that were observed on site during the site visit.

The section of the report following the above identifies a number of potential impacts for the proposed project, including direct and indirect impacts for the construction, operation and decommissioning phases of the project, as well as cumulative impacts taken together with similar projects in the region.

The report concludes that there are some sensitivities on site related to natural habitat and to individual species, but that these can be minimised or avoided with the application of appropriate mitigation or management measures. There will be residual impacts, primarily on natural habitat, but the amount of habitat that will be lost to the project is insignificant compared to the area in hectares of the regional vegetation type that occurs on site and therefore the residual impacts are considered acceptable, on condition local sensitivities of biodiversity importance are avoided. On this basis, it is recommended that the project be authorised.

The report includes a comprehensive list of Appendices containing lists of species and species of concern with a geographical distribution that includes the site as well as lists of species protected according to National legislation.

SPECIALISTS DECLARATION

I, David Hoare as the appointed independent specialist, in terms of the 2014 EIA Regulations (as amended), hereby declare that I:

- act as the independent specialist in this application;
- perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- declare that there are no circumstances that may compromise my objectivity in performing such work;
- have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- will comply with the Act, Regulations and all other applicable legislation;
- have no, and will not engage in, conflicting interests in the undertaking of the activity;
- have no vested interest in the proposed activity proceeding;
- undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- all the particulars furnished by me in this specialist input/study are true and correct; and
- realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of specialist:



Name of specialist:

Dr D B Hoare

Date:

27 September 2021

TERMS OF REFERENCE

The study was to adhere to the following:

- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended.
- Consideration of the procedures for the assessment and minimum criteria for reporting on identified environmental themes (GNR320 of 20 March 2020)
- Adherence to all appropriate best practice guidelines, relevant legislation and authority requirements.
- Provide a thorough overview of all applicable legislation, guidelines.
- Identification of sensitive areas to be avoided (including providing shapefiles/kmls).
- Assessment of the significance of the proposed development during the Pre-construction, Construction, Operation, Decommissioning Phases and Cumulative impacts. Potential impacts should be rated in terms of the direct, indirect and cumulative.
 - Direct impacts: are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity. These impacts are usually associated with the construction, operation or maintenance of an activity and are generally obvious and quantifiable.
 - Indirect impacts: of an activity are indirect or induced changes that may occur as a result of the activity. These types of impacts include all the potential impacts that do not manifest immediately when the activity is undertaken, or which occur at a different place as a result of the activity.
 - Cumulative impacts: are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities. Cumulative impacts can occur from the collective impacts of individual minor actions over a period of time and can include both direct and indirect impacts.
- Implications of specialist findings for the proposed development (e.g. permits, licenses etc).
- Specify if any further assessment will be required. Include an Impact Statement, concluding whether project can be authorised or not.
- Recommend mitigation measures in order to minimise the impact of the proposed development.

LIMITATIONS, ASSUMPTIONS & UNCERTAINTIES

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

- Compiling the list of species that could potentially occur on site is limited by the paucity of collection records for the area. The list of plant species that could potentially occur on site was therefore taken from a wider area and from literature sources that may include species that do not occur on site and may miss species that do occur on site. In order to compile a comprehensive site-specific list of the biota on site, studies would be required that would include different seasons, be undertaken over a number of years and include extensive sampling. To some degree, this was achieved for this site, although long-term drought limited the presence / detectability of plant species.
- The timing of the site visits included the summer flowering season. However, due to persistent drought, many species of plants were not flowering on site, the majority were not even persisting in vegetative form. The field survey was therefore considered to have taken place during the correct season and co-incides with the maximum emergence of perennial and dominant species, but constrained by persistent drought.
- Rare and threatened plant and animal species are, by their nature, usually very difficult to locate and can be easily missed.
- The study excludes Avifauna, Bats, and Aquatic Ecology.

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
BA	Basic Assessment
ESA	Ecological Support Area
IUCN	International Union for the Conservation of Nature
I&APs	Interested and Affected Parties
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
ONA	Other Natural Areas
PA	Protected Area
REDZ	Renewable Energy Development Zone
SCC	Species of conservation concern
SEA	Strategic Environmental Assessment
SANBI	South African National Biodiversity Institute
ToPS	Threatened and Protected Species
ToR	Terms of Reference
WEF	Wind Energy Facility

ABBREVIATIONS

%	Percentage
MW	Megawatt
kV	Kilovolt
cm	Centimetres
m	Metres
km	Kilometres

GLOSSARY

Definitions	
Alternative	Alternatives can refer to any of the following but are not limited to: alternative sites for development, alternative projects for a particular site, alternative site layouts, alternative designs, alternative processes and alternative materials.
Category 1a Listed Invasive Species	Species listed 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 List of Invasive Species. Landowners are obliged to take immediate steps to control Category 1a species.
Category 1b Listed Invasive Species	Species listed 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 List 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.
Category 2 Listed Invasive Species	Species which 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.
Category 3 Listed Invasive Species	A species listed by notice in terms of section 70(1)(a) of the act, as species which are subject to exemptions in terms of section 71(3) and prohibitions in terms of section 71A of the act, as specified in the notice. 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.
Connectivity	The spatial continuity of a habitat or land cover type across a landscape.
Corridor	A relatively narrow strip of a particular type that differs from the areas adjacent on both sides.
Edge	The portion of an ecosystem or cover type near its perimeter, and within which environmental conditions may differ from interior locations in the ecosystem.
Exempted Alien Species	An alien species that is not regulated in terms of this statutory framework - as defined in Notice 2 of the AIS List.
Fragmentation	The breaking up of a habitat or cover type into smaller, disconnected parcels, often associated with, but not equivalent to, habitat loss.
Prohibited Alien Species	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.
Mitigate	The implementation of practical measures to reduce adverse impacts or enhance beneficial impacts of an action.
"No-Go" option	The "no-go" development alternative option assumes the site remains in its current state, i.e. there is no construction of a WEF and associated infrastructure in the proposed project area.
Patch	A surface area that differs from its surroundings in nature or appearance.
Rehabilitation	Less than full restoration of an ecosystem to its predisturbance condition.
Restoration	To return a site to an approximation of its condition before alteration.
Riparian	The land adjacent to a river or stream that is, at least periodically, influenced by flooding.
Runoff	Non-channelized surface water flow.

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INTRODUCTION

Background

Greater Karoo Renewable Energy (Pty) Ltd intends to construct five projects within the boundaries of the area being assessed here, as follows:

1. Angora Wind Energy Facility (blue area)
2. Merino Wind Energy Facility (yellow area)
3. Nku solar PV (NW site)
4. Moriri Solar PV (SW site)
5. Kwana Solar PV (E site).

The position of these is shown in the map below (Figure 1).

The proposed facility is located just to the north of the Beaufort West Renewable Energy Development Zone (REDZ 11), one of the eleven REDZ formally gazetted in South Africa for development of solar and wind energy generation facilities.

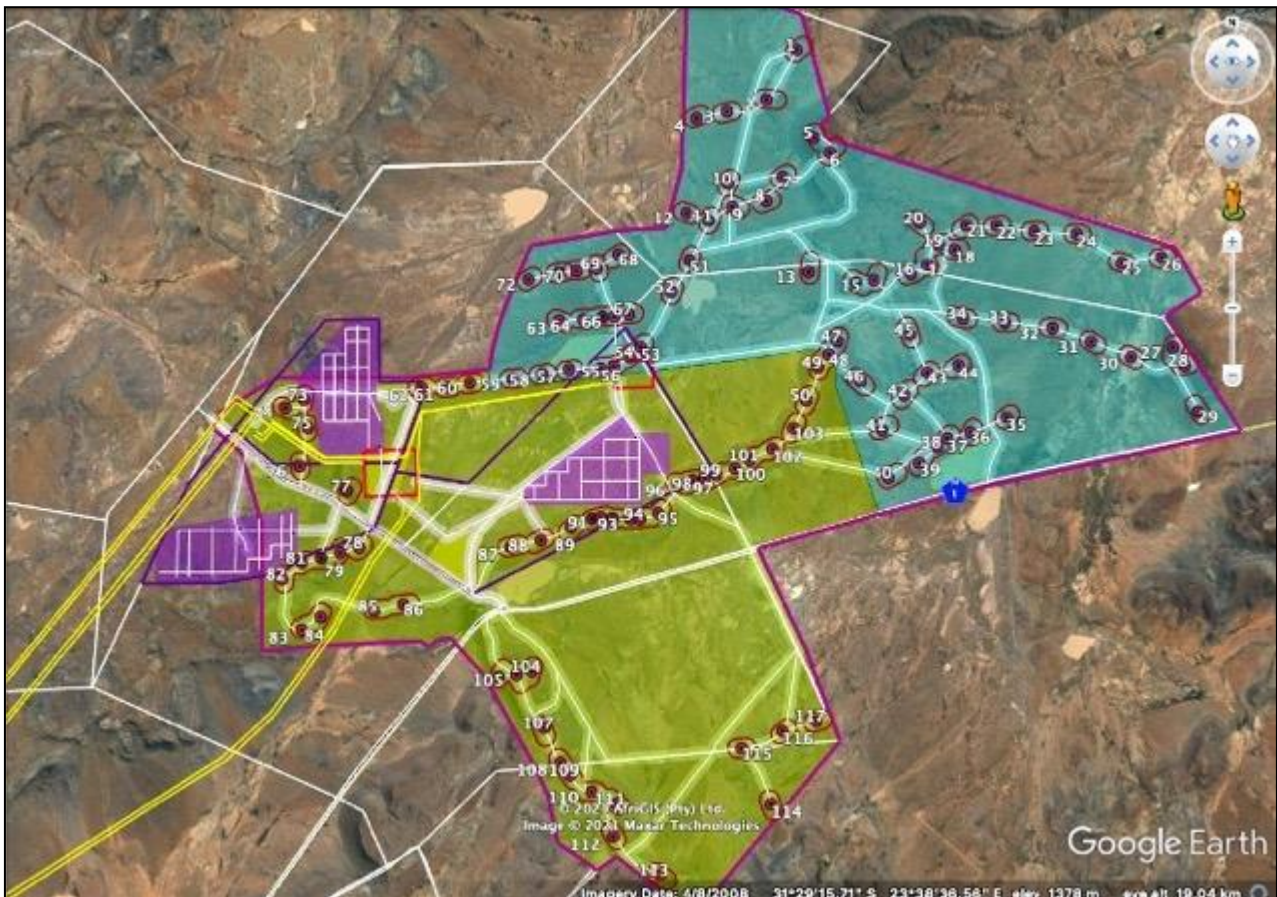


Figure 1: Location of the separate projects in relation to the study area boundary.

APPROACH & METHODOLOGY

This report provides a Scoping level description of the site and assessment of the proposed project from an ecology perspective. The detailed methodology followed as well as the sources of data and information used as part of this assessment is described below.

Assessment philosophy

Many parts of South Africa contain high levels of biodiversity at species and ecosystem level. At any single site there may be large numbers of species or high ecological complexity. Sites also vary in their natural character and uniqueness and the level to which they have been previously disturbed. Assessing the potential impacts of a proposed development often requires evaluating the conservation value of a site relative to other natural areas and relative to the national importance of the site in terms of biodiversity conservation. A simple approach to evaluating the relative importance of a site includes assessing the following:

- Is the site unique in terms of natural or biodiversity features?
- Is the protection of biodiversity features on the site of national/provincial importance?
- Would development of the site lead to contravention of any international, national or provincial legislation, policy, convention or regulation?

Thus, the general approach adopted for this type of study is to identify any critical biodiversity issues that may lead to the decision that the proposed project cannot take place, i.e. to specifically focus on red flags and/or potential fatal flaws. Biodiversity issues are assessed by documenting whether any important biodiversity features occur on site, including species, ecosystems or processes that maintain ecosystems and/or species. These can be organised in a hierarchical fashion, as follows:

Species

1. threatened plant species;
2. protected trees; and
3. threatened animal species.

Ecosystems

1. threatened ecosystems;
2. protected ecosystems;
3. critical biodiversity areas;
4. areas of high biodiversity; and
5. centres of endemism.

Processes

1. corridors;
2. mega-conservancy networks;
3. rivers and wetlands; and
4. important topographical features.

It is not the intention to provide comprehensive lists of all species that occur on site, since most of the species on these lists are usually common or widespread species. Rare, threatened, protected and conservation-worthy species and habitats are considered to be the highest priority, the presence of which are most likely to result in significant negative impacts on the ecological environment. The focus on national and provincial priorities and critical biodiversity issues is in line with National legislation protecting environmental and biodiversity resources, including, but not limited to the following which ensure protection of ecological processes, natural systems and natural beauty as well as the preservation of biotic diversity in the natural environment:

1. National Environmental Management Act, 1998 (NEMA) (Act 107 of 1998); and
2. National Environmental Management Biodiversity Act, 2004. (Act 10 Of 2004).

Approach

The study commenced as a desktop-study followed by site-specific field surveys on 25th – 27th April 2016, 11th October 2020, 4th - 6th December 2020, and 30th - 31st July 2021. During the field survey, the entire footprint of the proposed project was traversed on foot.

Aerial imagery from Google Earth was used to identify and map habitats on site. Patterns identified from satellite imagery were verified on the ground. During the field survey, a checklist of plant species was compiled as well as an estimate of cover/abundance. From this vegetation survey, as well as *ad hoc* observations on site, a checklist of plant species occurring on site was compiled. Digital photographs were taken at locations where features of interest were observed.

Field surveys

The study area was visited and assessed to confirm patterns identified from the desktop assessment. Site-specific field surveys were conducted on 25th – 27th April 2016, 11th October 2020, 4th - 6th December 2020, and 30th - 31st July 2021.

Specific features of potential concern were investigated in the field, including the following:

- General vegetation status, i.e. whether the vegetation was natural, disturbed/secondary or transformed;
- Presence of habitats of conservation concern in terms of high biodiversity, presence of SCC, specific sensitivities, e.g. wetlands, and any other factors that would indicate an elevated biodiversity or functional value that could not be determined from the desktop assessment;
- Presence of protected trees; and
- Potential presence of SCC, including observation of individual plants found on site or habitats that are suitable for any of the species identified from the desktop assessment.

Key parts of the development site were visited during the site visit in such a way as to ensure all major variation was covered and that any unusual habitats or features were observed. A checklist of species occurring on site was collected during the surveys (Appendix 3, highlighted in green). Plant names follow Germishuizen *et al.* (2005). The season of the survey was favourable, and it there is moderate confidence that many of species present on site were identifiable at the time of the survey, the main limitation being the persistent drought on site over a period of a number of years. The survey was of adequate duration and intensity to characterise the flora of the development site as per the regulations.

Camera-trap surveys

A specific requirement for this site was to undertake camera-trap surveys to assess the possible occurrence of Riverine Rabbit on site. An array of cameras was positioned within habitat assessed to be potentially suitable for Riverine Rabbit, which is primarily the main drainage system in the south-central part of the study area. These cameras were left on site for 6 weeks, during which time they were monitored regularly to ensure proper functioning, to clear and record memory card data, and to check battery levels. A separate detailed report will be compiled for the specific Riverine Rabbit survey, but the camera traps also detected various other mobile fauna on site, specifically within this drainage habitat. The data from these cameras is included here to provide information on faunal species presence on site.

Species of conservation concern

There are two types of species of concern for the site under investigation, (i) those listed by conservation authorities as being on a Red List and are therefore considered to be at risk of extinction, and (ii) those listed as protected according to National and/or Provincial legislation.

Red List plant species

Determining the conservation status of a species is required to identify those species that are at greatest risk of extinction and, therefore, in most need of conservation action. South Africa has adopted the International Union for Conservation of Nature (IUCN) Red List Categories and Criteria to provide an objective, rigorous, scientifically founded system to identify Red List species. A published list of the Red List species of South African plants (Raimondo *et al.*, 2009) contains a list of all species that are considered to be at risk of extinction. This list is updated regularly to take new information into account, but these are not published in book/paper format. Updated assessments are provided on the SANBI website (<http://redlist.sanbi.org/>). According to the website of the Red List of Southern African Plants (<http://redlist.sanbi.org/>), *the conservation status of plants indicated on the Red List of South African Plants Online represents the status of the species within South Africa's borders. This means that when a species is not endemic to South Africa, only the portion of the species population occurring within South Africa has been assessed. The global conservation status, which is a result of the assessment of the entire global range of a species, can be found on the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species: <http://www.iucnredlist.org>.* The South African assessment is used in this study.

The purpose of listing Red List species is to provide information on the potential occurrence of species at risk of extinction in the study area that may be affected by the proposed infrastructure. Species appearing on these lists can then be assessed in terms of their habitat requirements to determine whether any of them have a likelihood of occurring in habitats that may be affected by the proposed infrastructure.

Lists were compiled specifically for any species at risk of extinction (Red List species) previously recorded in the area. Historical occurrences of threatened plant species were obtained from the South African National Biodiversity Institute (<http://posa.sanbi.org>) for the quarter degree square/s within which the study area is situated. Habitat information for each species was obtained from various published sources. The probability of finding any of these species was then assessed by comparing the habitat requirements with those habitats that were found, during the field survey of the site, to occur there.

Protected trees

Regulations published for the National Forests Act (Act 84 of 1998) (NFA) as amended, provide a list of protected tree species for South Africa. The species on this list were assessed in order to determine which protected tree species have a geographical distribution that coincides with the study area and habitat requirements that may be met by available habitat in the study area. The distribution of species on this list were obtained from published sources (e.g. van Wyk & van Wyk 1997) and from the SANBI Biodiversity Information System website (<http://sibis.sanbi.org/>) for quarter degree grids in which species have been previously recorded. Species that have been recorded anywhere in proximity to the site (within 100 km), or where it is considered possible that they could occur there, were listed and were considered as being at risk of occurring there.

Other protected species

National legislation was evaluated in order to provide lists of any plant or animal species that have protected status. The most important legislation is the following:

- National Environmental Management: Biodiversity Act (Act No 10 of 2004); and
- Northern Cape Nature Conservation Act (Act No. 9 of 2009).

This legislation contains lists of species that are protected. These lists were used to identify any species that have a geographical range that includes the study area and habitat requirements that are met by those found on site. These species were searched for within suitable habitats on site or, where relevant, if it is possible that they could occur on site, this was stated.

Red List animal species

Lists of threatened animal species that have a geographical range that includes the study area were obtained from literature sources (for example, Alexander & Marais 2007, Branch 1988, 2001, du Preez & Carruthers 2009, Friedmann & Daly 2004, Mills & Hes 1997, Monadjem *et al.*, 2010). The likelihood of any of them occurring was evaluated based on habitat preference and habitats available within the study area. The three parameters used to assess the probability of occurrence for each species were as follows:

- *Habitat requirements*: most Red Data animals have very specific habitat requirements and the presence of these habitat characteristics within the study area were assessed;

- *Habitat status*: in the event that available habitat is considered suitable for these species, the status or ecological condition was assessed. Often, a high level of degradation of a specific habitat type will negate the potential presence of Red Data species (especially wetland-related habitats where water-quality plays a major role); and
- *Habitat linkage*: movement between areas used for breeding and feeding purposes forms an essential part of ecological existence of many species. The connectivity of the study area to these surrounding habitats and adequacy of these linkages are assessed for the ecological functioning Red Data species within the study area.

Mammal threat status is according to Child et al. (2016), reptile threat status is according to Bates et al. 2014, and amphibian threat status is according to Minter et al. (2004).

Species probability of occurrence

Some species of plants may be cryptic, difficult to find, rare, ephemeral or generally not easy to identify while undertaking a survey of a large area. An assessment of the possibility of these species occurring there was therefore provided. For all threatened or protected flora that occur in the general geographical area of the site, a rating of the likelihood of it occurring on site is given as follows:

- LOW: no suitable habitats occur on site / habitats on site do not match habitat description for species;
- MEDIUM: habitats on site match general habitat description for species (e.g. karoo shrubland), but detailed microhabitat requirements (e.g. mountain shrubland on shallow soils overlying sandstone) are absent on the site or are unknown from the descriptions given in the literature or from the authorities;
- HIGH: habitats found on site match very strongly the general and microhabitat description for the species (e.g. mountain shrubland on shallow soils overlying sandstone);
- DEFINITE: species found in habitats on site.

Sources of information

Vegetation and plant species

- Broad vegetation types occurring on site were obtained from Mucina and Rutherford (2006), with updates according to the SANBI BGIS website (<http://bgis.sanbi.org>).
- The conservation status of the vegetation types were obtained from Mucina and Rutherford (2006) and the National List of Ecosystems that re Threatened and in need of protection (GN1002 of 2011), published under the National Environmental Management: Biodiversity Act (Act No. 10, 2004).
- The plant species checklist of species that could potentially occur on site was compiled from a plant species checklist extracted from the NewPosa database of the South African National biodiversity Institute (SANBI) for the quarter degree grids 2821CA.
- The IUCN Red List Category for plant species, as well as supplementary information on habitats and distribution, was obtained from the SANBI Threatened Species Programme (Red List of South African Plants, <http://redlist.sanbi.org>).

Fauna

- Lists of animal species that have a geographical range that includes the study area were obtained from literature sources (Bates et al., 2014 for reptiles, du Preez & Carruthers 2009 for frogs, Mills & Hes 1997 and Friedmann and Daly, 2004 for mammals). This was supplemented with information from the Animal Demography Unit website (adu.uct.ac.za) and literature searches for specific animals, where necessary.

Regional plans

- Information from the National Protected Areas Expansion Strategy (NPAES) was consulted for possible inclusion of the site into a protected area in future (available on <http://bgis.sanbi.org>).
- The Northern Cape Biodiversity Area Maps were consulted for inclusion of the site into a Critical Biodiversity Area or Ecological Support Area (biodiversityadvisor.sanbi.org).

Habitat sensitivity

The purpose of producing a habitat sensitivity map is to provide information on the location of potentially sensitive features in the study area. This was compiled by taking the following into consideration:

1. The general status of the vegetation of the study area was derived by compiling a landcover data layer for the study area (*sensu* Fairbanks *et al.*, 2000) using available satellite imagery and aerial photography. From this, it can be seen which areas are transformed versus those that are still in a natural status.
2. Various provincial, regional or national level conservation planning studies have been undertaken in the area, e.g. the National Spatial Biodiversity Assessment (NSBA). The mapped results from these were taken into consideration in compiling the habitat sensitivity map.
3. Habitats in which various species of plants or animals occur that may be protected or are considered to have high conservation status are considered to be sensitive.

An explanation of the different sensitivity classes is given in Table 1. Areas containing untransformed natural vegetation of conservation concern, high diversity or habitat complexity, Red List organisms or systems vital to sustaining ecological functions are considered potentially sensitive. In contrast, any transformed area that has no importance for the functioning of ecosystems is considered to potentially have low sensitivity.

Table 1: Explanation of sensitivity ratings.

Sensitivity	Factors contributing to sensitivity	Example of qualifying features
VERY HIGH	<p>Indigenous natural areas that are highly positive for <u>any</u> of the following:</p> <ul style="list-style-type: none"> • presence of threatened species (Critically Endangered, Endangered, Vulnerable) and/or habitat critical for the survival of populations of threatened species. • <u>High</u> conservation status (low proportion remaining intact, highly fragmented, habitat for species that are at risk). • <u>Protected</u> habitats (areas protected according to national / provincial legislation, e.g. National Forests Act, Draft Ecosystem List of NEM:BA, Integrated Coastal Zone Management Act, Mountain Catchment Areas Act, Lake Areas Development Act) <p>And may also be positive for the following:</p> <ul style="list-style-type: none"> • <u>High</u> intrinsic biodiversity value (<u>high</u> species richness and/or turnover, unique ecosystems) • <u>High</u> value ecological goods & services (e.g. water supply, erosion control, soil formation, carbon storage, pollination, refugia, food production, raw materials, genetic resources, cultural value) • <u>Low</u> ability to respond to disturbance (low resilience, dominant species very old). 	<ul style="list-style-type: none"> • CBA 1 areas. • Remaining areas of vegetation type listed in Draft Ecosystem List of NEM:BA as Critically Endangered, Endangered or Vulnerable. • Protected forest patches. • Confirmed presence of populations of threatened species.
HIGH	<p>Indigenous natural areas that are positive for any of the following:</p> <ul style="list-style-type: none"> • <u>High</u> intrinsic biodiversity value (<u>moderate/high</u> species richness and/or turnover). • presence of habitat highly suitable for threatened species (Critically Endangered, Endangered, Vulnerable species). • <u>Moderate</u> ability to respond to disturbance (<u>moderate</u> resilience, dominant species of intermediate age). 	<ul style="list-style-type: none"> • CBA 2 “critical biodiversity areas”. • Habitat where a threatened species could potentially occur (habitat is suitable, but no confirmed records). • Confirmed habitat for species of lower threat

Sensitivity	Factors contributing to sensitivity	Example of qualifying features
	<ul style="list-style-type: none"> • <u>Moderate</u> conservation status (moderate proportion remaining intact, moderately fragmented, habitat for species that are at risk). • <u>Moderate to high</u> value ecological goods & services (e.g. water supply, erosion control, soil formation, carbon storage, pollination, refugia, food production, raw materials, genetic resources, cultural value). <p>And may also be positive for the following:</p> <ul style="list-style-type: none"> • <u>Protected</u> habitats (areas protected according to national / provincial legislation, e.g. National Forests Act, Draft Ecosystem List of NEM:BA, Integrated Coastal Zone Management Act, Mountain Catchment Areas Act, Lake Areas Development Act) 	<p>status (near threatened, rare).</p> <ul style="list-style-type: none"> • Habitat containing individuals of extreme age. • Habitat with low ability to recover from disturbance. • Habitat with exceptionally high diversity (richness or turnover). • Habitat with unique species composition and narrow distribution. • Ecosystem providing high value ecosystem goods and services.
MEDIUM-HIGH	Indigenous natural areas that are positive for <u>one</u> or <u>two</u> of the factors listed above, but not a combination of factors.	<ul style="list-style-type: none"> • CBA 2 “corridor areas”. • Habitat with high diversity (richness or turnover). • Habitat where a species of lower threat status (e.g. (near threatened, rare) could potentially occur (habitat is suitable, but no confirmed records).
MEDIUM	Other indigenous natural areas in which factors listed above are of no particular concern. May also include natural buffers around ecologically sensitive areas and natural links or corridors in which natural habitat is still ecologically functional.	<ul style="list-style-type: none"> • Natural habitat with no specific sensitivities.
MEDIUM-LOW	Degraded or disturbed indigenous natural vegetation.	<ul style="list-style-type: none"> • Highly degraded areas or highly disturbed areas in which the original species composition has been lost.
LOW	No natural habitat remaining.	<ul style="list-style-type: none"> • Transformed areas.

Any natural vegetation within which there are features of conservation concern will be classified into one of the high sensitivity classes (MEDIUM-HIGH, HIGH or VERY HIGH). The difference between these three high classes is based on a combination of factors and can be summarised as follows:

1. Areas classified into the VERY HIGH class are vital for the survival of species or ecosystems. They are either known sites for threatened species or are ecosystems that have been identified as being remaining areas of vegetation of critical conservation importance. CBA1 areas would qualify for inclusion into this class.
2. Areas classified into the HIGH class are of high biodiversity value, but do not necessarily contain features that would put them into the VERY HIGH class. For example, a site that is known to contain a population of a threatened species would be in the VERY HIGH class, but a site where a threatened species could potentially occur (habitat is suitable), but it is not known whether it does occur there or not, is classified into the HIGH sensitivity class. The class also includes any areas that are not specifically identified as having high conservation status, but have high local species richness, unique species composition, low resilience or provide very

important ecosystem goods and services. CBA2 “irreplaceable biodiversity areas” would qualify for inclusion into this class, if there were no other factors that would put them into the highest class.

3. Areas classified into the MEDIUM-HIGH sensitivity class are natural vegetation in which there are one or two features that make them of biodiversity value, but not to the extent that they would be classified into one of the other two higher categories. CBA2 “corridor areas” would qualify for inclusion into this class.

Impact assessment methodology

The Impact Assessment Methodology assists in evaluating the overall effect of a proposed activity on the environment. The determination of the effect of an environmental impact on an environmental parameter is determined through a systematic analysis of the various components of the impact. This is undertaken using information that is available to the environmental practitioner through the process of the environmental impact assessment. The impact evaluation of predicted impacts was undertaken through an assessment of the significance of the impacts.

Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale i.e. site, local, national or global whereas Intensity is defined by the severity of the impact e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in Table 2.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

Impact Rating System

Impact assessment must take account of the nature, scale and duration of effects on the environment whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is also assessed according to the project stages:

- planning
- construction
- operation
- decommissioning

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed.

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the mitigation of the impact. Impacts have been consolidated into one rating. In assessing the significance of each issue the following criteria (including an allocated point system) is used:

Table 2: Description of impact assessment terms

NATURE		
A brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity.		
GEOGRAPHICAL EXTENT		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country

PROBABILITY		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity.		
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
CUMULATIVE EFFECT		
This describes the cumulative effect of the impacts on the environmental parameter. A cumulative effect/impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.		
1	Negligible Cumulative Impact	The impact would result in negligible to no cumulative effects
2	Low Cumulative Impact	The impact would result in insignificant cumulative effects
3	Medium Cumulative Impact	The impact would result in minor cumulative effects
4	High Cumulative Impact	The impact would result in significant cumulative effects
INTENSITY / MAGNITUDE		
Describes the severity of an impact.		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.

2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
SIGNIFICANCE		
<p>Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula:</p> <p>(Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity.</p> <p>The summation of the different criteria will produce a non weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.</p>		
6 to 28	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive Low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive Medium impact	The anticipated impact will have moderate positive effects.
51 to 73	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive High impact	The anticipated impact will have significant positive effects.
74 to 96	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive Very high impact	The anticipated impact will have highly significant positive effects.

Table 3: Impact table format.

IMPACT TABLE FORMAT	
Environmental parameter	A brief description of the environmental aspect likely to be affected by the proposed activity e.g. Surface water
Issue/Impact/Environmental Effect/Nature	A brief description of the nature of the impact that is likely to affect the environmental aspect as a result of the proposed activity e.g. alteration of aquatic biota The environmental impact that is likely to positively or negatively affect the environment as a result of the proposed activity e.g. oil spill in surface water
Extent	
Probability	A brief description indicating the chances of the impact occurring
Reversibility	A brief description of the ability of the environmental components recovery after a disturbance as a result of the proposed activity

Irreplaceable loss of resources	A brief description of the degree in which irreplaceable resources are likely to be lost	
Duration	A brief description of the amount of time the proposed activity is likely to take to its completion	
Cumulative effect	A brief description of whether the impact will be exacerbated as a result of the proposed activity	
Intensity/magnitude	A brief description of whether the impact has the ability to alter the functionality or quality of a system permanently or temporarily	
Significance rating	A brief description of the importance of an impact which in turn dictates the level of mitigation required	
	Pre-mitigation impact rating	Post-mitigation impact rating
Extent	4	1
Probability	4	1
Reversibility	4	1
Irreplaceable loss	4	1
Duration	4	1
Cumulative effect	4	1
Intensity/magnitude	4	1
Significance rating	-96 (high negative)	-6 (low negative)
Mitigation measures	Outline/explain the mitigation measures to be undertaken to ameliorate the impacts that are likely to arise from the proposed activity. Describe how the mitigation measures have reduced/enhanced the impact with relevance to the impact criteria used in analyzing the significance. These measures will be detailed in the EMPR.	

RELEVANT LEGISLATIVE AND PERMIT REQUIREMENTS

Relevant legislation is provided in this section to provide a description of the key legal considerations of importance to the proposed project. The applicable legislation is listed below.

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.

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

NEMA is the framework environmental management legislation, enacted as part of the government's mandate to ensure every person's constitutional right to an environment that is not harmful to his or her health or wellbeing. It is administered by DEA but several functions have been delegated to the provincial environment departments. One of the purposes of NEMA is to provide for co-operative environmental governance by establishing principles for decision-making on matters affecting the environment. The Act further aims to provide for institutions that will promote cooperative governance and procedures for coordinating environmental functions exercised by organs of state and to provide for the administration and enforcement of other environmental management laws.

NEMA requires, inter alia, that:

- “development must be socially, environmentally, and economically sustainable”,
- “disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied.” ,
- “a risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions”,

NEMA states that “the environment is held in public trust for the people, the beneficial use of environmental resources must serve the public interest and the environment must be protected as the people's common heritage.”

This report considers the Environmental Impact Assessment (EIA) Regulations of 2014 (NEMA, 2014) as amended in 2017 (NEMA, 2017), under the National Environmental Management Act, (Act No. 107 of 1998). According to these Regulations under Listing Notice 1 (GRN No. 327), Listing Notice 2 (GRN No 325) and Listing Notice 3 (GRN No 324), the activities listed are identified as activities that may require Environmental Authorisation prior to commencement of that activity and to identify competent authorities in terms of sections 24(2) and 24D of the Act.

National Environmental Management: Biodiversity Act (Act No 10 of 2004)

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.

In terms of the Biodiversity Act, the developer has a responsibility for:

- The conservation of endangered ecosystems and restriction of activities according to the categorisation of the area (not just by listed activity as specified in the EIA regulations).
- Promote the application of appropriate environmental management tools in order to ensure integrated environmental management of activities thereby ensuring that all development within the area are in line with ecological sustainable development and protection of biodiversity.
- Limit further loss of biodiversity and conserve endangered ecosystems.

Chapter 4 of the Act relates to threatened or protected ecosystems or species. According to Section 57 of the Act, "Restricted activities involving listed threatened or protected species":

- (1) A person may not carry out a restricted activity involving a specimen of a listed threatened or protected species without a permit issued in terms of Chapter 7.

Such activities include any that are "of a nature that may negatively impact on the survival of a listed threatened or protected species".

Alien and Invasive Species

Chapter 5 of NEM:BA relates to species and organisms posing a potential threat to biodiversity. The Act defines alien species and provides lists of invasive species in 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 in 2014 (NEM:BA, 2014). The Alien and Invasive Species (AIS) lists were subsequently published in Government Notice R 864 of 29 July 2016 (NEM:BA, 2016).

According to Section 75 of the Act, "Control and eradication of listed invasive species":

- (1) Control and eradication of a listed invasive species must be carried out by means of methods that are appropriate for the species concerned and the environment in which it occurs.
- (2) Any action taken to control and eradicate a listed invasive species must be executed with caution and in a manner that may cause the least possible harm to biodiversity and damage to the environment.
- (3) The methods employed to control and eradicate a listed invasive species must also be directed at the offspring, propagating material and re-growth of such invasive species in order to prevent such species from producing offspring, forming seed, regenerating or re-establishing itself in any manner.

The National Environmental Management: Biodiversity Act (NEMBA) regulates all invasive organisms in South Africa, including a wide range of fauna and flora. Chapter 5 of the Act relates to species and organisms posing a potential threat to biodiversity. The purpose of Chapter 5 is:

- a) to prevent the unauthorized introduction and spread of alien species and invasive species to ecosystems and habitats where they do not naturally occur;
- b) to manage and control alien species and invasive species to prevent or minimize harm to the environment and to biodiversity in particular;
- c) to eradicate alien species and invasive species from ecosystems and habitats where they may harm such ecosystems or habitats;

According to Section 65 of the Act, "Restricted activities involving alien species":

- 1) A person may not carry out a restricted activity involving a specimen of an alien species without a permit issued in terms of Chapter 7. Restricted activities include the following:
 - a. Importing into the Republic, including introducing from the sea, any specimen of a listed invasive species.
 - b. Having in possession or exercising physical control over any specimen of a listed invasive species.
 - c. Growing, breeding or in any other way propagating any specimen of a listed invasive species, or causing it to multiply.
 - d. Conveying, moving or otherwise translocating any specimen of a listed invasive species.
 - e. Selling or otherwise trading in, buying, receiving, giving, donating or accepting as a gift, or in any other way acquiring or disposing of any specimen of a listed invasive species.
 - f. Spreading or allowing the spread of any specimen of a listed invasive species.
 - g. Releasing any specimen of a listed invasive species.
 - h. Additional activities that apply to aquatic species.

- 2) A permit referred to in subsection (1) may be issued only after a prescribed assessment of risks and potential impacts on biodiversity is carried out.

3)

An "**alien species**" is defined in the Act as:

- a) a species that is not an indigenous species; or
- b) an indigenous species translocated or intended to be translocated to a place outside its natural distribution range in nature, but not an indigenous species that has extended its natural distribution range by means of migration or dispersal without human intervention.

According to Section 71 of the Act, "Restricted activities involving listed invasive species":

- 1) A person may not carry out a restricted activity involving a specimen of a listed invasive species without a permit issued in terms of Chapter 7.
- 2) A permit referred to in subsection (1) may be issued only after a prescribed assessment of risks and potential impacts on biodiversity is carried out.

An "**invasive species**" is defined in the Act as any species whose establishment and spread outside of its natural distribution range:

- a) threaten ecosystems, habitats or other species or have demonstrable potential to threaten ecosystems, habitats or other species; and
- b) may result in economic or environmental harm or harm to human health.

A "**listed invasive species**" is defined in the Act as any invasive species listed in terms of section 70(1).

According to Section 73 of the Act, "Duty of care relating to listed invasive species":

- 2) A person who is the owner of land on which a listed invasive species occurs must-
 - a) notify any relevant competent authority, in writing, of the listed invasive species occurring on that land;
 - b) take steps to control and eradicate the listed invasive species and to prevent it from spreading; and
 - c) take all the required steps to prevent or minimize harm to biodiversity.

According to Section 75 of the Act, "Control and eradication of listed invasive species":

- (1) Control and eradication of a listed invasive species must be carried out by means of methods that are appropriate for the species concerned and the environment in which it occurs.
- (2) Any action taken to control and eradicate a listed invasive species must be executed with caution and in a manner that may cause the least possible harm to biodiversity and damage to the environment.
- (3) The methods employed to control and eradicate a listed invasive species must also be directed at the offspring, propagating material and re-growth of such invasive species in order to prevent such species from producing offspring, forming seed, regenerating or re-establishing itself in any manner.

Government Notice No. 1002 of 2011: National List of Ecosystems that are Threatened and in need of protection

Published under Section 52(1)(a) of the National Environmental Management: Biodiversity Act (Act No. 10 of 2004). This Act provides for the listing of threatened or protected ecosystems based on national criteria. The list of threatened terrestrial ecosystems supersedes the information regarding terrestrial ecosystem status in the National Spatial Biodiversity Assessment (2004).

The EIA Regulations (2014, as amended) include three lists of activities that require environmental authorisation:

- Listing Notice 1: activities that require a basic assessment (GNR. 327 of 2014, as amended),
- Listing Notice 2: activities that require a full environmental impact assessment report (EIR) (GNR. 325 of 2014, as amended),
- Listing Notice 3: activities that require a basic assessment in specific identified geographical areas only (GNR. 324 of 2014, as amended).

The proposed WEF is located partially within the Komsberg Renewable Energy Development Zone (REDZ 2), one of the eight REDZ formally gazetted¹ in South Africa indicating the procedure to be followed in applying for environmental authorisation (EA) for large scale solar and wind energy generation facilities. Considering that a portion of the proposed facility is located outside of the Komsberg REDZ, the Rondekop WEF will be subject to a full Environmental Impact Assessment (EIA) process in terms of the National Environmental Management Act (Act 107 of 1998) (NEMA) as amended and EIA Regulations, 2014 (as amended).

The full list of trigger activities has been included in the application form and will be assessed and discussed in the Ecology Impact Assessment Report.

GNR 151: Critically Endangered, Endangered, Vulnerable and Protected Species List

Published under Section 56(1) of the National Environmental Management: Biodiversity Act (Act No. 10 of 2004).

GNR 1187: Amendment of Critically Endangered, Endangered, Vulnerable and Protected Species List

Published under Section 56(1) of the National Environmental Management: Biodiversity Act (Act No. 10 of 2004).

Government Notice No. 40733 of 2017: Draft National Biodiversity Offset Policy

Published under the National Environmental Management Act (Act No. 107 of 1998). The aim of the Policy is to ensure that significant residual impacts of developments are remedied as required by NEMA, thereby ensuring sustainable development as required by section 24 of the Constitution of the Republic of South Africa, 1996. This policy should be taken into consideration with every development application that still has significant residual impact after the Mitigation Sequence has been followed. The mitigation sequence entails the consecutive application of avoiding or preventing loss, then at minimizing or mitigating what cannot be avoided, rehabilitating where possible and, as a last resort, offsetting the residual impact. The Policy specifies that one impact that has come across consistently as unmitigatable is the rapid and consistent transformation of certain ecosystems and vegetation types, leading to the loss of ecosystems and extinction of species. The Policy specifically targets ecosystems where the ability to reach protected area targets is lost or close to being lost. However, the Policy states that “[w]here ecosystems remain largely untransformed, intact and functional, an offset would not be required for developments that lead to transformation, provided they have not been identified as a biodiversity priority”. Biodiversity offsets should be considered to remedy residual negative impacts on biodiversity of ‘medium’ to ‘high’ significance. Residual impacts of ‘very high’ significance are a fatal flaw for development and residual biodiversity impacts of ‘low’ significance would usually not require offsets. The Policy indicates that impacts should preferably be avoided in protected areas, CBAs, verified wetland and river features and areas earmarked for protected area expansion.

National Forests Act (Act no 84 of 1998)

Protected trees

According to this act, the Minister may declare a tree, group of trees, woodland or a species of trees as protected. The prohibitions provide that ‘no person may cut, damage, disturb, destroy or remove any *protected tree*, or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a licence granted by the Minister’.

Forests

Prohibits the destruction of indigenous trees in any natural forest without a licence.

National Water Act (Act 36 of 1998)

Wetlands, riparian zones and watercourses are defined in the Water Act as a water resource and any activities that are contemplated that could affect the wetlands requires authorisation (Section 21 of the National Water Act of 1998). A “watercourse” in terms of the National Water Act (Act 36 of 1998) means:

- River or spring;
- A natural channel in which water flows regularly or intermittently;

¹ Formally gazetted on 16 February 2018 (government notice 114).

- A wetland, lake or dam into which, or from which, water flows; and

Any collection of water which the Minister may, by notice in the gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

Conservation of Agricultural Resources (Act No. 43 of 1983) as amended in 2001

Declared Weeds and Invaders in South Africa are categorised according to one of the following categories:

- Category 1 plants: are prohibited and must be controlled.
- Category 2 plants: (commercially used plants) may be grown in demarcated areas providing that there is a permit and that steps are taken to prevent their spread.
- Category 3 plants: (ornamentally used plants) may no longer be planted; existing plants may remain, as long as all reasonable steps are taken to prevent the spreading thereof, except within the floodline of watercourses and wetlands.

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

Provides requirements for veldfire prevention through firebreaks and required measures for fire-fighting. Chapter 4 of the Act places a duty on landowners to prepare and maintain firebreaks. Chapter 5 of the Act places a duty on all landowners to acquire equipment and have available personnel to fight fires.

Northern Cape Nature Conservation Act, No. 9 of 2009

This Act provides for the sustainable utilisation of wild animals, aquatic biota and plants; provides for the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora; provides for offences and penalties for contravention of the Act; provides for the appointment of nature conservators to implement the provisions of the Act; and provides for the issuing of permits and other authorisations. Amongst other regulations, the following may apply to the current project:

- Boundary fences may not be altered in such a way as to prevent wild animals from freely moving onto or off of a property;
- Aquatic habitats may not be destroyed or damaged;
- The owner of land upon which an invasive species is found (plant or animal) must take the necessary steps to eradicate or destroy such species.

The Act provides lists of protected species for the Province. According to Northern Cape Nature Conservation officials, a permit is required for the removal of any species on this list.

Other Acts

Other Acts that may apply to biodiversity issues, but which are considered to not apply to the current site are as follows:

- National Environmental Management Protected Areas Act (Act No. 57 of 2003)
- Marine Living Resources Act (Act No. 18 of 1998)
- Sea Birds and Seals Protection Act (Act No. 46 of 1973)
- Lake Areas Development Act (Act No. 39 of 1975)
- Mountain Catchment Areas Act (Act No. 63 of 1970)
- Integrated Coastal Zone Management Act (Act No. 24 of 2008)

DESCRIPTION OF STUDY AREA

Location

The study area is close to the confluence of the Northern, Western and Eastern Cape boundaries. This is also approximately 70 km north of the Great Escarpment in a particularly rugged part of the Karoo. It is situated adjacent to the N1 National Road slightly south of halfway between Colesberg and Beaufort West (Figure 1).

The site is on portions of the Farms Rondavel, Nieuwefontein, Gegundefontein, Bult & Rietfontein and Vogelstruisfontein in the quarter degree grids 3123AD, BC, CB and DA. This is located approximately 35 km west-south-west of Richmond on the N1 road to Beaufort West (Figure 1). The entrance to the Farm Rondavel is also the entrance to the project area. A secondary gravel road runs from this point through the study area towards Hutchinson. The town of Victoria West is approximately 40 km directly to the west-north-west, but there is no direct road in that direction.

The N1 forms the south-eastern boundary of the study area and farm boundaries constitute the remaining boundaries.

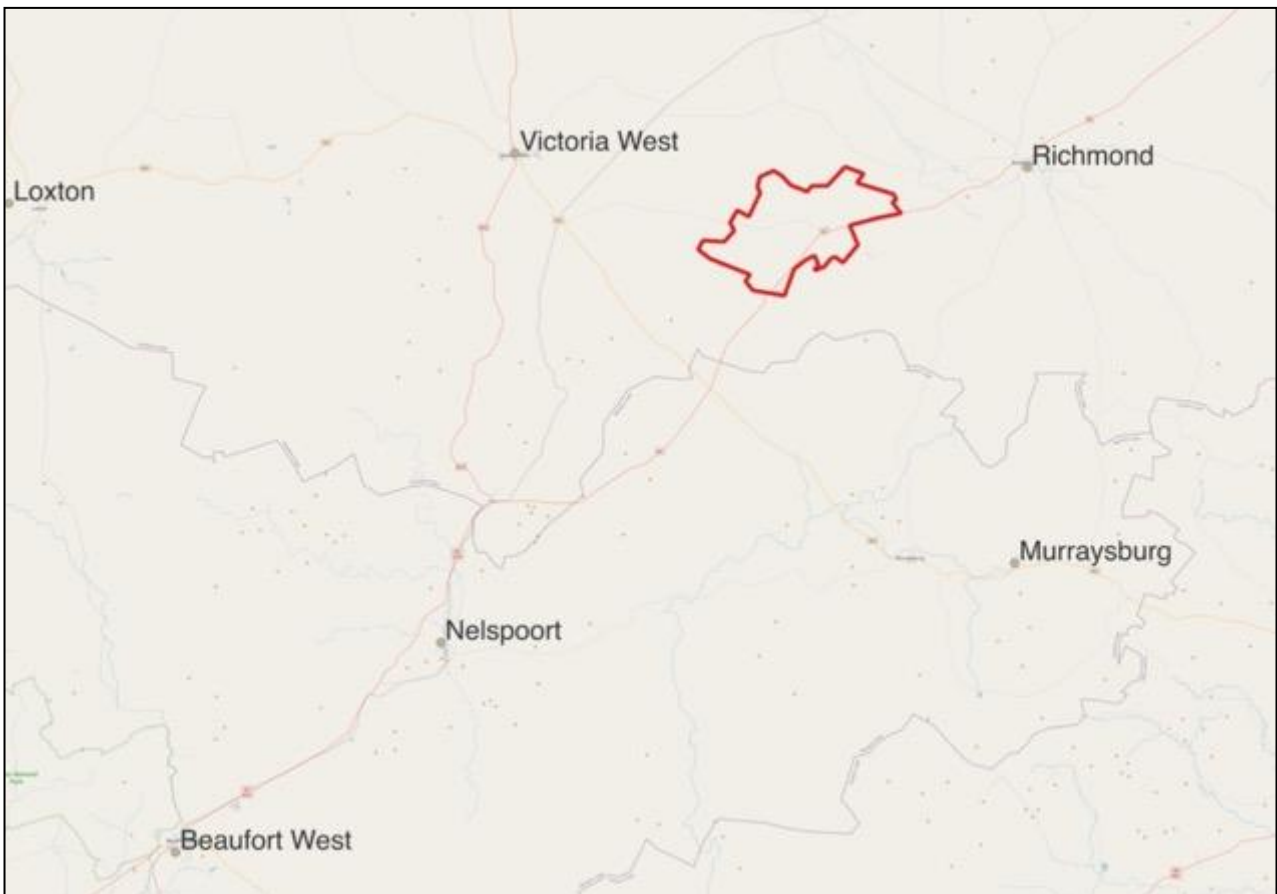


Figure 2: Location of the project.

Site conditions

A landcover map of the study area (Fairbanks *et al.* 2000) indicates that the entire study area consists of natural vegetation, classified as “shrubland and low fynbos” with scattered waterbodies. The 1:50 000 topocadastral maps of the study area confirm this pattern, including small areas of cultivation and homesteads associated with the farmhouse complexes at Rondavel and Bultfontein.

Topography and drainage

The study site is situated in an area with a combination of steep and relatively gentle topography (Figure 2). Adjacent to the N1, the landscape is gently sloping. Inland of this is a relatively steep escarpment / ridge area that runs more-or-less parallel to the national road / southern boundary (Figure 2). Above this the landscape is relatively flat again, with the exception of localised ridges, koppies and shallow valleys. The elevation on site varies from 1284 to 1507 m above sea level, an elevation difference of approximately 223 m.

The main drainage is in the southern part of the site. This is a non-perennial drainage that forms the upper reaches of the Brakrivier.

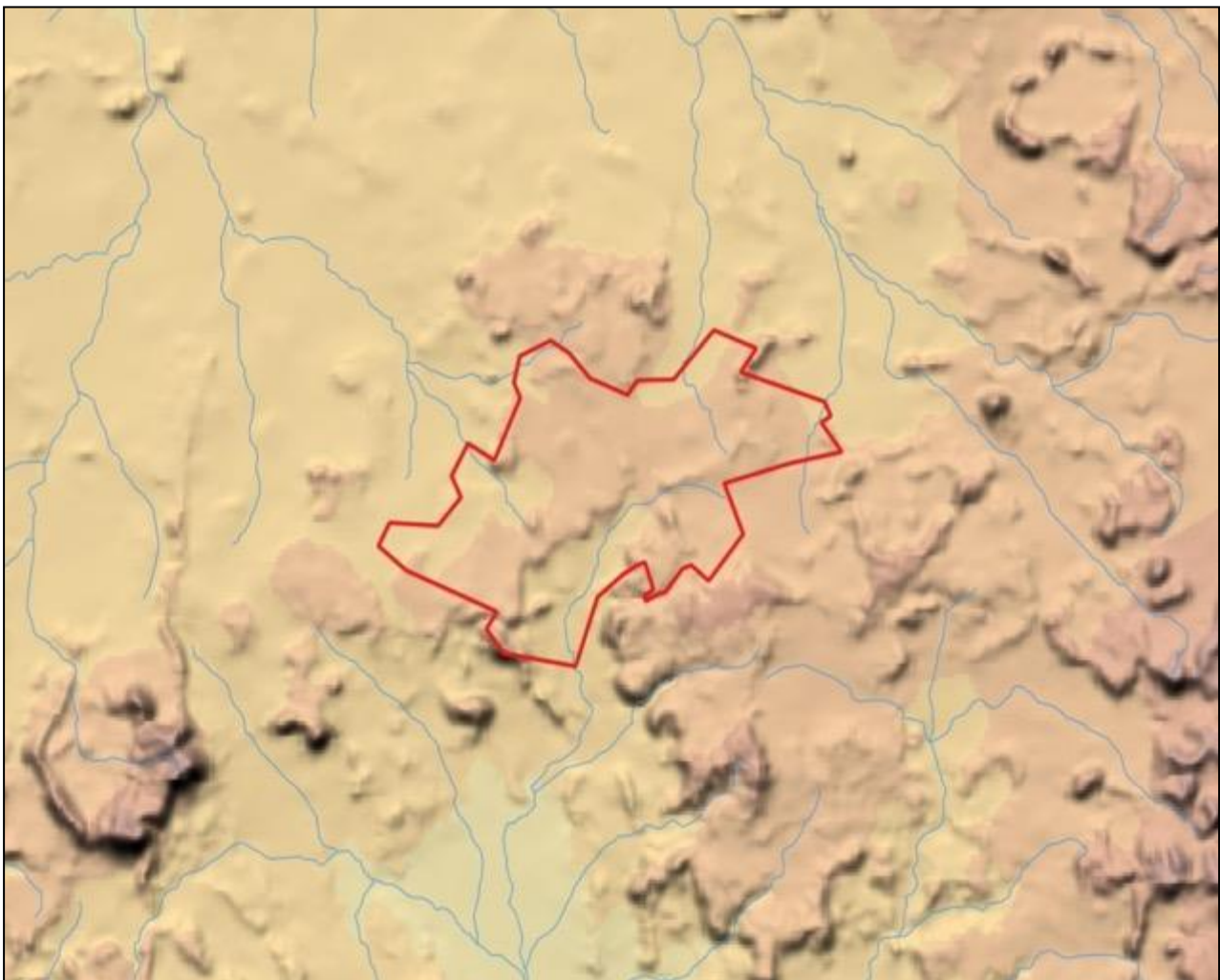


Figure 2: Drainage and topography of the site and surrounding areas.

Climate

The study area is within a relatively dry area. Rainfall occurs mainly in Summer and Autumn, peaking in March. Mean annual rainfall is just under 300 mm per year. All areas with less than 400 mm rainfall are considered to be arid and all areas with more than 600 mm are moist. The study area can therefore be considered to be arid. Winter frost is common and may occur for more than 80 days per year. Mean maximum and minimum monthly temperatures for Victoria West are 36.6°C and -8°C.

Broad vegetation patterns

The vegetation of the study area indicates that there are two regional vegetation types occurring in the study area, one of which only occurs as thin strips in parts of the study area. These are Eastern Upper Karoo across most of the site and Upper Karoo Hardeveld associated with low mountains. Another vegetation type, Southern Karoo Riviere, is shown as occurring nearby, but there is a possibility that this may occur within drainage areas on site, even though it is not mapped at a regional scale as occurring there. The distribution of these relative to the site is shown in Figure 3. The vegetation types that occur on site are briefly described below.

Upper Karoo Hardeveld (NKu2)

Distribution

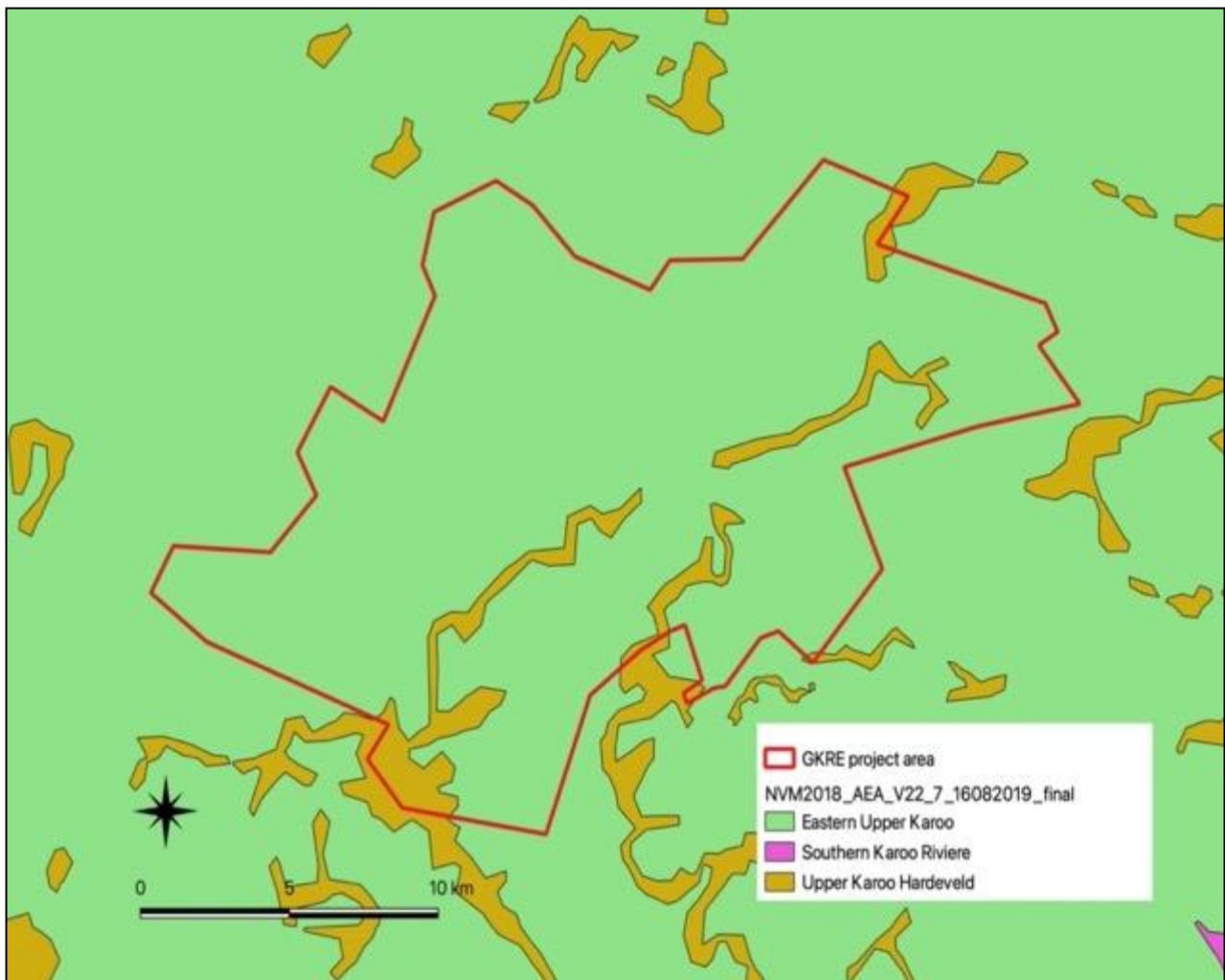


Figure 3: Broad regional vegetation types of the study area.

Northern, Western and Eastern Cape Provinces: Discrete areas of slopes and ridges including dolerite dykes and sills in the region spanning Middelpos in the west and Strydenburg, Richmond and Nieu-Bethesda in the east. Most crest areas and steep slopes of the Great Escarpment facing south between Teekloofpas (connecting Leeu-Gamka and Fraserburg) and eastwards to Graaff-Reinet. Altitude varies mostly from 1 000–1 900 m..

Vegetation & Landscape Features

Steep slopes of koppies, butts, mesas and parts of the Great Escarpment covered with large boulders and stones supporting sparse dwarf Karoo scrub with drought-tolerant grasses of genera such as *Aristida*, *Eragrostis* and *Stipagrostis*.

Geology & Soils

Primitive, skeletal soils in rocky areas developing over sedimentary rocks such as mudstones and arenites of the Adelaide Subgroup of the Karoo Supergroup and to a lesser extent also the Ecce Group (Waterford and Volksrust Formations) as well as Jurassic dolerite sills and dykes and subsummit positions of mesas and butts with dolerite boulder slopes. Almost entirely lb land type.

Climate

In the western part of its area this unit experiences the same climate as the Western Upper Karoo. In the eastern part the climate is very close to that of Karoo Escarpment. The MAP ranges from about 150 mm in the northwest to 350 mm along some grassland margins on the Great Escarpment and in the east. Water concentrates between rocks as a result of rainfall runoff. Incidence of frost is relatively high, but ranging widely from <30 days per year at lower altitudes to >80 days at highest altitudes. See also climate diagram for NKu 2 Upper Karoo Hardeveld (Figure 7.2).

Important Taxa

Tall Shrubs: *Lycium cinereum* (d), *Rhigozum obovatum* (d), *Cadaba aphylla*, *Diospyros austro-africana*, *Ehretia rigida* subsp. *rigida*, *Lycium oxycarpum*, *Melianthus comosus*, *Rhus burchellii*. **Low Shrubs:** *Chrysocoma ciliata* (d), *Eriocephalus ericoides* subsp. *ericoides* (d), *Euryops lateriflorus* (d), *Felicia muricata* (d), *Limeum aethiopicum* (d), *Pteronia glauca* (d), *Amphiglossa triflora*, *Aptosimum elongatum*, *A. spinescens*, *Asparagus mucronatus*, *A. retrofractus*, *A. striatus*, *A. suaveolens*, *Eriocephalus spinescens*, *Euryops annae*, *E. candollei*, *E. empetrifolium*, *E. nodosus*, *Felicia filifolia* subsp. *filifolia*, *Garuleum latifolium*, *Helichrysum lucilioides*, *H. zeyheri*, *Hermannia filifolia* var. *filifolia*, *H. multiflora*, *H. pulchella*, *H. vestita*, *Indigofera sessilifolia*, *Jamesbrittenia atropurpurea*, *Lessertia frutescens*, *Melolobium candicans*, *M. microphyllum*, *Microloma armatum*, *Monechma incanum*, *Nenax microphylla*, *Pegolettia retrofracta*, *Pelargonium abrotanifolium*, *P. ramosissimum*, *Pentzia globosa*, *P. spinescens*, *Plinthus karoocicus*, *Polygala seminuda*, *Pteronia adenocarpa*, *P. sordida*, *Rosenia humilis*, *Selago albida*, *Solanum capense*, *Sutera halimifolia*, *Tetragonia arbuscula*, *Wahlenbergia tenella*. **Succulent Shrubs:** *Aloe broomii*, *Drosanthemum lique*, *Faucaria bosscheana*, *Kleinia longiflora*, *Pachypodium succulentum*, *Trichodiadema barbatum*, *Zygophyllum flexuosum*. **Semiparasitic Shrub:** *Thesium lineatum* (d). **Herbs:** *Troglophyton capillaceum* subsp. *capillaceum*, *Dianthus caespitosus* subsp. *caespitosus*, *Gazania krebsiana*, *Lepidium africanum* subsp. *africanum*, *Leysera tenella*, *Pelargonium minimum*, *Sutera pinnatifida*, *Tribulus terrestris*. **Geophytic Herbs:** *Albuca setosa*, *Androcymbium albomarginatum*, *Asplenium cordatum*, *Boophone disticha*, *Cheilanthes bergiana*, *Drimia intricata*, *Oxalis depressa*, *Graminoids:* *Aristida adscensionis* (d), *A. congesta* (d), *A. diffusa* (d), *Cenchrus ciliaris* (d), *Enneapogon desvauxii* (d), *Eragrostis lehmanniana* (d), *E. obtusa* (d), *Sporobolus fimbriatus* (d), *Stipagrostis obtusa* (d), *Cynodon incompletus*, *Digitaria eriantha*, *Ehrharta calycina*, *Enneapogon scaber*, *E. scoparius*, *Eragrostis curvula*, *E. nindensis*, *E. procumbens*, *Fingerhuthia africana*, *Heteropogon contortus*, *Merxmüllera disticha*, *Stipagrostis ciliata*, *Themeda triandra*, *Tragus berteronianus*, *T. koelerioides*.

Endemic Taxa

Succulent Shrubs: *Aloe chlorantha*, *Crassula barbata* subsp. *broomii*, *Delosperma robustum*, *Sceletium expansum*, *Stomatium suaveolens*. **Low Shrubs:** *Cineraria polycephala*, *Euryops petraeus*, *Lotononis azureoides*, *Selago magnakarooica*. **Tall Shrub:** *Anisodonte malvastroides*. **Herbs:** *Cineraria arctotidea*, *Vellereophyton niveum*. **Succulent Herbs:** *Adromischus fallax*, *A. humilis*. **Geophytic Herbs:** *Gethyllis longistyla*, *Lachenalia auriolae*, *Ornithogalum paucifolium* subsp. *karooparkense*.

Eastern Upper Karoo (NKu4)

Distribution

Northern Cape, Eastern Cape and Western Cape Provinces: Between Carnarvon and Loxton in the west, De Aar, Petrusville and Venterstad in the north, Burgersdorp, Hofmeyr and Cradock in the east and the Great Escarpment and the Sneeuberge-Coetzeesberge mountain chain in the south. Altitude varies between mostly 1 000–1 700 m.

Vegetation & Landscape Features

Flats and gently sloping plains (interspersed with hills and rocky areas of Upper Karoo Hardeveld in the west, Besemkaree Koppies Shrubland in the northeast and Tarkastad Montane Shrubland in the southeast), dominated by dwarf microphyllous shrubs, with 'white' grasses of the genera *Aristida* and *Eragrostis* (these become prominent especially in the early autumn months after good summer rains). The grass cover increases along a gradient from southwest to northeast.

Geology & Soils

Mudstones and sandstones of the Beaufort Group (incl. both Adelaide and Tarkastad Subgroups) supporting duplex soils with prisma-cutanic and/or pedocutanic diagnostic horizons dominant (Da land type) as well as some shallow Glenrosa and Mispah soils (Fb and Fc land types). In places, less prominent Jurassic dolerites (Karoo Dolerite Suite) are also found.

Climate

Rainfall mainly in autumn and summer, peaking in March. MAP ranges from about 180 mm in the west to 430 mm in the east. Incidence of frost is relatively high, but ranging widely from <30 days (in the lower-altitude Cradock area) to >80 days of frost per year (bordering the Upper Karoo Hardeveld on the Compassberg and mountains immediately to the west). Mean maximum and minimum monthly temperatures in Middelburg (Grootfontein) are 36.1°C and -7.2°C for January and July, respectively. Corresponding values are 37°C and -8°C for Victoria West and 36.6°C and -4.2°C for Hofmeyr. See also climate diagram for NKu 4 Eastern Upper Karoo.

Important Taxa

Tall Shrubs: *Lycium cinereum* (d), *L. horridum*, *L. oxycarpum*. **Low Shrubs:** *Chrysocoma ciliata* (d), *Eriocephalus ericoides* subsp. *ericoides* (d), *E. spinescens* (d), *Pentzia globosa* (d), *P. incana* (d), *Phymaspermum parvifolium* (d), *Salsola calluna* (d), *Aptosimum procumbens*, *Felicia muricata*, *Gnidia polycephala*, *Helichrysum dregeanum*, *H. lucilioides*, *Limeum aethiopicum*, *Nenax microphylla*, *Osteospermum leptolobum*, *Plinthus karoocicus*, *Pteronia glauca*, *Rosenia humilis*, *Selago geniculata*, *S. saxatilis*. **Succulent Shrubs:** *Euphorbia hypogaea*, *Ruschia intricata*. **Herbs:** *Indigofera alternans*, *Pelargonium minimum*, *Tribulus terrestris*. **Geophytic Herbs:** *Moraea pallida* (d), *Moraea polystachya*, *Syringodea bifurcata*, *S. concolor*. **Succulent Herbs:** *Psilocalon coriarium*, *Tridentea jucunda*, *T. virescens*. **Graminoids:** *Aristida congesta* (d), *A. diffusa* (d), *Cynodon incompletus* (d), *Eragrostis bergiana* (d), *E. bicolor* (d), *E. lehmanniana* (d), *E. obtusa* (d), *Sporobolus fimbriatus* (d), *Stipagrostis ciliata* (d), *Tragus koelerioides* (d), *Aristida adscensionis*, *Chloris virgata*, *Cyperus usitatus*, *Digitaria eriantha*, *Enneapogon desvauxii*, *E. scoparius*, *Eragrostis curvula*, *Fingerhuthia africana*, *Heteropogon contortus*, *Sporobolus ludwigii*, *S. tenellus*, *Stipagrostis obtusa*, *Themeda triandra*, *Tragus berteronianus*.

Endemic Taxa

Succulent Shrubs: *Chasmatophyllum rouxii*, *Hertia cluytiifolia*, *Rabiea albinota*, *Salsola tetrandra*. **Tall Shrub:** *Phymaspermum scoparium*. **Low Shrubs:** *Aspalathus acicularis* subsp. *planifolia*, *Selago persimilis*, *S. walpersii*.

Conservation status of broad vegetation types

On the basis of a scientific approach used at national level by SANBI (Driver *et al.*, 2005), vegetation types can be categorised according to their conservation status which is, in turn, assessed according to the degree of transformation relative to the expected extent of each vegetation type. The status of a habitat or vegetation type is based on how much of its original area still remains intact relative to various thresholds. The original extent of a vegetation type is as presented in the most recent national vegetation map (Mucina, Rutherford & Powrie 2005) and is the extent of the vegetation type in the absence of any historical human impact. On a national scale the thresholds are as depicted in Table 4 below, as determined by best available scientific approaches (Driver *et al.*, 2005). The level at which an ecosystem becomes Critically Endangered differs from one ecosystem to another and varies from 16% to 36% (Driver *et al.*, 2005).

Determining ecosystem status (Driver *et al.*, 2005). *BT = biodiversity target (the minimum conservation requirement).

Habitat remaining (%)	80–100	least threatened	LT
	60–80	vulnerable	VU
	*BT–60	endangered	EN
	0–*BT	critically endangered	CR

Table 4: Conservation status of different vegetation types occurring in the study area.

Vegetation Type	Target (%)	Conserved (%)	Transformed (%)	Conservation status	
				Driver <i>et al.</i> 2005; Mucina <i>et al.</i> , 2006	National Ecosystem List (NEM:BA)
Eastern Upper Karoo	21	0.7	2	Least Threatened	Not listed
Upper Karoo Hardeveld	21	2.9	<1	Least Threatened	Not listed

According to scientific literature (Driver *et al.*, 2005; Mucina *et al.*, 2006), as shown in Table 3, both vegetation types are listed as Least Threatened.

The National List of Ecosystems that are Threatened and need of protection (GN1002 of 2011), published under the National Environmental Management: Biodiversity Act (Act No. 10, 2004), lists national vegetation types that are afforded protection on the basis of rates of transformation. The thresholds for listing in this legislation are higher than in the scientific literature, which means there are fewer ecosystems listed in the National Ecosystem List versus in the scientific literature.

Neither vegetation types are listed in the National List of Ecosystems that are Threatened and in need of protection (GN1002 of 2011).

Biodiversity Conservation Plans

The Northern Cape Critical Biodiversity Area (CBA) Map (Figure 4) was published in 2016 (Holness & Oosthuysen 2016) and “updates, revises and replaces all older systematic biodiversity plans and associated products for the province”. The Northern Cape CBA map classifies the natural vegetation of the province according to conservation value in decreasing value, as follows:

1. Protected
2. Critical Biodiversity Area One (Irreplaceable Areas) (RED)
3. Critical Biodiversity Area Two (Important Areas) (ORANGE)
4. Ecological Support Area (GREEN)
5. Other Natural Area (YELLOW)

This shows features within the study area within four of these classes, as follows:

1. Critical Biodiversity Areas: The two main drainage lines, as well as an area in the north of the site are within a CBA1 area.
2. Ecological Support Areas: Other drainage lines and an area in the southern part of the study area is within ECAs.
3. Other Natural Areas: Most remaining areas on site are indicated as being in a natural state.

The presence of CBA1 areas indicate that these areas are considered important for biodiversity conservation. Additionally, the ESAs indicate that the site has importance in a wider ecological context for supporting biodiversity patterns.

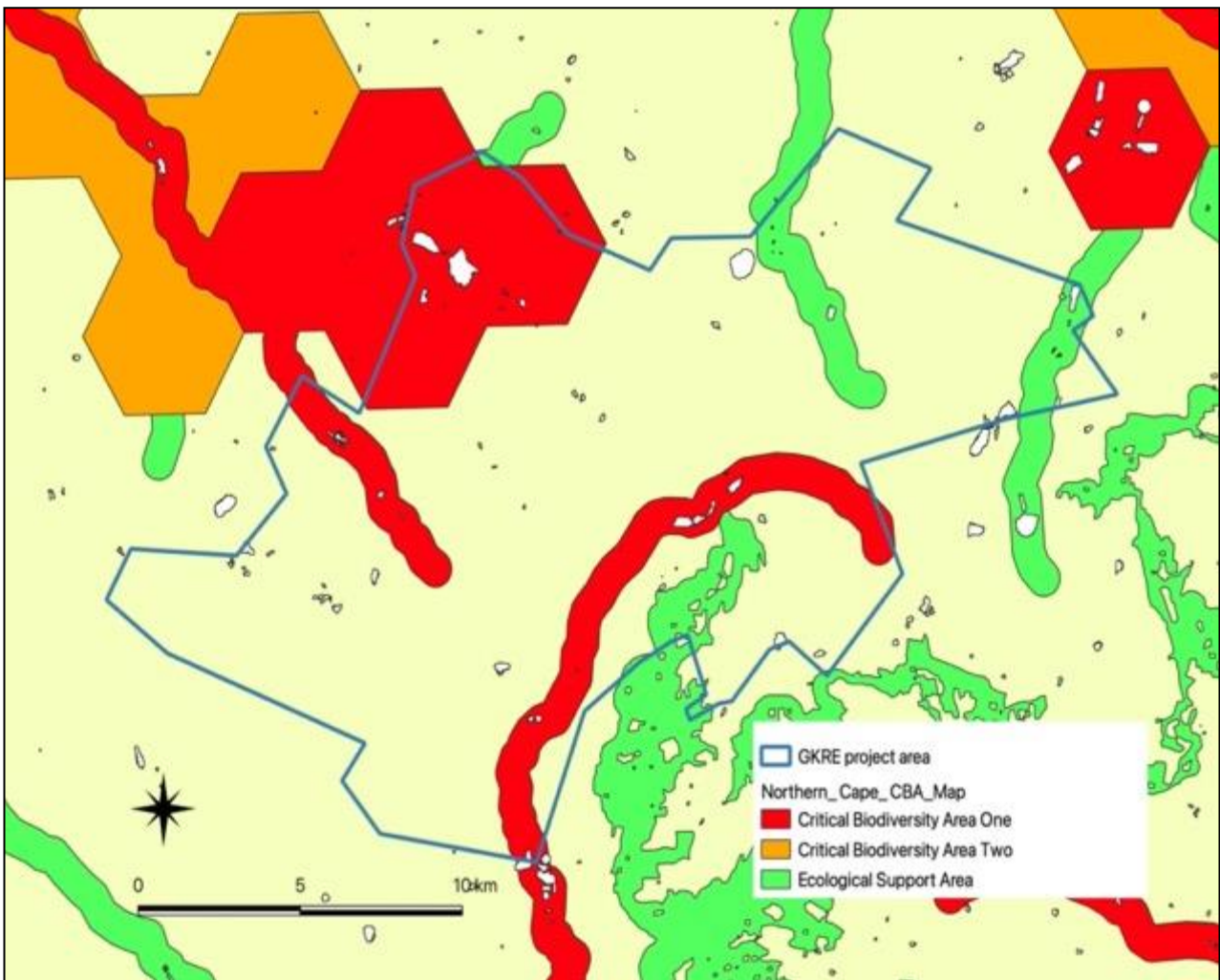


Figure 4: Northern Cape CBA map for the study area.

Proposed protected areas

According to the National Parks Area Expansion Strategy (NPAES), there are no areas within the study area that have been identified as priority areas for inclusion in future protected areas. The study area is therefore **outside the NPAES focus area**. There are many areas outside of the study site, to the north, south, east and west that are included as being part of future protected areas, but not within or adjacent to the site itself.

Red List plant species of the study area

Lists of plant species previously recorded in the study area were obtained from the South African National Biodiversity Institute (SANBI) website (<http://newposa.sanbi.org/>). These are listed in Appendix 1. Additional species that could occur in similar habitats, as determined from database searches and literature sources, but have not been recorded in

these grids are also listed. There are seven species on this list that have a geographical distribution that could include the site.

The species on this list were evaluated to determine the likelihood of any of them occurring on site on the basis of habitat suitability. There are three species listed as Rare that are considered to occur within the geographical area under consideration and could potentially occur on site (see Appendix 1). These species are *Anisodonteia malavastroides*, *Aloe broomii* var. *tarkaensis* and *Tridentea virescens*. These are all species with wide geographical distributions, but which are rarely encountered. None of them are considered to be threatened. None were seen on site.

Table 5: Explanation of IUCN Version 3.1 categories (IUCN 2001) and Orange List categories (Victor & Keith 2004).

IUCN / Orange List category	Definition	Class
EX	Extinct	Extinct
CR	Critically Endangered	Red List
EN	Endangered	Red List
VU	Vulnerable	Red List
NT	Near Threatened	Orange List
Declining	Declining taxa	Orange List
Rare	Rare	Orange List
Critically Rare	Rare: only one subpopulation	Orange List
Rare-Sparse	Rare: widely distributed but rare	Orange List
DDD	Data Deficient: well known but not enough information for assessment	Orange List
DDT	Data Deficient: taxonomic problems	Data Deficient
DDX	Data Deficient: unknown species	Data Deficient

Protected plants (National Environmental Management: Biodiversity Act)

Plant species protected under the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004) are listed in Appendix 6. None of the species on this list were found on site, although several have a geographical distribution that includes the site.

Protected plants (Northern Cape Nature Conservation Act)

Plant species protected under the Northern Cape Nature Conservation Act, 2009 (Act 9 of 2009) are listed in Appendix 5. A number of species were found on site that are protected according to the Northern Cape Nature Conservation Act, 2009 (Act 9 of 2009). From the field surveys, this includes the following: *Chasmatophyllum musculinum* (Aizoaceae), *Delosperma lootsbergense* (Aizoaceae), *Delosperma multiflorum* (Aizoaceae), *Drosanthemum hispidum* (Aizoaceae), *Drosanthemum lique* (Aizoaceae), *Galenia africana* (Aizoaceae), *Galenia glandulifera* (Aizoaceae), *Galenia procumbens* (Aizoaceae), *Galenia pubescens* (Aizoaceae), *Galenia secunda* (Aizoaceae), *Hereroa incurva* (Aizoaceae), *Mesembryanthemum coriarium* (Aizoaceae), *Mesembryanthemum crystallinum* (Aizoaceae), *Mesembryanthemum nodiflorum* (Aizoaceae), *Pleiospilos compactus* (Aizoaceae), *Ruschia cradockensis* (Aizoaceae), *Ruschia intricata* (Aizoaceae), *Ruschia spinosa* (Aizoaceae), *Trichodiadema attonsum* (Aizoaceae), *Trichodiadema rogersiae* (Aizoaceae), *Trichodiadema setuliferum* (Aizoaceae), *Bulbine abyssinica* (Asphodelaceae), *Haworthia bolusii* var. *blackbeardiana* (Asphodelaceae), *Haworthia bolusii* var. *bolusii* (Asphodelaceae), *Haworthia marumiana* var. *marumiana* (Asphodelaceae), *Haworthiopsis tessellata* (Asphodelaceae), *Kniphofia stricta* (Asphodelaceae), *Trachyandra acocksii* (Asphodelaceae), *Trachyandra karrooica* (Asphodelaceae), *Aloe broomii* (Asphodelaceae), *Aloe claviflora* (Asphodelaceae), *Euphorbia caterviflora* (Euphorbiaceae), *Euphorbia clavarioides* (Euphorbiaceae), *Euphorbia decepta*

(Euphorbiaceae), *Euphorbia mauritanica* (Euphorbiaceae), *Euphorbia rhombifolia* (Euphorbiaceae), *Euphorbia stellispina* (Euphorbiaceae), *Pelargonium abrotanifolium* (Geraniaceae), *Pelargonium alchemilloides* (Geraniaceae), *Pelargonium aridum* (Geraniaceae), *Pelargonium karoicum* (Geraniaceae), *Pelargonium minimum* (Geraniaceae), *Pelargonium proliferu* (Geraniaceae), *Pelargonium tragacanthoides* (Geraniaceae), *Babiana bainesii* (Iridaceae), *Babiana hypogaea* (Iridaceae), *Babiana sambucina* subsp. *sambucina* (Iridaceae), *Dierama pendulum* (Iridaceae), *Gethyllis longistyla* (Iridaceae), *Hesperantha longituba* (Iridaceae), *Lapeirousia plicata* subsp. *plicata* (Iridaceae), *Moraea polystachya* (Iridaceae), *Romulea macowanii* var. *alticola* (Iridaceae), *Syringodea concolor* (Iridaceae), *Tritonia karoica* (Iridaceae), *Tritonia laxifolia* (Iridaceae), . Despite not being threatened, any impacts on these species will require a permit from the relevant authorities. There is a possibility that additional protected species occur on site that were not detected during the field survey. Note that many of these species are widespread and not of any conservation concern, but protected due to the fact that the Northern Cape Nature Conservation Act, 2009 (Act 9 of 2009) protects entire families of flowering plants irrespective of whether some members are rare or common. The implication is that a comprehensive list of species occurring within the footprint of the proposed infrastructure is required and a permit application submitted for any of those listed as protected.

Protected trees

Tree species protected under the National Forest Act are listed in Appendix 2. There is a single species that is known to have a geographical distribution that includes the grids in which the proposed infrastructure is to be located, namely *Boscia albitrunca*.

Boscia albitrunca (Shepherd's Tree / Witgatboom / !Xhi) occurs in semi-desert areas and bushveld, often on termitaria, but is common on sandy to loamy soils and calcrete soils. The site is very marginal to the overall geographical distribution of the species. The species could potentially occur on site but it is considered to be unlikely. It was not recorded during multiple surveys of the site.

In summary, a single species of protected trees has a possibility of being found on site.

Animal species of the study area

According to the records (FitzPatrick Institute of African Ornithology – Virtual Museum, Frog Records, 2021) only two species (Table 6) were recently collected within the area (QD 3123DA). These are the Common Caco (*Cacosternum boettgeri*) and Tandy's Sand Frog (*Tomopterna tandyi*), both with a listed conservation status of "Least Concern". Due to the recent droughts, the probability of encountering any specimens are low.

Table 6: List of Amphibians associated with the QDS (3123DA) of the study site.

Family	Genus and species name	Common name	Conservation status
Pyxicephalidae	<i>Cacosternum boettgeri</i>	Common Caco	Least Concern
Pyxicephalidae	<i>Tomopterna tandyi</i>	Tandy's Sand Frog	Least Concern

The semi-arid area south of Richmond is known for a low diversity of mammals, firstly related to the lack of open water and secondly the long history of farming in the region. The impact of the sheep farming is that the migration corridors of larger mammals were restricted and over time many species have been lost to the area. In recent years with the increase in hunting, some farmers have reintroduced some of the mammals that were previously present in the area. The obvious threat of predators to livestock further contribute to the low diversity of mammals occurring in the area. The smaller cats e.g. *Genetta genetta*, *Felis nigripes* (Vulnerable) and the less feared small fox, *Otocyon megalotis* are recorded recently in the QDS (FitzPatrick Institute of African Ornithology – Virtual Museum, Mammal Records, 2021 and i-Naturalist, 2021) (Table 7). There was some rodent activity (active burrows and tracks) observed, but the species were not identified during the survey.

The endangered *Bunolagus monticularis* is not expected in the area (known distribution range further south), but a survey is currently being conducted to confirm its absence/presence in the study area (separate report to be completed at the end of October 2021).

Table 7: Summary of expected mammals associated with the QDS 3123DA (shaded species represent either observation or signs of activity).

Family	Genus and species name	Common name	Conservation status
Bathyergidae	<i>Cryptomys hottentotus</i>	African Mole-rat	Least Concern
Bovidae	<i>Raphicerus campestris</i>	Steenbok	Least Concern
Bovidae	<i>Antidorcas marsupialis</i>	Springbok	Least Concern
Bovidae	<i>Pelea capreolus</i>	Grey Rhebok	Least Concern
Canidae	<i>Otocyon megalotis</i>	Bat-eared Fox	Least Concern
Cercopithecidae	<i>Papio ursinus</i>	Cape Baboon	Least Concern
Felidae	<i>Felis nigripes</i>	Black-footed Cat	Vulnerable
Herpestidae	<i>Suricata suricatta</i>	Meerkat	Least Concern
Herpestidae	<i>Herpestes pulverulentus</i>	Cape Grey Mongoose	Least Concern
Leporidae	<i>Lepus saxatilis</i>	Scrub Hare	Least Concern
Leporidae	<i>Lepus capensis</i>	Cape Hare	Least Concern
Muridae	<i>Rhabdomys pumilio</i>	Four-striped Grass Mouse	Least Concern
Mustelidae	<i>Ictonyx striatus</i>	Striped polecat	Least Concern
Orycteropodidae	<i>Orycteropus afer</i>	Aardvark	Least Concern
Pedetidae	<i>Pedetes capensis</i>	Springhare	Least Concern
Procaviidae	<i>Procavia capensis</i>	Rock hyrax	Least concern
Sciuridae	<i>Geosciurus inauris</i>	Cape Ground Squirrel	Least Concern
Viverridae	<i>Genetta genetta</i>	Small-spotted Genet	Least Concern

One will expect a more extensive list of reptiles for the study, but the combined list for the QDS (FitzPatrick Institute of African Ornithology – Virtual Museum, Mammal Records, 2021 and i-Naturalist, 2021) give a short list of recently confirmed specimens (Table 8). This can be a result of the recent extensive drought and modified landscape (grazing and vegetation modification) associated with the agricultural activities. There are no species list as red data for the area.

Table 8: List of expected reptiles on the area of the proposed development (FitzPatrick Institute of African Ornithology – Virtual Museum, Reptile Records, 2021 and i-Naturalist, 2021)

Family	Genus and species name	Common name	Conservation status
Agamidae	<i>Agama atra</i>	Southern Rock Agama	Least Concern
Agamidae	<i>Agama aculeata</i>	Ground Agama	Least Concern
Colubridae	<i>Lamprophis aurora</i>	Aurora House Snake	Least Concern
Cordylidae	<i>Karusasaurus polyzonus</i>	Karoo Girdled Lizard	Least Concern
Cordylidae	<i>Cordylus cordylus</i>	Cape Girdled Lizard	Least Concern
Gekkonidae	<i>Afroedura karroica</i>	Karoo Flat Gecko	Least Concern
Lacertidae	<i>Meroles suborbitalis</i>	Spotted Sand Lizard	Least Concern
Lacertidae	<i>Pedioplanis namaquensis</i>	Namaqua Sand Lizard	Least Concern
Scincidae	<i>Trachylepis sulcata</i>	Western Rock Skink	Least Concern
Scincidae	<i>Plestiodon gilberti</i>	Gilbert's Skink	Least Concern
Testudinidae	<i>Stigmochelys pardalis</i>	Leopard Tortoise	Least Concern
Varanidae	<i>Varanus albigularis</i>	Rock Monitor	Least Concern

A number of scorpions (Table 9) are listed for the larger area around the study site (African Snake Bite Institute, 2021) and a number of active burrows of these animals were noted during the survey.

Table 9: List of possible Scorpions that can occur on the study site, as these are listed in the larger area surrounding Richmond)

Family	Genus and species name	Common name	Conservation status
Buthidae	<i>Parabuthus granulatus</i>	Rough Thicktail Scorpion	Least Concern
Buthidae	<i>Parabuthus mossambicensis</i>	Mozambique Thicktail Scorpion	Least Concern
Buthidae	<i>Uroplectes carinatus</i>	Common Lesser-Thicktail Scorpion	Least Concern
Buthidae	<i>Uroplectes triangulifer</i>	Highveld Lesser-Thicktail Scorpion	Least Concern
Scorpionidae	<i>Opisthophthalmus carinatus</i>	Radiant Burrower	Least Concern
Scorpionidae	<i>Opisthophthalmus karrooensis</i>	Karoo Burrower	Least Concern

From the surveys conducted, it is clear that the animal diversity is low and it can be linked to the current drought conditions and the semi-arid conditions associated with the region, as well as the history of habitat management associated with livestock production.

Habitats on site

A map of habitats on site is provided in (Figure 5). This shows various habitat units on site, as follows:

1. Hills and mountains
2. Rocky areas
3. Plains
4. Drainage areas
5. Drainage scrub
6. Open water
7. No natural habitat

Hills and mountains

The site is characterised by the presence of a range of hills that form a mini-escarpment parallel to the national road. The topography within these areas is relatively steep and rugged. There are also various low hills and the free-standing Bloukop inland of the mini-escarpment. The vegetation in these areas is a grassy dwarf karroid shrubland.

Rocky areas

There are various parts of the hills that contain outcrops of rocks, either as shelves or as boulders. The vegetation within these areas is largely woody, consisting of various low- to medium-height shrubs. The rocky areas constitute important refugia for small mammals and reptiles, including as potential habitat for the Near Threatened Karoo Dwarf Tortoise (*Homopus boulengeri*).

Plains

The plains on the lowlands have gently undulating topography. They are found between the hills throughout the site. The vegetation in these areas is mostly a dwarf karroid shrubland. These areas have been moderately to heavily grazed throughout the study area.

Drainage areas

In the lowest parts of the plains, often in wide bands, are areas that are shaped by fluvial processes and are either channelled in places or eroded from water movement. The soils are mostly deep sands where they have not been eroded away. The vegetation is a karroid dwarf shrubland or a sparse weedy community in eroded areas.

Drainage scrub

This forms part of the drainage areas, but has been mapped as a separate unit due to the clearly different vegetation structure and composition. The vegetation is a scrub or shrubland with shrubs up to 3 m high in places. The vegetation is relatively dense and the soils are deep and sandy. It constitutes an important refuge for wildlife, both in terms of the dense vegetation cover as well as the deep sands which are ideal for burrowing animals. Although considered unlikely that it would occur on site, this is the habitat that most closely matches the habitat requirements of the Critically Endangered Riverine Rabbit.

Open water

There are a number of farm dams on site. These are all man-made, but they nevertheless constitute an important water resource for wildlife. There is a possibility that the Protected Giant Bullfrog occurs in the general area, in which case these areas of open water may constitute important habitat for them.

No natural habitat

All areas where natural habitat has been lost have been included in this map unit. This includes farm houses, roads, cultivated areas, previously cultivated areas, quarries and other disturbed areas.

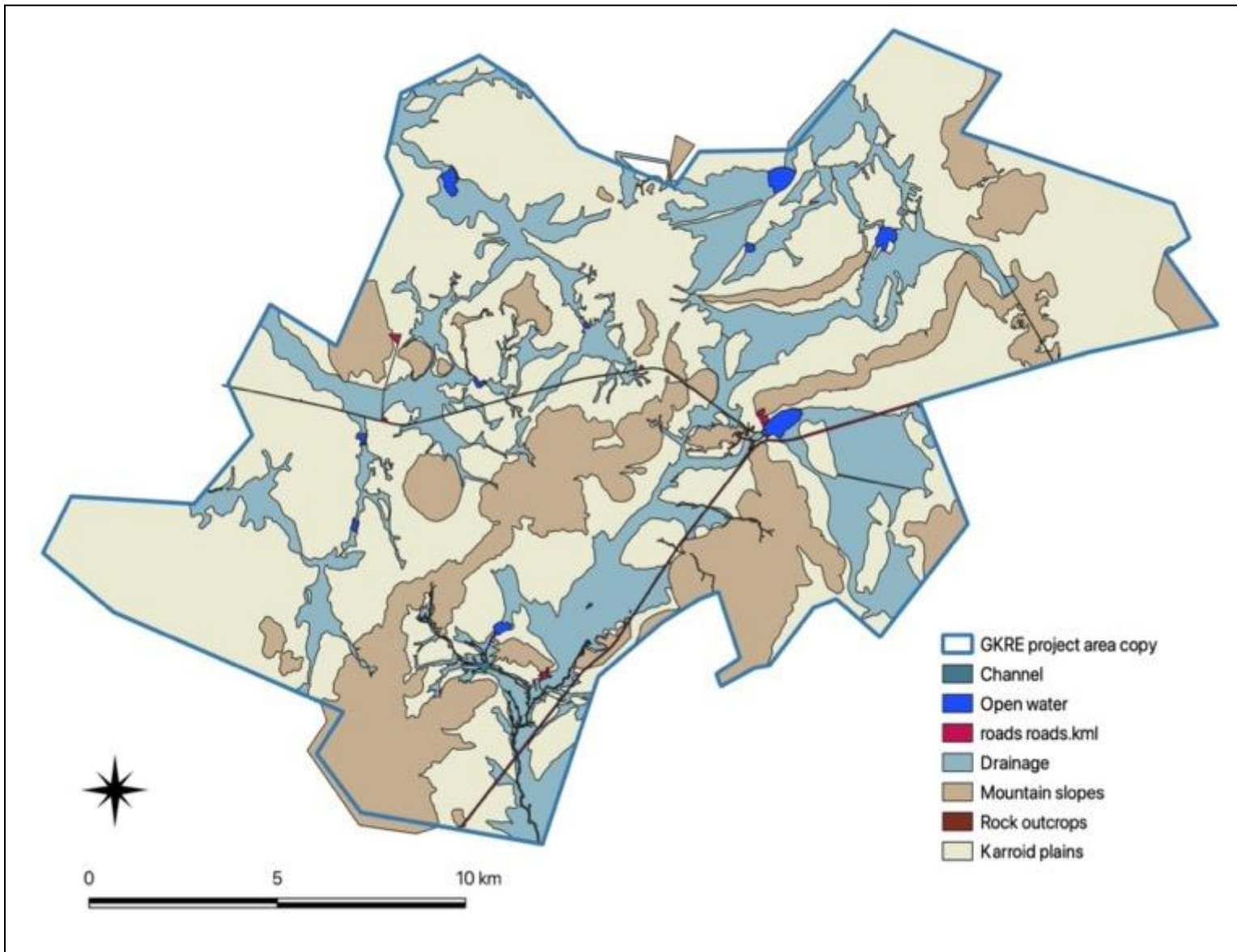


Figure 5: Habitats of the study area.

Habitat sensitivity

To determine sensitivity on site, local and regional factors were taken into account. There are some habitats on site that have been described as sensitive in their own right, irrespective of regional assessments. This includes primarily the dry stream beds and associated riparian zones. Rocky outcrops and steep slopes are more sensitive than surrounding areas, mainly due to higher floristic diversity and the likelihood of plant species with low local abundance occurring there.

At a regional level, the Critical Biodiversity Area (CBA) map for Northern Cape indicates the northern part of the site as being important for conservation. There are also two drainage lines (the two main ones on site) that are designated as being CBA1 areas. The remaining drainage lines of the study area are indicated as being Ecological Support Areas (ESAs).

In terms of other species of concern and overall biological diversity, including both plants and animals, the low hills and mountain ranges are the areas with the most species as well as being most likely to contain any species of concern. However, the southern main drainage line is the most likely habitat for the Critically Endangered Riverine Rabbit, if it occurs on site, which is unknown but possible.

A summary of sensitivities that occur on site and that may be vulnerable to damage from the proposed project are as follows:

1. Dry stream beds, including the associated riparian habitats and adjacent floodplains;
2. CBA1 areas;
3. Habitat suitable for Riverine Rabbit.

Based on this information, a map of habitat sensitivity on site is provided in Figure 6. This shows main habitat sensitivity classes on site, namely VERY HIGH for habitat suitable for Riverine Rabbit, HIGH for other CBA1 areas and riparian habitats, MEDIUM-HIGH for ridges, outcrops, hills and mountain slopes, and MEDIUM for plains vegetation.

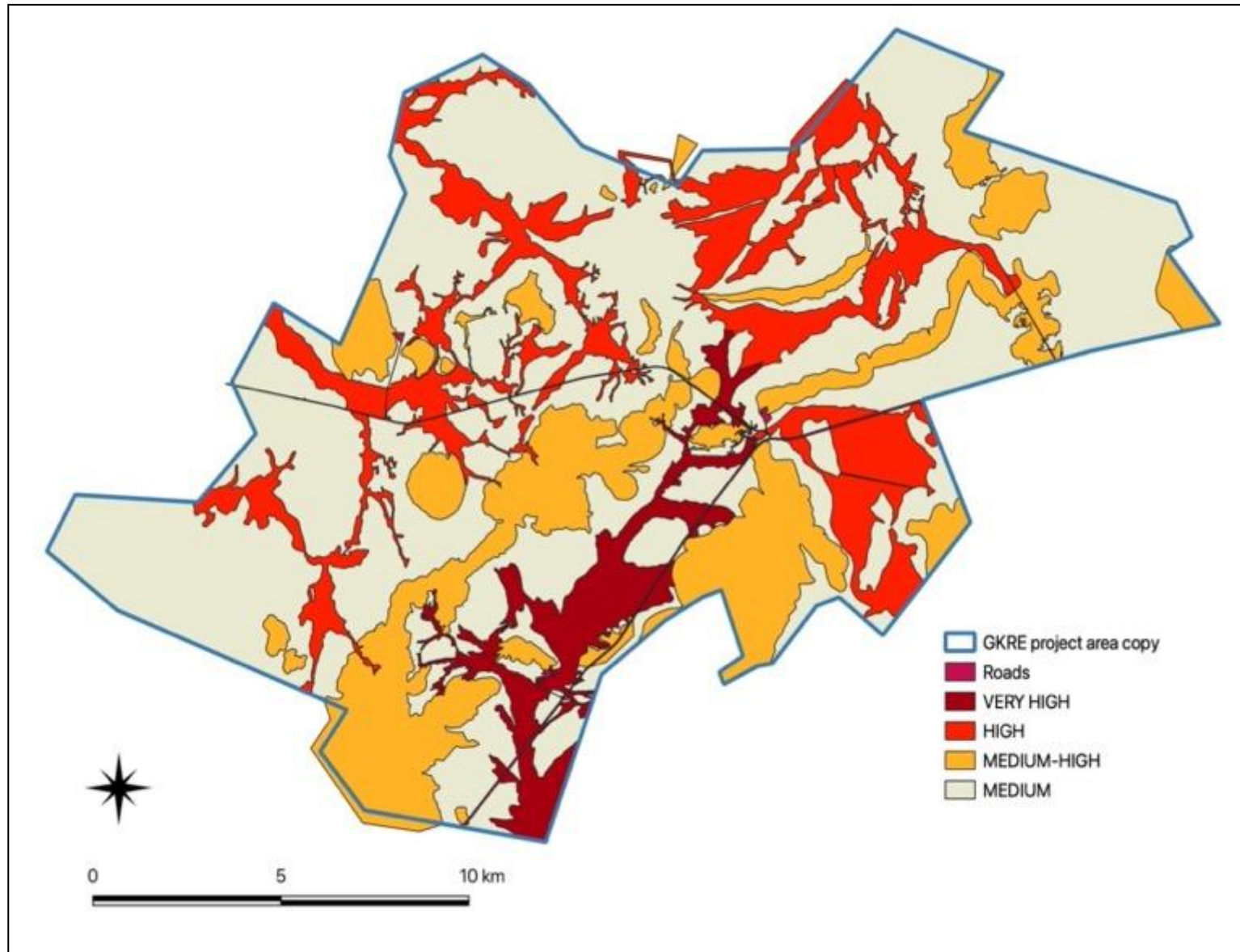


Figure 6: Habitat sensitivity of the study area.

DESCRIPTION OF POTENTIAL IMPACTS

Potential issues relevant to impacts on the ecology of the study area include the following:

- Impacts on biodiversity: this includes any impacts on populations of individual species of concern (flora and fauna), including protected species, and on overall species richness. This includes impacts on genetic variability, population dynamics, overall species existence or health and on habitats important for species of concern.
- Impacts on sensitive habitats: this includes impacts on any sensitive or protected habitats, including indigenous grassland and wetland vegetation that leads to direct or indirect loss of such habitat.
- Impacts on ecosystem function: this includes impacts on any processes or factors that maintain ecosystem health and character, including the following:
 - disruption to nutrient-flow dynamics;
 - impedance of movement of material or water;
 - habitat fragmentation;
 - changes to abiotic environmental conditions;
 - changes to disturbance regimes, e.g. increased or decreased incidence of fire;
 - changes to successional processes;
 - effects on pollinators;
 - increased invasion by alien plants.

Changes to factors such as these may lead to a reduction in the resilience of plant communities and ecosystems or loss or change in ecosystem function.

- Secondary and cumulative impacts on ecology: this includes an assessment of the impacts of the proposed project taken in combination with the impacts of other known projects for the area or secondary impacts that may arise from changes in the social, economic or ecological environment.
- Impacts on the economic use of vegetation: this includes any impacts that affect the productivity or function of ecosystems in such a way as to reduce the economic value to users, e.g. reduction in grazing capacity, loss of harvestable products. It is a general consideration of the impact of a project on the supply of so-called ecosystem goods and services.

Potential sensitive receptors in the general study area

A summary of the potential ecological issues for the study area is as follows (issues assessed by other specialists, e.g. on birds and on wetland and hydrological function, are not included here):

- Presence of natural vegetation on site, some of which has high conservation value due to being within Critical Biodiversity Areas (CBA1). Designated-natural vegetation on site is vulnerable to disturbance, especially direct habitat loss and habitat fragmentation.
- Possible presence of Critically Endangered mammal on site.
- Presence of dry stream beds and associated riparian vegetation on site, assessed as being sensitive to impacts associated with development as well as being important habitat for various plant and animal species.
- Presence of various plant species protected according to the Northern Cape Nature Conservation Act (Act 9 of 2009). The identity of such species requires detailed floristic surveys within the footprint of the proposed project.
- Potential invasion of natural habitats by alien invasive plants, thus causing additional impacts on biodiversity features.

Construction Phase Impacts

Direct impacts

Direct impacts include the following:

1. Loss and/or fragmentation of indigenous natural vegetation due to clearing;
2. Loss of individuals of protected plants;
3. Loss of faunal habitat and refugia;
4. Direct mortality of fauna due to machinery, construction and increased traffic;
5. Displacement and/or disturbance of fauna due to increased activity and noise levels;
6. Increased poaching and/or illegal collecting due to increased access to the area.

Indirect impacts

Indirect impacts during the construction phase include the following:

1. Establishment and spread of alien invasive plants due to the clearing and disturbance of indigenous vegetation;
2. Increased runoff and erosion due to clearing of vegetation, construction of hard surfaces and compaction of surfaces, leading to changes in downslope areas.

Operational Phase Impacts

Direct impacts

Ongoing direct impacts will include the following:

1. Continued disturbance to natural habitats due to general operational activities and maintenance;
2. Direct mortality of fauna through traffic, illegal collecting, poaching and collisions and/or entanglement with infrastructure;

Indirect impacts

These will include the following:

1. Continued establishment and spread of alien invasive plant species due to the presence of migration corridors and disturbance vectors;
2. Continued runoff and erosion due to the presence of hard surfaces that change the infiltration and runoff properties of the landscape;
3. Changes to behavioural patterns of animals, including possible migration away or towards the project area;
4. Positive potential impact on climate change due to generation of electricity without the need for coal mining or burning of coal, currently the main form of power generation in South Africa.

Decommissioning Phase Impacts

Direct impacts

These will include the following:

1. Loss and disturbance of natural vegetation due to the removal of infrastructure and need for working sites;
2. Direct mortality of fauna due to machinery, construction and increased traffic;
3. Displacement and/or disturbance of fauna due to increased activity and noise levels;

Indirect impacts

These will occur due to renewed disturbance due to decommissioning activities, as follows:

1. Continued establishment and spread of alien invasive plant species due to the presence of migration corridors and disturbance vectors;
2. Continued runoff and erosion due to the presence of hard surfaces that change the infiltration and runoff properties of the landscape;
3. Changes to behavioural patterns of animals, including possible migration away or towards the project area;

DISCUSSION AND CONCLUSIONS

The study area consists mostly of natural habitat that is used for commercial animal husbandry. There are existing transmission power lines running across the site with associated access tracks as well infrastructure associated with two farmsteads, but no other infrastructure on site. Existing impacts on natural habitat are related to grazing effects and erosion in lowland areas. The proposal to build a renewable energy facilities on site will therefore have significant effects on natural habitat. The existing biodiversity on site is, however, relatively limited in terms of uniqueness or potential presence of species of concern, with the possible presence of one Critically Endangered mammal species.

The vegetation on site is not considered to be part of any threatened ecosystem and has not been assessed as being of high conservation value due to rates of transformation. The regional vegetation types that occur on site, Eastern Upper Karoo and Upper Karoo Hardeveld, are both widespread and have low rates of transformation across their geographical range.

There are three plant species listed as Rare (*Anisodonteia malavastroides*, *Aloe broomii* var. *tarkaensis* and *Tridentea virescens*) that could potentially occur on site, but these are all three widespread species that are naturally rare where they are found. None have been previously recorded on this site. There are also two plant species protected according to National legislation (*Crinum bulbispermum* and *Harpagophytum procumbens*) that could potentially occur in the geographical area, but these are also very widespread species. In all five cases the loss of some individuals, if they are found to occur on site, would not affect the conservation status of any of the species. It is, however, unlikely that any of them would be affected.

There are a small number of fauna species of conservation concern that were assessed as having a possibility of occurring on site. The Riverine Rabbit has been previously recorded in the grid in which the site is found and there are some small patches of habitat that are marginally suited to the species, but the known distribution of the species does not include the site and it is not known to occur in this area so it is therefore considered unlikely that it would be found on site. All other species listed here are highly mobile species that are unlikely to be affected by any activities on site.

A risk assessment was undertaken which identified seven potential negative impacts due to construction or operation of the proposed infrastructure. The potential impacts are as follows:

1. Direct loss of vegetation. For Solar PV projects, where the local impact will be relatively extensive, this will be limited primarily to lowland plains areas, where the vegetation has been assessed as having relatively low biodiversity value. For wind energy projects, the main impact on terrestrial ecosystems is due to road construction and not to the turbines themselves. The placement of roads is therefore critical in limiting impacts.
2. Loss, fragmentation or degradation of faunal habitat;
3. Displacement of populations of mobile species;
4. Mortality of populations of sedentary species during construction;
5. Loss of indigenous natural vegetation during construction;
6. Loss of protected plants during construction;
7. Introduction and/or spread of declared weeds and alien invasive plants in terrestrial habitats;

A preliminary assessment indicates that these potential impacts will have a significance of low, medium or high. If appropriate mitigation measures are put in place, it is probable that most impacts will have low to medium significance. This, in combination with the limited amount of biodiversity of significance likely to be affected indicates that the project is unlikely to have significant biodiversity impacts, in terms of those issues investigated in this study. The current opinion is that the project should be able to proceed on condition the recommended EIA studies are undertaken and that appropriate mitigation measures, such as those suggested, are put in place to minimise predicted impacts.

Possible impacts on the Riverine Rabbit

The Critically Endangered *Bunolagus monticularis* (Riverine Rabbit) occurs along seasonal rivers in the Nama Karoo. While much is known about Riverine Rabbit distribution in the Nama Karoo, there are still areas where they may occur, but which have not been surveyed yet. The broader distribution of the species is associated with the riparian vegetation along the seasonal river catchments (Duthie et al, 1989) in the south Central Karoo between Beaufort West and Williston and Sutherland and Victoria West. It is a habitat specialist occupying a very restricted and specialised riverine shrubland niche that is linked to its feeding preferences. It is known to be a browser and feeds on the flowers and leaves of Karoo shrubs (e.g. *Pteronia erythrochaetha*, *Kochia pubescens*, *Salsola glabrescens* and Mesembryanthemaceae) (Duthie et al, 1989). In addition, it will graze on new grass shoots of the shrubs during the wet season and selected grass species (Duthie et al, 1989) to supplement its diet. The dense and diverse vegetation provides shelter from heat and predators and the soft and deep silt soils are of critical importance to the species as it uses these soils for burrowing and constructing breeding dens. Its range has severely reduced due to habitat destruction (mostly agricultural development) and this resulted in *B. monticularis* being recognised as one of Southern Africa's most endangered mammals. Its "Endangered" conservation status was first recognised in 1981, but in 2002 it was upgraded to "Critically Endangered" with less than 250 (estimated number) mature individuals in the wild, placing the species at an extremely high risk of extinction.

The following factors have contributed to population reduction:

- Fragmentation and loss of its unique habitat type is considered the most important contributing factor in the population decline.
 - Mainly due to a loss of the unique riverine habitats (overgrazing and cultivation).
 - This resulted in a loss of important food sources.
- Due to cultivation in the riparian zone and overgrazing, soil erosion causes more habitat loss.
 - Wood collection and bush clearing exposes the rabbits to predators and heat.
- Some hunting with snares, gin traps and dogs further contribute to the decline in numbers.
- Dams, weirs and other construction activities (e.g. canals) further transform the habitat and restrict migration corridors.

Conclusions

In general, the site is not considered to have high sensitivity or biodiversity value. There are some natural habitats that are worthy of protection or that may be sensitive to disturbance. There are also a small number of species of conservation concern that could potentially occur within habitats on site. The site therefore contains potential sensitivities and, should the project proceed, care is required to manage potential impacts on biodiversity on site, but the overall impact of the project on biodiversity is likely to be relatively low. The project should therefore be allowed to proceed, on condition recommendations are adhered to, as suggested.

From an ecological perspective it is clear that the proposed development will have a low impact on the biota, but if the access roads and final placement of structures are sensitive to the animals, impacts can be limited. On a local scale, one can expect a low to moderate impact on the habitat for the animals, whilst a low to very low impact can be expected on a regional level.

It is recommended that access roads are linked to existing roads and tracks, as the current activities (although of low frequency) will have a small impact on the burrowing animals (e.g. mammals) and will force them further from roads. It is recommended that once the final layout is confirmed, the ecologists complete a walk down survey to determine if there are any noticeable activities along the proposed corridor and discuss any deviation if needed.

Plan of study for EIA

The following site specific assessments are recommended for the EIA phase:

1. Detailed camera-trap survey of potential Riverine Rabbit habitat, as per recommended protocols. This survey will provide incidental information on the occurrence of other mobile flora on site.
2. More detailed floristic surveys of main footprint areas in order to document composition, especially of protected species. Ideally, this should be undertaken after an appropriate time-period after rainfall to allow emergence of any species of potential interest.

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APPENDICES:

Appendix 1: Plant species of conservation importance (Threatened, Near Threatened and Declining) that have historically been recorded in the study area.

Sources: see text.

Family	Taxon	Status	Habitat	Likelihood of occurrence on site
Apocynaceae	<i>Tridentea virescens</i>	RARE	Warmbad in southern Namibia to Kakamas and Prieska in the Northern Cape stretching east to Prince Albert and Aberdeen. Stony ground, or hard loam in floodplains.	MEDIUM
Malvaceae	<i>Anisodonteia malavastroides</i>	RARE	This species is endemic to the mountains of the Great Karoo, where it occurs in the Nuweveld and Sneeuwberg mountains between Beaufort West and Middelburg. It occurs in arid grassland on summit plateaus and escarpments.	MEDIUM
Asphodelaceae	<i>Aloe broomii</i> var. <i>tarkaensis</i>	LC	Tarkastad, Middelburg and Graaff-Reinet districts, possibly also in the Victoria West district. Low, stony ridges.	MEDIUM

* Conservation Status Category assessment according to IUCN Ver. 3.1 (IUCN, 2001), as evaluated by the Threatened Species Programme of the South African National Biodiversity Institute in Pretoria. *IUCN (3.1) Categories: VU = Vulnerable, EN = Endangered, CR = Critically Endangered, NT = Near Threatened.

Appendix 2: List of protected tree species (National Forests Act).

Vachellia erioloba	Vachellia haematoxylon
Adansonia digitata	Azelia quanzensis
Balanites subsp. maughamii	Barringtonia racemosa
Boscia albitrunca	Brachystegia spiciformis
Breonadia salicina	Bruguiera gymnorhiza
Cassipourea swaziensis	Catha edulis
Ceriops tagal	Cleistanthus schlechteri var. schlechteri
Colubrina nicholsonii	Combretum imberbe
Curtisia dentata	Elaeodendron (Cassine) transvaalensis
Erythrophysa transvaalensis	Euclea pseudobenus
Ficus trichopoda	Leucadendron argenteum
Lumnitzera racemosa var. racemosa	Lydenburgia abottii
Lydenburgia cassinoides	Mimusops caffra
Newtonia hildebrandtii var. hildebrandtii	Ocotea bullata
Ozoroa namaensis	Philenoptera violacea (Lonchocarpus capassa)
Pittosporum viridiflorum	Podocarpus elongatus
Podocarpus falcatus	Podocarpus henkelii
Podocarpus latifolius	Protea comptonii
Protea curvata	Prunus africana
Pterocarpus angolensis	Rhizophora mucronata
Sclerocarya birrea subsp. caffra	Securidaca longependunculata
Sideroxylon inerme subsp. inerme	Tephrosia pondoensis
Warburgia salutaris	Widdringtonia cedarbergensis
Widdringtonia schwarzii	

Boscia albitrunca has a geographical distribution that is close to the study area.

Appendix 3: Plant species recorded on site and nearby.

This list was compiled by extracting a list of species that have been recorded within a rectangular area that includes the study area as well as similar habitats in surrounding areas, as obtained from <http://newposa.sanbi.org/> accessed on 12 September 2021. It is probable that it includes some species that occur in habitats that do not occur on site. The list was supplemented from field observations, as well as observations from www.inaturalist.org, which are photographic observations verified by an online community.

The list is arranged by family in alphabetical order. Species listed in green are those that were found on site and those in blue are from iNaturalist for the general area.

Acanthaceae *Aptosimum indivisum* Indigenous
Acanthaceae *Aptosimum procumbens* Indigenous
Acanthaceae *Blepharis capensis* Indigenous
Acanthaceae *Justicia incana* Indigenous
Agavaceae *Agave americana** (Category 1b)
Aizoaceae *Chasmatophyllum musculinum* Indigenous
Aizoaceae *Delosperma lootbergense* Indigenous; Endemic
Aizoaceae *Delosperma multiflorum* Indigenous; Endemic
Aizoaceae *Drosanthemum hispidum* Indigenous; Endemic
Aizoaceae *Drosanthemum lique* Indigenous; Endemic
Aizoaceae *Galenia africana* Indigenous
Aizoaceae *Galenia glandulifera* Indigenous; Endemic
Aizoaceae *Galenia procumbens* Indigenous; Endemic
Aizoaceae *Galenia pubescens* Indigenous; Endemic
Aizoaceae *Galenia secunda* Indigenous
Aizoaceae *Hereroa incurva* Indigenous; Endemic
Aizoaceae *Mesembryanthemum coriarium* Indigenous
Aizoaceae *Mesembryanthemum crystallinum*
Aizoaceae *Mesembryanthemum nodiflorum* Indigenous
Aizoaceae *Pleiospilos compactus* Indigenous
Aizoaceae *Ruschia cradockensis*
Aizoaceae *Ruschia intricata*
Aizoaceae *Ruschia spinosa*
Aizoaceae *Ruschia sp.*
Aizoaceae *Trichodiadema attonsum* Indigenous; Endemic
Aizoaceae *Trichodiadema rogersiae* Indigenous; Endemic
Aizoaceae *Trichodiadema setuliferum* Indigenous; Endemic
Alliaceae *Allium sp.*
Amaranthaceae *Amaranthus thunbergii* Indigenous
Amaranthaceae *Amaranthus hybridus**
Amaranthaceae *Atriplex nummularia**
Amaranthaceae *Atriplex semibaccata**
Amaranthaceae *Blitum virgatum* subsp. *virgatum* Not indigenous; Cryptogenic
Amaranthaceae *Caroxylon aphyllum*
Amaranthaceae *Dysphania schraderiana* Indigenous
Amaranthaceae *Exomis microphylla* var. *axyrioides* Indigenous; Endemic
Amaranthaceae *Salsola kali* Not indigenous; Naturalised; Invasive
Amaranthaceae *Sericorema remotiflora* Indigenous
Amaryllidaceae *Cyrтанthus macowanii* Indigenous; Endemic
Amaryllidaceae *Brunsvigia radulosa*
Amaryllidaceae *Boophone disticha*
Anacardiaceae *Schinus molle**
Anacardiaceae *Searsia burchellii*
Anacardiaceae *Searsia discolor* Indigenous

Anacardiaceae *Searsia divaricata* Indigenous
 Anacardiaceae *Searsia lancea* Indigenous
 Anacardiaceae *Searsia lucida*
 Anacardiaceae *Searsia pyroides* Indigenous
 Apiaceae *Berula thunbergii*
 Apiaceae *Chamarea longipedicellata* Indigenous
 Apiaceae *Chamarea* sp.
 Apiaceae *Deverra denudata* subsp. *aphylla* Indigenous
 Apocynaceae *Gomphocarpus fruticosus* Indigenous
 Apocynaceae *Cynanchum orangeanum* Indigenous
 Apocynaceae *Cynanchum viminale* Indigenous
 Apocynaceae *Duvalia maculata* Indigenous
 Apocynaceae *Fockea comaru* Indigenous
 Apocynaceae *Huernia barbata* subsp. *barbata* Indigenous
 Apocynaceae *Stapelia grandiflora* var. *grandiflora* Indigenous
 Apocynaceae *Microloma armatum* Indigenous
 Apocynaceae *Tridentea jucunda* Indigenous
 Apocynaceae *Tridentea virescens* Indigenous RARE
 Apocynaceae *Xysmalobium gomphocarpoides* Indigenous
 Aponogetonaceae *Aponogeton junceus*
 Asparagaceae *Asparagus asparagoides* Indigenous
 Asparagaceae *Asparagus burchellii* Indigenous
 Asparagaceae *Asparagus capensis* var. *capensis* Indigenous
 Asparagaceae *Asparagus exuvialis* Indigenous
 Asparagaceae *Asparagus glaucus* Indigenous
 Asparagaceae *Asparagus laricinus* Indigenous
 Asparagaceae *Asparagus mucronatus* Indigenous
 Asparagaceae *Asparagus suaveolens*
 Asparagaceae *Asparagus retrofactus*
 Asparagaceae *Daubenya comata* Indigenous
 Asphodelaceae *Bulbine abyssinica* Indigenous
 Asphodelaceae *Haworthia bolusii* var. *blackbeardiana* Indigenous; Endemic
 Asphodelaceae *Haworthia bolusii* var. *bolusii* Indigenous; Endemic
 Asphodelaceae *Haworthia marumiana* var. *marumiana* Indigenous; Endemic
 Asphodelaceae *Haworthiopsis tessellata* Indigenous
 Asphodelaceae *Kniphofia stricta* Indigenous; Endemic
 Asphodelaceae *Trachyandra acocksii* Indigenous; Endemic
 Asphodelaceae *Trachyandra karrooica* Indigenous
 Asphodelaceae *Aloe broomii*
 Asphodelaceae *Aloe claviflora*
 Aspleniaceae *Asplenium cordatum* Indigenous
 Asteraceae *Arctotheca calendula* Indigenous
 Asteraceae *Arctotis adpressa* Indigenous; Endemic
 Asteraceae *Arctotis dregei* Indigenous
 Asteraceae *Arctotis leiocarpa* Indigenous
 Asteraceae *Arctotis* sp.
 Asteraceae *Arctotis subacaulis* Indigenous
 Asteraceae *Centaurea calcitrapa** Not indigenous; Naturalised
 Asteraceae *Chrysocoma ciliata*
 Asteraceae *Cineraria aspera* Indigenous
 Asteraceae *Cineraria lyratiformis* Indigenous
 Asteraceae *Cirsium vulgare** Category 1b
 Asteraceae *Conyza scabrida* Indigenous
 Asteraceae *Crassothonna protecta* Indigenous
 Asteraceae *Crassothonna sedifolia* Indigenous
 Asteraceae *Curio radicans* Indigenous
 Asteraceae *Cuspidia cernua* subsp. *annua* Indigenous; Endemic

Asteraceae *Denekia capensis* Indigenous
 Asteraceae *Dicrothamnus rhinocerotis* Indigenous; Endemic
 Asteraceae *Dimorphotheca caulescens* Indigenous
 Asteraceae *Dimorphotheca cuneata* Indigenous
 Asteraceae *Eriocephalus africanus*
 Asteraceae *Eriocephalus ericoides*
 Asteraceae *Eriocephalus eximius* Indigenous
 Asteraceae *Eriocephalus* sp.
 Asteraceae *Euryops annae* Indigenous
 Asteraceae *Euryops lateriflorus* Indigenous
 Asteraceae *Euryops nodosus* Indigenous
 Asteraceae *Euryops oligoglossus* subsp. *oligoglossus* Indigenous
 Asteraceae *Euryops petraeus* Indigenous; Endemic
 Asteraceae *Euryops tenuissimus* subsp. *trifurcatus* Indigenous; Endemic
 Asteraceae *Felicia filifolia* subsp. *filifolia* Indigenous
 Asteraceae *Felicia filifolia* subsp. *schaeferi* Indigenous
 Asteraceae *Felicia muricata* subsp. *muricata* Indigenous
 Asteraceae *Felicia ovata* Indigenous; Endemic
 Asteraceae *Garuleum bipinnatum* Indigenous; Endemic
 Asteraceae *Garuleum pinnatifidum* Indigenous; Endemic
 Asteraceae *Gazania krebsiana* subsp. *arctotoides* Indigenous
 Asteraceae *Gazania krebsiana* subsp. *krebsiana* Indigenous
 Asteraceae *Gazania linearis* var. *linearis* Indigenous
 Asteraceae *Geigeria ornativa* subsp. *ornativa* Indigenous
 Asteraceae *Helichrysum albo-brunneum* Indigenous
 Asteraceae *Helichrysum cerastioides* var. *cerastioides* Indigenous
 Asteraceae *Helichrysum hamulosum* Indigenous; Endemic
 Asteraceae *Helichrysum lineare* Indigenous
 Asteraceae *Helichrysum lucilioides* Indigenous
 Asteraceae *Helichrysum nudifolium* var. *nudifolium* Indigenous
 Asteraceae *Helichrysum pumilio* subsp. *pumilio* Indigenous; Endemic
 Asteraceae *Helichrysum rosum* var. *arcuatum* Indigenous; Endemic
 Asteraceae *Helichrysum splendidum* Indigenous
 Asteraceae *Helichrysum stoloniferum* Indigenous; Endemic
 Asteraceae *Helichrysum tysonii* Indigenous; Endemic
 Asteraceae *Helichrysum zeyheri* Indigenous
 Asteraceae *Hertia cluytiifolia* Indigenous
 Asteraceae *Hilliardiella capensis* Indigenous
 Asteraceae *Oedera humilis*
 Asteraceae *Oedera oppositifolia* Indigenous; Endemic
 Asteraceae *Oedera spinescens* Indigenous; Endemic
 Asteraceae *Osteospermum incanum* subsp. *subcanescens* Indigenous; Endemic
 Asteraceae *Osteospermum leptolobum* Indigenous
 Asteraceae *Osteospermum scariosum* var. *scariosum* Indigenous
 Asteraceae *Osteospermum sinuatum* Indigenous
 Asteraceae *Osteospermum sinuatum* var. *sinuatum* Indigenous
 Asteraceae *Osteospermum spinescens* Indigenous
 Asteraceae *Othonna auriculifolia* Indigenous; Endemic
 Asteraceae *Othonna coronopifolia* Indigenous; Endemic
 Asteraceae *Pegolettia retrofracta* Indigenous
 Asteraceae *Pentzia globosa* Indigenous
 Asteraceae *Pentzia incana* Indigenous
 Asteraceae *Pentzia punctata* Indigenous
 Asteraceae *Pentzia quinquefida* Indigenous
 Asteraceae *Phymaspermum aciculare* Indigenous
 Asteraceae *Phymaspermum parvifolium* Indigenous
 Asteraceae *Phymaspermum thymelaeoides* Indigenous

Asteraceae *Pteronia adenocarpa* Indigenous; Endemic
 Asteraceae *Pteronia glauca*
 Asteraceae *Pteronia glomerata*
 Asteraceae *Pteronia viscosa*
 Asteraceae *Senecio alchelleifolius* Indigenous
 Asteraceae *Senecio acutifolius* Indigenous
 Asteraceae *Senecio cotyledonis* Indigenous
 Asteraceae *Senecio erysimoides* Indigenous
 Asteraceae *Senecio hastatus* Indigenous
 Asteraceae *Senecio reptans* Indigenous; Endemic
 Asteraceae *Sonchus asper*
 Asteraceae *Tagetes minuta**
 Asteraceae *Taraxacum officinale**
 Asteraceae *Tarhonanthus minor*
 Asteraceae *Ursinia pilifera* Indigenous; Endemic
 Asteraceae *Vallereophyton* sp.
 Asteraceae *Xanthium spinosum** (Category 1b)
 Asteraceae *Cichorium intybus**
 Bignoniaceae *Rhigozum obovatum* Indigenous
 Boraginaceae *Anchusa riparia* Indigenous
 Brassicaceae *Cadaba aphylla*
 Brassicaceae *Erucastrum strigosum* Indigenous
 Brassicaceae *Heliophila cornuta* var. *squamata* Indigenous
 Brassicaceae *Heliophila crithmifolia* Indigenous
 Brassicaceae *Heliophila rigidiuscula* Indigenous
 Brassicaceae *Heliophila suavissima* Indigenous
 Brassicaceae *Lepidium africanum* subsp. *divaricatum* Indigenous
 Brassicaceae *Lepidium trifurcum* Indigenous
 Brassicaceae *Sisymbrium capense* Indigenous
 Brassicaceae *Sisymbrium turczaninowii* Indigenous
 Cactaceae *Cylindropuntia imbricata imbricata** (Category 1b)
 Cactaceae *Cylindropuntia pallida** (Category 1b)
 Cactaceae *Opuntia ficus-indica** (Category 1b)
 Cactaceae *Opuntia robusta** (Category 1b)
 Campanulaceae *Wahlenbergia albens* Indigenous
 Campanulaceae *Wahlenbergia androsacea* Indigenous
 Campanulaceae *Wahlenbergia nodosa* Indigenous
 Campanulaceae *Wahlenbergia thunbergiana* Indigenous
 Capparaceae *Boscia albitrunca* Indigenous PROTECTED
 Caryophyllaceae *Dianthus laingsburgensis* (wrong id / distribution)
 Caryophyllaceae *Pollichia campestris*
 Caryophyllaceae *Silene undulata undulata*
 Characeae *Chara* sp.
 Colchicaceae *Colchicum asteroides* Indigenous; Endemic
 Colchicaceae *Colchicum burkei* Indigenous
 Colchicaceae *Colchicum melanthioides* subsp. *melanthioides* Indigenous
 Colchicaceae *Ornithoglossum vulgare* Indigenous
 Colchicaceae *Ornithoglossum undulatum* Indigenous
 Convolvulaceae *Convolvulus sagittatus* Indigenous
 Crassulaceae *Adromischus filicaulis* subsp. *marlothii* Indigenous; Endemic
 Crassulaceae *Adromischus triflorus* Indigenous; Endemic
 Crassulaceae *Adromischus trigynus* Indigenous; Endemic
 Crassulaceae *Anacampseros* sp. Indigenous; Endemic
 Crassulaceae *Crassula campestris*
 Crassulaceae *Crassula capitella capitella*
 Crassulaceae *Crassula corallina*
 Crassulaceae *Crassula muscosa* var. *muscosa* Indigenous

Crassulaceae *Crassula pyramidalis*
 Crassulaceae *Crassula subaphylla*
 Crassulaceae *Crassula vaillantii*
 Cucurbitaceae *Kedrostis africana* Indigenous
 Cyperaceae *Afroscirpoides dioeca* Indigenous
 Cyperaceae *Carex glomerabilis* Indigenous
 Cyperaceae *Cyperus capensis* Indigenous
 Cyperaceae *Cyperus congestus* Indigenous
 Cyperaceae *Cyperus marginatus* Indigenous
 Cyperaceae *Cyperus usitatus* Indigenous
 Cyperaceae *Isolepis expallescens* Indigenous; Endemic
 Cyperaceae *Isolepis sororia* Indigenous; Endemic
 Dryopteridaceae *Dryopteris antarctica* Indigenous
 Dryopteridaceae *Dryopteris dracomontana* Indigenous
 Ebenaceae *Diospyros austro-africana* var. *microphylla* Indigenous
 Ebenaceae *Diospyros austroafricana* Indigenous
 Ebenaceae *Diospyros lycioides*
 Ericaceae *Erica woodii* var. *woodii* Indigenous
 Eriospermaceae *Eriospermum alcornone*
 Euphorbiaceae *Euphorbia caterviflora*
 Euphorbiaceae *Euphorbia clavarioides*
 Euphorbiaceae *Euphorbia decepta* Indigenous; Endemic
 Euphorbiaceae *Euphorbia mauritanica* Indigenous
 Euphorbiaceae *Euphorbia rhombifolia*
 Euphorbiaceae *Euphorbia stellispina* Indigenous; Endemic
 Fabaceae *Aspalathus perforata* Indigenous; Endemic
 Fabaceae *Aspalathus triquetra* Indigenous; Endemic
 Fabaceae *Aspalathus ulicina* subsp. *ulicina* Indigenous; Endemic RARE wrong ID or location (Tulbagh)?
 Fabaceae *Cullen tomentosum* Indigenous
 Fabaceae *Calobota spinescens* Indigenous
 Fabaceae *Indigastrum niveum* Indigenous
 Fabaceae *Indigofera alternans* var. *alternans* Indigenous
 Fabaceae *Indigofera sessilifolia* Indigenous
 Fabaceae *Lessertia annularis* Indigenous
 Fabaceae *Lessertia frutescens* subsp. *microphylla* Indigenous
 Fabaceae *Melolobium calycinum* Indigenous
 Fabaceae *Melolobium candicans*
 Fabaceae *Melolobium microphyllum* Indigenous
 Fabaceae *Prosopis glandulosa** (Category 1b)
 Fabaceae *Rhynchosia capensis* Indigenous; Endemic
 Fabaceae *Vachellia karroo* Indigenous
 Geraniaceae *Erodium cicutarium**
 Geraniaceae *Pelargonium abrotanifolium*
 Geraniaceae *Pelargonium alchemilloides*
 Geraniaceae *Pelargonium aridum*
 Geraniaceae *Pelargonium karooicum*
 Geraniaceae *Pelargonium minimum*
 Geraniaceae *Monsonia salmoniflora*
 Geraniaceae *Pelargonium proliferum* Indigenous; Endemic
 Geraniaceae *Pelargonium tragacanthoides* Indigenous
 Grimmiaceae *Grimmia laevigata*
 Hyacinthaceae *Albuca prasina* Indigenous
 Hyacinthaceae *Albuca setosa* Indigenous
 Hyacinthaceae *Daubenya comata* Indigenous; Endemic
 Hyacinthaceae *Drimia anomala* Indigenous; Endemic
 Hyacinthaceae *Drimia platyphylla* Indigenous; Endemic
 Hyacinthaceae *Lachenalia ensifolia* Indigenous; Endemic

Hyacinthaceae *Massonia dentata* Indigenous; Endemic
 Hypoxidaceae *Empodium gloriosum* Indigenous; Endemic
 Iridaceae *Babiana bainesii* Indigenous
 Iridaceae *Babiana hypogaea* Indigenous
 Iridaceae *Babiana sambucina* subsp. *sambucina* Indigenous; Endemic
 Iridaceae *Dierama pendulum* Indigenous; Endemic
 Iridaceae *Gethyllis longistyla* Indigenous
 Iridaceae *Hesperantha longituba* Indigenous
 Iridaceae *Lapeirousia plicata* subsp. *plicata* Indigenous
 Iridaceae *Moraea polystachya*
 Iridaceae *Romulea macowanii* var. *alticola* Indigenous
 Iridaceae *Syringodea concolor* Indigenous; Endemic
 Iridaceae *Tritonia karoica* Indigenous; Endemic
 Iridaceae *Tritonia laxifolia* Indigenous
 Juncaceae *Juncus rigidus* Indigenous
 Juncaceae *Juncus excertus* Indigenous
 Lamiaceae *Mentha longifolia capensis* Indigenous
 Lamiaceae *Salvia runcinata* Indigenous
 Lamiaceae *Salvia stenophylla* Indigenous
 Lamiaceae *Salvia verbenaca* Indigenous
 Lamiaceae *Stachys hyssopoides* Indigenous
 Lamiaceae *Stachys rugosa* Indigenous
 Limeaceae *Limeum aethiopicum* Indigenous
 Limeaceae *Limeum aethiopicum* var. *aethiopicum* Indigenous; Endemic
 Limeaceae *Limeum fenestratum* var. *fenestratum* Indigenous
 Limeaceae *Limeum humifusum* Indigenous
 Loranthaceae *Moquiniella rubra* Indigenous
 Loranthaceae *Septulina glauca* Indigenous
 Malvaceae *Anisodonteia capensis* Indigenous; Endemic
 Malvaceae *Hermannia coccocarpa* Indigenous
 Malvaceae *Hermannia cuneifolia* var. *cuneifolia* Indigenous
 Malvaceae *Hermannia cuneifolia* var. *glabrescens* Indigenous
 Malvaceae *Hermannia filifolia*
 Malvaceae *Hermannia grandiflora* Indigenous
 Malvaceae *Hermannia pulchella* Indigenous
 Malvaceae *Hermannia spinosa*
 Malvaceae *Hermannia vestita*
 Malvaceae *Hermannia vestita* Indigenous
 Melianthaceae *Melianthus comosus*
 Melianthaceae *Melianthus dregeanus* subsp. *dregeanus* Indigenous; Endemic
 Myrtaceae *Eucalyptus camaldulensis** (Category 1b)
 Orchidaceae *Eulophia ovalis* var. *ovalis* Indigenous
 Orchidaceae *Habenaria arenaria* Indigenous
 Orobanchaceae *Hyobanche sanguinea* Indigenous
 Osmundaceae *Todea barbara* Indigenous
 Oxalidaceae *Oxalis depressa* Indigenous
 Oxalidaceae *Oxalis obliquifolia* Indigenous
 Oxalidaceae *Oxalis smithiana* Indigenous
 Papaveraceae *Argemone ochroleuca** (Category 1b)
 Pedaliaceae *Pterodiscus speciosus* Indigenous
 Pedaliaceae *Sesamum capense* Indigenous
 Plantaginaceae *Veronica anagallis-aquatica**
 Poaceae *Agrostis lachnantha* var. *lachnantha* Indigenous
 Poaceae *Amelichloa clandestina** Not indigenous; Naturalised
 Poaceae *Aristida adscensionis* Indigenous
 Poaceae *Aristida congesta* subsp. *congesta* Indigenous
 Poaceae *Aristida diffusa* subsp. *burkei* Indigenous

Poaceae *Aristida diffusa* subsp. *diffusa* Indigenous; Endemic
 Poaceae *Aristida* sp.
 Poaceae *Arundo donax** (Category 1b)
 Poaceae *Brachiaria eruciformis* Indigenous
 Poaceae *Bromus catharticus* Not indigenous; Naturalised; Invasive
 Poaceae *Bromus* sp.
 Poaceae *Cenchrus ciliaris* Indigenous
 Poaceae *Cymbopogon prolixus* Indigenous
 Poaceae *Cymbopogon pospischilii* Indigenous; Endemic
 Poaceae *Cynodon incompletus* Indigenous; Endemic
 Poaceae *Digitaria eriantha*
 Poaceae *Digitaria sanguinalis* Not indigenous; Naturalised
 Poaceae *Echinochloa crus-galli* Indigenous
 Poaceae *Ehrharta calycina* Indigenous
 Poaceae *Ehrharta erecta* var. *erecta* Indigenous
 Poaceae *Ehrharta pusilla* Indigenous
 Poaceae *Enneapogon desvauxii* Indigenous
 Poaceae *Enneapogon scoparius* Indigenous
 Poaceae *Eragrostis bicolor* Indigenous
 Poaceae *Eragrostis chloromelas* Indigenous
 Poaceae *Eragrostis cilianensis* Indigenous
 Poaceae *Eragrostis curvula* Indigenous
 Poaceae *Eragrostis cylindriflora* Indigenous
 Poaceae *Eragrostis lehmanniana* var. *lehmanniana* Indigenous
 Poaceae *Eragrostis nindensis* Indigenous
 Poaceae *Eragrostis obtusa* Indigenous
 Poaceae *Eragrostis tef* Not indigenous; Naturalised
 Poaceae *Eragrostis truncata* Indigenous
 Poaceae *Eustachys paspaloides* Indigenous
 Poaceae *Festuca arundinacea* Not indigenous; Naturalised
 Poaceae *Fingerhuthia africana* Indigenous
 Poaceae *Fingerhuthia sesleriiformis* Indigenous
 Poaceae *Heteropogon contortus*
 Poaceae *Koeleria capensis* Indigenous
 Poaceae *Leptochloa fusca* Indigenous
 Poaceae *Lolium arundinaceum**
 Poaceae *Lolium multiflorum* Not indigenous; Naturalised; Invasive
 Poaceae *Lolium perenne* Not indigenous; Naturalised; Invasive
 Poaceae *Lolium temulentum* Not indigenous; Naturalised; Invasive
 Poaceae *Melica decumbens*
 Poaceae *Miscanthus ecklonii* Indigenous
 Poaceae *Panicum coloratum* Indigenous
 Poaceae *Paspalum dilatatum* Not indigenous; Naturalised; Invasive
 Poaceae *Paspalum distichum**
 Poaceae *Phragmites australis* Indigenous
 Poaceae *Polypogon monspeliensis* Not indigenous; Naturalised
 Poaceae *Schismus barbatus* Indigenous
 Poaceae *Setaria italica* Not indigenous; Naturalised
 Poaceae *Setaria verticillata* Indigenous
 Poaceae *Sporobolus fimbriatus* Indigenous
 Poaceae *Sporobolus ioclados* Indigenous
 Poaceae *Sporobolus tenellus* Indigenous
 Poaceae *Stipa dregeana* var. *dregeana* Indigenous; Endemic
 Poaceae *Stipagrostis ciliata* var. *capensis* Indigenous
 Poaceae *Stipagrostis namaquensis*
 Poaceae *Stipagrostis obtusa* Indigenous
 Poaceae *Tetrachne dregei* Indigenous

Poaceae *Themeda triandra*
 Poaceae *Tragus berteronianus* Indigenous
 Poaceae *Tragus koelerioides* Indigenous
 Poaceae *Tragus racemosus* Indigenous
 Poaceae *Tribolium purpureum* Indigenous
 Poaceae *Trisetopsis hirtula* Indigenous
 Poaceae *Trisetopsis imberbis* Indigenous
 Poaceae *Typha capensis* Indigenous
 Polygalaceae *Muraltia alticola* Indigenous
 Polygalaceae *Polygala leptophylla*
 Polygalaceae *Polygala* sp.
 Polygonaceae *Polygonum aviculare*
 Polypodiaceae *Polypodium vulgare* Indigenous
 Pteridaceae *Adiantum capillus-veneris* Indigenous
 Pteridaceae *Asplenium cordatum* Indigenous
 Pteridaceae *Cheilanthes eckloniana* Indigenous
 Pteridaceae *Cheilanthes hirta* var. *brevipilosa* Indigenous
 Pteridaceae *Cheilanthes hirta* var. *hirta* Indigenous
 Pteridaceae *Cheilanthes induta* Indigenous; Endemic
 Pteridaceae *Pellaea calomelanos* var. *calomelanos* Indigenous
 Ranunculaceae *Ranunculus multifidus*
 Rosaceae *Rubus rigidus* Indigenous
 Rubiaceae *Anthospermum spathulatum* subsp. *spathulatum* Indigenous
 Rubiaceae *Nenax microphylla* Indigenous
 Salicaceae *Populus x canescens**
 Salicaceae *Salix babylonica babylonica**
 Salviniaceae *Azolla filiculoides** Category 1b
 Santalaceae *Lacomucinaea lineata* Indigenous
 Santalaceae *Thesium megalocarpum* Indigenous
 Santalaceae *Thesium hystricoides* Indigenous
 Santalaceae *Thesium namaquense* Indigenous
 Santalaceae *Viscum* sp.
 Santalaceae *Viscum capense*
 Santalaceae *Viscum continuum*
 Scrophulariaceae *Aptosimum indivisum* Indigenous
 Scrophulariaceae *Buddleja glomerata* Indigenous; Endemic
 Scrophulariaceae *Chaenostoma macrosiphon* Indigenous; Endemic
 Scrophulariaceae *Chaenostoma rotundifolium* Indigenous; Endemic
 Scrophulariaceae *Diascia alonsooides* Indigenous; Endemic
 Scrophulariaceae *Gomphostigma virgatum*
 Scrophulariaceae *Jamesbrittenia filicaulis*
 Scrophulariaceae *Jamesbrittenia tysonii*
 Scrophulariaceae *Limosella africana* Indigenous
 Scrophulariaceae *Limosella grandiflora* Indigenous
 Scrophulariaceae *Manulea crassifolia* subsp. *thodeana* Indigenous
 Scrophulariaceae *Nemesia cynanchifolia* Indigenous
 Scrophulariaceae *Nemesia fruticans* Indigenous
 Scrophulariaceae *Peliostomum leucorrhizum* Indigenous
 Scrophulariaceae *Selago acocksii* Indigenous; Endemic
 Scrophulariaceae *Selago albida* Indigenous
 Scrophulariaceae *Selago corymbosa* Indigenous; Endemic
 Scrophulariaceae *Selago crassifolia* Indigenous; Endemic
 Scrophulariaceae *Selago densiflora*
 Scrophulariaceae *Selago divaricata* Indigenous
 Scrophulariaceae *Selago geniculata* Indigenous; Endemic
 Scrophulariaceae *Selago saxatilis* Indigenous
 Scrophulariaceae *Selago* sp.

Scrophulariaceae *Zaluzianskya peduncularis* Indigenous
Simaroubaceae *Ailanthus altissima** Category 1b
Solanaceae *Datura ferox** (Category 1b)
Solanaceae *Lycium cinereum*
Solanaceae *Lycium horridum*
Solanaceae *Lycium oxycarpum*
Solanaceae *Lycium pumilum*
Solanaceae *Lycium schizocalyx*
Solanaceae *Solanum nigrum* Indigenous
Solanaceae *Solanum retroflexum* Indigenous
Solanaceae *Solanum tomentosum*
Solanaceae *Withania somnifera* Indigenous
Thymelaeaceae *Lasiosiphon microphyllus* Indigenous; Endemic
Urticaceae *Urtica lobulata* Indigenous
Urticaceae *Urtica urens* Not indigenous; Naturalised; Invasive
Verbenaceae *Chascanum pinnatifidum* subsp. *pinnatifidum*
Vitaceae *Rhoicissus tridentata* subsp. *tridentata* Indigenous; Endemic
Zygophyllaceae *Roepera incrustata*

Appendix 4: Animal species with a geographical distribution that includes the study area.

Notes:

1. Species of conservation concern are in red lettering.
2. Species protected according to the National Environmental Management: Biodiversity Act of 2004 (Act 10 of 2000) (see Appendix 6) marked with "N"

Amphibians:

Pyxicephalidae:

Cacosternum boettgeri

Tomopterna tandyi

Mammals:

Bathyergidae:

Cryptomys hottentotus

Bovidae:

Raphicerus campestris

Antidorcus marsupialis

Pelea capreolus

Canidae:

Otocyon megalotis

Cercopithecidae:

Papio ursinus

Felidae:

Felis nigripes

Herpestidae:

Suricata suricatta

Herpestes pulverulentus

Leporidae:

Lepus saxatilis

Lepus capensis

Muridae:

Rhabdomys pumilo

Mustelidae:

Ictonyx striatus

Orycteropodidae:

Orycteropus afer

Pedetidae:

Pedetes capensis

Procaviidae:

Procavia capensis

Sciuridae:

Geosciurus inauris

Viverridae:

Genetta genetta

Reptiles:

Agamidae:

Agama atra

Agama aculeata

Colubridae:

Lamprophis aurora

Cordylidae:

Karusasaurus polyzonus

Cordylus cordylus

Gekkonidae:

Afroedura karroica

Lacertidae:

Meroles suborbitalis

Pedioplanis namaquensis

Scincidae:

Trachylepis sulcata

Plestiodon gilberti

Testudinidae:

Stigmochelys pardalis

Varanidae:

Varanus albigularis

Scorpions:

Buthidae:

Parabuthus granulatus

Parabuthus mossambicensis

Uroplectes carinatus

Uroplectes triangulifer

Scorpionidae:

Opisththalmus carinatus

Opisththalmus karrooensis

Appendix 5: Flora protected under the Northern Cape Nature Conservation Act No. 9 of 2009.

SCHEDULE 1: SPECIALLY PROTECTED SPECIES

As per the Northern Cape Nature Conservation Act, No. 9 of 2009, Schedule 1

Family: AMARYLLIDACEAE	
<i>Clivia mirabilis</i>	Oorlofskloof bush lily / <i>Clivia</i>
<i>Haemanthus graniticus</i>	April fool
<i>Hessea pusilla</i>	
<i>Strumaria bidentata</i>	
<i>Strumaria perryae</i>	
Family: ANACARDIACEAE	
<i>Ozoroa</i> spp.	All species
Family: APIACEAE	
<i>Centella tridentata</i>	
<i>Chamarea snijmaniae</i>	
Family: APOCYNACEAE	
<i>Hoodia gordonii</i>	
<i>Pachypodium namaquanum</i>	Elephant's trunk
Family: ASPHODOLACEAE	
<i>Aloe buhrii</i>	
<i>Aloe dichotoma</i>	
<i>Aloe dichotoma</i> var. <i>rumosissima</i>	Maiden quiver tree
<i>Aloe dabenorisana</i>	
<i>Aloe erinacea</i>	
<i>Aloe meyeri</i>	
<i>Aloe pearsonii</i>	
<i>Aloe pillansii</i>	
<i>Trachyandra prolifera</i>	
Family: ASTERACEAE	
<i>Athanasia adenantha</i>	
<i>Athanasia spathulata</i>	
<i>Cotula filifolia</i>	
<i>Euryops mirus</i>	
<i>Euryops rosulatus</i>	
<i>Euryops virgatus</i>	
<i>Felicia diffusa</i> subsp. <i>khamiesbergensis</i>	
<i>Othonna armiana</i>	
Family: CRASSULACEAE	
<i>Tylecodon torulosus</i>	
Family: DIOSCORACEAE	
<i>Dioscorea</i> spp.	Elephant's foot, all species
Family: ERIOSPERMACEAE	
<i>Eriospermum erinum</i>	
<i>Eriospermum glaciale</i>	
Family: FABACEAE	
<i>Amphithalea obtusiloba</i>	
<i>Lotononis acutiflora</i>	
<i>Lotononis polycephala</i>	
<i>Lessertia</i> spp.	
<i>Sceletium toruosum</i>	
<i>Sutherlandia</i> spp.	Cancer Bush, all species

Wiborgia fusca subsp. macrocarpa	
Family: GERANIACEAE	
Pelargonium spp.	Pelargonium, all species
Family: HYACINTHACEAE	
Drimia nana	
Ornithogalum bicornutum	
Ornithogalum inclusum	
Family: IRIDACEAE	
Babiana framesii	
Ferraria kamiesbergensis	
Freesia marginata	
Geissorhiza subrigida	
Hesperantha minima	
Hesperantha oligantha	
Hesperantha rivulicola	
Lapeirousia verecunda	
Moraea kamiesensis	
Moraea namaquana	
Romulea albiflora	
Romulea discifera	
Romulea maculata	
Romulea rupestris	
Family: MOLLUGINACEAE	
Hypertelis trachysperma	
Psammotropha spicata	
Family: ORCHIDACEAE	
Corycium ingeanum	
Disa macrostachya	Disa
Family: OXALIDACEAE	
Oxalis pseudo-hirta	Sorrel
Family: PEDALIACEAE	
Harpagophytum spp.	Devils' claw
Family: POACEAE	
Prionanthium dentatum	
Secale strictum subsp. africanum	Wild rye
Family: PROTEACEAE	
Leucadendron meyerianum	Tolbos
Mimetes spp.	All species
Orothamnus zeyheri	
Family: ROSACEAE	
Cliffortia arborea	Sterboom
Family: SCROPHULARIACEAE	
Charadrophila capensis	Cape Gloxinia
Family: STANGERIACEAE	
Stangeria spp.	Cycads, all species
Family: ZAMIACEAE	
Encephalartos spp.	Cycads, all species

SCHEDULE 2: PROTECTED SPECIES

As per the Northern Cape Nature Conservation Act, No. 9 of 2009, Schedule 2

Family: ACANTHACEAE	
Barleria paillosa	
Monechme saxatile	

Peristrophe spp.	All species
Family: ADIANTHACEAE	
Adiantum spp.	Maidenhair Fern, all species
Family: AGAPANTHACEAE	
Agapanthus spp.	All species
Family: AIZOACEAE (MESEMBRYANTHEMACEAE)	All species
Family: AMARYLLIDACEAE	All species except those listed in Schedule 1
Family: ANTHERICACEAE	All species
Family: APIACEAE	All species except those listed in Schedule 1
Family: APOCYNACEAE	All species except those listed in Schedule 1
Family: AQUIFOLIACEAE	All species
Ilex mitis	
Family: ARACEAE	
Zantedeschia spp.	Arum lilies, all species
Family: ARALIACEAE	
Cussonia spp.	Cabbage trees, all species
Family: ASPHODOLACEAE	All species except those listed in Schedule 1 and the species <i>Aloe ferox</i>
Family: ASTERACEAE	
Helichrysum jubilatam	
Felicia deserti	
Gnaphalium simii	
Lopholaena longipes	
Senecio albo-punctatus	
Senecio trachylaenus	
Trichogyne lerouxiae	
Tripteris pinnatilobata	
Troglophyton acocksianum	
Vellereophyton lasianthum	
Family: BURMANNIACEAE	
Burmannia madagascariensis	Wild ginger
Family: BURSERACEAE	
Commiphora spp.	All species
Family: CAPPARACEAE	
Boscia spp.	Shepherd's trees, all species
Family: CARYOPHYLLACEAE	
Dianthus spp.	All species
Family: CELASTRACEAE	
Gymnosporia spp.	All species
Family: COLCHICACEAE	
Androcymbium spp.	All species
Gloriosa spp.	All species
Family: COMBRETACEAE	
Combretum spp.	All species
Family: CRASSULACEAE	All species except those listed in Schedule 1
Family: CUPPRESSACEAE	
Widdringtonia spp.	Wild cypress, all species
Family: CYATHEACEAE	
Cyathea spp.	Tree ferns, all species
Cyathea capensis	Tree Fern
Family: CYPERACEAE	
Carex acocksii	
Family: DROSERACEAE	
Drosera spp.	Sundews, all species

Family: DRYOPTERIDACEAE	
Rumohra spp.	Seven Weeks Fern, all species
Family: ERICACEAE	Erica, all species
Family: EUPHORBIACEAE	
Alchornea laxiflora	Venda Bead-string
Euphorbia spp.	All species
Family: FABACEAE	
Aspalathus spp.	Tea Bush, all species
Erythrina zeyheri	Ploughbreaker
Argyrobium petiolare	
Caesalpinia bracteata	
Calliandra redacta	
Crotalaria pearsonii	
Indigofera limosa	
Lebeckia bowieana	
Polhillia involucrate	
Rhynchosia emarginata	
Wiborgia humilis	
Family: HYACINTHACEAE	
Daubinya spp	
Lachenalia spp.	Daubinya, all species
Veltheimia spp.	Viooltjie, all species
Eucomis spp.	Pineapple flower, all species
Neopatersonia namaquensis	
Ornithogalum spp.	All species
Family: IRIDACEAE	All species except those listed in Schedule 1
Family: LAURACEAE	
Ocotea spp.	Stinkwood, all species
Family: MESEMBRYANTHEMACEAE	All species
Family: MELIACEAE	
Nymania capensis	Chinese Lantern
Family: OLEACEAE	
Olea europea subsp. africana	Wild olive
Family: ORCHIDACEAE	Orchids, all species except those listed in Schedule 1
Family: OROBANCHACEAE	
Harveya spp.	Harveya, all species
Family: OXALIDACEAE	
Oxalis spp.	Sorrel, all species except those listed in Schedule 1
Family: PLUMBAGINACEAE	
Afrolimon namaquanum	
Family: POACEAE	
Brachiaria dura var. dura	
Dregeochloa calviniensis	
Pentaschistis lima	
Family: PODOCARPACEAE	
Podocarpus spp.	Yellowwoods, all species
Family: PORTULACACEAE	
Anacampseros spp.	All species
Avonia spp.	All species
Portulaca foliosa	
Family: PROTEACEAE	All species except those listed in Schedule 1
Family: RESTIONACEAE	All species
Family: RHAMNACEAE	

Phylica spp.	All species
Family: RUTACEAE	
Agathosma spp.	Buchu, all species
Family: SCROPHULARIACEAE	
Diascia spp.	All species
Halleria spp.	All species
Jamesbrittenia spp.	All species
Manulea spp.	All species
Nemesia spp.	All species
Phyllopodium spp.	All species
Polycarena filiformis	
Chaenostoma longipedicellatum	
Family: STRELITZIACEAE	
Strelitzia spp.	All species
Family: TECOPHILACEAE	
Cyanella spp.	All species
Family: THYMELAEACEAE	
Gnidia leipoldtii	
Family: ZINGIBERACEAE	
Siphonochilus aethiopicus	Wild ginger

Appendix 6: Flora and vertebrate animal species protected under the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004)

(as updated in R. 1187, 14 December 2007)

CRITICALLY ENDANGERED SPECIES

Flora

Adenium swazicum
Aloe pillansii
Diaphanathe millarii
Dioscorea ebutsniorum
Encephalartos aemulans
Encephalartos brevifoliolatus
Encephalartos cerinus
Encephalartos dolomiticus
Encephalartos heenanii
Encephalartos hirsutus
Encephalartos inopinus
Encephalartos latifrons
Encephalartos middelburgensis
Encephalartos nubimontanus
Encephalartos woodii

Reptilia

Loggerhead sea turtle
Leatherback sea turtle
Hawksbill sea turtle

Aves

Wattled crane
Blue swallow
Egyptian vulture
Cape parrot

Mammalia

Riverine rabbit
Rough-haired golden mole

ENDANGERED SPECIES

Flora

Angraecum africae
Encephalartos arenarius
Encephalartos cupidus
Encephalartos horridus
Encephalartos laevifolius
Encephalartos lebomboensis
Encephalartos msinganus
Jubaeopsis caffra
Siphonochilus aethiopicus
Warburgia salutaris
Newtonia hilderbrandi

Reptilia

Green turtle
Giant girdled lizard
Olive ridley turtle
Geometric tortoise

Aves

Blue crane
Grey crowned crane
Saddle-billed stork
Bearded vulture
White-backed vulture
Cape vulture
Hooded vulture
Pink-backed pelican
Pel's fishing owl
Lappet-faced vulture

Mammalia

Robust golden mole
Tsessebe
Black rhinoceros
Mountain zebra
African wild dog
Gunning's golden mole
Oribi
Red squirrel
Four-toed elephant-shrew

VULNERABLE SPECIES

Flora

Aloe albida
Encephalartos cycadifolius
Encephalartos Eugene-maraisii
Encephalartos ngovanus
Merwillia plumbea
Zantedeschia jucunda

Aves

White-headed vulture
Tawny eagle
Kori bustard
Black stork
Southern banded snake eagle
Blue korhaan
Taita falcon
Lesser kestrel
Peregrine falcon

Bald ibis
Ludwig's bustard
Martial eagle
Bataleur
Grass owl

Mammalia

Cheetah
Samango monkey
Giant golden mole
Giant rat
Bontebok
Tree hyrax
Roan antelope
Pangolin
Juliana's golden mole
Suni
Large-eared free-tailed bat
Lion
Leopard
Blue duiker

PROTECTED SPECIES

Flora

Adenia wilmsii
Aloe simii
Clivia mirabilis
Disa macrostachya
Disa nubigena
Disa physodes
Disa procera
Disa sabulosa
Encephelartos altensteinii
Encephelartos caffer
Encephelartos dyerianus
Encephelartos frederici-guilielmi
Encephelartos ghellinckii
Encephelartos humilis
Encephelartos lanatus
Encephelartos lehmannii
Encephelartos longifolius
Encephelartos natalensis
Encephelartos paucidentatus
Encephelartos princeps
Encephelartos senticosus
Encephelartos transvenosus
Encephelartos trispinosus
Encephelartos umbeluziensis
Encephelartos villosus
Euphorbia clivicola
Euphorbia meloformis
Euphorbia obesa
Harpagophytum procumbens
Harpagophytum zeyherii
Hoodia gordonii
Hoodia currorii

Protea odorata
Stangeria eriopus

Amphibia

Giant bullfrog
African bullfrog

Reptilia

Gaboon adder
Namaqua dwarf adder
Smith's dwarf chameleon
Armadillo girdled lizard
Nile crocodile
African rock python

Aves

Southern ground hornbill
African marsh harrier
Denham's bustard
Jackass penguin

Mammalia

Cape clawless otter
South African hedgehog
White rhinoceros
Black wildebeest
Spotted hyaena
Black-footed cat
Brown hyaena
Serval
African elephant
Spotted-necked otter
Honey badger
Sharpe's grysbok
Reedbuck
Cape fox

Appendix 7: Curriculum vitae: Dr David Hoare

Education

Matric - Graeme College, Grahamstown, 1984

B.Sc (majors: Botany, Zoology) - Rhodes University, 1991-1993

B.Sc (Hons) (Botany) - Rhodes University, 1994 with distinction

M.Sc (Botany) - University of Pretoria, 1995-1997 with distinction

PhD (Botany) – Nelson Mandela Metropolitan University, Port Elizabeth

Main areas of specialisation

- Vegetation ecology, primarily in grasslands, thicket, coastal systems, wetlands.
- Plant biodiversity and threatened plant species specialist.
- Alien plant identification and control / management plans.
- Remote sensing, analysis and mapping of vegetation.
- Specialist consultant for environmental management projects.

Membership

Professional Natural Scientist, South African Council for Natural Scientific Professions, 16 August 2005 – present. Reg. no. 400221/05 (Ecology, Botany)

Member, International Association of Vegetation Scientists (IAVS)

Member, Ecological Society of America (ESA)

Member, International Association for Impact Assessment (IAIA)

Member, Herpetological Association of Africa (HAA)

Employment history

1 December 2004 – present, Director, David Hoare Consulting (Pty) Ltd. Consultant, specialist consultant contracted to various companies and organisations.

1 January 2009 – 30 June 2009, Lecturer, University of Pretoria, Botany Dept.

1 January 2013 – 30 June 2013, Lecturer, University of Pretoria, Botany Dept.

1 February 1998 – 30 November 2004, Researcher, Agricultural Research Council, Range and Forage Institute, Private Bag X05, Lynn East, 0039. Duties: project management, general vegetation ecology, remote sensing image processing.

Experience as consultant

Ecological consultant since 1995. Author of over 500 specialist ecological consulting reports. Wide experience in ecological studies within grassland, savanna and fynbos, as well as riparian, coastal and wetland vegetation.

Publication record:**Refereed scientific articles (in chronological order):****Journal articles:**

- HOARE, D.B.** & BREDEKAMP, G.J. 1999. Grassland communities of the Amatola / Winterberg mountain region of the Eastern Cape, South Africa. *South African Journal of Botany* 64: 44-61.
- HOARE, D.B.**, VICTOR, J.E., LUBKE, R.A. & MUCINA, L., 2000. Vegetation of the coastal fynbos and rocky headlands south of George, South Africa. *Bothalia* 30: 87-96.
- VICTOR, J.E., **HOARE, D.B.** & LUBKE, R.A., 2000. Checklist of plant species of the coastal fynbos and rocky headlands south of George, South Africa. *Bothalia* 30: 97-101.
- MUCINA, L, BREDEKAMP, G.J., **HOARE, D.B** & MCDONALD, D.J. 2000. A National Vegetation Database for South Africa *South African Journal of Science* 96: 1-2.
- HOARE, D.B.** & BREDEKAMP, G.J. 2001. Syntaxonomy and environmental gradients of the grasslands of the Stormberg / Drakensberg mountain region of the Eastern Cape, South Africa.. *South African Journal of Botany* 67: 595 – 608.
- LUBKE, R.A., **HOARE, D.B.**, VICTOR, J.E. & KETELAAR, R. 2003. The vegetation of the habitat of the Brenton blue butterfly, *Orachrysops niobe* (Trimen), in the Western Cape, South Africa. *South African Journal of Science* 99: 201–206.
- HOARE, D.B** & FROST, P. 2004. Phenological classification of natural vegetation in southern Africa using AVHRR vegetation index data. *Applied Vegetation Science* 7: 19-28.
- FOX, S.C., HOFFMANN, M.T. and HOARE, D. 2005. The phenological pattern of vegetation in Namaqualand, South Africa and its climatic correlates using NOAA-AVHRR NDVI data. *South African Geographic Journal*, 87: 85–94.
- Pfab, M.F., Compaan, P.C., Whittington-Jones, C.A., Engelbrecht, I., Dumalisile, L., Mills, L., West, S.D., Muller, P., Masterson, G.P.R., Nevhutalu, L.S., Holness, S.D., **Hoare, D.B.** 2017. The Gauteng Conservation Plan: Planning for biodiversity in a rapidly urbanising province. *Bothalia*, Vol. 47:1. a2182. <https://doi.org/10.4102/abc.v47i1.2182>.

Book chapters and conference proceedings:

- HOARE, D.B.** 2002. Biodiversity and performance of grassland ecosystems in communal and commercial farming systems in South Africa. Proceedings of the FAO's Biodiversity and Ecosystem Approach in Agriculture, Forestry and Fisheries Event: 12–13 October, 2002. Food and Agriculture Organisation of the United Nations, Viale delle Terme di Caracalla, Rome, Italy. pp. 10 - 27.
- STEENKAMP, Y., VAN WYK, A.E., VICTOR, J.E., **HOARE, D.B.**, DOLD, A.P., SMITH, G.F. & COWLING, R.M. 2005. Maputaland-Pondoland-Albany Hotspot. In: Mittermeier, R.A., Gil, P.R., Hoffmann, M., Pilgrim, J., Brooks, T., Mittermeier, C.G., Lamoreux, J. & Fonseca, G.A.B. da (eds.) *Hotspots revisited*. CEMEX, pp.218–229. ISBN 968-6397-77-9
- STEENKAMP, Y., VAN WYK, A.E., VICTOR, J.E., **HOARE, D.B.**, DOLD, A.P., SMITH, G.F. & COWLING, R.M. 2005. Maputaland-Pondoland-Albany Hotspot. <http://www.biodiversityhotspots.org/xp/hotspots/maputaland/>.
- HOARE, D.B.**, MUCINA, L., RUTHERFORD, M.C., VLOK, J., EUSTON-BROWN, D., PALMER, A.R., POWRIE, L.W., LECHMERE-OERTEL, R.G., PROCHE, S.M., DOLD, T. and WARD, R.A. *Albany Thickets*. in Mucina, L. and Rutherford, M.C. (eds.) 2006. The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19, South African National Biodiversity Institute, Pretoria.
- MUCINA, L., **HOARE, D.B.**, LÖTTER, M.C., DU PREEZ, P.J., RUTHERFORD, M.C., SCOTT-SHAW, C.R., BREDEKAMP, G.J., POWRIE, L.W., SCOTT, L., CAMP, K.G.T., CILLIERS, S.S., BEZUIDENHOUT, H., MOSTERT, T.H., SIEBERT, S.J., WINTER, P.J.D., BURROWS, J.E., DOBSON, L., WARD, R.A., STALMANS, M., OLIVER, E.G.H., SIEBERT, F., SCHMIDT, E., KOBISI, K., KOSE, L. 2006. *Grassland Biome*. In: Mucina, L. & Rutherford, M.C. (eds.) The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.
- RUTHERFORD, M.C., MUCINA, L., LÖTTER, M.C., BREDEKAMP, G.J., SMIT, J.H.L., SCOTT-SHAW, C.R., **HOARE, D.B.**, GOODMAN, P.S., BEZUIDENHOUT, H., SCOTT, L. & ELLIS, F., POWRIE, L.W., SIEBERT, F., MOSTERT, T.H., HENNING, B.J., VENTER, C.E., CAMP, K.G.T., SIEBERT, S.J., MATTHEWS, W.S., BURROWS, J.E., DOBSON, L., VAN ROOYEN, N., SCHMIDT, E., WINTER, P.J.D., DU PREEZ, P.J., WARD, R.A., WILLIAMSON, S. and HURTER, P.J.H. 2006. *Savanna Biome*. In: Mucina, L. & Rutherford, M.C. (eds.) The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.
- MUCINA, L., RUTHERFORD, M.C., PALMER, A.R., MILTON, S.J., SCOTT, L., VAN DER MERWE, B., **HOARE, D.B.**, BEZUIDENHOUT, H., VLOK, J.H.J., EUSTON-BROWN, D.I.W., POWRIE, L.W. & DOLD, A.P. 2006. *Nama-Karoo Biome*. In: Mucina, L. & Rutherford, M.C. (eds.) The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.

MUCINA, L., SCOTT-SHAW, C.R., RUTHERFORD, M.C., CAMP, K.G.T., MATTHEWS, W.S., POWRIE, L.W. and **HOARE, D.B.** 2006. *Indian Ocean Coastal Belt*. In: Mucina, L. & Rutherford, M.C. (eds.) The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.

Conference Presentations:

- HOARE, D.B. & LUBKE, R.A. *Management effects on diversity at Goukamma Nature Reserve, Southern Cape*; Paper presentation, Fynbos Forum, Bienne Donne, July 1994
- HOARE, D.B., VICTOR, J.E. & LUBKE, R.A. *Description of the coastal fynbos south of George, southern Cape*; Paper presentation, Fynbos Forum, Bienne Donne, July 1994
- HOARE, D.B. & LUBKE, R.A. *Management effects on fynbos diversity at Goukamma Nature Reserve, Southern Cape*; Paper presentation, South African Association of Botanists Annual Congress, Bloemfontein, January 1995
- HOARE, D.B. & BOTHA, C.E.J. *Anatomy and ecophysiology of the dunegrass *Ehrharta villosa* var. *maxima**; Poster presentation, South African Association of Botanists Annual Congress, Bloemfontein, January 1995
- HOARE, D.B., PALMER, A.R. & BREDENKAMP, G.J. 1996. *Modelling grassland community distributions in the Eastern Cape using annual rainfall and elevation*; Poster presentation, South African Association of Botanists Annual Congress, Stellenbosch, January 1996
- HOARE, D.B. *Modelling vegetation on a past climate as a test for palaeontological hypotheses on vegetation distributions*; Paper presentation, Randse Afrikaanse Universiteit postgraduate symposium, 1997
- HOARE, D.B., VICTOR, J.E. & BREDENKAMP, G.J. *Historical and ecological links between grassy fynbos and afro-montane fynbos in the Eastern Cape*; Paper presentation, South African Association of Botanists Annual Congress, Cape Town, January 1998
- LUBKE, R.A., HOARE, D.B., VICTOR, J.E. & KETELAAR, R. *The habitat of the Brenton Blue Butterfly*. Paper presentation, South African Association of Botanists Annual Congress, Cape Town, January 1998
- HOARE, D.B. & PANAGOS, M.D. *Satellite stratification of vegetation – structure or floristic composition?* Poster presentation at the 34th Annual Congress of the Grassland Society of South Africa, Warmbaths, 1-4 February 1999.
- HOARE, D.B. & WESSELS, K. *Conservation status and threats to grasslands of the northern regions of South Africa*, Poster presentation at the South African Association of Botanists Annual Congress, Potchefstroom, January 2000.
- HOARE, D.B. *Phenological dynamics of Eastern Cape vegetation*. Oral paper presentation at the South African Association of Botanists Annual Congress, Grahamstown, January 2002.
- HOARE, D.B., MUCINA, L., VAN DER MERWE, J.P.H. & PALMER, A.R. *Classification and digital mapping of grasslands of the Eastern Cape* Poster presentation at the South African Association of Botanists Annual Congress, Grahamstown, January 2002.
- HOARE, D.B. *Deriving phenological variables for Eastern Cape vegetation using satellite data* Poster presentation at the South African Association of Botanists Annual Congress, Grahamstown, January 2002.
- MUCINA, L., RUTHERFORD, M.C., HOARE, D.B. & POWRIE, L.W. 2003. *VegMap: The new vegetation map of South Africa, Lesotho and Swaziland*. In: Pedrotti, F. (ed.) *Abstracts: Water Resources and Vegetation*, 46th Symposium of the International Association for Vegetation Science, June 8 to 14 – Napoli, Italy.
- HOARE, D.B. 2003. *Species diversity patterns in moist temperate grasslands of South Africa*. *Proceedings of the VIIth International Rangeland Congress*, 26 July – 1 August 2003, Durban South Africa. *African Journal of Range and Forage Science*. 20: 84.

Unpublished technical reports:

- PALMER, A.R., HOARE, D.B. & HINTSA, M.D., 1999. *Using satellite imagery to map veld condition in Mpumalanga: A preliminary report*. Report to the National Department of Agriculture (Directorate Resource Conservation). ARC Range and Forage Institute, Grahamstown.
- HOARE, D.B. 1999. *The classification and mapping of the savanna biome of South Africa: methodology for mapping the vegetation communities of the South African savanna at a scale of 1:250 000*. Report to the National Department of Agriculture (Directorate Resource Conservation). ARC Range and Forage Institute, Pretoria.
- HOARE, D.B. 1999. *The classification and mapping of the savanna biome of South Africa: size and coverage of field data that exists on the database of vegetation data for South African savanna*. Report to the National Department of Agriculture (Directorate Resource Conservation). ARC Range and Forage Institute, Pretoria.
- THOMPSON, M.W., VAN DEN BERG, H.M., NEWBY, T.S. & HOARE, D.B. 2001. *Guideline procedures for national land-cover mapping and change monitoring*. Report no. ENV/P/C 2001-006 produced for Department of Water Affairs and Forestry, National Department of Agriculture and Department of Environment Affairs and Tourism. Copyright: Council for Scientific and Industrial Research (CSIR) and Agricultural Research Council (ARC).

- HOARE, D.B. 2003. Natural resource survey of node O R Tambo, using remote sensing techniques, Unpublished report and database of field data for ARC Institute for Soil, Climate & Water, ARC Range and Forage Institute, Grahamstown.
- HOARE, D.B. 2003. Short-term changes in vegetation of Suikerbosrand Nature Reserve, South Africa, on the basis of resampled vegetation sites. Gauteng Department of Agriculture, Conservation, Environment and Land Affairs, Conservation Division.
- BRITTON, D., SILBERBAUER, L., ROBERTSON, H., LUBKE, R., HOARE, D., VICTOR, J., EDGE, D. & BALL, J. 1997. The Life-history, ecology and conservation of the Brenton Blue Butterfly (*Orachrysops niobe*) (Trimen)(*Lycaenidea*) at Brenton-on-Sea. Unpublished report for the Endangered Wildlife Trust of Southern Africa, Johannesburg. 38pp.
- HOARE, D.B., VICTOR, J.E. & MARNEWIC, G. 2005. Vegetation and flora of the wetlands of Nylsvley River catchment as component of a project to develop a framework for the sustainable management of wetlands in Limpopo Province.

Consulting reports:

Total of over 380 specialist consulting reports for various environmental projects from 1995 – present.

Workshops / symposia attended:

- International Association for Impact Assessment Annual Congress, Durban, 16 – 19 May 2018.
- Workshop on remote sensing of rangelands presented by Paul Tueller, University of Nevada Reno, USA, VIIIth International Rangeland Congress, 26 July – 1 August 2003, Durban South Africa.
- VIIIth International Rangeland Congress, 26 July – 1 August 2003, Durban South Africa.
- BioMap workshop, Stellenbosch, March 2002 to develop strategies for studying vegetation dynamics of Namaqualand using remote sensing techniques
- South African Association of Botanists Annual Congress, Grahamstown, January 2002.
- 28th International Symposium on Remote Sensing of Environment, Somerset West, 27-31 March 2000.
- Workshop on Vegetation Structural Characterisation: Tree Cover, Height and Biomass, 28th International Symposium on Remote Sensing of Environment, Strand, 26 March 2000.
- South African Association of Botanists Annual Congress, Potchefstroom, January 2000
- National Botanical Institute Vegmap Workshop, Kirstenbosch, Cape Town, 30 September-1 October 1999.
- Sustainable Land Management – Guidelines for Impact Monitoring, Orientation Workshop: Sharing Impact Monitoring Experience, Zithabiseni, 27-29 September 1999.
- WWF Macro Economic Reforms and Sustainable Development in Southern Africa, Environmental Economic Training Workshop, development Bank, Midrand, 13-14 September 1999.
- 34th Annual Congress of the Grassland Society of South Africa, Warmbaths, 1-4 February 1999
- Expert Workshop on National Indicators of Environmental Sustainable Development, Dept. of Environmental Affairs and Tourism, Roodevallei Country Lodge, Roodeplaat Dam, Pretoria, 20-21 October 1998.
- South African Association of Botanists Annual Congress, Cape Town, January 1998
- Randse Afrikaanse Universiteit postgraduate symposium, 1997.
- South African Association of Botanists Annual Congress, Bloemfontein, January 1995.