REPORT ON THE TERRESTRIAL ECOLOGY (FLORA AND FAUNA)

Basic Assessment report for the proposed development of the 325 MW Kudusberg Wind Energy Facility located west of the R354 Between Matjiesfontein and Sutherland in the Northern and Western Cape

Report prepared for:

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EXECUTIVE SUMMARY

The proposed Kudusberg Wind Energy Facility (WEF) is located southwest of Sutherland, and lies partly in the Northern Cape and partly in the Western Cape. The area falls within the Cape Winelands and Namaqua District Municipalities. The total area covered by the study site is approximately 30 000 ha, when considering the extent of affected cadastral units. The Kudusberg Wind Farm (Pty) Ltd proposes to develop a 325 megawatt (MW) WEF, consisting of a maximum of 56 turbines. The proposed facility is located within the Komsberg Renewable Energy Development Zone (REDZ 2), one of the eight REDZ formally gazetted in South Africa for development of solar and wind energy generation facilities.

The core area of the development site occupies some 19 300 ha and is located between 32° 47’ 18.0” S and 32° 56' 02" S latitude; 20° 11’ 24” E and 20° 24’ 56” E longitude and occurs in the 3220 CC and 3220 CD topocadastral quarter degree grids. It occupies the slopes and broad ridges of mountain ranges bordering the southern Tanqua Karoo as well as the southern and southeastern slopes of the Klein-Roggeveldberge and Komsberg below the Roggeveld section of the Great Escarpment, facing the Moordenaars Karoo. Geologically, the region is almost entirely covered by greenish-grey mudstone and subordinate sandstone. The altitude ranges from 800 m along the Gatsrivier in the west of the site to 1367 m on Oliviersberg. The region is drained by seven rivers, mostly in a westerly and northerly direction. Annual rainfall in the region is approximately 250 mm and falls mainly from March to August. Winter temperatures are generally low and frost is a common occurrence.

The aim of this study, as part of a Basic Assessment, was to assess the terrestrial ecology of the study area with reference to fauna and flora and to evaluate the impact of the proposed development on the biodiversity. The study commenced as a desktop study, followed by field-based surveys from 17 to 20 July 2018 and again from 5 to 13 September 2018. During the first site visit, field surveys consisted of sampling the different vegetation types (habitats) on site based on a stratification of satellite images including a brief survey of fauna in the area. The vegetation was classified and a vegetation map produced. Checklists of fauna and flora present as well as potentially present on site were compiled, including listing of rare, threatened and/or protected species. The sensitivity of the area and the possible impacts of the development on the biodiversity of the area were assessed. The second site visit focused on searching for Species of Conservation Concern within the footprint of the development to improve micro-siting of the infrastructure.

According to Mucina and Rutherford (2006) the Koedoesberge-Moordenaars Karoo (SKv 6) and the Central Mountain Shale Renosterveld (FRs 5) cover the study site. The vegetation occurs at the transition between the Fynbos Biome and the Succulent Karoo Biome and elements of both biomes are therefore represented. Van der Merwe *et al*. (2008a, 2008b) described six vegetation units for the study area. The current brief vegetation survey classified the study area into six physiognomic-floristic habitat types, (1) cliffs; (2) the mountain crests, upper plateaux and upper slopes; (3) the midslopes and mid-plateaux; (4) footslopes and lower plateaux; (5) plains; and (6) drainage lines (mountain streams and rivers in the valleys).

The study area has been very poorly collected botanically. In the two quarter degree grids in which the study area falls (3220 CC and 3220 DD) only 131 plant taxa are listed in the SANBI database. The list based on the four quarter degree grids 3220 CA; 3220 CB; 3220 CC and 3220 CD amounts to 255 plant taxa. However, with the inclusion of plant taxa from two major botanical studies in the region and the current site survey, a total of 792 taxa could be present in the study area. Twenty-seven of these 792 plant species are classified as threatened according the IUCN Red List Categories. Two of the species are classified as Critically Endangered; five as Endangered; and twenty-one as Vulnerable. The threatened species are dominated by geophytic species (50% of all threatened species listed for the study area), in particular of the family Iridaceae. According to the lists of

protected flora in the Northern Cape, 354 of the 792 species were classified as either Schedule 1 (Specially Protected Species) or Schedule 2 (Protected Species). In total 223 species qualified as protected in the Western Cape province. Twenty-two of the species potentially on site (Appendix A) qualify as CITES Appendix II species. Although the study area does not fall in the Hantam – Roggeveld Centre of Endemism, 8% of the species recorded on site are listed as endemic or near-endemic to the Centre. There are no nationally protected tree species on site.

Fifty-seven mammal species occur/could potentially occur on the site. Among the listed mammal species only three have a threatened status.

- The riverine rabbit, *Bunolagus monticularis,* is listed as Critically Endangered, however there is a low likelihood of it being affected by the development, since the habitat of the riverine rabbit is in the dense riparian vegetation, on alluvial soils, along seasonal rivers and the development is primarily on the crests of the mountains.
- The leopard *Panthera pardus* (Vulnerable) is known to occur in the area, and
- The black-footed cat *Felis nigripes* (Vulnerable) has a high likelihood of occurrence.

For the 3220 grid, 50 reptile species are listed that could possibly occur at the study site. None of the reptiles have a threatened status. Six frog species, none of them threatened, could potentially occur in the study area. Lists for butterflies (77 species), lacewings (25 species) and dragonflies (12 species) are provided. None of these groups contain any threatened species although *Lepidochrysops bacchus* (butterfly) is classified as Schedule 2 in the Western Cape. Six scorpion species could potentially occur on site.

The study area is not located in a Protected Area, although a small section in the southeast falls marginally within a zone earmarked for the National Protected Areas Expansion Strategy (NPAES). **Two turbines lie in this area earmarked for NPAES.** Small sections of the study area are classified as **Critical Biodiversity Areas** (CBAs) in the Western Cape (2017 version) and this does **affect the position of six turbines**. A seventh turbine falls partially into a CBA. Most of the development in the Western Cape lies in Other Natural Areas (ONAs), with some Ecological Support Areas (ESAs) being impacted. In the Northern Cape, parts of the development fall in ESAs and the rest in ONAs. It should be noted that the mapping of CBAs, ESAs and ONAs for the Western Cape has changed markedly since 2010. According to the previous mapping almost the entire WEF development in the Western Cape would have been located in a CBA, which is no longer the case.

The ecological sensitivity of the Komsberg REDZ was evaluated in the Strategic Environmental Asssessment (SEA) on renewable energy, based on a large number of environmental parameters. The resultant sensitivity map showed that almost the entire study area had a High sensitivity, with the Oliviersberg and all water courses with a Very High sensitivity. Four turbines at Oliviersberg are located in the Very High sensitivity zone of the SEA (CSIR, 2015). **It should however, be noted that the 2010 Western Cape CBA mapping was used for the scoring of the area in the SEA and not the revised CBA delineation of 2017.** In the current assessment, the locations of the four turbines on Oliviersberg were no longer classified as 'Very High', but was reduced to 'Moderate'. One turbine was slightly moved to avoid the trigonometric beacon.

The sensitivity map compiled in the current study (considering a number of biodiversity and ecological parameters) scored the mountain crest habitat, that will be affected most severely by the development, as moderate. **Considering the current sensitivity map of the plant associations the improved micro-siting of eight turbines or their crane pads is called for (1, 3, 31, 35, 37, 42, 22 and 36). In the revised layout provided on 15 October 2018 these turbines/associated crane pads were all repositioned to avoid the Very High sensitivity features.**

A full assessment of the direct, and indirect impacts during the construction, operational and decommissioning phases of the development is provided. The construction phase will have the largest impact on the environment. Overall, the roads, loss of vegetation and resulting erosion will have the highest associated impacts. Faunal behaviour will be affected by a loss of habitat, altered physical conditions of the habitat, increased human presence, increased noise and light levels, and habitat dissection.

Mitigation measures and their monitoring are described for each impact.

The main recommendations arising from this report are briefly summarized below:

- The layout (provided in July 2018) would cause the irreversible/largely irreversible loss of approximately 126 ha of natural vegetation within the direct footprint of the development. In spite of the total loss of the vegetation within the 126 ha footprint, large portions of the crest and midslope habitats still remain unaffected to ensure that ecological patterns or processes continue without being adversely affected.
- The development falls in an area that is partly contained in a CBA. A CBA should be kept in a natural or near-natural state, with no further loss of habitat or land-use change permitted. Only low-impact, biodiversity-sensitive land-use is considered appropriate. Ideally, development of CBAs should be avoided and if this cannot be done then the mitigation hierarchy should be applied. If the impact cannot be avoided or reduced to a residual low significance level a biodiversity offset needs to be considered as a last resort.
- The current layout lies predominantly in a **moderate** sensitivity zone (see Sensitivity analysis in Chapter 8).
- **After mitigation measures have been applied, most of the impacts had a low or very low score.**
- The preferred option for the construction camp is option 2. Option 3 was found to be flawed by the heritage specialists and option 1 was in a visual very high sensitivity zone and furthermore contained a rocky sheet.
- The preferred option for the substation is option 3, followed by option 1 (option 2 was withdrawn).
- The preferred northern access route is the western one (Alternative 1), which could follow an existing track and is also shorter than the eastern route (Alternative 2). None of the Alternatives were considered flawed.

SPECIALIST DECLARATION

We, Noel van Rooyen and Gretel van Rooyen, as the appointed independent specialists, in terms of the 2014 EIA Regulations, hereby declare that we:

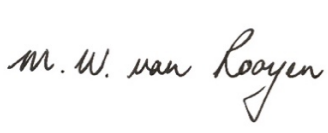
- act as independent specialists in this application;
- perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- regard the information contained in this report, as it relates to our specialist input/study, to be true and correct;
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations 2014, and amendments 2017, and any specific environmental management act;
- declare that there are no circumstances that may compromise our 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 our 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; or the objectivity of any report, plan or document to be prepared by us for submission to the competent authority; 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.

Indemnity and conditions relating to this report:

The observations, findings, recommendations and conclusions provided in the current report are based on the compilers' best scientific and professional knowledge and other available information. If new information should become available Ekotrust cc reserves the right to modify aspects of the report. This report (hard copy and/or electronic) must not be amended or extended without the prior written consent of the author. Furthermore, any recommendations, statements or conclusions drawn from or based on this report must make reference to the report. If these recommendations, statements or conclusions form part of a main report relating to the current investigation, this report must be included in its entirety (as an Appendix).

Although Ekotrust cc has exercised due care in preparing this report, it accepts no liability, and by receiving this document, the client indemnifies Ekotrust cc against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, and by the use of the information contained in this document.

Signature of specialists:



Name of specialist:	Dr N van Rooyen	Prof. MW van Rooyen
Date:	18 October 2018	18 October 2018

TERMS OF REFERENCE AS PROVIDED BY CSIR

- Describe the terrestrial ecological features of the project area, with focus on features that are potentially impacted by the proposed project. The description should include the major habitat forms within the study site, giving due consideration to terrestrial ecology (flora and fauna), Species of Conservation Concern (SCC) or Protected Species. It is important to note that parts of the Kudusberg WEF site fall a Critical Biodiversity Area (CBA) (2017 CBA datasets) with minor sections considered focus areas in the National Protected Areas Expansion Strategy (NPAES, 2016);
- Consider seasonal changes and long-term trends, such as due to climate change;
- List all Species of Conservation Concern or Protected Species that occur or could potentially occur on site;
- Map the sensitive ecological features within the proposed project area, showing any "no-go" areas (i.e. "very high" sensitivity). Specify set-backs or buffers, and provide reasons for these recommendations.
- Map the extent of disturbance and transformation of the site;
- Identify and assess the potential impacts of the project on the terrestrial environment and provide mitigation measures to include in the environmental management plan; and
- The assessment should be based on existing information, national and provincial databases, SANBI mapping, mapping in the Wind and Solar SEA (CSIR, 2015), professional experience and field work conducted.

LIMITATIONS, ASSUMPTIONS AND UNCERTAINTIES

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

- Two site visits were conducted: the first from 17 to 20 July 2018 and the second from 5 to 13 September 2018. The timing of these site visits coincided quite well with the flowering time of most of the SCC (see section 6. Flora).
- The area has been poorly collected and the list of plant species that could potentially occur on site was therefore taken from a far broader area than the study site.
- The terrain is fairly inaccessible with few roads to the crests where most of the development is planned.
- Rare and threatened plant and animal species are usually not easily spotted and can easily be missed.
- The site layout was presented as Google .kml images but the proposed roads were not finalised at the time of the site visits.
- It should be borne in mind that the sensitivity map provided in the SEA (CSIR, 2015) was based on an earlier version of the mapping of CBAs in the Western Cape. The SEA sensitivity map is therefore noted, but the sensitivity map produced in this study is used as benchmark.
- Cumulative impacts are assessed by adding expected impacts from this proposed development to existing and proposed developments with similar impacts in a 50 km radius of the site. The existing and proposed developments that were taken into consideration for cumulative impacts include:

    - Brandvalley WEF;
    - Esizayo WEF
    - Gunstfontein WEF NC;
    - Hidden Valley WEF NC;
    - Karreebosch Wind Farm NC & WC;
    - Konstabel Renewable Energy;
    - Maralla East;
    - Maralla West;
    - Perdekraal Renewable Energy Western Cape;
    - Rietkloof WEF;
    - Rietrug WEF NC;
    - Roggeveld WEF WC & NC;
    - Rondekop WEF
    - Sutherland Wind Farm NC & WC;
    - Suurplaat WEF NC & WC; and
    - Witberg WEF WC.

ACRONYMS

AIS	Alien and Invasive species
BA	Basic Assessment
BAR	Basic Assessment Report
CBA	Critical Biodiversity Area
CBD	Convention on Biodiversity
CITES	Convention on the International Trade in Endangered Species of Wild Fauna and Flora
CSIR	Council for Scientific and Industrial Research
DAFF	Department of Agriculture, Forestry and Fisheries
DEA	Department of Environmental Affairs
DEA&DP	Department of Environmental Affairs and Development Planning
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EMPr	Environmental Management Plan Report
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
SEA	Strategic Environmental Assessment
SANBI	South African National Biodiversity Institute
ToPS	Threatened and Protected Species
ToR	Terms of Reference
WC	Western Cape province
WCNECO	Western Cape Nature and Environmental Conservation Ordinance
WEF	Wind Energy Facility

ABBREVIATIONS

%	Percentage
MW	Megawatt
kV	Kilovolt
V	Volt
cm	centimetres
m	metres
km	kilometres
kg	kilogram

GLOSSARY

Definitions	
Alternative	A possible course of action, in place of another, that would meet the same purpose and need (of the proposal). 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.
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.
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.
Wind measuring mast	A mast installed prior to wind farm development to monitor wind speed and direction.

LIST OF FIGURES

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COMPLIANCE WITH APPENDIX 6 OF THE 2014 EIA REGULATIONS AND AMENDMENTS

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	**Addressed in the Specialist Report**
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist/s who prepared the report; and ii. the expertise of the specialist/s to compile a specialist report including a *curriculum vitae*/s;	See Appendix F with CVs
b) a declaration that the specialists are independent in a form as may be specified by the competent authority;	See Specialist Declaration (p. iv)
c) an indication of the scope of, and the purpose for which, the report was prepared;	Terms of Reference; 1. Introduction
(A) an indication of the quality and age of base data used for the specialist report;	2. Approach and methods; Limitations, Assumptions & uncertainties
(B) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	9. Key issues & potential impacts; 10. Assessment of impacts 11. Impact assessment summary
d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	2. Approach and methods; 6. Flora
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	2. Approach and methods
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	8. Ecological Sensitivity Analysis
g) an identification of any areas to be avoided, including buffers;	8. Sensitivity map
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	8. Sensitivity map
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Assumptions, limitations & uncertainties
j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities;	10. Assessment of impacts; 11. Impact assessment summary
k) any mitigation measures for inclusion in the EMPr;	10. Assessment of impacts 13. Input into EMPr
l) any conditions for inclusion in the environmental authorisation (EA);	10. Assessment of impacts
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	13. Input into the EMPr
n) a reasoned opinion- i. as to whether the proposed activity, activities or portions thereof should be authorised; (A) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	10. Assessment of impacts; 11. Impact assessment summary 12. Conclusions 13. Input into EMPr
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	n.a.
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	To be provided by CSIR
q) any other information requested by the competent authority.	n.a.
2) Where a government notice *gazetted* by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	n.a.

1. INTRODUCTION

1.1 Scope and Objectives

The Kudusberg Wind Farm (Pty) Ltd proposes to develop a 325 megawatt (MW) Wind Energy Facility (WEF) near Sutherland, in the Northern and Western Cape provinces, South Africa. The proposed facility is located within the Witzenberg and Karoo Hoogland local municipalities, which fall within the Cape Winelands and Namakwa District Municipalities respectively.

The proposed facility is located within the Komsberg Renewable Energy Development Zone (REDZ 2), one of the eight REDZ formally gazetted in South Africa for development of solar and wind energy generation facilities. In line with the gazetted process for projects located within REDZ, the Kudusberg WEF will be subject to a Basic Assessment (BA) process instead of a full Environmental Impact Assessment (EIA) process in terms of the National Environmental Management Act (Act 107 of 1998) (NEMA, 1998), EIA Regulations (NEMA, 2014; NEMA, 2017).

1.2 Project Description

The Kudusberg WEF will have an energy generation capacity of up to 325 megawatt (MW) and will consist of the following components:

- Up to 56 wind turbines, each with a capacity of between 3 MW and 6.5 MW. Turbine foundations will be up to 30 m in diameter and up to 5 m in depth and hub height of each turbine will be up to 140 m and its rotor diameter up to 180 m. Permanently compacted, hardstanding, laydown areas of 90 m x 50 m will be prepared for each wind turbine (total footprint 25.2 ha) during construction and for ongoing maintenance purposes for the lifetime of the turbines. Electrical transformers (690 V/33 kV) will be erected adjacent to each turbine to step up the voltage to 33 kV. The typical footprint of these transformers is 2 m x 2 m, but can be up to 10 m x 10 m at certain locations. Wherever feasible underground 33 kV cabling will be buried along access roads between turbines, with overhead 33 kV lines grouping turbines to crossing valleys and ridges outside of the road footprints to get to the onsite 33/132 kV substation.
- Internal access roads up to 12 m wide, including structures for storm water control, are required to access each turbine and the substation, with a total footprint of about 82.44 ha. Where possible, existing roads will be upgraded. Turns will have a radius of up to 50 m for abnormal loads (especially turbine blades) to access the various turbine positions.
- One 33/132 kV on-site substation is planned and three alternative sites have been proposed. The total footprint of this onsite substation will be approximately 2.25 ha.
- Up to 4 x 140 m tall (depending on the final hub height) wind measuring lattice masts, strategically placed within the wind farm development footprint to collect data on wind conditions during the operational phase, have been erected.
- A construction camp (~12.6 ha), consisting of an on-site concrete batching plant for use during the construction phase, offices and administration will be constructed. During the operational phase, the camp will be used as offices and operations and maintenance buildings.
- Fencing will be limited to the construction camp, batching plant and substation. The entire WEF will not be fenced off. The height of fences is anticipated to be up to 4 m.
- Temporary infrastructure to obtain water from available local sources/existing or new boreholes including a potential temporary above ground pipeline (approximately 35 cm diameter) to feed water

to the on-site batching plant will be erected. Water will potentially be stored in temporary water storage tanks. The necessary approvals from the DWS will be applied for separately.

Several of the components have alternatives. The proposed site was selected through an environmental and social pre-feasibility assessment and no further site location alternatives other than Kudusberg will be considered in this process. Based on the hilly to mountainous terrain, the climatic conditions and current land use being agricultural, it was determined that the Kudusberg site would be best-suited for a WEF, instead of any other type of renewable energy technology.

One turbine layout is to be assessed for Kudusberg WEF based on 56 wind turbines with associated crane pad areas. The proposed layout will be amended, as needed, based on specialist input and input from I&APs.

The proposed access to the site is from the tarred R354 connecting Matjiesfontein and Sutherland, turning west onto the district gravel road DR02249 and then heading southwest onto the R356 (MR00319) provincial gravel road from where the main access road (MN04469/OG51) branches off towards the south. The upgrade of the DR02249 and R356 public roads may involve the upgrade of any watercourse crossings to facilitate the abnormal loads to be transported to site, especially for tower sections, nacelles and blades. The intersections between DR02249 and R354 as well as DR02249 and the R356 will have to be widened to a curve radius of 50 m in order to facilitate safe passage of the very long low bed trailers used for blade transportation. The upgrade of the MN04469/0G51 is anticipated to include limited widening, straightening of curves and the installation of culverts or bridges at watercourse crossings. The two access road alternatives branch off from the MN04469 to connect to the new wind farm road network between the turbines on the ridges. Access road alternative 1 is the western route and is approximately 4.6 km long, almost all of which follows an existing jeep track. Access road alternative 2 is the eastern route of 5.7 km, almost all of which would be a new road. Each road section will be buffered by approximately 200 m in order to allow for incremental alternatives i.e. reroute within the buffer in order to avoid any sensitive features identified during the detailed specialist assessments.

Three alternative construction camp locations, including the area required for a batching plant, are considered. Construction camp 1 is located on a flat high-lying area between turbines 43 and 47; Construction camp 2 is located adjacent to and east of the MN04469 public road on the remainder of the farm Urias Gat 193; and Construction camp 3 is located adjacent to and east of the MN04469 public road on portion 6 of the farm Urias Gat 193.

Three onsite 33/132 kV substation location alternatives are considered. Substation alternative 1 is located south of turbine 38 and north of turbine 9; Substation alternative 2 is located south of turbine 42 and north of turbine 13; and Substation alternative 3 is located southeast of turbine 44.

It is mandatory to consider the “no-go” option in the BA process. 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.

1.3 Process

The proposed WEF is to be located within the Komsberg REDZ (REDZ 2) (published in terms of Section 24(3) of the National Environmental Management Act, 1998 (NEMA) in GN R114 of 16 February 2018), known as Komsberg. In terms of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) and the 2014 NEMA EIA Regulations promulgated in Government Gazette 40772 and Government Notice (GN) R326, R327, R325 and R324 on 7 April 2017, wind and solar PV projects located within REDZs are subject to a BA and reduced decision-making period by the authorities. A BA Process, contemplated in terms of Regulation

19 and 20 of the Environmental Impact Assessment Regulations, 2014, is required to obtain Environmental Authorisation (EA) for this large scale WEF, as required in terms of NEMA.

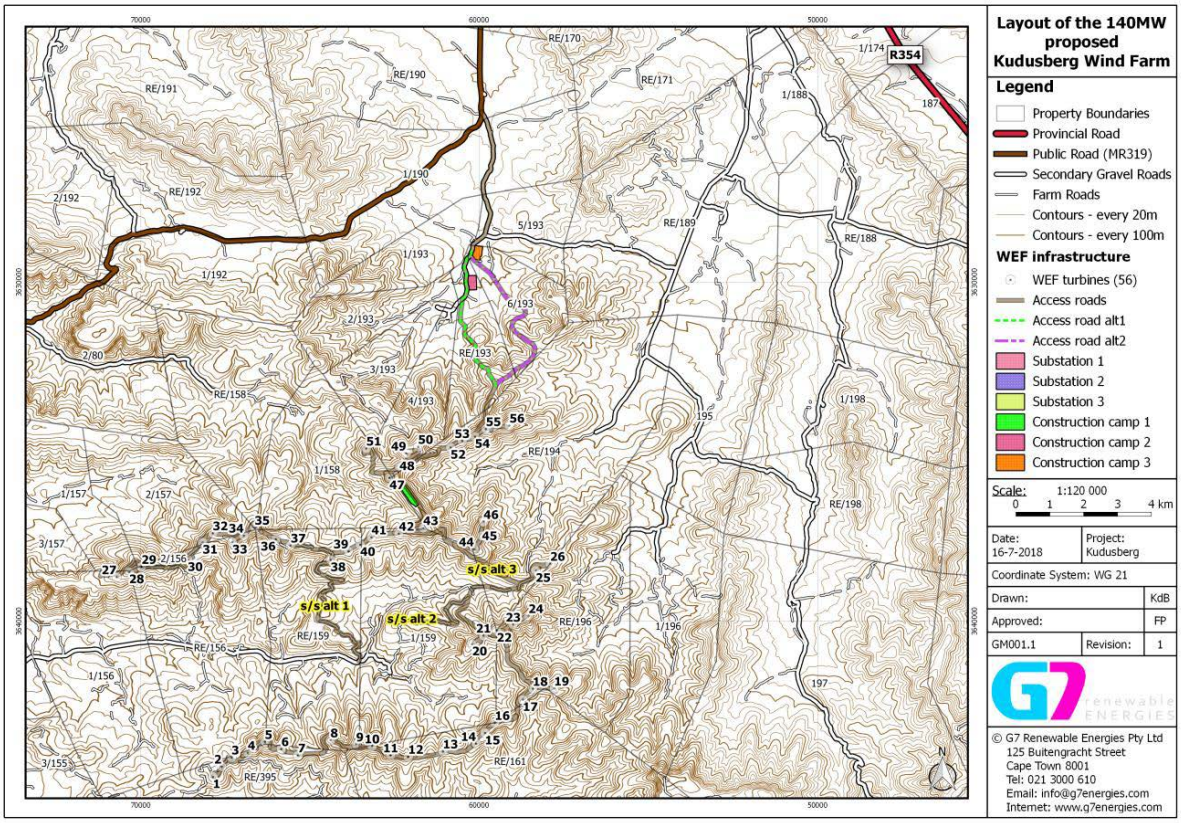


Figure 1: Layout of the proposed 325 MW Kudusberg Wind Energy Facility project with access roads (Figure as provided by G7 Renewable Energies Pty Ltd). Location of substation alternatives highlighted in yellow.

2. APPROACH AND METHODOLOGY

2.1 Approach

The study commenced as a desktop study, followed by field-based surveys from 17 to 20 July 2018 and a follow-up survey from 5 to 13 September 2018. The focus of the first site visit (17-20 July) was to conduct surveys for the classification of the vegetation into plant associations (plant communities) and at the same time to search for Species of Conservation Concern (SCC). The second site visit (5-13 September) focused on searching for SCC. To accomplish this, most of the planned roads, turbine locations, crane pads, construction camps and substations (as indicated in the layout of July 2018) was traversed on foot.

Hard copy and digital information from spatial databases, such as the geological survey maps (3220 Sutherland), Land Type maps (3220 Sutherland), daffarcgis.nda.agric.za, topocadastral maps (3220 CC Pienaarsfontein and 3220 CD Oliviersberg), vegetation types (Mucina & Rutherford 2006), NewPosa database of SANBI, and databases of the Animal Demography Unit, University of Cape Town, were sourced to provide information on topography, geology, land types, broad vegetation types, flora and fauna of the study area. Information on the climate was sourced from the Weather Bureau (1988, 1998).

Satellite images (Google Earth) were used to identify broad habitat types on site. The vegetation survey consisted of visiting the habitat types and systematically recording plant species on site, and estimating their cover-abundance. Physical habitat features were noted. A checklist of the plant species on site was compiled (see Appendix A). During the site visit, digital photographs were taken, and representative photographs of the different plant associations are included in the report. The site was also surveyed for rare, threatened and/or endemic plant species during the site visit.

The animal survey was limited to day-time visual assessments of the site. Animal species present on the site were mainly attained by means of direct or indirect sighting methods (animals, spoor, burrows, scats, sounds), whilst traversing the site by vehicle or on foot. Threatened species are generally uncommon and/or localised and the survey may have been insufficient to record their presence at or near the development.

2.2 Data analyses

A classification of the vegetation data was done with the TURBOVEG and JUICE computer programmes (Hennekens and Schaminee, 2001, Tichy *et al.,* 2011). A differential table of the vegetation was compiled (Appendix C) and the different plant associations were described.

2.3 Plant species checklists

The checklist in Appendix A was compiled from various sources. All plant species (the term species is used here in a general sense to denote species, subspecies and varieties) recorded during the site visit are listed in the checklist. A plant species checklist of the 3220CA, CB, CC and CD quarter degree grids was obtained from the NewPosa database of the South African National Biodiversity Institute (newposa.sanbi.org) and is also included in Appendix A. Additionally, the species listed by Van der Merwe *et al*. (2008a, 2008b) and Clark *et al*. (2011) are incorporated in the species list.

The checklist in Appendix A is considered to represent the most up to date information on the species that could **potentially** occur on site.

2.4 Red Data plant species

The Red Data status, conservation and protected status of all plant species provided in Appendix A were determined from available literature and Acts, e.g. NEM:BA (2013), NCNCA (2009), WCNECO (1974, as amended 2000) and CITES (2017). The two site visits covered the flowering times of most of the SCC.

2.5 Fauna

Species lists (the term species is used here in a general sense to denote species, subspecies and varieties) of the faunal component were sourced from the Animal Demography Unit, University of Cape Town website (adu.uct.ac.za) and consulting of available databases and/or relevant literature, e.g. Skinner and Chimimba (2005) and Alexander and Marais (2007), to determine the diversity, conservation status and distribution of relevant faunal species. Bird and bat species are assessed by other specialists.

2.6 Sensitivity assessment

A sensitivity assessment of each plant association was done and a rating awarded. A sensitivity map was drawn based on a number of criteria discussed (see section 8 Ecological Sensitivity Analysis for full methodology).

2.7 Impact assessment

An assessment of the ecological impacts and their significance on the terrestrial system, is discussed and mitigation measures proposed. The impact assessment was based on the criteria and methodology outlined in the BA Report (CSIR, in preparation).

2.8 Sources of information

Vegetation:

- Vegetation types occurring in the area were obtained from Mucina and Rutherford (2006);
- Conservation status of the vegetation types was obtained from Mucina and Rutherford (2006) and the National List of Threatened Ecosystems (NEMA, 2011);
- A finer scale vegetation mapping of the area was obtained from Van der Merwe *et al*. (2008a, 2008b);
- Information on endemic or near-endemic species to the Hantam – Roggeveld Centre of Endemism (Van Wyk and Smith, 2001) was obtained from Clark *et al.* (2011);
- A plant species checklist of the 3220CA, CB, CC and CD quarter degree grids was obtained from the NewPosa database of the South African National Biodiversity Institute (SANBI) (Appendix A).
- The IUCN Red List Category for the plant species was extracted from the Threatened Species Programme (Red List of South African plants version 2017.1).

Fauna

- Lists of mammals, reptiles, frogs, butterflies, lacewings and dragonflies were extracted from the Animal Demography Unit, University of Cape Town website (http://vmus.adu.org.za) and supplemented by information gathered in Bates *et al*. (2014) for reptiles; Skinner and Chimimba (2005) for mammals; and Mecenero *et al.* (2013) for butterflies. The reptile list was furthermore

verified and expanded by Mr Marius Burger (sungazer@iafrica.com), a renowned herpetologist.

- The IUCN Red List Category for the animal species was extracted from Bates *et al*. (2014) for reptiles; Skinner and Chimimba (2005) for mammals; and Mecenero *et al.* (2013) for butterflies. No IUCN Categories are however available for lacewings.

Other

- The website of the National Protected Areas Expansion Strategy (NPAES) was consulted for possible inclusion of the site into a protected area in future.
- The Northern and Western Cape Biodiversity Area Maps were consulted for inclusion of the site into a Critical Biodiversity Area or Ecological Support Area (biodiversityadvisor.sanbi.org).

2.9 IUCN Classification into threatened and non-threatened categories

For the IUCN Categories, the following definitions were applied (see Figure 2). The colours in Figure 2 were applied to the checklist of plants and animals in Appendices A and B.

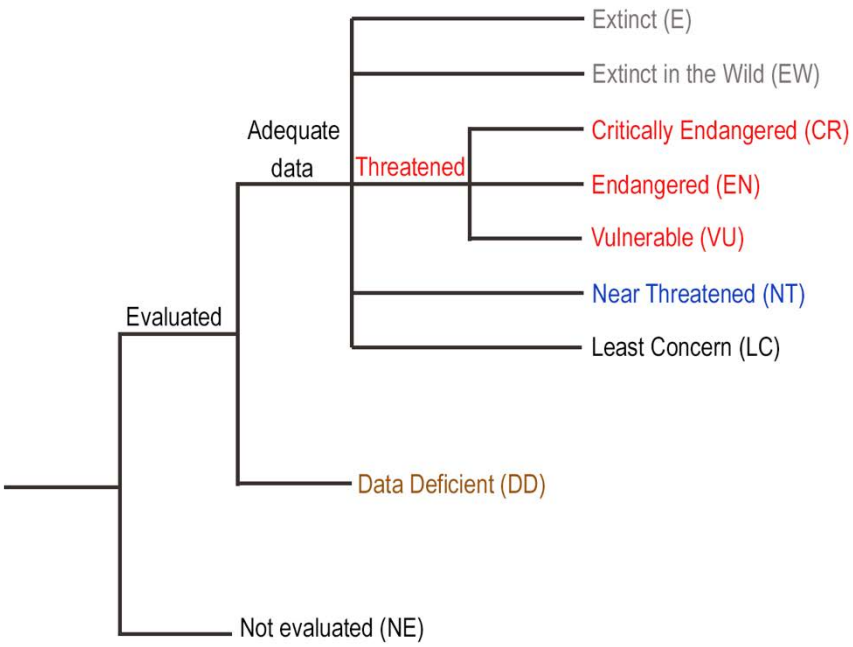


Figure 2: Schematic representation of the relationship between the various IUCN Red List Categories.

2.9.1 Threatened Species and Species of Conservation Concern (SCC)

Extinct Categories:

- **Extinct (E):** A species is Extinct when there is no reasonable doubt that the last individual has died. Species should be classified as Extinct only once exhaustive surveys throughout the species' known range have failed to record an individual.
- **Extinct in the Wild (EW):** A species is Extinct in the Wild when it is known to survive only in cultivation

or as a naturalized population (or populations) well outside the past range.

Threatened Categories:

- **Critically Endangered (CR):** A species is Critically Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Critically Endangered, indicating that the species is facing an extremely high risk of extinction.
- **Endangered (EN):** A species is Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Endangered, indicating that it is facing a very high risk of extinction.
- **Vulnerable (VU):** A species is Vulnerable when the best available evidence indicates that it meets at least one of the five IUCN criteria for Vulnerable, indicating that it is facing a high risk of extinction.

2.9.2 Not Threatened Categories but of conservation concern:

- **Near Threatened (NT):** A species is Near Threatened when available evidence indicates that it nearly meets any of the IUCN criteria for Vulnerable, and is therefore likely to become at risk of extinction in the near future.
- **Data Deficient (DD):** A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking.

2.9.3 Not Threatened Categories:

- **Least Concern (LC):** A species is Least Concern when it has been evaluated against the IUCN criteria and does not qualify for any of the above categories. Species classified as Least Concern are considered at low risk of extinction. Widespread and abundant species are typically classified in this category.
- **Not Evaluated (NE):** A taxon is Not Evaluated when it is has not yet been evaluated against the five IUCN criteria. This category often applies to alien species.

2.9.4 Additional Categories identified by the Threatened Species Programme in South Africa

- **Critically Rare:** A species is Critically Rare when it is known to occur at a single site, but is not exposed to any direct or plausible potential threat and does not otherwise qualify for a category of threat according to one of the five IUCN criteria.
- **Rare:** A species is Rare when it meets at least one of four South African criteria for rarity, but is not exposed to any direct or plausible potential threat and does not qualify for a category of threat according to one of the five IUCN criteria. The four criteria are as follows:
    - Restricted range: Extent of Occurrence (EoO) <500 km^2, OR
    - Habitat specialist: Species is restricted to a specialized microhabitat so that it has a very small Area of Occupancy (AoO), typically smaller than 20 km^2, OR
    - Low densities of individuals: Species always occurs as single individuals or very small subpopulations (typically fewer than 50 mature individuals) scattered over a wide area, OR
    - Small global population: Less than 10 000 mature individuals.

3. REGULATORY FRAMEWORK

3.1 Introduction

The White Paper on the conservation and sustainable use of South Africa's biodiversity and the National Environmental Management Act (Act No. 107 of 1998) specify that due care must be taken to conserve and avoid negative impacts on biodiversity and that the sustainable, equitable and efficient use of biological resources must be promoted. Various acts provide control over natural resources in terms of their conservation, the use of biological resources and avoidance of negative impacts on biodiversity. Some international conventions are also relevant to sustainable development.

3.2 Natural resources

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

3.3 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.

3.4 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 well-being. 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.

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.

3.5 National Environmental Management: Biodiversity Act (Act No. 10 of 2004) (NEM:BA)

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

Threatened ecosystems

Section 53 of NEM:BA lists the threatened status of ecosystems, i.e. critically endangered ecosystems, endangered ecosystems, and vulnerable ecosystems. The list of threatened ecosystems was published in 2011 (NEM:BA, 2011). Thirty-four percent of South Africa's 440 terrestrial ecosystems are considered threatened. Of these, 5% are critically endangered (mostly in fynbos and forest biomes), 13% are endangered (mostly in the grassland and savanna biomes), and 16% are vulnerable (mostly in the fynbos and grassland biomes).

Threatened or Protected Species (ToPS) Regulations

Section 56 of NEM:BA makes provision for the declaration of species which are of such high conservation value, national importance or are considered threatened that they need protection, i.e. critically endangered species, endangered species and vulnerable species. Lists of species that are threatened or protected, and associated activities that are prohibited and/or exempted from restriction were published in the Government Gazette Vol 574, No 36375 of 16 April 2013 (NEM:BA, 2013). Any proposed development involving one or more threatened or protected species and/or prohibited/restricted activities will require a permit in term of these Threatened or Protected Species (ToPS) Regulations of 2013, as read with NEM:BA.

Alien and Invasive Species (AIS) Regulations

Chapter 5 of NEM:BA provides for the protection of biodiversity from alien and invasive species. The act defines alien species and 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).

In terms of the aforementioned legislation, the following categories of declared alien and invasive plants are recognised in South Africa (see Glossary for explanations):

1. Exempted Alien Species
2. Prohibited Alien Species
3. Category 1a Listed Invasive Species
4. Category 1b Listed Invasive Species
5. Category 2 Listed Invasive Species
6. Category 3 Listed Invasive Species

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

NEM:PAA provides for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes; for the establishment of a national

register of all national, provincial and local protected areas; for the management of those areas in accordance with national norms and standards; for intergovernmental co-operation and public consultation in matters concerning protected areas; and for matters in connection therewith.

3.7 National Environmental Management: Air Quality Act (Act No. 39 of 2004) (NEM:AQ)

According to the Regulations promulgated in terms of the National Environmental Management: Air Quality Act, atmospheric emissions produced by any activity, i.e. agricultural, commercial or industrial, and that is disposed of into the atmosphere requires an application for an atmospheric emission license (AEL) issued by the relevant competent authority.

3.8 National Forests Act (Act No. 84 of 1998) (NFA)

The National Forest Act makes provision for the declaration of for example specially protected areas, forest nature reserves, forest wilderness areas and protected woodlands. A list of declared protected tree species in terms of the NFA was published in 2017 (NFA, 2017). In terms of section 15(1) of this act, no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree or any product derived from a protected tree, except under a license or exemption granted by the Minister to an applicant and subject to such period and conditions as may be stipulated. The competent authority responsible for considering and issuing the license will be the national Department of Agriculture, Forestry and Fisheries (DAFF).

3.9 National Water Act (Act No. 36 of 1998) (NWA)

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

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

A separate aquatic impact assessment has been undertaken to inform the Kudusberg wind farm.

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

The objectives of the Conservation of Agricultural Resources Act are to provide for the conservation of the natural agricultural resources by the maintenance of the production potential of the land, by combating and preventing erosion and weakening or destruction of the water resources, and by protecting natural vegetation and combating weeds and invader plants. In order to achieve the objectives, certain control measures are prescribed to which land users must comply. The activities mentioned relate to:

- the cultivation of virgin soil;
- the irrigation of land;
- the prevention or control of waterlogging or salinisation of land;
- the utilisation and protection of vleis, marshes and water courses;
- the regulation of the flow pattern of run-off water;

- the utilisation and protection of vegetation; and
- the restoration or reclamation of eroded land.

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

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

4. ENVIRONMENTAL DESCRIPTION

4.1 Location

The site is located southwest of Sutherland, and lies partly in the Northern Cape and partly in the Western Cape. The area falls within the Cape Winelands and Namaqua District Municipalities. The total area covered by the study site is approximately 30 000 ha, when considering the extent of affected cadastral units (Figure 3). The core area where most of the proposed development will occur area is approximately 19 300 ha (Figures 4 - 5). The topocadastral quarter degree grid references are 3220 CC PIENAARSFONTEIN and 3220 CD OLIVIERSBERG. The site is located between 32° 47' 18.0" S and 32° 56' 02" S latitude; 20° 11' 24" E and 20° 24' 56" E longitude.

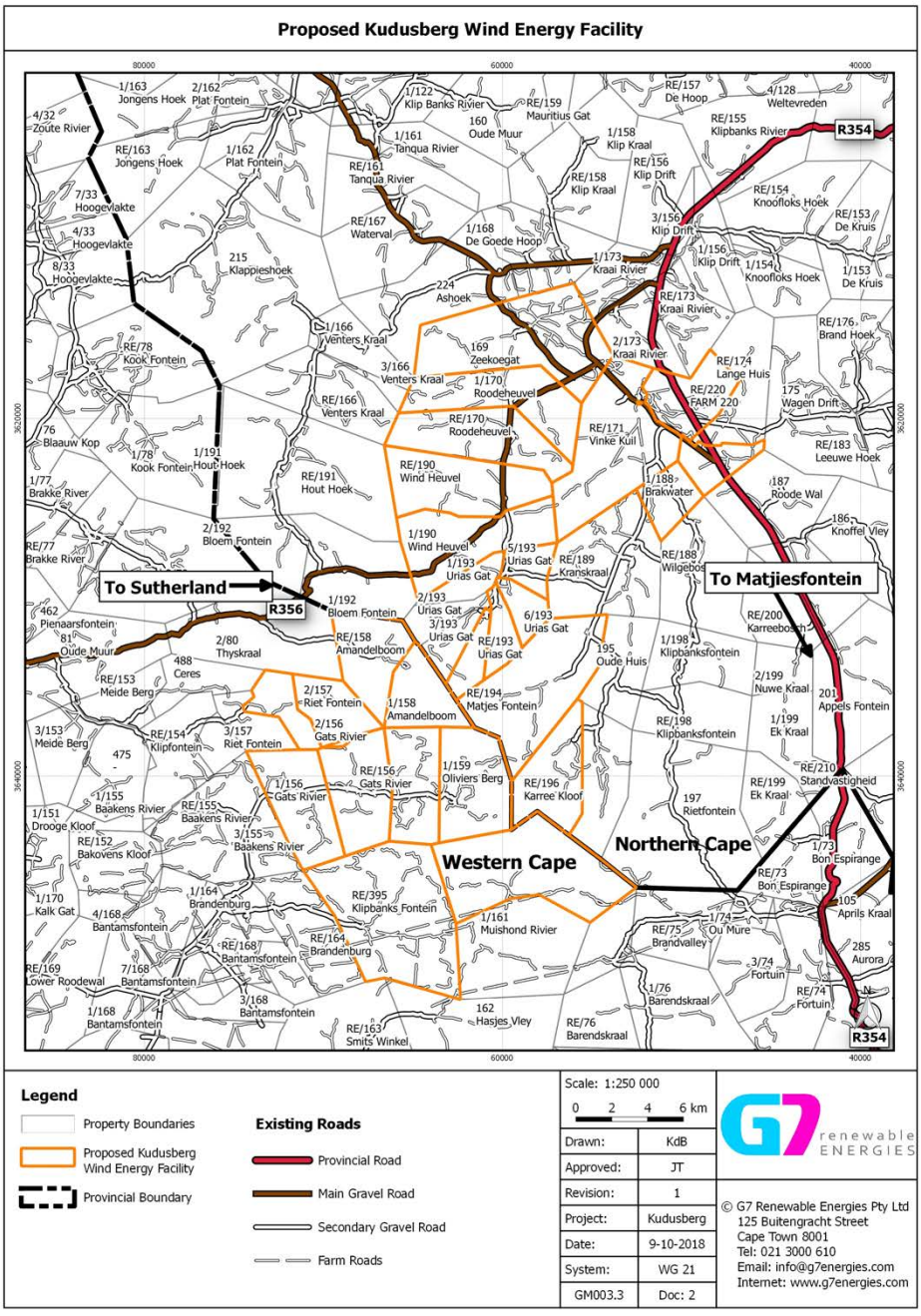


Figure 3. Site location of the proposed Kudusberg WEF (Figure as provided by G7 Renewable Energies Pty Ltd).

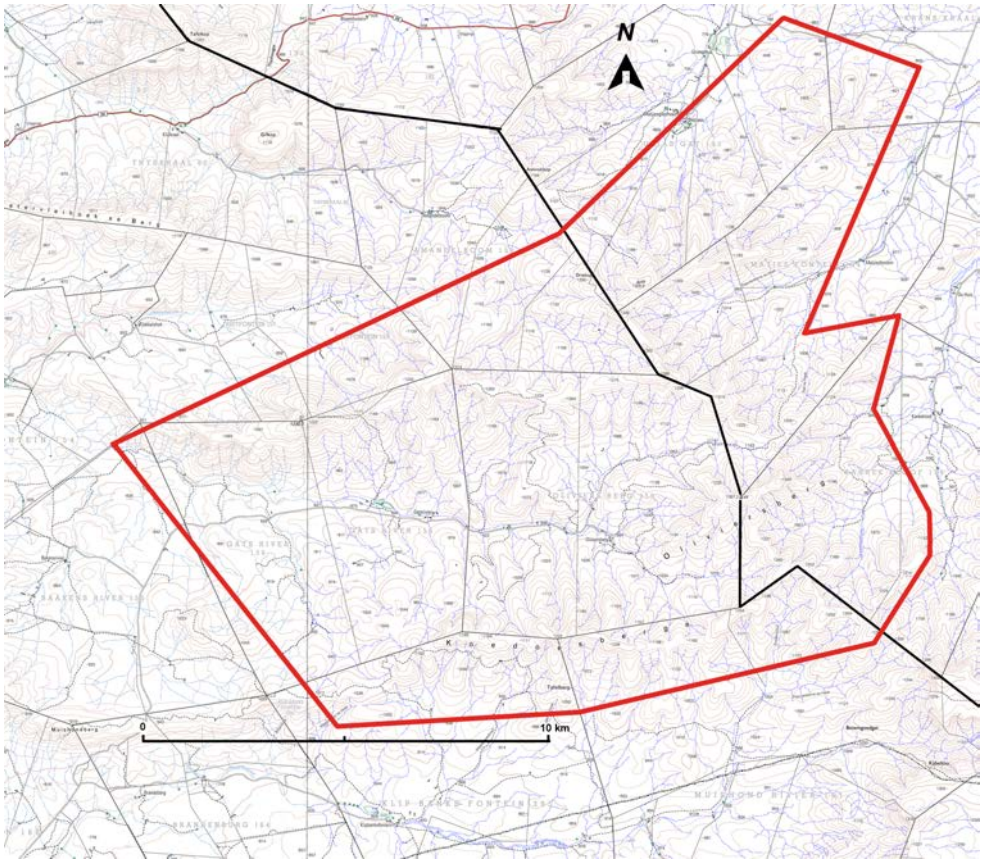


Figure 4. Topocadastral map indicating the location of the core Kudusberg WEF site (site outlined in red).

Figure 5. Satellite image indicating the approximate location of the core Kudusberg WEF site (site outlined in red).

4.2 Terrain morphology and drainage

The site occurs on the slopes and broad ridges of low mountain ranges bordering the southern Tanqua Karoo, such as the Kudusberge and Oliviersberg south of the Roggeveld section of the Great Escarpment, facing the Moordenaars Karoo. The landscape is undulating to hilly in the valleys. The altitude ranges from 800 m along the Gatsrivier in the west of the site to 1367.2 m on Oliviersberg. Other high points are the 1366 m to the north of the Oliviersberg and 1254 m on the Koedoesberge in the south (Figure 6).

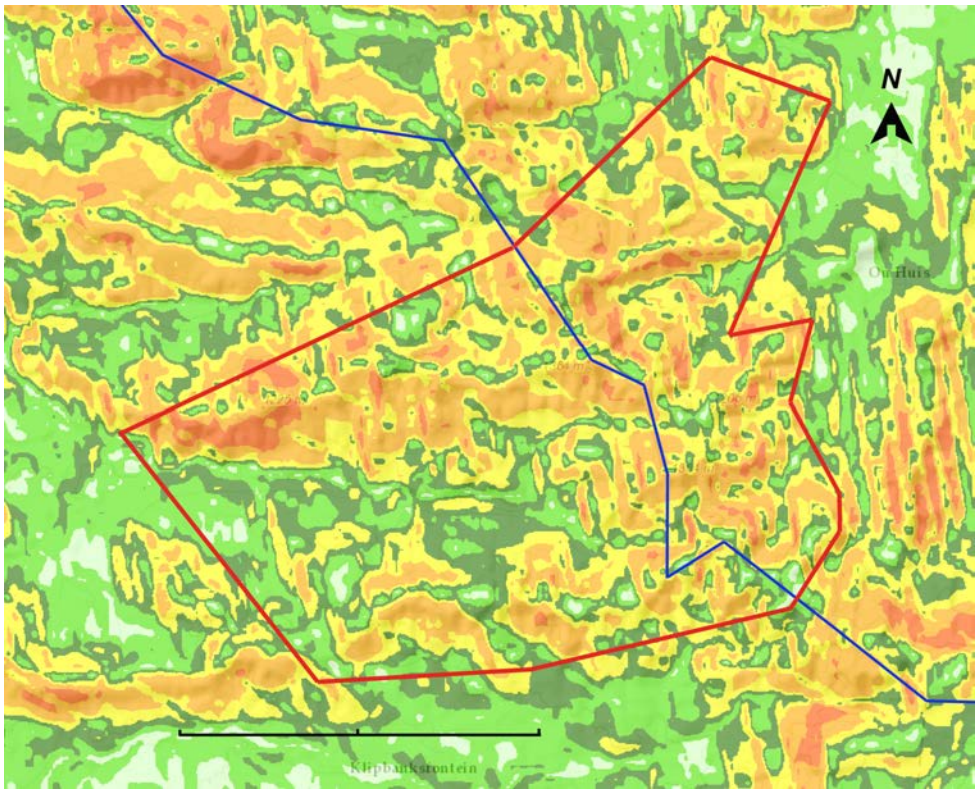


Figure 6. Slope categories in the vicinity of the Kudusberg WEF (site outlined in red) (daffarcgis.nda.agric.za).

Legend:

Grey	-	slope ≤2%;	Light green	-	slope >2-5%;
Dark green	-	slope >5-8%;	Yellow	-	slope >8-12%;
Light orange	-	slope >12-20%;	Dark orange	-	slope >20%.

The region is drained by seven rivers, mostly in a westerly and northerly direction (Figure 7). The Muishondrivier in the south, Gatsrivier in the centre, Jakkalsrivier and Brakrivier in the north and northwest of the site, drain the area towards the west and northwest, while the Kareekloofrivier, Uriasgatrivier and Wilgebosrivier drain the region northeast and northwards.

The site falls in primary catchment E, secondary catchment E2, tertiary catchment E22 and E23 and the quaternary catchments E23A, E23B, E23H, E23G and E22B (Figure 7).

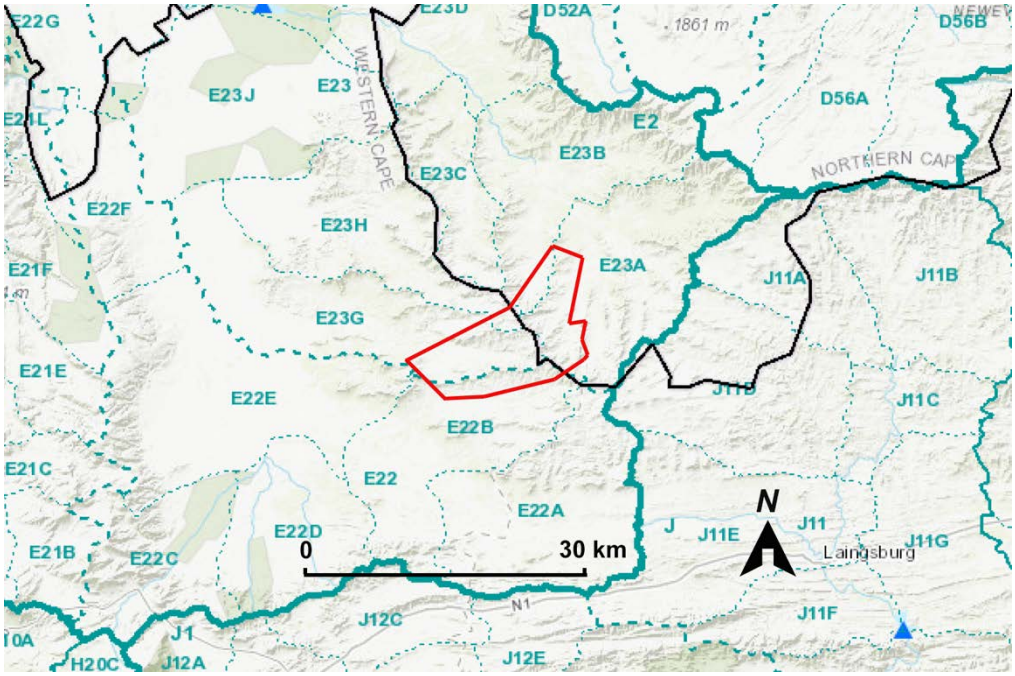


Figure 7. Catchments in the Kudusberg region (site outlined in red) (daffarcgis.nda.agric.za).

4.3 Climate

4.3.1 Regional climate

The following summary of the regional climate in the Koedoesberge-Moordenaars Karoo is provided by Mucina and Rutherford (2006). The mean annual precipitation is approximately 206 mm with a peak in March and an annual precipitation coefficient of variation of 37%, which indicates the unpredictable nature of the rainfall. Mean annual potential evaporation is 2425 mm, while the mean annual soil moisture stress is 80%. The mean annual temperature is 15.8°C and frost is frequent in winter at a mean of 30 days per annum.

4.3.2 Rainfall

The mean annual rainfall as measured at Sutherland is 266 mm (Table 1, Figure 8). The total annual rainfall at Sutherland during dry and wet years respectively may range from 132 mm to 467 mm, indicating a high variation in the annual rainfall and therefore a rainfall scenario that is highly unpredictable (Table 1). The rainy season at Sutherland is predominantly from March to August when about 63% of the annual rainfall occurs. The wettest months are March and June and the driest period is from September to February, when less than 20 mm of rain per month is recorded. The maximum rainfall measured over a 24-hour period at Sutherland was 86 mm, recorded in March. Highest monthly rainfall recorded was 115 mm, measured in January (Table 1).

The mean annual rainfall as measured at Touws River to the southwest is 256 mm per annum (Table 2, Figure 9). The total annual rainfall at Touws River during dry and wet years respectively may range from 134 mm to 339 mm, indicating a high variation in the annual rainfall and therefore a rainfall scenario that is unpredictable (Table 2). The rainy season at Touws River is predominantly from March to August when about 68% of the annual rainfall occurs. The wettest months are April and June and the driest period is from September to February, when less than 20 mm of rain per month is recorded. The maximum rainfall measured over a 24-hour period at Touws River was 73 mm in April. Highest monthly rainfall recorded was 107 mm, also measured in April (Table 2).

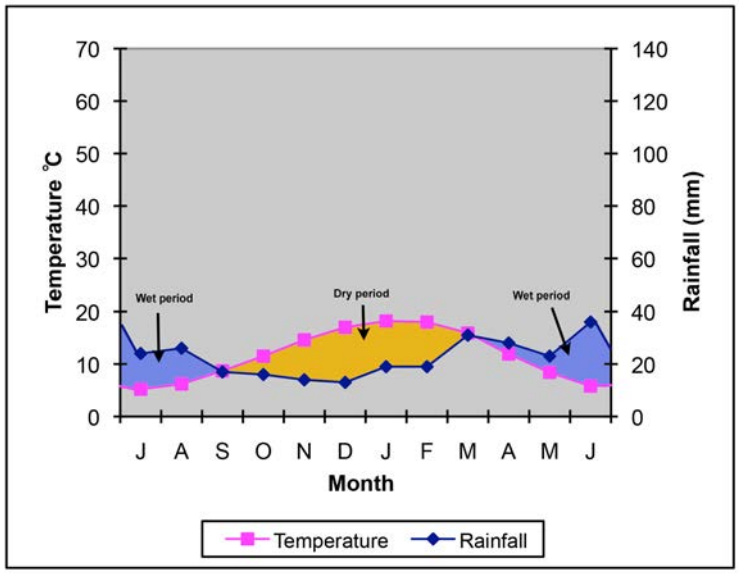


Figure 8. Climate diagram for Sutherland. Months on X-axis are from July to June. When the rainfall curve is below the temperature curve it indicates a dry period.

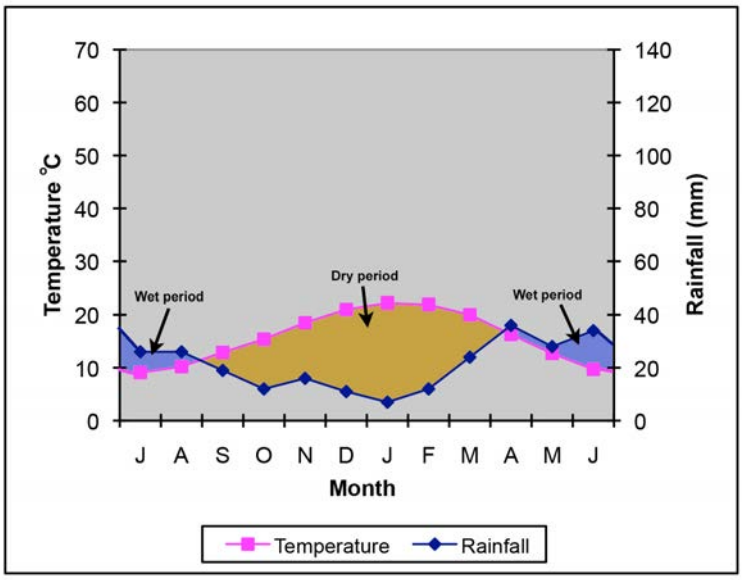


Figure 9. Climate diagram for Touws River. Months on X-axis are from July to June. When the rainfall curve is below the temperature curve it indicates a dry period.

4.3.3 Temperature

The mean annual temperature for Sutherland is 11.8°C (Table 3) with the extreme maximum and minimum temperatures 35.5°C and -13.6°C respectively. The mean daily maximum for January is 27.1°C and for July it is 12.8°C, whereas the mean daily minimum for January is 9.2°C and for July it is -2.4°C. Frost may occur anytime throughout the year.

The mean annual temperature for Touws River is 15.8°C (Table 4) with the extreme maximum and minimum temperatures 40.7°C and -5.6°C respectively. The mean daily maximum for January is 30.6°C and for July it is 15.7°C, whereas the mean daily minimum for January is 13.6°C and for July it is 2.6°C. Frost may occur from April to October.

Table 1: Maximum rainfall (mm) in 24 hours, highest maximum and lowest monthly minimum rainfall at Sutherland: 32° 23' S; 20° 40' E; 1459 m (Weather Bureau 1998)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
*Max	62	39	86	47	41	49	38	24	19	22	31	31	86
*High	115	93	88	103	87	110	86	103	79	47	72	72	467
*Low	0	0	0	2	1	0	2	3	0	0	0	0	132
Mean	19	19	31	28	23	36	24	26	17	16	14	13	266

*Max = maximum rainfall recorded in 24 hours
*High = highest monthly and annual maximum rainfall (mm)
*Low = lowest monthly and annual minimum rainfall (mm)
*Mean = mean monthly and annual rainfall (mm)

Table 2: Maximum rainfall (mm) in 24 hours, highest maximum and lowest monthly minimum rainfall at Touws River: 33° 23' S; 20° 02' E; 771 m (Weather Bureau 1998)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
*Max	48	25	52	73	36	32	39	22	51	22	33	19	73
*High	57	50	81	107	85	74	62	68	57	37	59	42	339
*Low	0	0	0	0	5	0	2	5	2	0	0	0	134
*Mean	7	12	24	36	28	34	26	26	19	12	16	11	256

*Max = maximum rainfall recorded in 24 hours
*High = highest monthly and annual maximum rainfall (mm)
*Low = lowest monthly and annual minimum rainfall (mm)
*Mean = mean monthly and annual rainfall (mm)

Table 3: Temperature data (°C) for Sutherland: 32° 23' S; 20° 40' E; 1459 m (Weather Bureau 1998)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Max	27.1	26.9	24.6	20.3	16.2	12.7	12.8	14.1	17.2	20.4	23.6	25.9	20.2
*Max	35.5	35	33.7	30.1	27.5	21.0	21.2	24.0	29.8	32.8	34.5	34.7	35.5
Min	9.2	9.2	7.2	3.6	0.6	-1.2	-2.4	-1.6	0.2	2.6	5.7	8.0	3.4
*Min	0.1	-1.0	-3.0	-8.8	-9.9	-12.8	-13.6	-13.6	-11.6	-9.4	-4.0	-2.5	-13.6
Mean	18.2	18.0	15.9	11.9	8.4	5.8	5.2	6.2	8.7	11.5	14.6	17.0	11.8

*Max = maximum rainfall recorded in 24 hours
*High = highest monthly and annual maximum rainfall (mm)
*Low = lowest monthly and annual minimum rainfall (mm)
*Mean = mean monthly and annual rainfall (mm)

Table 4: Temperature data (°C) for Touws River: 33° 23' S; 20° 02' E; 771 m (Weather Bureau 1998)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Max	30.6	30.0	28.0	23.8	19.5	15.9	15.7	17.3	20.2	23.3	26.6	29.1	23.3
*Max	39.0	40.3	38.0	35.0	31.1	24.0	24.9	28.5	33.4	35.8	40.7	39.0	40.7
Min	13.7	13.9	12.1	8.8	5.8	3.4	2.6	3.4	5.6	7.5	10.4	12.9	8.3
*Min	6.7	5.4	3.0	0.5	-2.2	-5.6	-5.0	-5.0	-2.3	-0.5	2.5	2.7	-5.6
Mean	22.2	21.9	20.0	16.3	12.7	9.7	9.1	10.2	12.9	15.4	18.5	21.0	15.8

*Max = mean daily maximum temperature for the month
*Max = extreme maximum temperature recorded per month
*Min = mean daily minimum temperature for the month
*Min = extreme minimum temperature recorded per month

4.3.4 Thunder, snow, hail, fog, cloudiness and relative air humidity

At Sutherland, thunder is heard mainly in February on a mean of 10.8 days per year. Snow may occur from April to October on a mean of 5.7 days per year. Hail is a rare occurrence but may occur during most months. Fog

may occur in winter on a mean of 5.0 days per year. Cloud cover at 14:00 is the highest in April and May and in September and October (3.0 – 3.1 eights) and the lowest in December and January (2.1 – 2.3 eights) (Table 5). The highest mean relative air humidity (%) at 08:00 occurs during the autumn and winter months (March to August; 84 – 86%) and the lowest relative air humidity at 14:00 (31 - 32%) occurs in summer (January and February) (Table 5, Weather Bureau 1988, 1998).

Table 5: Mean days with thunder, hail and fog per month; cloud cover at 14:00 and percentage relative air humidity at 08:00 and 14:00 at Sutherland: 32° 23' S; 20° 40' E; 1459 m (Weather Bureau 1988, 1998)

	Days with				Cloud	Relative air humidity (%)	
	Thunder	Snow	Hail	Fog	(1 – 8)	08:00	14:00
Jan	1.4	0.0	0.2	0.0	2.1	67	31
Feb	2.1	0.0	0.0	0.0	2.4	72	32
Mar	1.9	0.0	0.1	0.4	2.6	80	36
Apr	1.3	0.2	0.1	1.0	3.1	86	41
May	0.7	0.4	0.0	0.6	3.0	84	44
Jun	0.4	1.1	0.1	0.6	2.9	85	50
Jul	0.3	1.3	0.0	1.3	2.4	84	46
Aug	0.3	1.9	0.1	0.6	2.7	84	44
Sep	0.5	0.4	0.0	0.4	3.0	81	38
Oct	0.6	0.4	0.0	0.1	3.1	72	35
Nov	0.9	0.0	0.1	0.0	2.8	64	32
Dec	0.4	0.0	0.0	0.0	2.3	62	32
Year	10.8	5.7	0.7	5.0	2.7	77	39

At Touws River, thunder is heard mainly in November and February at a mean of 5.2 days per year. Snow is a rare occurrence but may occur in July on a mean of 0.1 days per year. Hail is also a rare occurrence. Fog may occur in winter on a mean of 1.3 days per year. Cloud cover at 14:00 is the highest from April to October (3.0 – 3.3 eights) and the lowest in January (1.9 eights) (Table 6). The highest mean relative air humidity (%) at 08:00 occurs during autumn, winter and spring months (March to September; 82 – 86%) and the lowest relative air humidity at 14:00 (28 – 31%) occurs in summer (November to January) (Table 6, Weather Bureau 1988, 1998).

Table 6: Mean days with thunder, hail and fog per month; cloud cover at 14:00 and percentage relative air humidity at 08:00 and 14:00 at Touws River: 33° 23' S; 20° 02' E; 771 m (Weather Bureau 1998)

	Days with				Cloud	Relative air humidity (%)	
	Thunder	Snow	Hail	Fog	(1 – 8)	08:00	14:00
Jan	0.3	0.0	0.0	0.0	1.9	74	28
Feb	0.9	0.0	0.0	0.0	2.1	78	31
Mar	0.4	0.0	0.0	0.0	2.3	82	31
Apr	0.7	0.0	0.0	0.0	3.1	84	36
May	0.3	0.0	0.0	0.3	3.2	82	40
Jun	0.1	0.0	0.1	0.1	3.1	83	47
Jul	0.1	0.1	0.0	0.4	3.0	85	46
Aug	0.3	0.0	0.0	0.3	3.1	86	43
Sep	0.4	0.0	0.1	0.1	3.3	83	36
Oct	0.7	0.0	0.0	0.1	3.1	75	31
Nov	1.0	0.0	0.1	0.0	2.9	70	29
Dec	0.0	0.0	0.0	0.0	2.4	70	29
Year	5.2	0.1	0.3	1.3	2.8	80	36

4.4 Geology

The geology of the site is depicted in the 1:250 000 geological map 3220 Sutherland (Figure 10). The region is almost entirely covered by greenish-grey mudstone and subordinate sandstone of the Abrahamskraal Formation (Pa) of the Beaufort Group. While the steep upper slopes, cliffs and crests of the region consist mainly of sandstone, the middle and lower slopes are dominated by mudstone and subordinate sandstones. Some minor east-west trending fold axes and minor faults occur in the region.

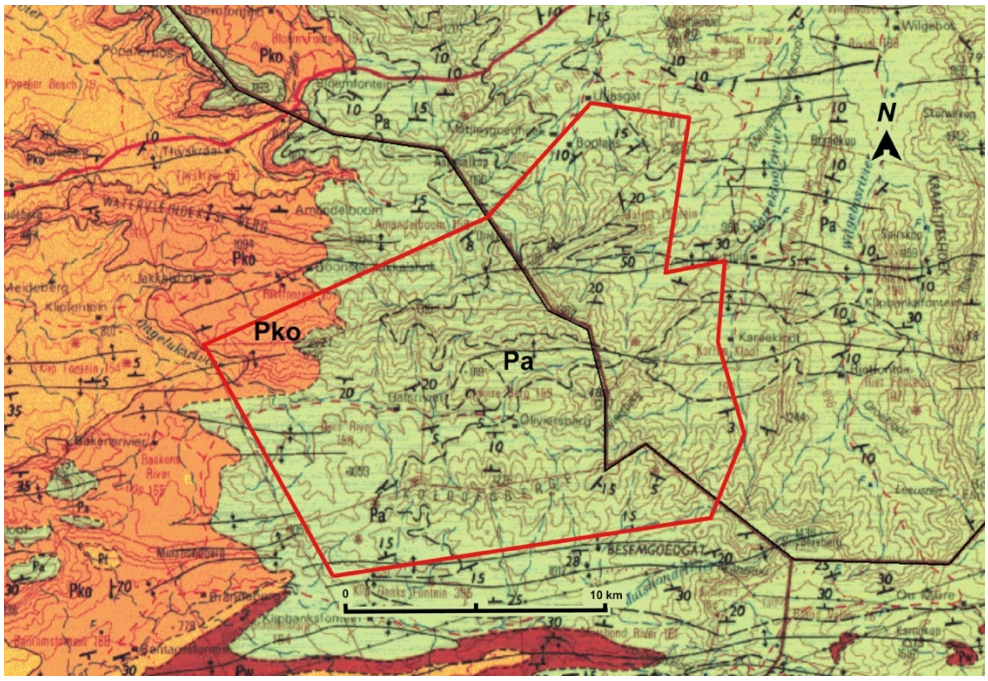


Figure 10. Geology of the Kudusberg WEF region (site outlined in red).

Legend:

Pa (pale green) = Abrahamskraal Formation (Adelaide Subgroup, Lower Beaufort Group) consisting of mudrock and subordinate sandstone.

Pko (orange - in northwest of study region) = Koedoesberg Formation and Waterford Formation consisting of grey sandstone with alternating thin siltstone beds and shale.

4.5 Land Types

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

The site falls mainly in the Fc 269 Land Type (Figure 10) while smaller portions of the Fc 274, Fc 291 and Fc 293 Land Types are also present on site**.** Other land types in the region include the Fc 295 and Ib 232 Land Types. The Fc Land Types are characterised by Glenrosa and/or Mispah soil forms (other soils may occur) and lime is generally present in the landscape.

The Fc 269 Land Type covers 1495 km^2 in the region. Terrain units 1, 2, 3, 4 and 5 are distinguished in the Fc 269 Land Type covering 10%, 1%, 69%, 15% and 5% of the landscape. Slopes range from 2 – 5% in terrain unit 1, > 100% in terrain unit 2, 25 – 80% in terrain unit 3, 2 – 6% in terrain unit 4 and 0 – 4% in terrain unit 5. Rocks

cover 50% of terrain unit 1, 100% of terrain unit 2, 40% of terrain unit 3, 10% of terrain unit 4 and 30% of terrain unit 5. The A-horizon consists of fine sand to sandy loam soils, while sandy clay-loam to clayey soils may occur in the B-horizon. The soils are derived from mudstone, siltstone and sandstone of the Beaufort Group and sandstone, siltstone and shale of the Ecca Group, Karoo Sequence. It is important to note that crests (where the bulk of the proposed developed will occur) cover only approximately 10% of the landscape.

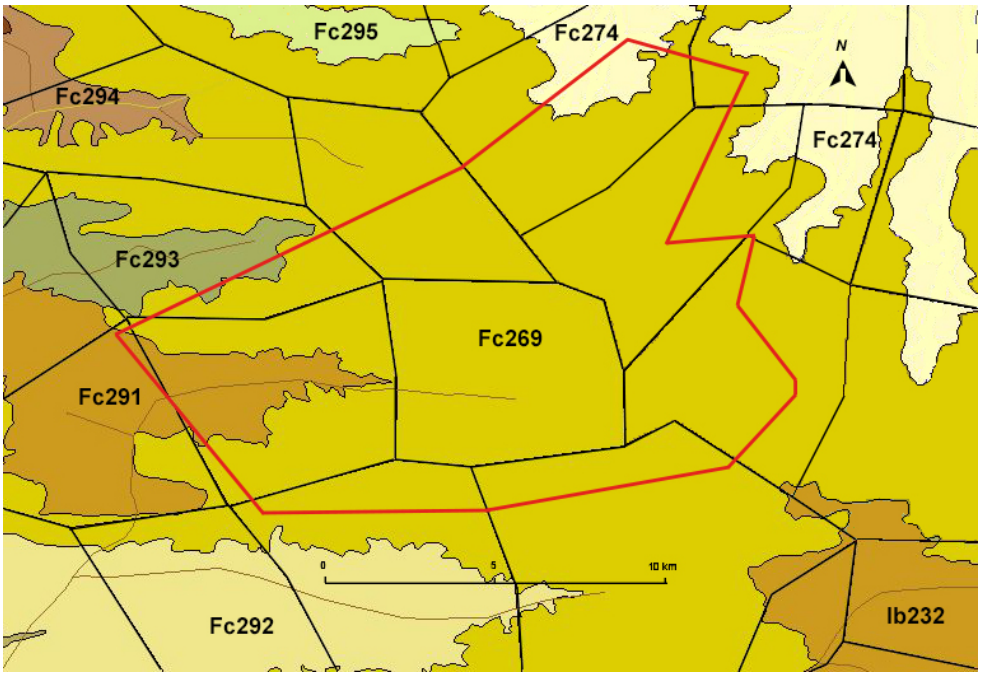


Figure 11. Land Types in the vicinity of the Kudusberg WEF (site outlined in red).

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

Critical Biodiversity Areas are areas required to meet biodiversity targets for ecosystems, species or ecological processes. An ESA is not essential for meeting biodiversity targets but plays an important role in supporting the ecological functioning in a CBA.

In the Northern Cape there is only a small area classified as a CBA, with most of the area classified as an ESA and small sections classified as ONAs (Namakwa Biodiversity Sector Plan 2016) (Figure 12).

Mapping of the CBAs in the Western Cape changed quite markedly from 2010 to 2017 (Figure 12b & c). In 2010 almost the entire section of the Kudusberg site, located in the Western Cape, was classified as a CBA (biodiversityadvisor.sanbi.org; Kirkwood *et al.*, 2010), whereas the area covered by a CBA in 2017 is substantially smaller and covers isolated patches in the northern, western and central sections of the site. Rivers and streams were mapped as ESAs in the Western Cape in 2017.

Furthermore, mapping of the Northern Cape and Western Cape CBAs and ESAs do not appear to match and different criteria were obviously applied.

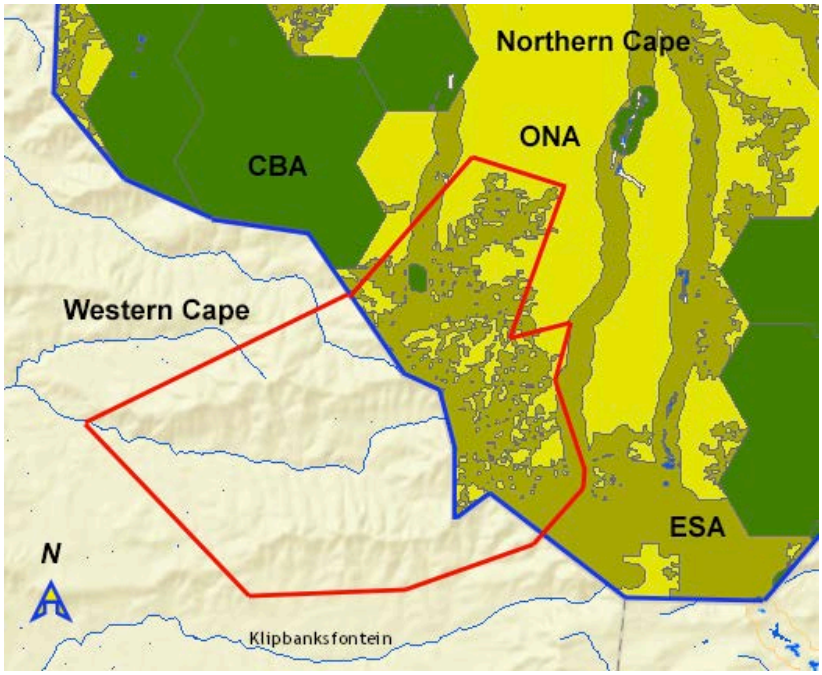


Figure 12a. Critical Biodiversity Areas (dark green), Ecological Support Areas (olive green) and Other Natural Areas identified (yellow) in the study area (Northern Cape) (biodiversityadvisor.sanbi.org).

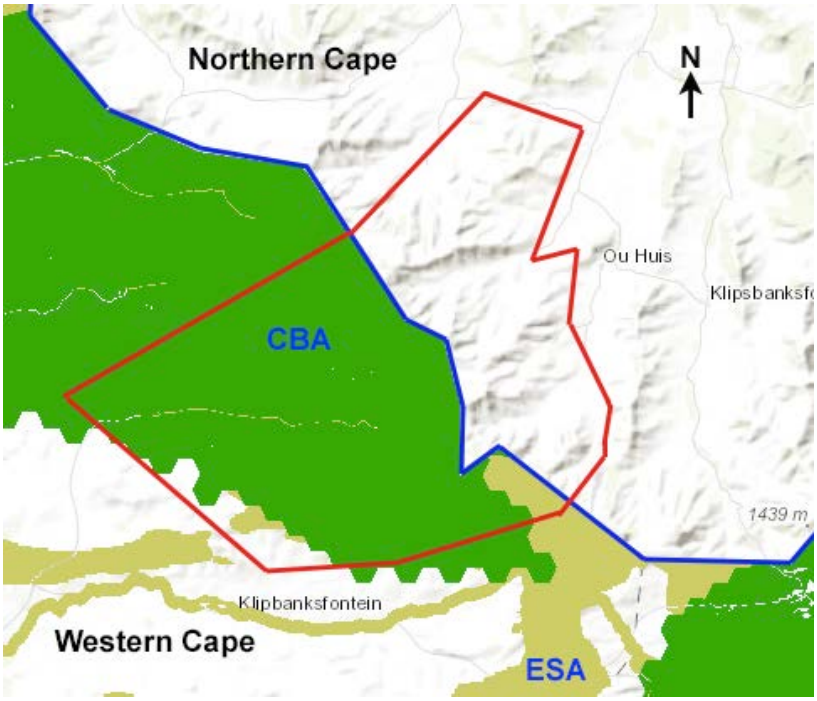


Figure 12b. Critical Biodiversity Areas (dark green), Ecological Support Areas (olive green) and Other Natural Areas (white) identified in the study area (Western Cape) according to the CBA mapping in 2010 (biodiversityadvisor.sanbi.org; Kirkwood *et al.*, 2010). The 2010 mapping of CBAs is not used in the current report. The SEA Sensitivity map (CSIR, 2015) was however based on this outdated mapping.

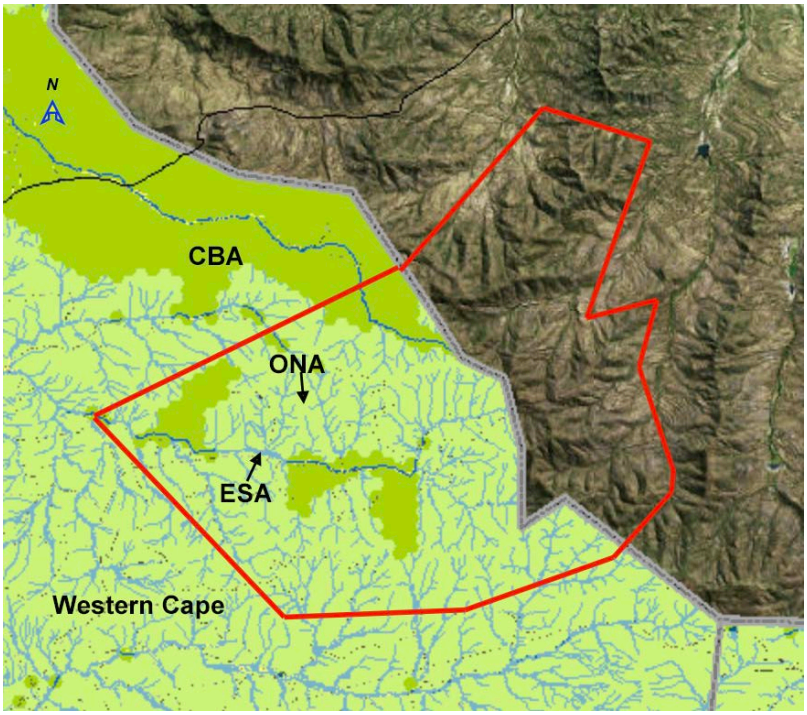


Figure 12c. Critical Biodiversity Areas (green), Ecological Support Areas (light blue) and Other Natural Areas (lime green) identified in the study area (Western Cape) according to the CBA mapping in 2017 (biodiversityadvisor.sanbi.org; Pool-Stanvliet *et al*., 2017).

4.7 Sensitivity mapping according to the SEA

In the SEA for wind and solar photovoltaic energy in South Africa, the terrestrial and aquatic sensitivity in the Komsberg REDZ was scored by taking the following parameters into account (Skowno *et al.,* 2015):

- Land cover;
- Aquatic features and associated buffers;
- Protected areas;
- SKEP Expert Derived Priority Areas;
- Riverine rabbit habitat;
- Topographic features;
- NPAES priority areas;
- Sensitive vegetation;
- Regional endemism;
- Western Cape Critical Biodiversity Areas; and
- Namakwa Critical Biodiversity Areas.

The absolute sensitivity map for the study area indicated that the rivers in the area were scored 16-21 (blue, red and purple), the Oliviersberg has a score of 11 (salmon), while the remainder of the mountainous areas were scored as 6-9 (light and dark green). The plains were scored 1 (lime green) (Figure 13). **All scores above 10 were regarded as very high; those from 6 – 10 were high; those from 1 – 5 were medium; and a score of 0 was classified as low** (Figure 13).

Although the one criterium included in the SEA sensitivity map is outdated (Western Cape Critical Biodiversity Areas), the other criteria are still relevant and consequently useful information can still be gleaned from the

map.

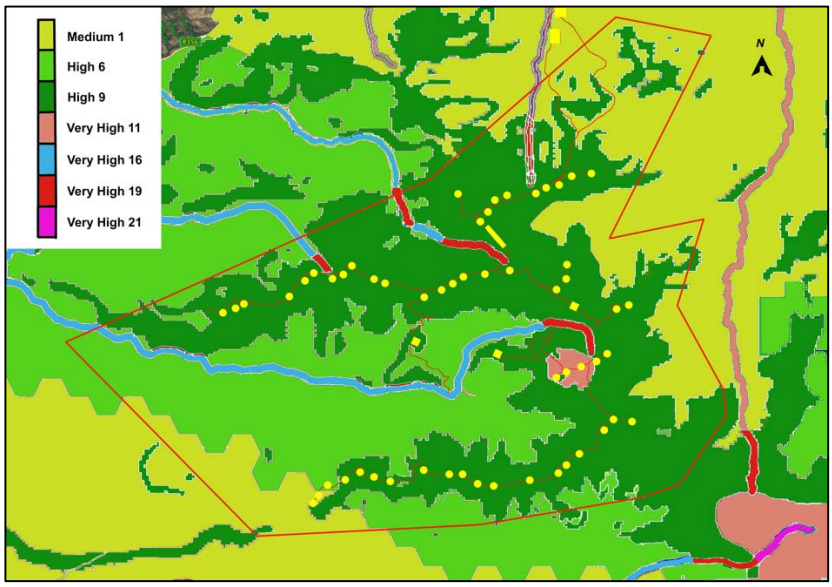


Figure 13: Simplified Absolute Sensitivity map for Kudusberg WEF as scored in the Strategic Environmental Assessment (Skowno *et al.,* 2015). Development infrastructure in yellow and roads in red.

4.8 Mapping of National Protected Area Expansion Strategy (NPAES)

Only a small portion in the southwestern part of the study area falls into an area earmarked for further expansion of National Protected Areas (NPAES 2010) (Figure 14).

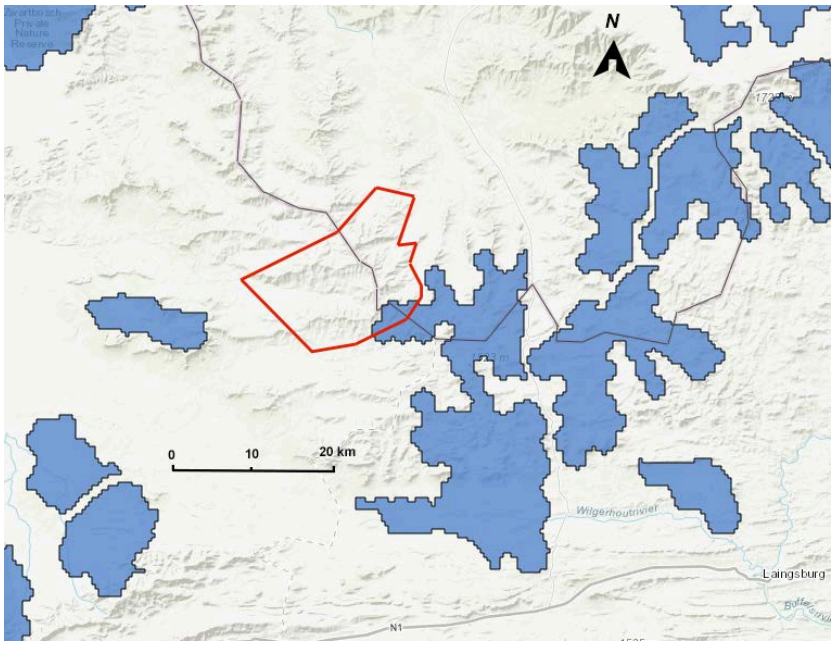


Figure 14. Areas earmarked for the National Protected Area Expansion Strategy in the vicinity of the Kudusberg WEF (site outlined in red).

5. VEGETATION

5.1 Introduction

Phytogeographically, the study area falls in the Cape and the Karoo – Namib Regional Centres of Endemism (White, 1983). The vegetation types in the region fall in the Succulent Karoo and Fynbos Biomes (Rutherford and Westfall, 1986; Mucina and Rutherford, 2006), and specifically in the Karoo Renosterveld Bioregion (F09) and Rainshadow Valley Karoo Bioregion (SKv).

5.2. Vegetation types (Mucina and Rutherford, 2006)

Various vegetation types occur in the region of which the Koedoesberge-Moordenaars Karoo (SKv 6) and the Central Mountain Shale Renosterveld (FRs 5) cover the study site (Mucina and Rutherford, 2006) (Figure 15).

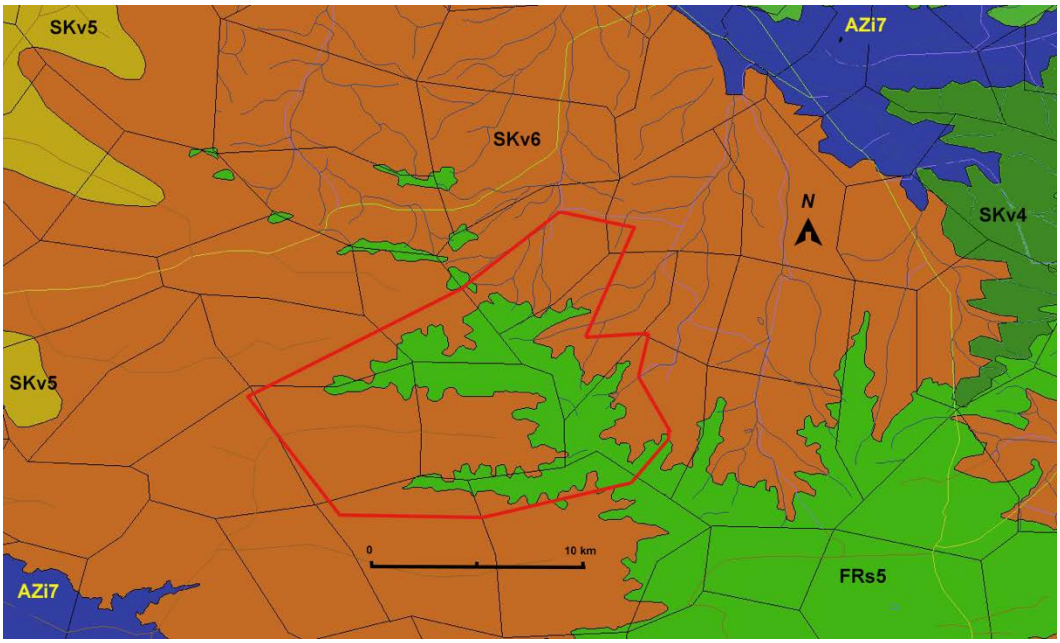


Figure 15. Vegetation types in the vicinity of the Kudusberg WEF (indicated in red) (Mucina and Rutherford, 2006). SKv4 = Tanqua Escarpment Shrubland; SKv5 = Tanqua Karoo; SKv6 = Koedoesberge – Moordenaars Karoo; AZi7 = Tanqua Wash Riviere; FRs5 = Central Mountain Shale Renosterveld.

Koedoesberge – Moordenaars Karoo (SKv 6)

This vegetation type occurs on the low mountain ranges bordering the southern Tanqua Karoo in the vicinity of Laingsburg and Merweville. The slightly undulating to hilly landscape is covered by low succulent scrub and some tall shrubs. The geology consists mainly of mudstone, but also shale and sandstone of the Beaufort and Ecca Groups (Mucina and Rutherford, 2006).

The succulent shrubs are represented by *Hereroa odorata, Antimima fergusoniae, Mesembryanthemum noctiflorum, Crassula nudicaulis, Euphorbia rhombifolia, Hoodia gordonii, Monsonia crassicaule* and *Tylecodon reticulatus.* Dwarf shrubs include *Pteronia incana, Aptosimum spinescens, Asparagus capensis, Chrysocoma ciliata, Eriocephalus africanus, Felicia filifolia, Justicia spartioides, Pteronia glauca* and *Tetraena retrofracta*.

Geophytes are represented by *Drimia intricata, Geissorhiza karooica* and *Romulea eustinii.* The grass layer consists of *Aristida adscensionis, Aristida diffusa, Ehrharta calycina, Enneapogon scaber, Fingerhuthia africana, Stipagrostis ciliata* and *Stipagrostis obtusa*. A number of endemic species occur in this vegetation types, e.g. *Antimima karroidea, Calamophyllum teretiusculum, Drosanthemum comptonii, Lachenalia comptonii* and *Strumaria undulata* (Mucina and Rutherford, 2006).

The vegetation type is regarded as "least threatened" and only a small portion is conserved in the Gamkapoort Nature Reserve.

Central Mountain Shale Renosterveld (FRs 5)

This vegetation type is located on the southern and southeastern slopes of the Klein-Roggeveldberge and Komsberg below the Roggeveld section of the Great Escarpment, facing the Moordenaars Karoo. The terrain consists of slopes and broad ridges of low mountains and escarpments, with tall shrubs dominated by renosterbos and other non-succulent Karoo shrubs and with a rich geophytic flora. The soils are clayey and derived from mudstones and subordinate sandstone of the Beaufort Group (Mucina and Rutherford, 2006).

The shrubland is dominated by *Dicerothamnus rhinocerotis*. Other shrub and dwarf shrub species include *Amphiglossa tomentosa, Asparagus capensis, Chrysocoma ciliata, Diospyros austro-africana*, various *Eriocephalus* spp., *Euryops imbricatus, Felicia muricata, Galenia africana, Helichrysum dregeanum, Lycium cinereum, Nenax microphylla, Pentzia incana, Osteospermum sinuatum* and *Roepera spinosa.* Succulent shrubs and herbs are represented by *Delosperma subincanum, Euphorbia stolonifera, Tylecodon reticulatus, Tylecodon wallichii, Crassula muscosa* and *Curio radicans*. The forb layer is characterised by *Dianthus caespitosus, Heliophila pendula* and *Osteospermum acanthospermum*. *Bulbine asphodelioides, Drimia intricata, Othonna auriculifolia* and *Oxalis obtusa* are prominent geophytes in this vegetation type. The conspicuous grass species include *Ehrharta calycina, Karroochloa purpurea* and *Tenaxia (=Merxmuellera)* spp. (Mucina and Rutherford, 2006).

The vegetation type is regarded as "least threatened" and none is conserved in statutory or private conservation areas. It does not appear to have any endemic species.

5.3 Vegetation units (associations, sub-associations and variants) (Van der Merwe *et al*., 2008a, 2008b)

The vegetation of the Hantam – Tanqua – Roggeveld subregion was described by Van der Merwe *et al*. (2008a, 2008b) (Figure 16). The vegetation occurs at the transition between the Fynbos Biome and the Succulent Karoo Biome and elements of both biomes are represented in the subregion.

The Fynbos Biome related vegetation units that are found in the study area include:

1. *Galenia africana – Dicerothamnus rhinocerotis* Mountain Renosterveld (Variant 2.1.1)
2. *Oedera genistifolia – Dicerothamnus rhinocerotis* Mountain Renosterveld (Variant 2.1.2)
3. *Tenaxia (=Merxmuellera) stricta – Dicerothamnus rhinocerotis* Mountain Renosterveld (Subassociation 2.3)

The Succulent Karoo Biome related vegetation units that are found in the study area include:

4. *Montinia caryophyllacea – Pteronia glauca* Roggeveld Escarpment Karoo (Subassociation 4.1)
5. *Galenia africana – Pteronia glauca* Escarpment Karoo (Subassociation 4.2)
6. *Malephora crassa – Mesembryanthemum noctiflorum* Tanqua Karoo (Subassociation 7.3)

7. *Ruschia intricata – Mesembryanthemum noctiflorum* Tanqua Karoo (Subassociation 7.5).

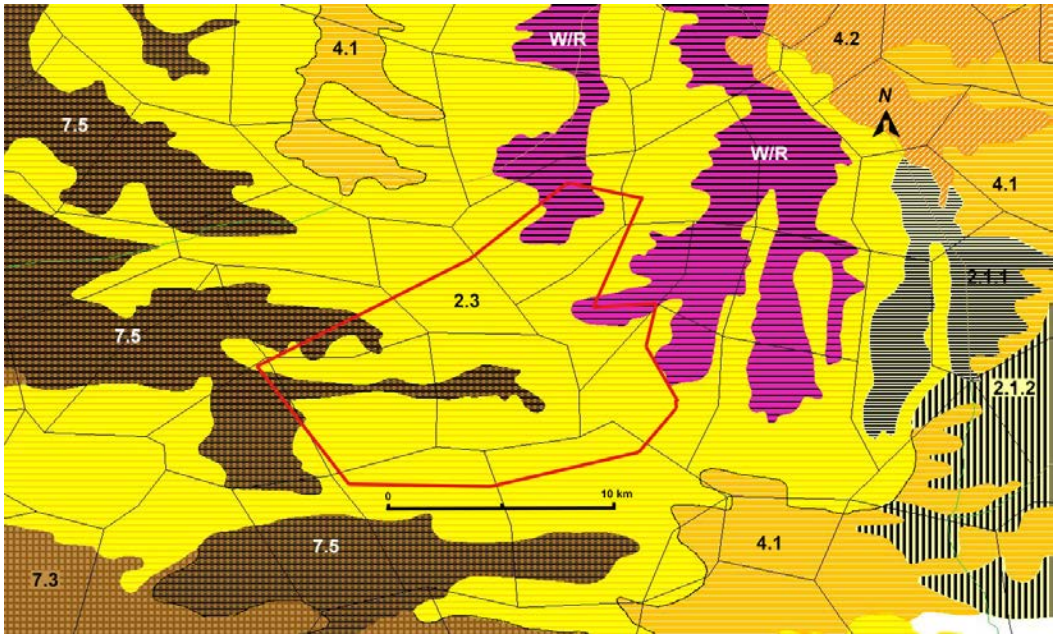


Figure 16. Vegetation map of the Kudusberg WEF region (Van der Merwe *et al*., 2008a, 2008b) (site outlined in red).

Legend:
2.1.1 = *Galenia africana – Dicerothamnus rhinocerotis* Mountain Renosterveld
2.1.2 = *Oedera genistifolia – Dicerothamnus rhinocerotis* Mountain Renosterveld
2.3 = *Tenaxia (=Merxmuellera) stricta – Dicerothamnus rhinocerotis* Mountain Renosterveld
4.1 = *Montinia caryophyllacea – Pteronia glauca* Roggeveld Escarpment Karoo
4.2 = *Galenia africana – Pteronia glauca* Escarpment Karoo
7.3 = *Malephora crassa – Mesembryanthemum noctiflorum* Tanqua Karoo
7.5 = *Ruschia intricata – Mesembryanthemum noctiflorum* Tanqua Karoo
W/R = Windheuwel/Rooiheuwel mosaic

The Windheuwel/Rooiheuwel mosaic (W/R) is spatially diverse and consists of vegetation units 4.1, 4.2 on the rocky ridges and 7.3 on the brackish plains.

A brief description of the vegetation units, according to Van der Merwe (2008a; 2008b), in the study area is presented below:

1. *Galenia africana – Dicerothamnus rhinocerotis* Mountain Renosterveld (Variant 2.1.1)

This vegetation unit is floristically very diverse and occurs on the mudstones of the Beaufort Group and the shales of the Ecca Group (Figure 16). It occurs on undulating terrain at an altitude ranging from 600 m to 1300 m above sea level. A high shrub cover is present, resulting primarily from the presence of *Dicerothamnus rhinocerotis* as well as the diagnostic species *Galenia africana*. Various annual species such as *Cotula nudicaulis, Polycarena aurea, Erodium cicutarium, Leysera tenella* and the annual grass *Bromus pectinatus* are present.

2. *Oedera genistifolia – Dicerothamnus rhinocerotis* Mountain Renosterveld (Variant 2.1.2)

This variant occurs on the mudstones of the Beaufort Group in the Klein Roggeveld Mountains (Figure 16). It is

found at altitudes from 1000 m to 1300 m above sea level on level terrain to gentle slopes. The high shrub cover is primarily the result of the presence of *Dicerothamnus rhinocerotis* as well as *Oedera genistifolia* and *Euryops lateriflorus*. *Tenaxia (Merxmuellera) stricta* dominates the grass component of this variant.

3. *Tenaxia (=Merxmuellera) stricta – Dicerothamnus rhinocerotis* Mountain Renosterveld (Subassociation 2.3)

This vegetation unit is located in the Roggeveld Mountains and includes the higher-lying vegetation of the Koedoesberg and Basterberg Mountains and according to Figure 16 covers most of the site. It occurs on the mudstones of the Beaufort Group and the shales of the Ecca Group, and occasionally on dolerites. The high-lying gentle to moderately steep slopes are covered with stones and boulders. The altitude ranges from 900 to 1600 m above sea level. The renosterbos, *Dicerothamnus rhinocerotis*, the grass, *Tenaxia stricta,* and the dwarf shrub, *Chrysocoma ciliata,* are the dominant species. Other species present include *Asparagus capensis, Euryops lateriflorus* and *Eriocephalus ericoides.*

4. *Montinia caryophyllacea – Pteronia glauca* Roggeveld Escarpment Karoo (Subassociation 4.1)

This vegetation unit (part of the W/R mosaic which occurs in the north and northeast of the site) characterises the rocky west-facing slopes of the Roggeveld Mountains and occurs at intermediate altitudes of 700 to 1100 m above sea level (Figure 16). It occurs on gentle to moderate, and sometimes steep slopes with a high rock cover. The vegetation is characterised by a high shrub cover, while grasses and annuals are usually absent. The vegetation is dominated by *Pteronia glauca*, with *Montinia caryophyllacea* and *Tylecodon wallichii* the other prominent species.

5. *Galenia africana – Pteronia glauca* Escarpment Karoo (Subassociation 4.2)

This vegetation unit (part of the W/R mosaic) is located on the rocky slopes of the Hantam Mountain, the Platberg escarpment and the slopes where the Roggeveld and Klein Roggeveld Mountains meet (Figure 16). It is also found between the Roggeveld and Koedoesberg Mountains in the vicinity of the farms Windheuwel and Rooiheuwel at altitudes ranging from 700 to 1200 m above sea level. Ecca shales and dolerite intrusions predominate in this vegetation unit. The shrub cover is high while the grass and annual forb components are not well represented. *Pteronia glauca, Pentzia incana, Eriocephalus ericoides, Osteospermum sinuatum* and *Galenia africana* are the prominent species in this unit.

6. *Malephora crassa – Mesembryanthemum noctiflorum* Tanqua Karoo (Subassociation 7.3)

This vegetation unit (part of the W/R mosaic occurring in the north and northeast of the site) is found predominantly on brackish plains at the southern extreme of the Tanqua Basin, i.e. Ceres Karoo, and between the Roggeveld and Koedoesberg Mountains. Shales of the Ecca Group and Dwyka tillites are found in these areas. The altitude ranges from 200 to 1000 m above sea level. The shrub cover is moderate while grasses and annual forbs are mostly absent. Prominent species include *Malephora crassa, Atriplex lindleyi, Ruschia intricata, Mesembryanthemum noctiflorum, Salsola tuberculata* and *Pteronia pallens*.

7. *Ruschia intricata – Mesembryanthemum noctiflorum* Tanqua Karoo (Subassociation 7.5)

This vegetation unit is located at the foothills of the Koedoesberg Mountains on Ecca shales and occurs in the central valley in the study site. The level to gently sloping ridges, have a low rock cover. The shrub cover is moderate while grasses and annual forbs are usually absent. The dominant species are *Ruschia intricata* and *Mesembryanthemum noctiflorum*.

5.4 Plant associations on the Kudusberg study site

The vegetation at the site was surveyed 17 to 20 July and 5 to 13 September 2018 and classified into associations, subassociations and variants (Appendix C; Figure 17). Six physiognomic terrain types were identified that are floristically identifiable, i.e. (1) cliffs; (2) the mountain crests, upper plateaux and upper slopes; (3) the midslopes and mid-plateaux; (4) footslopes and lower plateaux; (5) plains; and (6) drainage lines (mountain streams and rivers in the valleys).

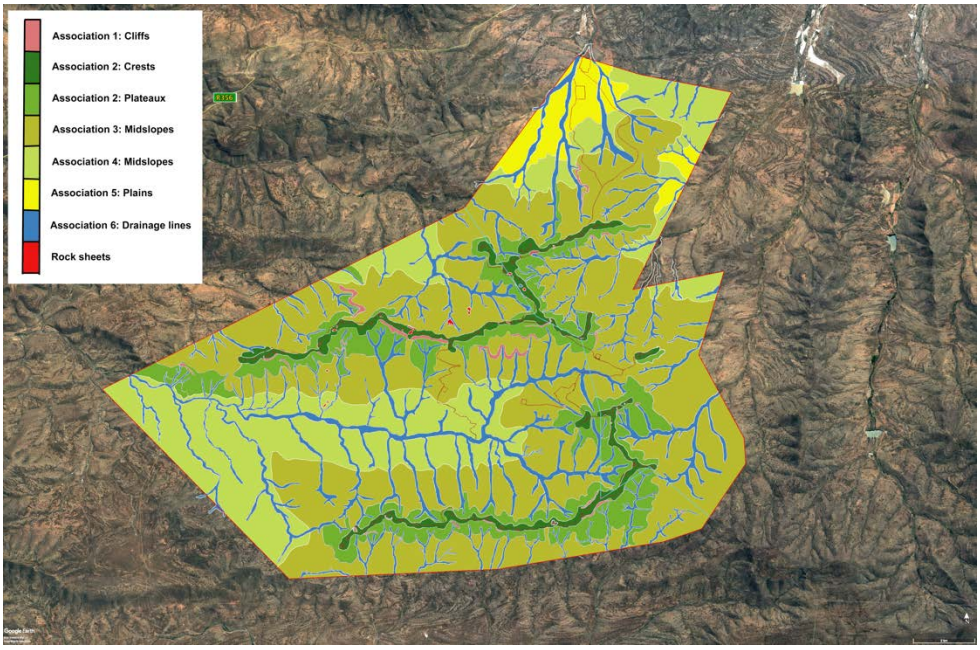


Figure 17. Vegetation map of the Kudusberg WEF.

Figure 18. Typical landscape of the Kudusberg WEF in the Koedoesberg – Oliviersberg region.

Overall, the vegetation of the mountains on site is dominated by leaf succulents and karroid dwarf shrubs such as *Ruschia* spp., *Eriocephalus* spp., *Pteronia* spp., *Euryop*s spp., *Crassula* spp., *Pelargonium* spp., *Tylecodon* spp., *Amphiglossa tomentosa, Leipoldtia schultzei, Pentzia incana, Hirpicium alienatum, Asparagus capensis, Galenia africana* and *Hermannia cuneifolia* (Figure 18).

The rivers and streams are characterised by trees and shrubs such as *Searsia lancea, Vachellia karoo, Lycium cinereum, Diospyros austro-africana* and *Searsia undulata*. Other prominent species include *Galenia africana, Salvia disermas, Melianthus comosus, Chrysocoma ciliata, Stachys rugosa, Berkheya heterophylla, Ehrharta longiflora* and *Ehrharta delicatula.*

The different plant associations and subassociations of the Kudusberg site are described below (see Appendix C for the diagnostic table):

1. *Searsia undulata* cliffs

Along the mountain slopes and along the major drainage lines, rocky cliffs that are poorly covered by vegetation occur locally (Figure 19a & b). Many of the plant species also occur on other rocky outcrops in the area. Plant species recorded include *Searsia undulata, Diospyros austro-africana, Dicerothamnus rhinocerotis, Tenaxia stricta, Wiborgia sericea, Eriocephalus africanus, Pteronia incana, Ruschia intricata, Amphiglossa tomentosa, Aloe microstigma* and *Euryops lateriflorus.*

Figure 19a. An example of the cliffs along the midslopes of the mountains (Association 1).

Figure 19b. Association 1: The typical habitat along the cliffs in the region.

2. *Ruschia divaricata* mountain crests/plateaux

The mountain crests, plateaux and upper slopes are characterised by many leaf succulents of the Aizoaceae such as *Mesembryanthemum* spp., *Ruschia* spp. and *Leipoldtia schultzei* (Figure 20a & b). Other prominent species include *Dicerothamnus rhinocerotis, Eriocephalus* spp., *Amphiglossa tomentosa, Pteronia* spp., *Pelargonium* spp., *Euryops lateriflorus, Euryops imbricatus, Tylecodon wallichii, Tylecodon reticulatus, Babiana cuneata, Euphorbia stolonifera, Asparagus capensis* and *Wiborgia sericea*.

Figure 20a. Association 2: Dwarf shrubs on the mountain crests dominated by leaf-succulents of the Mesembryanthemaceae, e.g. *Ruschia divaricata* and *Leipoldtia schultzei* and various *Pteronia* spp.

Figure 20b. Association 2: Typical dwarf shrub vegetation of the mountain crests and plateaux with *Ruschia spinosa, Euryops imbricatus* and *Dicerothamnus rhinocerotis* some of the prominent species.

Three subassociations are distinguished:

2a. *Dicerothamnus rhinocerotis – Ruschia divaricata* upper mountain crests/plateaux

This subassociation occurs at high altitudes and is characterised by *Dicerothamnus rhinocerotis, Pteronia incana, Ruschia spinosa, Tylecodon* spp*., Drimia capensis, Rosenia oppositifolia, Pteronia* spp*., Babiana cuneata* and *Euryops lateriflorus*. Three variants are distinguished in this subassociation but are not described (see Appendix C).

2b. *Antimima* spp. – *Ruschia divaricata* mountain crests/plateaux

This subassociation occurs on the crest/plateaux and prominent species include *Ruschia centrocapsula, Ruschia divaricata, Antimima* spp*., Ruschia spinosa, Tylecodon reticulatus, Euryops lateriflorus, Crassula vaillantii, Stomatium villetii* and *Ehrharta calycina*.

2c. *Felicia filifolia – Ruschia divaricata* mountain crests/plateaux and upper slopes

On some of the mountain plateaux and crests the species diversity is relatively low with many species of higher altitudes that are not present. Prominent species include *Ruschia divaricata, Euphorbia loricata, Felicia filifolia, Cotyledon orbiculata, Euphorbia rhombifolia, Crassula deltoidea, Pelargonium abrotanifolia* and *Othonna rechingerii.*

3. *Lapeirousia plicata – Euryops multifidus* midslopes to upper slopes

Plant species prominent in the vegetation on the terraces and midslopes include: *Lapeirousia plicata, Euryops multifidus, Eriocephalus purpureus, Felicia filifolia, Pteronia glauca, Gazania heterochaeta, Monsonia crassicaule, Amphiglossa tomentosum, Aptosimum spinescens, Eriospermum capense, Crassula deltoidea, Ruschia spinosa, Leipoldtia schultzei* and *Galenia africana* (Figure 21).

Figure 21. Association 3: Rocky midslopes with dwarf shrubs dominating the landscape. *Euryops multifidus, Eriocephalus decussatus* and *Ruschia spinosa* are some of the prominent species.

4. *Leipoldtia schultzei – Euphorbia mauritanica* lower slopes

The vegetation on the lower slopes of the mountains is characterised by species such as *Euphorbia mauritanica, Aloe microstigma, Searsia undulata, Felicia filifolia, Crassula umbella, Cotyledon orbiculata, Pelargonium magenteum, Chrysocoma ciliata, Nenax cinerea, Galenia africana, Leipoldtia schultzei* and *Ruschia spinosa* (Figure 22a & b).

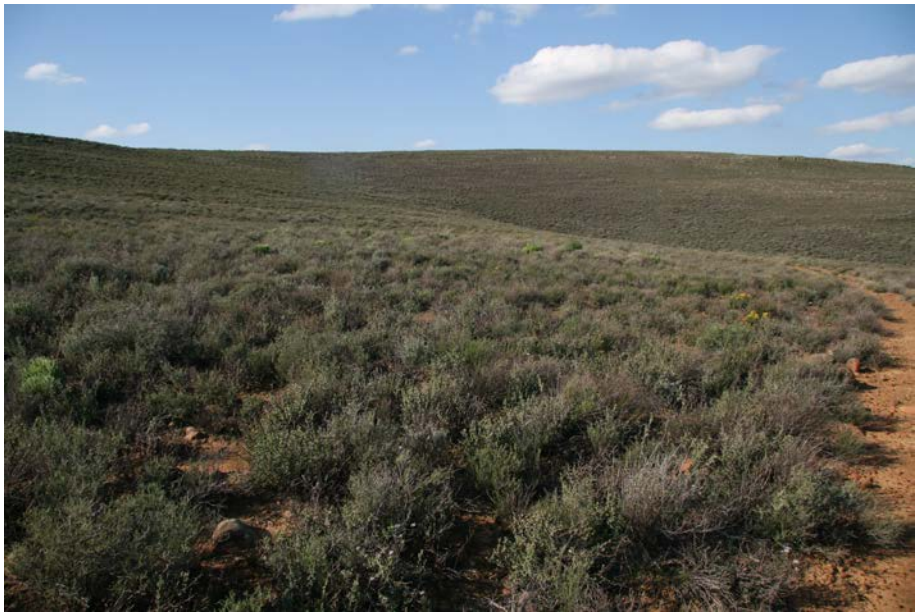


Figure 22a. Association 4: Gentle footslopes with *Leipoldtia schultzei, Felicia filifolia* and *Chrysocoma ciliata* the prominent species.

Figure 22b. Association 4: *Euphorbia mauritanica* and *Pelargonium magenteum* characterise the lower north-facing slopes of the mountains.

5. *Pteronia pallens* plains

These plains occur in the north along the northern access route and are dominated by *Pteronia pallens* and *Ruschia spinosa*. Other species of note include *Tylecodon wallichii, Vachellia karroo, Lycium horridum, Pentzia incana* and *Galenia africana* (Figure 23).

Figure 23. Northern plains dominated by the dwarf shrub *Pteronia pallens*.

6. *Searsia lancea - Vachellia karroo* drainage lines

Figure 24a. Some tree cover occurs along the rivers in the valleys with *Searsia lancea, Vachellia karroo* and *Searsia undulata* the prominent species.

Figure 24b. Trees and shrubs are less prominent along the rocky drainage lines higher up the mountain slopes.

The rivers in the valleys are differentiated by the presence of trees such as *Searsia lancea, Vachellia karoo, Lycium cinereum, Diospyros austro-africana* and *Searsia undulata* (Figure 24a & b). Other prominent species include *Galenia africana, Salvia disermas, Melianthus comosus, Arctotheca calendula, Pteronia* spp., *Chrysocoma ciliata, Stachys rugosa, Berkheya heterophylla, Gomphocarpus fruticosus, Oxalis pes-caprae, Ursinia nana,* and the grasses *Fingerhuthia africana, Ehrharta longiflora and Ehrharta delicatula*.

5.5 Sensitivity of vegetation to climate change

Information as to how the vegetation in the study area will respond to climate change is currently still lacking. Higher temperatures and reduced rainfall would probably negatively affect SCC. In mountainous landscapes, such as the Kudusberg site, there are generally many small microhabitats where a favourable microclimate for a particular species might be available. For example, Scherrer and Körner (2011) found that local plant distribution patterns were associated with topographically induced mosaics of micro-climates. In afromontane regions, they suggested that suitable topohabitats can provide microclimate refugia over relative short distances and in spatially small areas for a species. This would imply that vegetation change due to climate change will be a fairly slow process in such regions.

6. FLORA

6.1 Threats

Loss of habitat is regarded as the foremost cause of loss of biodiversity. Development (or change in land use) usually contributes to habitat loss and degradation in many biodiversity important areas. Much of the impact can be minimized through careful planning and avoidance of sensitive areas.

6.2 Vegetation types

Both major vegetation units occurring on site are classified as "Least Threatened" by Mucina and Rutherford (2006) and NEM:BA (2011).

6.3 Checklist

The study area has been very poorly collected botanically. In the two quarter degree grids in which the study area falls (3220 CC and 3220 DD) only 131 plant taxa are listed on the South African Biodiversity Institute's website (SANBI: newposa.sanbi.org – accessed 25 July 2018). Among the reasons for the poor collection are the lack of access routes and the absence of conservation areas, since most botanical specimens are collected along roads or in conservation areas. The list provided in Appendix A, therefore includes the four quarter degree grids 3220 CA; 3220 CB; 3220 CC and 3220 CD to provide a more representative list of species that could potentially occur in the study area. These four grid squares combined, list 255 species.

Two previous major botanical studies were conducted in the general area, *viz.* the study by Van der Merwe *et al.* (2008a, 2008b) and the study by Clark *et al.* (2011). Van der Merwe *et al.* (2008a, 2008b) classified the vegetation of the entire Roggeveld, Tanqua and Hantam area and the species list generated for the Koedoesberge and Oliviersberg region (88 taxa) were extracted and included in the list in Appendix A. In their study Clark *et al.* (2011) provided a checklist of plant species for the Roggeveld – Komsberg Escarpment (486 taxa) and reviewed the endemics and near-endemics of the Hantam – Roggeveld Centre of Endemism.

Including all species/taxa from the above-mentioned degree squares, the studies by Van der Merwe *et al*. (2008a, 2008b), Clark *et al.* (2001) and the current site visit (333 taxa recorded), a total of 792 taxa could be present in the study area (Appendix A).

At the time of the first site visit (17 – 20 July 2018) a relatively small percentage of the species were flowering and consequently the identification of many species was hampered. The second site visit was undertaken from 5 - 13 September 2018, and between these two site visits the flowering times of most of the SCC were covered (see section 6.4 for flowering times). Some species, however, do only flower from October onwards.

6.4 Threatened and rare plant species

Red Data Lists are a source of information for decision-makers. Where possible, species threatened by habitat destruction need to be conserved through mechanisms that conserve the entire ecosystem.

The Threatened Species Programme website (redlist.sanbi.org) of SANBI; the National Forests Act (Act No. 84 of 1998); the National Environmental Management: Biodiversity Act (Act No. 10 of 2004); CITES (2017)

appendices; and the lists of protected species of the Northern Cape Nature Conservation Act (Act No. 9 of 2009); and the Western Cape Nature and Environmental Conservation Ordinance, 1974 (No. 19 of 1974, as amended 2000) were consulted to classify the species in the study area into the relevant IUCN or protected categories (Appendix A).

6.4.1 Threatened IUCN Categories

Twenty-seven plant species are classified as threatened according the IUCN Red List Categories (version 3.1). These species (the term species is used here in a general sense to denote species, subspecies and varieties) are listed in Table 7, together with the reasons given for the classification by the Threatened Species Programme and an evaluation of the likelihood of occurrence in the study site, based on available knowledge of the distribution pattern of the species. Two of the species are classified as Critically Endangered; five as Endangered; and twenty-one as Vulnerable.

The threatened species listed in Table 7 are dominated by geophytic species (50% of all threatened species listed for the study area) in particular of the family Iridaceae. With the exception of *Oxalis lineolata* and *Mesembryanthemum tenuiflorum* none of these species have been recorded in the four quarter degree grids closest to the study site (3220 CA; 3220 CB; 3220 CC and 3220 CD). The rest of the threatened species in Table 7 (except for *Mesembryanthemum tenuiflorum*) were all recorded by Clark *et al.* (2011) for the Roggeveld – Komsberg escarpment lying to the north of the study area. *Mesembryanthemum tenuiflorum* was listed by Van der Merwe *et al.* (2008). Due to the poor collection in the vicinity of the study site, knowledge as to whether these species do in fact occur in the study area is currently not available. After considering the known distribution of these species, it was presumed that only one Endangered and 11 Vulnerable species listed in Table 7 was likely to occur in the study area. None of the IUCN 'threatened' species were encountered during the site visits. The flowering times of most of these species were covered by the field visits to the study area, or alternatively the species could easily be identified without flowers e.g. *Cliffortia arborea*.

Table 7: List of Critically Endangered, Endangered and Vulnerable species which could possibly occur in the study area (distribution according to Red List of Threatened Plants redlist.sanbi.org; accessed 9 August 2018)

Critically Endangered:	**Justification for classification**	**Flowering time**	**Likelihood of occurrence and whether the species was encountered during the site visits**
Romulea albiflora IRIDACEAE	Known from three collections from one continuous subpopulation. Part of the subpopulation was lost to cereal cultivation and the rest occurs on the edge of a ploughed field. There are fewer than 250 mature individuals extant and decline due to crop cultivation is continuing.	Sep - Oct	Unlikely; known distribution is further north. **Not recorded.**
Secale strictum subsp. *africanum* POACEAE	A range-restricted species that was once common on the Roggeveld, but is now known from one subpopulation on a farm, where there are fewer than 50 mature individuals. This taxon has experienced severe declines due to overgrazing and poor veld management. It is cultivated and several attempts are being made to reintroduce it to other properties on the Roggeveld.	Dec	Unlikely; known distribution is further north. **Not recorded.**
Endangered:			
Daubenya aurea HYACINTHACEAE	Plants at four to five locations continue to decline due to ongoing expansion of crop cultivation and overgrazing.	Sep	Unlikely; known distribution is further north. **Not recorded.**
Ixia thomasiae IRIDACEAE	A rare, and highly restricted species, known from two to three locations and declining due to ongoing habitat loss to crop cultivation.	Sep - Nov	Unlikely; known distribution is further north. **Not recorded.**
Oxalis lineolata OXALIDACEAE	A range-restricted species and only known from three locations, within a small area around Doornbosch. There is continuous decline as a result of habitat loss due to expanding crop cultivation. The species is estimated to have a population size between 150-300 individuals.	May - Jun	Unlikely; known distribution is further northwest. **Not recorded.**
Oxalis marlothii	A range-restricted species, occurring at two to three locations and declining due	Sep - Oct	Possible; known

OXALIDACEAE	to ongoing habitat loss and degradation.		distribution is quite close to study site. **Not recorded.**
Polhillia involucrata FABACEAE	A range-restricted Roggeveld endemic, this species has been recorded from three subpopulations that occur at two locations. Habitat loss in the past has occurred due to crop cultivation and livestock grazing. Being highly palatable, this species continues to experience ongoing decline as a result of overgrazing.	Jan	Unlikely; known distribution is further north. **Not recorded.**
Vulnerable:			
Asparagus mollis ASPARAGACEAE	A rare and poorly known species with a restricted range. There are fewer than 10 locations, and it continues to decline due to ongoing habitat loss in the Overberg. **Subpopulations in the northern part of the range are not threatened only the population in the Overberg is threatened.**	Jan	Not threatened in current study area. **Not recorded.**
Carex acocksii CYPERACEAE	One known location is potentially threatened by livestock overgrazing.	Oct – Nov	Unlikely; known distribution quite far north of the study site. **Not recorded.**
Cliffortia arborea ROSACEAE	Fewer than 10 known locations. Continues to decline due to inappropriate fire management and harvesting for firewood.	Oct - Dec	Could possibly occur. **Not recorded.**
Delosperma sphalmanthoides AIZOACEAE	A rare, localized habitat specialist, known from two to three locations and potentially threatened by habitat degradation due to overstocking of rangelands for livestock.	Aug	Could possibly occur; known distribution is further east. **Not recorded.**
Diascia lewisiae SCROPHULARIACEAE	Known from five small subpopulations that together consist of fewer than 1000 mature individuals. Four of the five subpopulations occur on private land and are potentially threatened by crop cultivation and road widening.	Aug - Sep	Unlikely; known distribution far north-west of study site. **Not recorded.**
Geissorhiza spiralis IRIDACEAE	Three known locations are potentially threatened by livestock overgrazing and soil erosion.	Jul - Sep	Could possibly occur; known distribution is further north. **Not recorded.**
Gethyllis pectinata IRIDACEAE	Known from one location. Potentially threatened by overgrazing and illegal bulb collecting.	Dec	Unlikely; known distribution quite far northwest of study site. **Not recorded.**
Helictotrichon barbatum POACEAE	Known from three disjunct locations and potentially threatened by overgrazing.	Nov	Could possibly occur, but preferred habitat is lower mountain slopes, where WEF development is limited. **Not recorded.**
Helictotrichon namaquense POACEAE	Acocks (1990) indicates that this taxon had a very similar distribution to *H. barbatum* occurring on all the Karoo mountains i.e. Bokkeveld, Kamiesberg, Roggeveld and Hantamsberg, but stated that it had disappeared from much of its range due to overgrazing. The species was rediscovered in 1986 in the Roggeveld where it was common along the roadside verges but declining due to being heavily grazed.	Sep	Could possibly occur. **Not recorded.**
Hesperantha hantamensis IRIDACEAE	Known from one location. Even though locally common and partly conserved in a nature reserve, it was and remains potentially threatened by dam expansion and road widening.	Jul - Sep	Unlikely, known distribution quite far northwest of the study site. **Not recorded.**
Hesperantha purpurea IRIDACEAE	Known from the type locality. Threatened by livestock overgrazing and trampling.	Sep	Unlikely; known distribution quite far northwest of the study site. **Not recorded.**
Ixia rivulicola IRIDACEAE	A localized habitat specialist, and potentially threatened by habitat degradation and disturbance due to crop cultivation and dam construction.	Oct - Nov	Unlikely; known distribution is further north. **Not recorded.**
Jamesbrittenia incisa SCROPHULARIACEAE	Known from seven locations. Declining in habitat quality and number of mature individuals due to livestock grazing.	Sep	Unlikely; known distribution is further north and east. **Not recorded.**
Lachenalia longituba HYACINTHACEAE	A range-restricted and localized habitat specialist, known from five locations and potentially threatened by habitat loss and degradation.	Apr - Jun	Could possibly occur. However, occurs in seasonally wet, boggy sites – a habitat that would have been

			highlighted in aquatic study. **Not recorded.**
Lachenalia schelpei HYACINTHACEAE	Known from one location. Not currently declining but potentially threatened by crop cultivation and overgrazing by goats.	Jun - Sep	Unlikely; known distribution is further north. **Not recorded.**
Lotononis venosa FABACEAE	Few known locations. Some of the habitat has been transformed for crop cultivation in the past. Further agricultural expansion and overgrazing by livestock are potential threats.	Sep	Could possibly occur. **Not recorded.**
Mesembryanthemum tenuiflorum AIZOACEAE	Habitat at five to 10 locations is declining due to mining.	Aug	Unlikely **Not recorded.**
Octopoma nanum AIZOACEAE	A localized habitat specialist with fewer than 10 known locations and declining due to overgrazing by livestock and game.	Nov	Could possibly occur. Found on flats and gentle slopes with loamy soils and sparse quartz grave. **Not recorded.**
Romulea hallii IRIDACEAE	A Roggeveld endemic known from two locations. It is potentially threatened by road maintenance and expansion and livestock overgrazing.	Jul - Aug	Could possibly occur. **Not recorded.**
Romulea membranacea IRIDACEAE	Known from six locations, five of which are threatened by rapidly expanding rooibos tea cultivation.	Jul - Aug	Unlikely; known distribution is further northwest. **Not recorded.**
Romulea multifida IRIDACEAE	Known from three locations. Potentially threatened by crop cultivation.	Aug	Could possibly occur. **Not recorded.**

6.4.2 Not threatened IUCN categories but of Conservation Concern

Near Threatened:

Nine species with a Near Threatened status have been recorded in the vicinity of the study area. Among the Near Threatened plant species 80% are geophytic, with most of these geophytes belonging to the Iridaceae.

Ehrharta eburnea	Poaceae	Flowering: Sep- Nov
Geissorhiza karooica **(observed on site)**	Iridaceae	Flowering: Aug - Sep
Lachenalia whitehillensis **(observed on site)**	Hyacinthaceae	Flowering: Oct
Manulea incana	Scrophulariaceae	Flowering: Sep - Oct
Pauridia alticola	Hypoxidaceae	Flowering: Jun - Sep
Romulea komsbergensis	Iridaceae	Flowering: Aug - Sep
Romulea subfistulosa	Iridaceae	Flowering: Aug - Oct
Romulea syringodeoflora	Iridaceae	Flowering: Oct
Romulea unifolia	Iridaceae	Flowering: Aug - Sep

Data Deficient:

Twelve species are classified as being Data Deficient, either due to information lacking on the abundance or due to taxonomic difficulties.

Antimima subtruncata	Aizoaceae	Flowering: Sep
Drosanthemum eburneum	Aizoaceae	Flowering: Aug - Sep
Gethyllis uteana	Amaryllidaceae	Flowering: ?
Hesperantha karooica	Iridaceae	Flowering: Sep
Hoodia gordonii **(reported on site by landowner)**	Apocynaceae	Flowering: Jul - Aug
Ornithogalum niveum	Hyacinthaceae	Flowering: ?
Oxalis hirsuta	Oxalidaceae	Flowering: ?
Oxalis pardalis	Oxalidaceae	Flowering: May - Jun
Pteronia quinqueflora	Asteraceae	Flowering: Jul
Senecio erysimoides	Asteraceae	Flowering: ?

Zaluzianskya marlothii	Scrophulariaceae	Flowering: Oct
Zaluzianskya sutherlandica	Scrophulariaceae	Flowering: Sep

6.4.3 Not threatened categories recognized by the South African Threatened Species Programme

The species listed in these two categories are not classified as threatened according to the IUCN classification, but are considered to be of conservation concern in a South African context. Two species were classified as Critically Rare and 22 as Rare. Once again geophytes constitute a large proportion of these species.

Critically Rare:

Antimima androsacea	Aizoaceae	Flowering: Aug
Moraea marginata	Iridaceae	Flowering: Nov

Rare:

Adromischus humilis	Crassulaceae	Flowering: Mar
Anisodontea procumbens	Malvaceae	Flowering: ?
Antimima emarcescens	Aizoaceae	Flowering: Aug - Sep
Babiana virginea	Iridaceae	Flowering: Jul - Oct
Bulbine torta **(observed on site)**	Asphodelaceae	Flowering: Jul - Sep
Cleretum lyratifolium **(observed on site)**	Aizoaceae	Flowering: Aug - Sep
Crassula roggeveldii	Crassulaceae	Flowering: Aug- Oct
Crassula vestita	Crassulaceae	Flowering: Jun - Sep
Devia xeromorpha	Iridaceae	Flowering: Dec - Jan
Eriocephalus grandiflorus **(observed on site)**	Asteraceae	Flowering: Jul - Sep
Euryops marlothii	Asteraceae	Flowering: Jul - Sep
Hesperantha teretifolia	Iridaceae	Flowering: Sep
Ixia brevituba	Iridaceae	Flowering: Sep
Moraea contorta **(observed on site)**	Iridaceae	Flowering: Sep
Moraea fenestrata	Iridaceae	Flowering: Aug - Sep
Moraea virgata subsp. *karooica*	Iridaceae	Flowering: Nov
Pectinaria articulata **(A *Pectinaria* sp. was observed on site, but none of the specimens were flowering)**	Apocynaceae	Flowering: May - Nov
Pelargonium torulosum	Geraniaceae	Flowering: Nov
Ruschia ceresiana	Aizoaceae	Flowering: ?
Strumaria karrooica	Amaryllidaceae	Flowering: Mar - Apr
Zaluzianskya inflata	Scrophulariaceae	Flowering: Jul - Sep
Zaluzianskya mirabilis	Scrophulariaceae	Flowering: Aug - Sep

Although the loss of a Species of Conservation Concern generally does not alter the patterns or processes of natural systems, in the sense that environmental functions and processes temporarily or permanently cease, the loss of a species is nevertheless regarded as of great biological importance.

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

Lists of Schedules 1 and 2 Flora were consulted to classify the species possibly present at the study site into these categories (Appendix A). Overall, 356 species were classified as either Schedule 1 (Specially protected species) or Schedule 2 (Protected species). The remainder of the species are classified as Schedule 3 (common

indigenous plant species), and 30 species were classified as exotic species although only two species are declared alien invasive species.

- Schedule 1 - Specially protected species:
  18 species (2% of all species on site)

- Schedule 2 - Protected species:
  338 species (43% of all species on site)

Comment: In the NCNCA (2009) (and to a lesser extent WCNECO (2000)), a number of families and genera, for example the family Aizoaceae, (formerly Mesembryanthemaceae) and genera such as *Lessertia, Nemesia, Manulea* and *Oxalis* are listed as either Specially Protected Species or Protected Species. This blank classification may be because of the presence of one or two species of vulnerable or higher status in the genus. Unfortunately, this then includes many species that are either common, or even weedy, e.g. *Galenia africana, Cleretum papulosum, Euphorbia mauritanica* or *Oxalis pes-caprae* that do not need to be awarded special conservation status. Nevertheless, permit applications should be done as required by the Northern Cape Department of Environment and Nature Conservation for all listed species.

6.6 Western Cape Nature and Environmental Conservation Ordinance, 1974 (No. 19 of 1974, as amended in 2000) (WCNECO)

In total 222 species (28% of all species on site) (Appendix A) qualified as protected according to the Western Cape Nature and Environmental Conservation Ordinance of 1974, as amended in 2000).

6.7 National Environmental Management: Biodiversity Act (Act No. 10 of 2004) (ToPS lists)

Only two plant species are ToPS-listed for the region, *Romulea albiflora* and *Secale strictum* subsp. *africanum* (Appendix A). None of these species were encountered during the site visits.

6.8 CITES classification (2017 lists)

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

Twenty-two of the species on site (Appendix A) qualify as CITES Appendix II species, this represents 3% of the species on site.

6.9 Centre of Endemism

The term endemic refers to a species that is restricted in its distribution and therefore occurs only in a specific

region. The Hantam – Roggeveld Centre of Endemism (Van Wyk and Smith, 2001) comprises the Hantamberge in the Calvinia District; the Roggeveldberge in the Middelpos and Sutherland Districts; the Komsberg in the Sutherland District; and the western and central Nuweveldberge in the Fraserburg and Merweville Districts. This area is a centre of diversity for the Asteraceae, especially for the genus *Euryops*. Annual Scrophulariaceae are also well represented with several endemic species in the genera *Diascia, Cromidon* and *Zaluzianskya*. Numerous *Selago* species are also local endemics. Most of the endemics however belong to the monocotyledons and are geophytes, particularly in the genera *Hesperantha, Ixia, Babiana, Daubenya, Romulea* and *Lachenalia*. Other families that include many endemics are the Aizoaceae, Oxalidaceae and Poaceae.

According to Mucina and Rutherford (2006) the core vegetation types of the Hantam – Roggeveld Centre of Endemism include the Nieuwoudtville Shale Renosterveld, Roggeveld Shale Renosterveld, Nieuwoudtville – Roggeveld Dolerite Renosterveld, Hantam Plateau Dolerite Renosterveld, Hantam Karoo and Roggeveld Karoo. They proposed the inclusion of the Koedoesberge – Moordenaars Karoo vegetation unit, and the areas adjoining the Tanqua Basin, into this centre.

According to the delineation of the Hantam – Roggeveld of Centre of Endemism by Van Wyk and Smith (2001), the study area does not fall in this centre. However, 150 species (20% of all species on site) possibly occurring in the study area are listed as endemic or near-endemic to the Hantam – Roggeveld Centre of Endemism, as delineated by Clark *et al*. (2011). Twenty-six of the listed endemic species were recorded in the study area in the current study (8% of the species recorded on site). The list is likely to expand substantially after the area has been more fully explored botanically and would probably warrant the inclusion of the Koedoesberge, Oliviersberge and other mountains in the study site in the Hantam – Roggeveld Centre of Endemism. A broader delineation of the centre was also proposed by Mucina and Rutherford (2006) who suggested including the Koedoesberge – Moordenaars Karoo vegetation type into the centre.

6.10 Protected trees (National Forest Act, Act No. 84 of 1998) (NFA 2017)

There are no nationally protected tree species on site.

6.11 Alien (exotic) species

The following 30 species are exotic, with two species classified as Category 1b species:

Alyssum minutum	Brassicaceae
Amsinckia retrorsa	Boraginaceae
Aster squamatus	Asteraceae
**Atriplex lindleyi* subsp. *inflata*	Amaranthaceae
Atriplex nummularia	Amaranthaceae
Avena barbata	Poaceae
Bromus diandrus	Poaceae
Bromus tectorum	Poaceae
Buglossoides arvensis	Boraginaceae
Capsella bursa-pastoris	Brassicaceae
Carex divisa	Cyperaceae
Chenopodium album	Amaranthaceae
Chenopodium murale	Amaranthaceae
Hordeum murinum subsp. *glaucum*	Poaceae
Hordeum murinum subsp. *leporinum*	Poaceae
Lolium temulentum var. *temulentum*	Poaceae

Malva parviflora	Malvaceae
Medicago laciniata var. *laciniata*	Fabaceae
Medicago polymorpha	Fabaceae
Polypogon monspeliensis	Poaceae
**Salsola kali*	Amaranthaceae
Scleranthus annuus	Caryophyllaceae
Silene cretica	Caryophyllaceae
Sisymbrium orientale	Brassicaceae
Sonchus asper subsp. *asper*	Asteraceae
Stellaria media	Caryophyllaceae
Torilis arvensis	Apiaceae
Vulpia brunoides	Poaceae
Vulpia muralis	Poaceae
Vulpia myuros	Poaceae

*Listed as Category 1b declared invasive species.

7. FAUNA

7.1 Introduction

Lists of animals that could occur or possibly occur on site were sourced from the Animal Demography Unit, University of Cape Town (adu.uct.ac.za) and supplemented by literature such as Mills and Hes (1997), Friedmann and Daly (2004), Skinner and Chimimba (2005) and Bates *et al*. (2014). Animal lists for the full 3220 degree grid were generated. It should be noted that birds, bats and aquatic fauna are not reported on in this report, although a list of the frogs and toads and dragonflies is provided.

7.2 Mammals

Fifty-seven mammal species occur/could potentially occur on the site (Appendix B). These include:

1 golden mole;
3 elephant shrews;
1 aardvark;
1 hyrax;
4 hares and rabbits;
15 rodents;
2 primates;
2 shrews;
18 carnivores;
9 even-toed ungulates; and
1 odd-toed ungulate.

Since the full 3220 grid contains a more diverse array of habitats, not all species are likely to occur in the study area. An estimate of the likelihood of occurrence for the species is indicated in Appendix B. Among the listed mammal species only three have a threatened status.

- The riverine rabbit, *Bunolagus monticularis,* is listed as Critically Endangered, however there is a low likelihood of it being affected by the development, since the habitat of the riverine rabbit is in the riparian vegetation, on alluvial soils, along seasonal rivers and **the development is primarily on the crests of the mountains.** Populations of the riverine rabbit occur between Sutherland and Fraserburg, to the north of the study site, and near Touwsriver, to the southwest. It has also been found in the Anysberg Nature Reserve where it preferred plains with cropland that had been abandoned about 10 years previously. Recent surveys on the Anysberg Nature Reserve could however not verify that the riverine rabbit was still on the reserve.
- The leopard *Panthera pardus* (Vulnerable) is known to occur in the area, and
- The black-footed cat *Felis nigripes* (Vulnerable) has a high likelihood of occurrence.

Eleven of the species are classified as Specially Protected Species according to NCNCA (19% of all mammal species) and 32 as Protected Species (56%) (Appendix B). The Specially Protected Species are predominantly carnivores, while all moles, elephant shrews, even-toed undulates and most rodents have a Protected Species status.

According to WCNECO only one species (riverine rabbit) is classified as an Endangered Wild Animal (1.8% of all mammal species) and 12 as Protected Wild Animal (21%) (Appendix B). Most of the Protected Wild Animals are even-toed ungulates or carnivores.

7.3 Reptiles

For the 3220 grid, 50 reptiles are listed that could possibly occur at the study site (Appendix B). These include:

- 3 chelonians;
- 28 lizards (comprising):
  - 2 agamas;
  - 1 chameleon;
  - 5 cordylids;
  - 10 gekkos;
  - 3 gerrhosaurids;
  - 4 typical lizards;
  - 3 skinks; and
- 19 snakes

None of the reptiles have a threatened status and none are classified as Specially Protected Species by NCNCA or Endangered Wild Animals by WCNECO (Appendix B). Seventy-two percent of the reptiles are Protected Species in the Northern Cape (36 of all reptile species) and 70% in the Western Cape (35 of all reptile species).

7.4 Frogs

Six frog species, none of them threatened, could potentially occur in the study area (Appendix B).

7.5 Invertebrates

Lists for butterflies (77 species), lacewings (25 species) and dragonflies (12 species) are provided in Appendix B. None of these groups contain any threatened species although *Lepidochrysops bacchus* (butterfly) is classified as Schedule 2 in the Western Cape Ordinance (WCNECO, 1974, as amended 2000).

Five scorpion species could potentially occur on site (Appendix B).

8. ECOLOGICAL SENSITIVITY ANALYSIS

8.1 Introduction

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

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

An **overall sensitivity model** (Table 8) was developed for each plant association on site. This was achieved by weighting each criterion and calculating the sum for the association, which reflects the sensitivity and sensitivity ranking. The parameters that were used to allocate the sensitivity rating were the following:

1. **Threatened status of the ecosystem** (depends on the percentage area intact, or degree of transformation) (Driver *et al*., 2005, Mucina and Rutherford, 2006, NEM:BA, 2011). The ecosystems are classified into the following categories:

- Low sensitivity: If “Least Threatened”, the vegetation type has most of its habitat intact, i.e. more than 80%; or the vegetation type is adequately statutory or formally conserved in parks and reserves.
- Moderate sensitivity: If “Vulnerable”, the vegetation type has from 60% to 80% of the ecosystem intact; less than 40% has been transformed which could result in some ecosystem functioning being altered, and/or the ecosystem is statutory poorly conserved. For example, the vegetation type is rich in plant species but is not a pristine example of a vegetation type, therefore some transformation or disturbance occurred, such as human structures and degraded veld due to overgrazing and/or bush encroachment.
- High sensitivity: If “Endangered”, the vegetation type has from 40% to 60% of the ecosystem intact; or 40% to 60% transformed due to disturbance, cultivation or alien species; or the ecosystem is statutory poorly conserved e.g. less than about 3% conserved.
- Very high sensitivity: If “Critically Endangered”, the vegetation type has only 16% to 36% of the ecosystem intact. The richer the ecosystem is in terms of species, the higher the percentage threshold.

Category rating:

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

2. **Percentage of red list plant species** (listed higher than 'least concern', LC) (Threatened species Programme, 2017). The rating is determined by the presence of rare flora in a plant community (calculated as percentage of the mean number of species per association).

Category rating:

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

3. **Percentage of association contained in a CBA, ESA and ONA**

Category rating:

Low – almost entire association in a ONA	= 1
Medium – almost entire association in a ESA	= 2
High <50% of association in a CBA	= 3
Very High > 50% of association in a CBA	= 4

4. **Presence of Northern Cape and/or Western Cape protected plant species** (Northern Cape Nature Conservation Act, Act No. 9 of 2009; Western Cape Nature and Environmental Conservation Ordinance, 1974 (No. 19 of 1974, as amended in 2000) (WCNECO, 1974). The rating depends on the number of protected species in relation to the total plant species per association.

Category rating:

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

5. **Percentage of plant species endemic to the Hantam – Roggeveld Centre of Endemism** (Clark *et al.,* 2011). The presence of endemic species should be considered as none, low, moderate to high, depending on the availability of habitat in the community. The number of species is expressed as a percentage of the number of species per community.

Category rating:

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

6. **Conservation value of the terrain type and/or habitat.** The assessment should be seen in the context of the presence of representative habitat in the broader region or in conservation areas.

Category rating:

Low	= 1
Moderate	= 2
High	= 3

7. **Degree of connectivity and/or fragmentation of the ecosystem.** The degree of connectivity with surrounding or adjacent natural areas and/or fragmentation of plant communities, is indicated as low,

moderate or high, e.g. high connectivity with surrounding similar habitat, or low fragmentation of habitat is considered as having a low rating.

Category rating (note reverse order)*:*

Low	= 3
Moderate	= 2
High	= 1

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

Category rating:

Low	= 1
Moderate	= 2
High	= 3

9. **Resilience** is a measure of the ability of a particular habitat/plant community to recover after an impact, i.e. high resilience infers low rating.

Category rating (note reverse order):

Low	= 3
Moderate	= 2
High	= 1

8.2 Weighting of sensitivity criteria

Threatened status of the vegetation type	= x5
Percentage of red list plant species	= x4
Percentage of association contained in a CBA, ESA and ONA	= x3
Percentage of Northern Cape or Western Cape protected species	= x4
Percentage of endemic species	= x2
Conservation value (habitat)	= x4
Degree of connectivity/fragmentation of habitat	= x2
Erosion	= x2
Resilience	= x3

8.3 Sensitivity rating

≤ 25	= very low	(VL)	(rating scale = 1)
26 – 39	= low	(L)	(rating scale = 2)
40 – 54	= moderate	(M)	(rating scale = 3)
55 – 69	= high	(H)	(rating scale = 4)
> 70	= very high	(VH)	(rating scale = 5)

In general, these sensitivity ratings are interpreted as follows:

- **Very low** sensitivity means that a minimum score is allocated to almost all the sensitivity criteria used. It is usually applicable to habitats that have been transformed, especially by human activities. New WEF structures can be placed here.
- **Low** sensitivity means the sensitivity should not have an influence on the decision about the project. However, any protected species may not be removed/destroyed without a permit. New WEF structures can be placed here, subject to the relevant mitigation measures being implemented.
- **Moderate** means a sensitivity rating that is real and sufficiently important to require management, e.g. mitigation measures, management or protection of the rare/threatened fauna and flora, protection of a specific habitat on the property and/or rehabilitation.
- **High** means a sensitivity rating where the habitat should be excluded from any development. This would imply no turbines, crane pads, construction camps or substations. Roads should be restricted to a minimum, but are essential to reach the mountain crests where the bulk of the development will occur. Wherever possible, existing roads should be used, but if new roads are essential, it is imperative that the mitigation measures are implemented.
- **Very high** means a sensitivity rating that should influence the decision whether or not to proceed with the project. These areas exclude all turbines, crane pads, construction camp, substation and roads.

Table 8: Sensitivity of the plant associations (see Figure 25)

	Plant associations					
	1	2	3	4	5	6
Threatened status (x5)	5	5	5	5	5	5
% Red Listed species (x4)	0	0	0	0	0	0
Area contained in CBA, ESA or ONA (x3)	3	3	9	9	3	9
% NCNCA and WCNECO species (x4)	8	12	12	12	12	12
% Endemic species (x2)	0	2	2	4	0	6
Conservation value (x4)	12	12	12	8	4	12
Connectivity (x2)	6	2	2	2	2	2
Erosion (x2)	2	4	6	4	2	4
Resilience (x3)	9	9	9	9	6	6
Sum:	45	49	57	53	34	56
Sensitivity rating:	M	M	H	M	L	H

The study site is located in a remote area and covers the mountains and valleys of the Koedoesberg – Oliviersberg region. The area in general is in good condition with minimal disturbance. The high sensitivity rankings are largely the result of the high levels of protected species.

- Association 1: Cliffs – This association had a **Moderate** sensitivity. The cliffs however, represent essential habitat (refugia) for many faunal species and should not form part of the development (see Section 9 - 12 on Impacts). The development should be able to proceed by avoiding the cliff habitat.
- Association 2: Crest – This association had a **Moderate** sensitivity. The WEF (roads and turbines) will primarily occupy this habitat.
- Association 3: Midslopes – The association had a **High** sensitivity. The roads leading to the mountain crests will inevitably pass through Association 3.
- Association 4: Footslopes – The association had a **Moderate** sensitivity. Some roads leading to the mountain crests will pass through this association.
- Association 5: Plains – This association had a **Low** sensitivity. Some roads leading to the mountain crests will pass through this association and the preferred construction site lies in this association.

- Association 6: Rivers and streams – This association had a **High** sensitivity. The roads leading to the mountain crests will have to cross some rivers and streams. A buffer of 32 m from the water course should always be applied when planning the roads. The recommendations of the aquatic specialists should be followed where rivers and streams and their buffer zones are concerned.

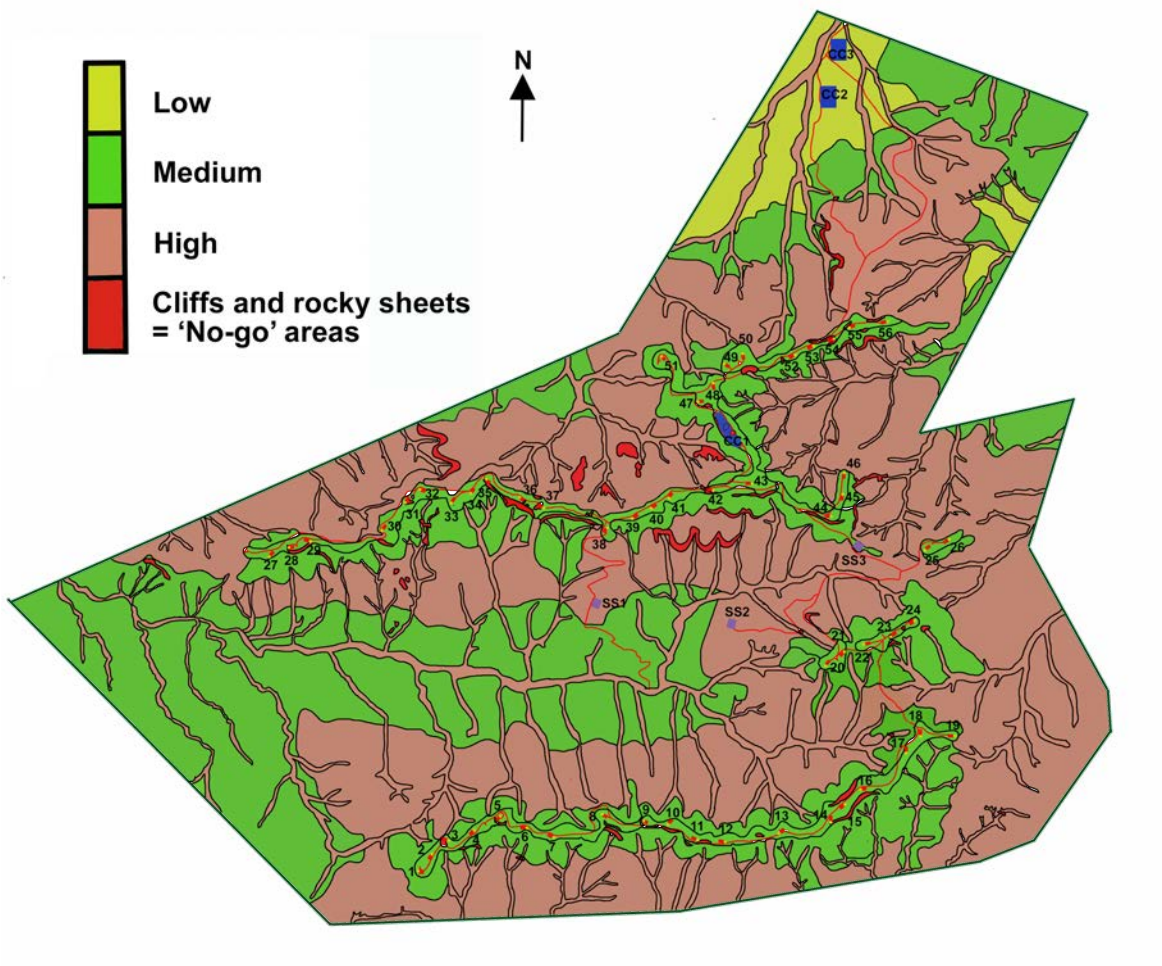


Figure 25. Sensitivity map of the Kudusberg WEF.

Considering the sensitivity map of the study site (Figure 25); the sensitivity map provided in the SEA Report (CSIR, 2015) (Figure 13); the CBA map of the Western Cape (Figure 12c); and the NPAES (Figure 14) some turbines might need to be relocated:

- Turbines 1, 3, 31, 35, 37, 42 lie partially on rocky sheets (Figure 25). A slight re-alignment of the turbines should be possible.
- Turbine 22 lies on the peak of Oliviersberg, where the trigonometric beacon is situated. A slight re-alignment of turbine 22 should avoid the beacon.
- Turbine 36 lies in the buffer area of one of the vernal pools.
- Construction Site 1 includes a rocky sheet and would therefore not be a preferred option (Figure 25).
- Turbines 9, 10 (partially), 27, 28, 29, 34 and 51 lie in a CBA (Western Cape).
- Furthermore, turbines 17 and 19 lie in an NPAES zone. These turbines however lie on the boundary of the area earmarked for NPAES and are located in a cadastral unit with a very small proportion being part of the NPAES.

9. IDENTIFICATION OF KEY ISSUES AND POTENTIAL IMPACTS

9.1. Key issues identified

The development of the proposed Kudusberg WEF may negatively impact the fauna and flora of the site in various ways. The current report does not address the avifauna and bats, nor the wetland component. These components will be discussed in separate specialist reports.

The potential key botanical issues include:

- The lack of background information to compile a checklist of the study area as well as to compile a list of SCC;
- Clearing of natural vegetation and potential loss of threatened, protected and endemic species;
- A large impact of road construction on vegetation and terrain;
- Most of the development occurs in a **Moderate** sensitivity zone, but several of the roads cross **High** sensitivity zones.
- The location of some of the turbines currently falls in 'no-go' areas (see Sensitivity Analysis), but improved micro-siting should be able to rectify this (accomplished in revised layout 15 October 2018);
- Increased dust deposition;
- Possible establishment of alien vegetation;
- Increased erosion (wind and water) and water run-off;
- Changes in local habitat features and ecological processes at the proposed substation, construction camp, crane pads and due to roads.

The potential key faunal issues include:

- Loss of faunal habitat and consequently loss of species;
- Increases in noise and light levels could potentially cause changes in behavioural patterns of animals;
- Increase in road traffic and concomitant road kills;
- Faunal mortalities as a result of soil compaction and construction activities;
- Soil compaction may hamper subsoil movement of some animals, e.g. mole rats;
- Increased human activities may cause animals to migrate.

Overall key impact identified:

- Loss of an unspoilt wilderness area and its potential as an untouched conservation area with a high ecotourism value.

9.2 Identification of Potential Impacts

The potential impacts for the different phases of the project, identified during the BA assessment, are listed below.

9.2.1 Construction phase

Direct impacts:

- The clearing of natural vegetation;
- The loss of threatened, protected and endemic individual plants/animals;

- Loss of faunal habitat and refugia due to clearing of vegetation and human activities close to rocky outcrops;
- Direct faunal mortalities due to construction, road works and increased traffic;
- Increased noise levels due to heavy machinery;
- Increased dust deposition may harm physiological processes of plants;
- Loss of certain plant/animal species due to collection (poaching) as a result of increased accessibility of the area;

Indirect impacts:

- Establishment of alien vegetation as a result of the clearing of the indigenous vegetation;
- Changed competitive hierarchies of plant species may lead to changes in species composition of communities;
- Changes in behavioural patterns of some animal species;
- Animals may be forced to migrate, which will negatively affect territorial animals such as the steenbok and klipspringer;
- Possible ingestion of waste material or ensnarement of animals;
- Increased erosion and water run-off, especially on the slopes due to vegetation clearance, road building and the compaction of the crane pads; and
- Siltation of drainage lines.

9.2.2 Operational phase

Direct impacts:

- Disturbance during the operational phase will be limited. Nevertheless, ongoing maintenance and associated disturbance may prevent natural vegetation from establishing on denuded areas;
- The loss of threatened, protected and endemic individual plants/animals might continue albeit at a very reduced rate; and
- Direct faunal mortalities (road kills).

Indirect impacts:

- Establishment of alien vegetation as a result of ongoing disturbance;
- Changed competitive hierarchies of plant species may lead to changes in species composition of communities;
- Changes in behavioural patterns of some animal species;
- Animals may be forced to migrate, which will negatively affect territorial animals such as the steenbok and klipspringer;
- Increased erosion and water run-off, especially on the slopes due to vegetation clearance, road building and the compaction of the crane pads; and
- Siltation of drainage lines.

9.2.3 Decommissioning phase

Direct impacts:

- The clearance of natural vegetation due to removal of infrastructure and building of a decommissioning site;
- The loss of threatened, protected and endemic individual plants/animals; and
- Increased dust deposition.

Indirect impacts:

- Establishment of alien vegetation as a result of the clearing of the indigenous vegetation;

- Changed competitive hierarchies of plant species may lead to changes in species composition of communities;
- Changes in behavioural patterns of some animal species;
- Animals may be forced to migrate, which will negatively affect territorial animals such as the steenbok;
- Possible ingestion or ensnarement of animals due to waste material lying around;
- Increased erosion and water run-off will continue due to vegetation clearance for road building; and
- Siltation of drainage lines.

9.2.4 Cumulative impacts:

- Cumulative habitat loss;
- Impact on broad-scale ecological processes;
- Biodiversity loss;
- Transformation of intact habitat within a CBA. Such CBAs are areas required to meet biodiversity targets for ecosystems, species or ecological processes and as such development in the areas is discouraged.
- Transformation of habitat within an ESA. ESAs are areas that are not essential for meeting biodiversity targets, but play an important role in supporting the ecological functioning in a CBA;
- May affect the suitability of the area for inclusion in NPAES; and
- Loss of wilderness character; ecotourism opportunities and the potential of an unspoilt conservation area.

10. ASSESSMENT OF SIGNIFICANCE OF ENVIRONMENTAL IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS

10.1 Introduction

Based on the site visits and literature review, the terrestrial ecological study assessed the potential impacts during the various phases of the proposed project on the receiving environment.

10.2 Site visits

The first site visit was undertaken in mid-winter (17 – 20 July 2018) and the second site visit in spring (5 – 13 September 2018). These two site visits covered the flowering times of most of the SCC (see Table 7 for more information on flowering times).

The most sensitive habitats identified were the cliffs, rocky sheets, drainage lines and their catchments. The majority of the development footprint lies within the mountain crest habitat and according to the Land Type maps this habitat type occupies only 10% of the Fc 269 Land Type that covers most of the study site.

10.2.1 Construction camp alternatives

Three alternative sites for the construction camp were assessed.

- The preferred location for the construction camp from a terrestrial ecological viewpoint would be Construction Camp 3. This site lies on a degraded part of the farm Urias Gat, and would cause the least loss of near pristine vegetation and undisturbed animal habitat. Increased noise and light levels would also have the least impact on animal populations. **The heritage specialists have however found this site unacceptable due to the presence of graves.**
- Construction Site 2 lies in the vicinity of Camp 3. It is more diverse botanically and would require more levelling to make it suitable.
- Construction Site 1 lies high up on a plateau in the mountainous section of the terrain. It is less disturbed than the other two options and furthermore contains a rocky sheet.
- Considering all information, construction camp 2 is thus preferred, followed by construction camp 1.

10.2.2 Substation alternatives

Two alternative sites for the substation were assessed (Substation 2 is apparently no longer an option).

- The preferred option for the substation would be along the planned route needed to access the turbines. This would be Substation 3.
- Although there is an existing track to Substation 1, it traverses a steep incline and would need major upgrading.
- None of the substation alternatives are flawed, but substation 3 is preferred, followed by substation 1.

10.2.3 Access road alternatives

- The preferred access road is Alternative 1 because it follows an existing track and is shorter than Alternative 2.
- Alternative 2 is however not flawed and could proceed should Alternative 1 no longer be available.

10.2.4 Intersection between R354 and DR02249

- The widening of this intersection to a curve radius of 50 m would largely occur in an area that has already been disturbed i.e. the road reserve, the site of an old kraal and a borrow pit.

10.3 Impacts during the construction phase and their significance

Each of the impacts is briefly described in terms of the nature; significance without mitigation; proposed mitigation measures; and the significance of the impact with the mitigation measures applied. The potential impacts identified in this specialist study were assessed on the basis of the methodology outlined in the BA Report. The criteria used for the assessment are scale (extent), duration, severity (consequence), probability, significance (derived from severity and probability) and direction.

Overall, the roads will have the largest negative impact on the site.

10.3.1 Direct impacts during the construction phase

The clearing of natural vegetation

Nature: Natural vegetation will be cleared for new access roads, upgrading of existing tracks, construction site, substation, turbines and crane pads. The removal of natural vegetation, in most instances near pristine vegetation, will result in many negative effects. The loss of the vegetation may cause a loss of individuals of threatened, protected and endemic species, it will also be accompanied by a loss of faunal habitat. Overall, this may lead to a loss of biodiversity. Vegetation loss is also invariably associated with increased water run-off and erosion, both water and wind erosion.

Vegetation clearance will inevitably occur at the turbine locations, crane pads, roads, construction and substation sites and the loss of vegetation at these sites will be permanent with no mitigation possible. **At the footprint, the severity of the impact is therefore extreme. Beyond the footprint, environmental functions and processes should however, not be altered.**

Some destruction of the vegetation adjacent to the footprint will also inevitably occur when preparing the sites. Unnecessary clearing of vegetation beyond the footprint of the development can however, largely be avoided.

Proposed mitigation measures:

- Vegetation clearance should be confined to the footprint of the development and unnecessary clearance should be avoided.
- Footprints of the turbines, crane pads, roads, construction and substation locations should be clearly demarcated.
- No collection of ‘fuelwood’ should be allowed on site.

Significance without and with mitigation measures (assessment refers to the footprint):

Parameter	Without mitigation	With mitigation
Extent	Site specific	Site specific
Duration	Long-term to permanent	Long-term to permanent
Severity	Severe to extreme	Severe
Probability	Very likely	Likely
Significance	**High to very high** (on footprint, however beyond footprint, environmental functions and processes should not be altered.)	**High**
Confidence level	High	High

The loss of Species of Conservation Concern (SCC)

Nature: The loss of the vegetation for new access roads, upgrading of existing tracks, construction site, substation, turbines and crane pads may cause a loss of individuals of SCC. The two site visits (during the design phase) did not reveal the presence of any species with a **IUCN threatened status**, although some SCC with a non-threatened status (NT or DD species and those classified by SANBI as Rare or Critically Rare) were observed. Most of these **non-threatened SCCs** occur as scattered individuals and cannot be avoided. Permits need to be obtained for their destruction.

Proposed mitigation measures:

- Placement of infrastructure should be done in such a way that no species with a **IUCN threatened status** are affected. A site visit or walk-through prior to construction of the access roads, construction site, substation, turbines and crane pads (final layout) to assess the presence of threatened SCC is proposed.

Significance without and with mitigation measures (assessment refers to the footprint):

Parameter	Without mitigation	With mitigation
Extent	Site specific	Site specific
Duration	Long-term to permanent	Long-term
Severity	Moderate	Moderate
Probability	Likely	Likely
Significance	**Low**	**Low**
Confidence level	High	Medium

The loss of faunal habitat

Nature: The loss of the vegetation for new access roads, upgrading of existing tracks, construction site, substation site, turbines and crane pads will also be accompanied by a loss of faunal habitat.

Proposed mitigation measures:

- Vegetation clearance should be confined to the footprint of the development and unnecessary clearance should be avoided. However, at the footprint vegetation clearance is inevitable and cannot be mitigated.
- Footprints of the turbines, crane pads, roads, construction and substation locations should be clearly demarcated prior to clearing to limit the impact of loss of faunal habitat.
- The cliffs and rocky sheets are no-go areas and should be avoided entirely.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Extent	Site specific	Site specific
Duration	Long-term to permanent	Medium term
Severity	Substantial	Moderate
Probability	Very likely	Unlikely
Significance	**Moderate**	**Low**
Confidence level	High	High

Direct faunal mortalities

Nature: Faunal mortalities may be caused by groundworks at the footprint of the infrastructure, construction vehicles or other operational activities and waste material. In particular slow-moving species such as tortoises, might be prone to these mortalities. Faunal mortalities may also be caused by electrical fences, should they be erected around the construction site and substation. Fatalities might also arise when animals ingest waste material or become ensnared in wires.

Proposed mitigation measures:

- Construction crew, in particular the drivers, should undergo environmental training to increase their awareness of environmental concerns. All construction contractors and crew should attend and pass an induction course. Although all road kills cannot be avoided, the increased awareness of drivers should be able to reduce the number of fatalities.
- Proper waste management procedures should be in place to avoid waste lying around and where possible to remove all waste material from the site.
- Electrical fences should be erected according to the norms and standards of the Nature Conservation Authorities in the Western and Northern Cape.
- Night driving should be limited.
- Speed limits should be set on all roads on site.
- No dogs or other pets should be allowed on site with the exception of those belonging to the landowners.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Extent	Site specific	Site specific
Duration	Short-term	Short-term
Severity	Moderate to Substantial	Moderate
Probability	Likely	Likely
Significance	**Low to Moderate**	**Low**
Confidence level	High	Medium

Loss of animal refugia

Nature: Animal refugia in some specialized habitats may be compromised by access routes. The cliffs, rocky outcrops and rock sheets are favoured habitat for many of the reptiles since they offer protection from predators. Destruction of these habitats will be associated with a reduction in the populations of these species.

Proposed mitigation measures:

- Development should avoid cliffs, rocky outcrops and rock sheets.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Extent	Site specific	Site specific
Duration	Permanent	Medium term
Severity	Substantial	Slight
Probability	Likely	Unlikely
Significance	**Moderate**	**Very low**
Confidence level	High	Medium

Increased dust deposition

Nature: Increased dust deposition may harm physiological processes of plants and a reduction in the photosynthetic capacity of the plants may occur.

Proposed mitigation measures:

- Excessive dust can be reduced by spraying water onto the soil to control dust generation. Other suitable dust control mitigation measures can also be considered.
- Increased dust levels are largely temporary and primarily applicable to the construction (and decommissioning) phases.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Extent	Site specific	Site specific
Duration	Short-term	Short-term
Severity	Moderate	Slight
Probability	Likely	Unlikely
Significance	**Low**	**Very low**
Confidence level	High	Medium

Loss of certain plant and animal species due to collection (poaching)

Nature: Some plant and animal species in the region are sought after by plant and animal collectors. As a result of the improved access (roads) to the area, illegal collection of plant and animal species may occur.

Proposed mitigation measures:

- Construction crew should undergo environmental training, by way of an induction course, to increase their awareness of environmental concerns.
- All instances of illegal collection should be reported to the Nature Conservation Authorities.
- Access to the site could be strictly regulated.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Extent	Site specific	Site specific
Duration	Long-term	Long-term
Severity	Moderate	Slight
Probability	Unlikely	Unlikely
Significance	**Low**	**Very low**
Confidence level	High	Medium

Increased noise and light levels

Nature: Construction activities will increase noise and light levels at the site. The elevated noise and light levels may alter the behavioural patterns of some animals.

Proposed mitigation measures:

- Suitable mitigation to reduce construction noise as per recommendations of the noise specialist, should be implemented.
- The SANS standards should be adhered to.
- Appropriate lighting should be installed to minimize negative effects on nocturnal animals.
- No construction should be done at night.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Extent	Site specific	Site specific
Duration	Short-term	Short-term
Severity	Substantial	Moderate
Probability	Likely	Likely
Significance	**Moderate**	**Low**
Confidence level	High	Medium

10.3.2 Indirect impacts during the construction phase

Establishment of alien vegetation

Nature: As a result of the loss of indigenous vegetation and resulting degradation, alien species might invade the area. Alien invasive species are currently not common in the area, with only two declared invasive species recorded (*Salsola kali* and *Atriplex lindleyi* subsp. *inflata*). Increased vehicle traffic, and import of soil may however facilitate the introduction of seeds of alien species. Infestation by invasive alien species may cause changes to the structure and functioning of the ecosystem and often exacerbates the further loss of indigenous vegetation.

Proposed mitigation measures:

- Implement a monitoring program for the early detection of alien invasive plant species and a control program to combat declared alien invasive plant species should be employed.
- No alien species should be used in rehabilitation.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Extent	Local	Local
Duration	Long-term	Long-term
Severity	Moderate	Slight
Probability	Likely	Unlikely
Significance	**Low**	**Very low**
Confidence level	Medium	Medium

Changes in animal behaviour

Nature: The increased human presence and/or construction operations will increase noise levels as well as light levels at night. The increased human presence, elevated noise and light levels, loss of animal habitat and compaction of soils may alter the behavioural patterns of some animals. Some of these changes may favour certain species and negatively affect others and consequently change the composition of the animal communities. Some of these changes could possibly increase levels of predation. Territorial species such as steenbok, grey duiker and klipspringer will be negatively affected as well as species that live or move in the soil. These species might undergo a reduction in their population size.

Proposed mitigation measures:

- Development should avoid cliffs and rocky sheets. The locations of the cliffs and rocky sheets have been identified and provided as a .kmz file.
- Soil compaction should be kept to a minimum by restricting driving to designated roads.
- Construction crew should undergo environmental training, by way of an induction course, to increase their awareness of environmental concerns.
- Appropriate lighting should be installed to minimize negative effects on nocturnal animals.
- No construction should be done at night, as far as possible.
- Suitable mitigation to reduce construction noise as per recommendations of the noise specialist, should be implemented.
- Both increased noise and light levels are temporary and should normalize once all construction has ceased.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Extent	Site specific	Site specific
Duration	Long-term	Short- to Long-term
Severity	Substantial	Moderate
Probability	Likely	Unlikely
Significance	**Moderate**	**Low**
Confidence level	Medium	Medium

Changes in community structure of plants

Nature: The vegetation clearance, soil compaction and high levels of disturbance will alter the physical character of a habitat. Some species will be more negatively affected than others and competitive hierarchies may change and consequently the composition of the plant communities may change. Pioneer species could increase.

Proposed mitigation measures:

- Soil compaction should be kept to a minimum by restricting driving to designated roads.
- Vegetation clearing and other disturbance should be restricted to the footprint of the development.
- Construction crew should undergo environmental training, by way of an induction course, to increase their awareness of environmental concerns.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Extent	Site specific	Site specific
Duration	Long-term	Long-term
Severity	Substantial	Moderate
Probability	Likely	Likely
Significance	**Moderate**	**Low**
Confidence level	High	Medium

Increased erosion and water run-off

Nature: Increased erosion (water and wind) and water run-off will be caused by the clearing of the indigenous vegetation and compaction of soil. The roads up the mountain slopes will be the main source of disturbance and erosion if not properly constructed and provided with water run-off structures. The construction site, substation site and crane pads will furthermore be levelled and compacted causing additional run-off and erosion. Increased run-off and erosion could affect hydrological processes in the area and will change water and silt discharge into the streams.

Proposed mitigation measures:

- Clearing of vegetation, compaction and levelling should be restricted to the footprint of the proposed development.
- A suitably qualified person should plan, design and supervise the proper construction of roads to minimize the impact on the environment.
- Roads should be provided with run-off structures.
- Roads should be designed to reduce the risk of erosion, in particular on 'High' sensitivity midslopes.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Extent	Local to regional	Site specific
Duration	Long-term	Long-term
Severity	Severe	Moderate
Probability	Likely	Likely
Significance	**High**	**Low**
Confidence level	Medium	Medium

10.4 Impacts during the operational phase and their significance

10.4.1 Direct impacts during the operational phase

The clearing or disturbance of natural vegetation

Nature: Clearing or disturbance of natural vegetation should be limited during the operational phase, although some removal might still arise due to maintenance activities.

Proposed mitigation measures:

- Vegetation clearance should be avoided wherever possible and new areas should not be denuded.
- Driving should be restricted to designated roads.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Extent	Site specific	Site specific
Duration	Long-term	Short-term
Severity	Moderate	Slight
Probability	Likely	Likely
Significance	**Low**	**Very low**
Confidence level	Medium	Medium

Direct faunal mortalities

Nature: Faunal mortalities may be caused by maintenance vehicles or other maintenance activities and waste. Faunal mortalities may also be caused by electrical fences, should they be erected around the construction site and substation. In particular slow-moving species such as tortoises, might be prone to road mortalities. Fatalities might also arise when animals ingest waste material or become ensnared in wires.

Proposed mitigation measures:

- Maintenance crew should undergo environmental training, by way of an induction course, to increase their awareness of environmental concerns.
- All excess wires and waste material should be removed from the site.
- Electrical fences should be erected according to the norms and standards of the Nature Conservation Authorities in the Western and Northern Cape.
- Night driving should be limited as far as possible.
- Speed limits should apply on all roads on site.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Extent	Site specific	Site specific
Duration	Long-term	Long-term
Severity	Moderate	Slight
Probability	Likely	Likely
Significance	**Low**	**Very low**
Confidence level	Medium	Medium

Increased noise levels

Nature: Turbines will increase noise levels on site during the operational phase. The elevated noise levels may alter the behavioural patterns of some sensitive animal species.

Proposed mitigation measures:

- Follow mitigation measures proposed by noise specialist and adhere to SANS standards.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Extent	Site specific	Site specific
Duration	Long-term	Long-term
Severity	Moderate	Moderate
Probability	Likely	Likely
Significance	**Low**	**Low**
Confidence level	Medium	Medium

Loss of certain plant and animal species due to collection (poaching)

Nature: Some plant and animal species in the region are sought after by plant and animal collectors. As a result of the improved access to the area, illegal collection of plant and animal species may occur.

Proposed mitigation measures:

- Limit or control access to the site from the north.
- Maintenance crews and operational staff should undergo environmental training, by way of an induction course, to increase their awareness of environmental concerns.
- All instances of illegal collection should be reported to the Nature Conservation Authorities.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Extent	Site specific	Site specific
Duration	Long-term	Long-term
Severity	Moderate	Slight
Probability	Unlikely	Unlikely
Significance	**Low**	**Very low**
Confidence level	Medium	Medium

10.4.2 Indirect impacts during the operational phase

Establishment of alien vegetation

Nature: As a result of the loss of indigenous vegetation and resulting degradation, alien species might invade the area. Increased vehicle traffic and import of soils may facilitate the introduction of seeds of alien species. Infestation by invasive alien species may eventually cause changes to the structure and functioning of the ecosystem and often exacerbates the further loss of indigenous vegetation.

Proposed mitigation measures:

- Implement a monitoring program for the early detection of alien invasive plant species.
- A control program to combat declared alien invasive plant species should be employed.
- No alien species should be used in rehabilitation.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Extent	Local	Site specific
Duration	Long-term	Long-term
Severity	Moderate	Slight
Probability	Likely	Likely
Significance	**Low**	**Very low**
Confidence level	Medium	Medium

Changes in animal behaviour

Nature: The loss of vegetation cover, compacting of soils, increased noise levels and the increased human presence will alter animal behavioural patterns by making certain sites unavailable, making roads difficult to traverse, and increasing levels of predation. Some animal species will be more severely affected than others. See examples under construction. These species might undergo a reduction in their population size. However, no new vegetation loss is anticipated during the operational phase and impacts on animal behaviour that are relevant during the operational stage are the residual impacts that could not be mitigated during the construction phase. Many of the smaller animals might return after the construction phase.

Proposed mitigation measures:

- Development should avoid cliffs and rocky sheets demarcated as no-go areas in the accompanying .kmz file.
- Soil compaction should be kept to a minimum by restricting driving to designated roads.
- Operation crew should undergo environmental training, by way of an induction course, to increase their awareness of environmental concerns.
- Appropriate lighting should be installed to minimize negative effects on nocturnal animals.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Extent	Site specific	Site specific
Duration	Long-term	Short- to Long-term
Severity	Substantial	Moderate
Probability	Likely	Unlikely
Significance	**Moderate**	**Low**
Confidence level	Medium	Medium

Increased erosion and water run-off

Nature: Increased erosion and water run-off will be caused by the clearing of the indigenous vegetation and soil disturbance during the construction phase. Where compaction occurred, the vegetation will not re-establish easily and increased run-off and erosion will continue. Increased run-off and erosion could affect hydrological processes in the area and will change water discharge into the streams and increase silt load. However, no new roads are to

be constructed in the operational phase as part of the wind farm and impacts due to increased erosion and water run-off during the operational stage will largely be the residual impacts that could not be mitigated.

Proposed mitigation measures:

- Proper road maintenance procedures should be in place.
- Should new sections of the road be needed a suitably qualified person should plan, design and supervise the proper construction of roads.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Extent	Site specific to Local	Site specific
Duration	Long-term	Long-term
Severity	Substantial	Moderate
Probability	Likely	Likely
Significance	**Moderate**	**Low**
Confidence level	High	Medium

10.5 Impacts during the decommissioning phase and their significance

10.5.1 Direct impacts during the decommissioning phase

The clearing of natural vegetation

Nature: Natural vegetation will be cleared for a new 'construction' camp. Some roads verges might also have to be cleared again.

Proposed mitigation measures:

- Vegetation clearance should be confined to the decommissioning camp and unnecessary clearance should be avoided.
- The site of the decommissioning camp should be the same as the original construction camp.
- Furthermore, no new access routes should be established but existing roads should be used.
- No collection of 'fuelwood' should be allowed on site.
- Areas where infrastructure was removed should be rehabilitated.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Extent	Site specific	Site specific
Duration	Short-term	Short-term
Severity	Moderate	Slight
Probability	Likely	Likely
Significance	**Low**	**Very low**
Confidence level	High	Medium

Direct faunal mortalities

Nature: Faunal mortalities may be caused by vehicles or other decommissioning activities and waste. In particular slow-moving species such as tortoises, might be prone to road mortalities. Fatalities might also arise when animals ingest waste material or become ensnared in it.

Proposed mitigation measures:

- Decommissioning crew should undergo environmental training, by way of an induction course, to increase their awareness of environmental concerns. Although all faunal mortalities by construction vehicles cannot be avoided, the increased awareness of drivers should be able to reduce the number of fatalities.
- Night driving should be restricted as far as possible.
- Speed limits should be set on all roads on site.
- Proper waste management procedures should be in place and no material should be left on site. Proper waste management should reduce the instances of ensnarement or ingestion of foreign material.
- All material brought in for the construction of the WEF should be removed.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Extent	Site specific	Site specific
Duration	Short-term	Short-term
Severity	Moderate	Slight
Probability	Likely	Likely
Significance	**Low**	**Very low**
Confidence level	Medium	Medium

Increased dust deposition

Nature: Increased dust deposition may harm physiological processes of plants. Increased dust levels are largely temporary.

Proposed mitigation measures:

- Excessive dust can be reduced by spraying water onto the soil to control dust. Other suitable dust control mitigation measures can also be considered.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Extent	Site specific	Site specific
Duration	Short-term	Short-term
Severity	Moderate	Slight
Probability	Likely	Likely
Significance	**Low**	**Very low**
Confidence level	High	Medium

10.5.2 Indirect impacts during the decommissioning phase

Changes in animal behaviour

Nature: The increased human presence and decommissioning operations will increase road traffic, noise levels as well light levels at night. The influences may alter the behavioural patterns of some animals. These will be transient impacts and will discontinue as soon as the decommissioning is completed. See construction and operational phases for examples.

Proposed mitigation measures:

- Decommissioning crew should undergo environmental training to increase their awareness of environmental concerns.
- Soil compaction should be kept to a minimum by restricting driving to designated roads.
- Appropriate lighting should be installed to minimize negative effects on nocturnal animals.
- No decommisioning should be done at night.
- Noise levels due to decommissioning cannot be mitigated. Both increased noise and light levels are temporary and should normalize once all decommissioning has ceased.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Extent	Site specific	Site specific
Duration	Short-term	Short-term
Severity	Substantial	Moderate
Probability	Likely	Likely
Significance	**Moderate**	**Low**
Confidence level	Medium	Medium

Increased erosion and water run-off

Nature: Some of the existing roads might have to be upgraded and increased erosion and water run-off will be caused by the clearing of the indigenous vegetation and soil disturbance during the decommissioning phase. Increased run-off and erosion could affect hydrological processes in the area and will change water discharge into the streams and increase silt load.

Proposed mitigation measures:

- No new roads should be built as part of the decommissioning of the wind farm.
- Proper road maintenance procedures should be in place.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Extent	Site specific to Local	Site specific
Duration	Long-term	Long-term
Severity	Moderate	Slight
Probability	Likely	Likely
Significance	**Low**	**Very low**
Confidence level	Medium	Low

10.6 Cumulative impacts

Cumulative impacts were evaluated in the light of the large number of proposed wind energy facilities in a 50 km radius of the Kudusberg WEF.

Vegetation loss and habitat destruction

Nature: Vegetation loss and habitat destruction of particularly the mountain crest vegetation, around which most of the developments are centred, will occur. The habitat destruction will lead to changes in the physical features of the habitat, with concomitant changes in ecological processes. Secondary vegetation will develop at sites where the vegetation was cleared or the soil compacted. The species composition of the associations may change and alien species might invade. Vegetation loss will also constitute the loss of animal habitat. A rough estimate indicates that within the Kudusberg WEF site the mountain crest habitat covers only approximately 10% of the total area (according to land type data). Considering all the developments in the region, the WEFs will cause a severe impact on the mountain crest habitat and its associated fauna and flora.

Possibilities for mitigation are limited because the vegetation loss is essential for the construction of roads, turbines, construction and substation sites and crane pads.

Proposed mitigation measures:

- All projects should adhere to the site-specific recommendations of the ecologists to ensure that all facilities mitigate impacts where possible. The Kudusberg WEF is to adhere to the mitigation measures proposed in this report.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Extent	Regional	Regional
Duration	Long-term	Long-term
Severity	Severe	Substantial
Probability	Very likely	Likely
Significance	**High**	**Moderate**
Confidence level	High	Medium

Loss of Species of Conservation Concern (SCC)

Nature: The loss of vegetation might cause the loss of SCC especially since the WEF developments occur over such a large area. This would primarily be applicable to threatened and rare plant species that have a restricted distribution range. No threatened SCCs were recorded during the two site visits. Some individuals classified as Near Threatened, Data Deficient or those classified as Rare by SANBI will however be lost.

Proposed mitigation measures:

- Once the final layout is available, a site visit or walk-through prior to construction of the access roads, construction site, substation, turbines and crane pads to assess the presence of threatened SCC is proposed. Placement of infrastructure should be done in such a way that no threatened SCCs are affected.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Extent	Regional	Regional
Duration	Long-term	Long-term
Severity	Substantial	Moderate
Probability	Likely	Likely
Significance	**Moderate**	**Low**
Confidence level	High	Medium

Dissection of mountain crest habitat

Nature: Dissection of the mountain crest habitat by a network of roads. Some burrowing animal species will find traversing these compacted roads difficult and levels of predation on these species might increase.

Possibilities for mitigation are limited because the road network is essential for the development.

Proposed mitigation measures:

- Do not place fences along the roads
- Use existing roads as much as possible

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Extent	Regional	Regional
Duration	Long-term	Long-term
Severity	Substantial	Substantial
Probability	Likely	Likely
Significance	**Moderate**	**Moderate**
Confidence level	High	Medium

Turbine noise

Nature: Turbines will increase noise levels above current levels. These increased noise levels might affect animal behaviour and might result in changes in faunal composition. The turbine noise would affect the entire mountain crest habitat in the region, reducing the possibilities of migration for animal species sensitive to the noise.

Proposed mitigation measures:

- The mitigation measures as indicated by the noise specialist must be adhered to.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Extent	Regional	Regional
Duration	Long-term	Long-term
Severity	Moderate	Moderate
Probability	Likely	Likely
Significance	**Low**	**Low**
Confidence level	High	Medium

Compromising integrity of CBA, ESA and NPAES

Nature: According to the 2017 mapping of CBAs in the Western Cape, the site is contained largely within an ESA and partly in a CBA. Development within CBAs is not encouraged as such development may result in biodiversity loss and therefore compromise the integrity of the CBA. Development is only permitted in a CBA on condition approval is granted by the relevant competent authority. The loss of the area might also have an effect on the future suitability of the terrain as protected area, although only a small portion of the site is contained in an area earmarked for the National Protected Area Expansion Strategy. Considering the large number of developments in the region, all CBAs in the region could be compromised and consequently the biodiversity target for ecosystems could be affected.

Proposed mitigation measures:

- The turbines falling within CBAs could possibly be moved to alternative locations that are outside the CBAs.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Extent	Regional	Regional
Duration	Long-term	Long-term
Severity	Severe	Slight
Probability	Likely	Likely
Significance	**High**	**Low**
Confidence level	High	Medium

Increased erosion and water run-off

Nature: Increased water run-off and erosion will alter hydrological processes and might affect catchments and downstream habitats especially since increased erosion and water run-off will occur on all mountain slopes in the area.

Proposed mitigation measures:

- A suitably qualified person should plan, design and supervise the proper construction of roads to minimize the impact on the environment.
- Roads should be provided with run-off structures.
- Roads should be designed to reduce the risk of erosion, in particular in the midslope habitat that has a 'High' sensitivity.

Significance without and with mitigation measures:

Parameter	Without mitigation	With mitigation
Extent	Regional	Regional
Duration	Long-term	Long-term
Severity	Substantial	Moderate
Probability	Likely	Likely
Significance	**Moderate**	**Low**
Confidence level	High	Medium

11. IMPACT ASSESSMENT SUMMARY

Tables 9 to 12 provide a summary of all terrestrial ecological impacts identified resulting from the proposed Kudusberg WEF.

Table 9. Impact assessment summary table for the Construction Phase

Impact pathway	Nature of potential impact/risk	Status1	Extent2	Duration3	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/ resource	Significance of impact/risk = consequence x probability (before mitigation)	Can impact be avoided?	Can impact be managed or mitigated?	Potential mitigation measures	Significance of residual risk/ impact (after mitigation)	Ranking of impact/ risk	Confidence level before mitigation
TERRESTRIAL ECOLOGY															
CONSTRUCTION PHASE															
Direct Impacts															
Habitat loss	Clearing of natural vegetation	Negative	Site specific	Long-term to permanent	Severe - extreme	Very likely	Low	Moderate	High – very high	No	Partly	1. Confine clearance to footprint of development. 2. Demarcate all footprints clearly. 3. No fuelwood collection.	High within the footprint, but sufficient crest habitat available for ecological patterns and processes to continue unaltered.	2	High
Biodiversity loss	Loss of Species of Conservation Concern	Negative	Site specific	Long-term to permanent	Moderate	Likely	Low	High	Low	Yes	Yes	1. Location of footprint such that no threatened SCC are affected. 2. A walk-through prior to construction of the access roads, construction site, substation, turbines and crane pads to assess the presence of threatened SCC is proposed	Low	4	High
Habitat loss	Loss of faunal habitat	Negative	Site specific	Long-term to permanent	Substantial	Very likely	Low	Moderate	Moderate	Yes	Yes	1. Confine clearance to footprint of development. 2. Demarcate all footprints clearly. 3. The cliffs and rocky sheets are no-go areas and should be avoided entirely. 4. No pets on site, except those of landowners.	Low	4	High
Biodiversity loss	Direct faunal mortalities	Negative	Site specific	Short-term	Moderate to substantial	Likely	Low	High	Low - moderate	Partially	Yes	1. Environmental training of construction crew. 2. Proper waste management procedures. 3. Electrical fences to standards of conservation authorities. 4. Limited night driving. 5. Speed limits.	Low	4	High
Habitat loss	Loss of animal refugia	Negative	Site specific	Permanent	Substantial	Likely	Low	High	Moderate	Yes	Yes	1. Development should avoid cliffs and rocky sheets.	Very low	5	High

1 Status: Positive (+) ; Negative (-)
2 Site; Local (<10 km); Regional (<100); National; International
3 Very short-term (instantaneous); Short-term (<1yr); Medium-term (1-10 years); Long-term (project duration); Permanent (beyond project decommissioning)

Impact pathway	Nature of potential impact/risk	Status1	Extent2	Duration3	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/ resource	Significance of impact/risk = consequence x probability (before mitigation)	Can impact be avoided?	Can impact be managed or mitigated?	Potential mitigation measures	Significance of residual risk/ impact (after mitigation)	Ranking of impact/ risk	Confidence level before mitigation
Disturbance	Increased dust deposition	Negative	Site specific	Short-term	Moderate	Likely	High	Low	Low	No	Yes	1. Apply suitable dust control measures	Very low	5	High
Species loss	Loss of animal and plant species by illegal collecting	Negative	Site specific	Long-term	Moderate	Unlikely	Low	High	Low	No	Yes	1. Strict access control. 2. Report instances to nature conservation authorities. 3. Environmental training of construction crew.	Very low	5	High
Disturbance	Increased noise and light levels	Negative	Site specific	Short-term	Substantial	Likely	High	Low	Moderate	No	Partly	1. Apply suitable mitigation as recommended by noise specialist 2. Appropriate lighting should be installed to minimize negative effects on nocturnal animals 3. Adhere to SANS lighting and noise standards 4. No construction at night.	Low	4	High
Indirect Impacts															
Disturbance	Establishment of alien vegetation	Negative	Local	Long-term	Moderate	Likely	High	Low	Low	Yes	Yes	1. Initiate an Invasive Alien Species Programme. 2. No alien species should be used for rehabilitation.	Very low	5	Medium
Faunal ecology	Changes in animal behaviour	Negative	Site specific	Long-term	Substantial	Likely	High	Low	Moderate	No	Yes	1. No development on cliffs and rocky sheets. 2. Restrict soil compaction to footprint. 3. Environmental training of construction crew. 4. Appropriate lighting should be applied. 5.No construction at night.	Low	4	Medium
Vegetation ecology	Changes in community composition of plants	Negative	Site specific	Long-term	Substantial	Likely	Moderate	Low	Moderate	No	Yes	1. Restrict soil compaction and vegetation clearance to footprint. 2. Environmental training of construction crew.	Low	4	High
Hydrology	Increased erosion and water run-off	Negative	Local to Regional	Long-term	Severe	Likely	Low	Moderate	High	No	Yes	1. Planning, design and supervision of all roads by suitably qualified person. 2. Roads must have water run-off structures. 3. Roads to be planned to avoid risk of erosion. 4. Restrict activities to footprint	Low	4	Medium

Table 10. Impact assessment summary table for the Operational Phase

Impact pathway	Nature of potential impact/risk	Status	Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/ resource	Significance of impact/risk = consequence x probability (before mitigation)	Can impact be avoided?	Can impact be managed or mitigated?	Potential mitigation measures	Significance of residual risk/ impact (after mitigation)	Ranking of impact/ risk	Confidence level
TERRESTRIAL ECOLOGY															
OPERATIONAL PHASE															
Direct Impacts															
Habitat loss	Clearing and disturbance of natural vegetation	Negative	Site specific	Long-term	Moderate	Likely	Low	Moderate	Low	Yes	Yes	1. Driving should be restricted to existing roads. 2. Avoid clearance of new areas.	Very low	5	Medium
Biodiversity loss	Direct faunal mortalities	Negative	Site specific	Long-term	Moderate	Likely	Low	High	Low	Yes	Yes	1. Restrict driving at night. 2. Environmental training of maintenance crew. 3. All waste material removed from site. 4. Maintain electrical fences according the accepted standards. 5. Apply speed limits on roads.	Very low	5	Medium
Disturbance	Increased noise levels	Negative	Site specific	Long-term	Moderate	Likely	High	Low	Low	No	No	1. Follow mitigation measures proposed by noise specialist and adhere to the SANS standards	Low	4	Medium
Biodiversity loss	Loss of animal and plant species by illegal collecting	Negative	Site specific	Long-term	Moderate	Unlikely	Low	High	Low	No	Yes	1. Strict access control. 2. Report instances to nature conservation authorities. 3. Environmental training of maintenance and operational crew.	Very low	5	Medium
Indirect Impacts															
Disturbance	Establishment of alien vegetation	Negative	Local	Long-term	Moderate	Likely	High	Low	Low	Yes	Yes	1. Initiate an Invasive Alien Species Programme. 2. No alien species should be used for rehabilitation.	Very low	5	Medium
Faunal ecology	Changes in animal behaviour	Negative	Site specific	Long-term	Substantial	Likely	High	Low	Moderate	No	Yes	1. No development on cliffs and rock sheets. 2. Restrict soil compaction to footprint. 3. Environmental training of maintenance and operational crew. 4. Appropriate lighting.	Low	4	Medium
Hydrology	Increased erosion and water run-off	Negative	Site specific to local	Long-term	Substantial	Likely	Low	Moderate	Moderate	No	Yes	1. Planning, design and supervision of all roads by suitably qualified person. 2. Roads must have water run-off structures. 3. Proper road maintenance procedures should be in place	Low	4	Medium

Table 11. Impact assessment summary table for the Decommissioning Phase

Impact pathway	Nature of potential impact/risk	Status[4]	Extent[5]	Duration[6]	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/ resource	Significance of impact/risk = consequence x probability (before mitigation)	Can impact be avoided?	Can impact be managed or mitigated?	Potential mitigation measures	Significance of residual risk/ impact (after mitigation)	Ranking of impact/ risk	Confidence level
TERESTRIAL ECOLOGY															
DECOMMISSIONING PHASE															
Direct Impacts															
Habitat loss	Clearing and disturbance of natural vegetation	Negative	Site specific	Short-term	Moderate	Likely	Moderate	Moderate	Low	Yes	Yes	1. Clearance should be limited to decommissioning camp. 2. Decommissioning camp should be at same location as construction camp. 3. Driving should be restricted to existing roads. 4. Rehabilitation of areas where infrastructure was removed. 5. No fuelwood collection.	Very low	5	High
Biodiversity loss	Direct faunal mortalities	Negative	Site specific	Short-term	Moderate	Likely	Low	Moderate	Low	No	Yes	1. Restrict driving at night. 2. Environmental training of decommissioning crew. 3. All material brought in for WEF should be removed again.	Very low	5	Medium
Disturbance	Increased dust deposition	Negative	Site specific	Short-term	Moderate	Likely	High	Low	Low	No	Yes	1. Apply suitable dust control measures.	Very low	5	High
Indirect Impacts															
Faunal ecology	Changes in animal behaviour	Negative	Site specific	Short-term	Substantial	Likely	High	Low	Moderate	No	Yes	1. Driving only on designated roads. 2. Restrict soil compaction to footprint. 3. Environmental training of decommissioning crew. 4. Appropriate lighting. 5. Apply mitigation measures proposed by noise specialist.	Low	4	Medium
Hydrology	Increased erosion and water run-off	Negative	Site specific to local	Long-term	Moderate	Likely	Low	Moderate	Low	No	Yes	1. No new roads to be constructed. 2. Proper road maintenance	Very low	5	Medium

4 Status: Positive (+) ; Negative (-)
5 Site; Local (<10 km); Regional (<100); National; International
6 Very short-term (instantaneous); Short-term (<1yr); Medium-term (1-10 years); Long-term (project duration); Permanent (beyond project decommissioning)

Table 12. Cumulative impact assessment summary table

Impact pathway	Nature of potential impact/risk	Status	Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/ resource	Significance of impact/risk = consequence x probability (before mitigation)	Can impact be avoided?	Can impact be managed or mitigated?	Potential mitigation measures	Significance of residual risk/ impact (after mitigation)	Ranking of impact/ risk	Confidence level
TERRESTRIAL ECOLOGY															
CUMULATIVE IMPACTS															
Habitat loss	Vegetation loss and habitat destruction	Negative	Regional	Long-term	Severe	Very likely	Low	High	High	No	No or partly	1. All projects should adhere to the site-specific recommendations of the ecologist to ensure that all facilities mitigate impacts where possible. The Kudusberg WEF is to adhere to the mitigation measures proposed in this report.	Moderate	3	High
Biodiversity loss	Loss of Species of Conservation Concern	Negative	Regional	Long-term	Substantial	Likely	Low	High	Moderate	Yes	Yes	1. Once the final layout is available, a site visit or walk-through prior to construction to the access roads, construction site, substation, turbines and crane pads to assess the presence of threatened SCC is proposed.	Low	4	High
Disturbance	Dissection of mountain crest habitat	Negative	Regional	Long-term	Substantial	Likely	Moderate	Moderate	Moderate	No	No or only partly	1. No fences along roads. 2. Use existing roads where possible.	Moderate	3	High
Disturbance	Turbine noise	Negative	Regional	Long-term	Moderate	Likely	High	Low	Low	No	No	1. SANS standards must be adhered to.	Low	4	High
Conservation	Compromising integrity of CBA, ESA and NPAES	Negative	Regional	Long-term	Severe	Likely	Low	High	High	No	No or partly	1. The relocation of those turbines falling in a CBA could be investigated.	Low	4	High
Disturbance	Increased erosion and water run-off	Negative	Regional	Long-term	Substantial	Likely	Low	Moderate	Moderate	No	Yes	1. A suitably qualified person should plan, design and supervise the proper construction of roads to minimize the impact on the environment. 2. Roads should be provided with run-off structures. 3.Roads should avoid steep slopes	Low	4	High

12. CONCLUSIONS

The main conclusions arising from this report are briefly summarized below:

- The current layout (provided in July 2018) would cause the irreversible loss of approximately 126 ha of natural vegetation within the direct footprint of the development:
    a. turbine footprint 4 ha;
    b. crane pads 25 ha;
    c. roads 82 ha;
    d. construction site 12.5 ha; and
    e. substation 2.25 ha.
- **In spite of the total loss of the vegetation within the 126 ha footprint, large portions of the crest and midslope habitats still remain unaffected to ensure that ecological patterns or processes continue without being adversely affected.**
- The current layout for the turbines and crane pads fall predominantly in a **moderate** sensitivity zone (see Sensitivity analysis in Figure 25). However, several roads lie in a **high** sensitivity zone.
- **After mitigation actions have been applied, most of the impacts had a low or very low score.**
- It is imperative that the turbines (1, 3, 31, 35, 37, 42, 22 and 36) falling partially or entirely in no-go areas (**very high** sensitivity) identified in the current study should be repositioned so as to avoid these areas. In most instances, this would merely imply micro-siting. Since the distance between the Kudusberg WEF turbines is generally quite large, the adjacent turbine locations will probably not be affected. Similarly, the high sensitivity zones of the other specialist studies, should be taken into consideration, when designing the final layout. **NOTE: These turbines have all been repositioned in the revised layout (15 October 2018) to avoid the very high sensitivity areas.**
- The development falls in an area that is partly contained in a CBA with seven turbines falling in the CBA. Critical Biodiversity Areas should be kept in a natural or near-natural state, with no further loss of habitat or land-use change permitted. Only low-impact, biodiversity-sensitive land-use is considered appropriate. Ideally, development of CBAs should be avoided and if this cannot be done then the mitigation hierarchy should be applied, which implies that if the impact cannot be avoided or reduced to a residual low significance level following mitigation, a biodiversity offset needs to be considered as a last resort. However, it should also be taken into consideration that the proposed facility is located within the Komsberg Renewable Energy Development Zone (REDZ 2), one of the eight REDZ formally gazetted in South Africa for development of solar and wind energy generation facilities.
- The lack of baseline data on plant diversity complicated the current study in the sense that there was no clear indication of which SCC could possibly occur on the site. The list of potential SCCs that were compiled for the current study was probably too broad, with many species probably having a low likelihood of occurring at the site. Two site visits were conducted to search for SCC within the development footprint.
- The percentage protected plant species on site (45% for the Northern Cape; 28% for the Western Cape), was exceptionally high. **Permits are needed for the loss of protected species.** Furthermore, the protected species are sometimes those with the highest cover values.
- The preferred option for the construction camp is option 2. Option 3 was found to be flawed by the heritage specialists and option 1 was in a visual very high sensitivity zone and furthermore contained a rocky sheet.
- The preferred option for the substation is option 3, followed by option 1 (option 2 was withdrawn by the landowner).
- The preferred northern access route is the western one (Alternative 1), which could follow an existing track and is also shorter than the eastern route (Alternative 2). None of the options are flawed.

Provided all mitigation measures, proposed by the various specialists, are applied and all very high sensitivity zones identified by the specialists are avoided, the project could be approved. The Northern and Western Cape Nature Conservation Authorities and DEA will however have to advise on how to deal with those turbines falling in the CBAs and NPAES and the large proportion of the provincially protected plant species that are affected.

13. INPUT INTO THE ENVIRONMENTAL MANAGEMENT PROGRAMME

Impact	Mitigation / Management Objectives	Mitigation / Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
A. TERRESTRIAL ECOLOGY IMPACTS					
A. DESIGN PHASE					
Potential impact on terrestrial ecology as a result of the proposed Kudusberg WEF and associated infrastructure.	Avoid or minimize impacts on terrestrial ecology on site. This is particularly important regarding the placement of the infrastructure to reduce the chances of SCC loss, avoiding cliffs and rocky sheets and road design to minimize erosion.	Ensure that the design of the WEF takes the sensitivity mapping of the ecological assessment into account to avoid and reduce impacts on Species and Habitats of Conservation Concern. Results of site visit to locate SCC should also be considered. Demarcation of CBA should inform design.	Ensure that this is taken into consideration during the planning and design phase.	During design cycle and before construction commences.	Project Developer and Appointed Ecological Specialist.
B. CONSTRUCTION PHASE					
Clearance of vegetation	Confine vegetation clearance to footprint and minimize disturbance of adjacent areas.	Demarcate all infrastructure sites clearly to avoid unnecessary clearance of the vegetation. Restrict driving to designated roads. Permits have to be obtained for the removal of NCNCA and WCNCA protected species.	Ensure that mitigation measures are enforced.	Every three months	The Environmental Control Officer (ECO) should monitor and report any incidences to the Holder of the EA
Impact on animal behaviour	Avoid or minimize impacts that could potentially affect animal behaviour.	Restrict night driving during construction phase. Proper waste management procedures should be put in place. Ensure electrical fences are built according to standards of Nature Conservation Authorities. Appropriate lighting to be installed in construction camp to minimize effect on nocturnal animals.	Ensure compliance with these mitigation measures.	Every three months	The ECO should monitor and report to the Holder of the EA.
Illegal collecting of animals/plants	Avoid loss of SCC through illegal collecting.	Ensure proper access control of the site. Staff and contractor training and education programmes.	Implement proper site access control.	Every three months	The ECO should monitor and report to the Holder of the EA.
Increased dust levels	Avoid or minimize increased dust levels.	Dust control measures should be implemented.	Ensure that dust control measures are in place.	Every three months	The ECO should monitor and report to the Holder of the EA.
Alien species invasion	Avoid invasion by alien species.	Implement a monitoring program for the early detection of alien invasive plant species. A control program to combat declared alien invasive plant species should be employed.	Ensure implementation of a control programme to combat alien invasive plants.	Every three months	The ECO should monitor and report to the Holder of the EA.

Impact	Mitigation / Management Objectives	Mitigation / Management Actions	Monitoring		
			Methodology	*Frequency*	*Responsibility*
C. OPERATIONAL PHASE					
Clearance of vegetation	Minimize disturbance and clearance of vegetation.	Restrict driving to designated roads.	Ensure that mitigation measures are enforced.	Every six months	The ECO should monitor and report to the Holder of the EA.
Impact on animal behaviour	Avoid or minimize impacts that could potentially affect animal behaviour.	Restrict night driving during operational phase. Proper waste management procedures should be put in place. Ensure electrical fences are maintained according to standards of Nature Conservation Authorities. Appropriate lighting to be installed in construction camp.	Ensure compliance with these mitigation measures.	Every six months	The ECO should monitor and report to the Holder of the EA.
Illegal collecting of animals/plants	Avoid loss of SCC through illegal collecting.	Ensure proper access control.	Implement proper site access control.	Every six months	The ECO should monitor and report to the Holder of the EA.
Alien species invasion	Avoid invasion by alien species.	Implement a monitoring program for the early detection of alien invasive plant species and a control program to combat declared alien invasive plant species should be employed.	Ensure implementation of a control programme to combat alien invasive plants.	Every six months	The ECO should monitor and report to the Holder of the EA.
C. DECOMMISSIONING PHASE					
Clearance of vegetation	Minimize disturbance and clearance of vegetation.	Restrict driving to designated roads. No new roads to be built. Decommissioning camp to be located at the construction camp site. Any areas that will be denuded as a result of activities on site, should be re-vegetated (rehabilitated) as soon as possible to prevent soil erosion and establishment of alien invasive plant species. No alien species should be used in landscaping or rehabilitation on the sites.	Ensure that mitigation measures are enforced.	Every three months	The ECO should monitor and report to the Holder of the EA.
Impact on animal behaviour	Avoid or minimize impacts that could potentially affect animal behaviour.	No night driving during decommissioning phase. Proper waste management procedures should be put in place. All material brought in for the development should be removed.	Ensure compliance with these mitigation measures.	Every three months	The ECO should monitor and report to the Holder of the EA.
Increased dust levels	Avoid or minimize increased dust levels.	Dust control measures should be implemented.	Ensure that dust control measures are in place.	Every three months	The ECO should monitor and report to the Holder of the EA.

Impact	Mitigation / Management Objectives	Mitigation / Management Actions	Monitoring		
			Methodology	***Frequency***	***Responsibility***
Alien species invasion	Avoid invasion by alien species.	Implement a monitoring program for the early detection of alien invasive plant species and a control program to combat declared alien invasive plant species should be employed.	Ensure implementation of a control programme to combat alien invasive plants.	Every three months	The ECO should monitor and report to the Holder of the EA.

14. ADDENDUM: REVISED LAYOUT PLAN

All turbines that were partially or entirely located on rocky sheets or cliffs were moved to avoid the 'Very High' sensitive feature.

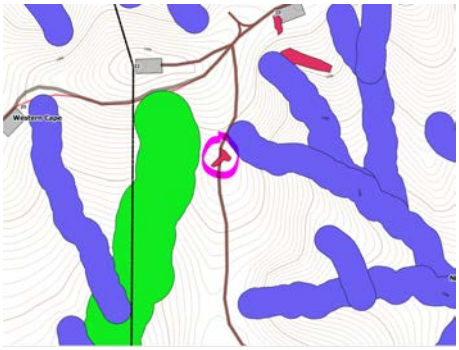
- Turbine #1: The crane pad was moved north of the turbine to avoid the area with a 'Very High' sensitivity. The turning roads have the same configuration than previously, but due to the rotation of the crane pad, it no longer overlaps with the sensitive area. No relocation of the turbine was needed.
- Turbine #3: The crane pad was moved to the east of the turbine and the road was moved south of the sensitive area. No relocation of the turbine was needed.
- Turbine #31: The crane pad was rotated towards the north and the access road shifted north to avoid crossing the sensitive area. No relocation of the turbine was needed.
- Turbine #35: The crane pad was rotated in order to avoid the sensitive area, but due to the complexity of the topography on the peak, its surface has been slightly increased to accommodate the turn for trucks. The turbine was shifted to the northwest.
- Turbine #36: The crane pad was rotated and the road rerouted to avoid the buffer zone of the vernal pool.
- Turbine #37: The crane pad was shifted southwest of the turbine and was rotated.
- Turbine #42: The crane pad was moved east of the turbine and the road shifted slightly south to accommodate the new crane pad.
- Turbine #22 was moved southward by 12 m. Road and crane pad have not been modified.

Changes to construction camp 1 and 2 as well as the common northern access road and Alternative 1 do not cross any of the features of 'Very High' sensitivity identified in the current report on the Kudusberg Terrestrial Ecology:

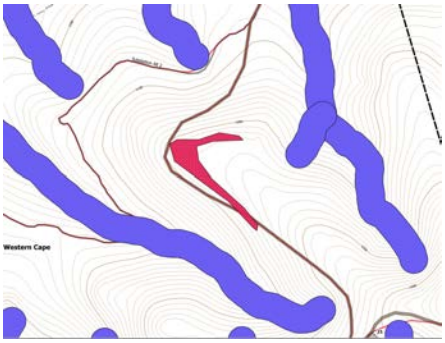
- Access road alternative 1 was rerouted to avoid heritage buffers.
- Layout of construction camp 1 and 2 was adjusted.
- Common northern access road was rerouted to avoid the farmstead buffer.

In four instances the revised road layout still either crossed or touched on a feature with very high sensitivity. These cases are explained below (colour codes; blue = buffers around small drainage lines; green = buffer around rivers; brown lines = rerouted roads; red lines = old road routes; red fill = very high ecology feature):

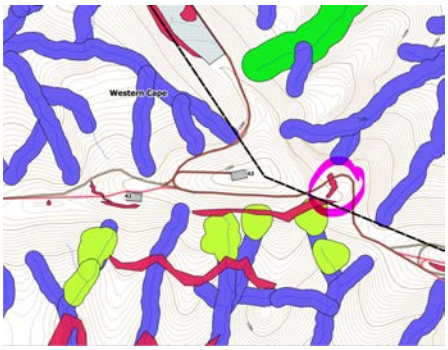
Case 1: This is not actually a rocky sheet or cliff, it is a patch with grey slate chips. These patches often contain two SCC viz. *Geissorhiza karooica* (Near Threatened) and *Zaluzianskya mirabilis* (Rare). Whenever these species occurred in this habitat, they were however, quite numerous. The road cannot be routed around the very high sensitive ecology feature (circled in pink) since the topography on that section is too steep. Rerouting will lengthen the road and cause more vegetation clearance and would additionally involve crossing of drainage lines. The current position of the road does therefore seem to be the most appropriate option.



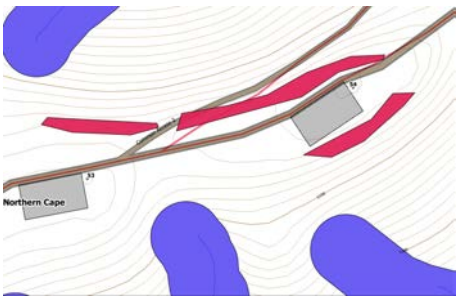
Case 2: The cliff has been mapped in red. The road crosses at a section that is less steep and there does not appear to be a suitable alternative since rerouting to the north or south involve extensive blasting to build the road. Should the road construction proceed all other mitigation measures regarding building of roads, mentioned in the impact assessment (Sections 10 and 11), should be applied.



Case 3: The road crosses the one end of a rocky sheet and once again there does not seem to be a suitable alternative with less impact to the environment or alternatively impacting one of the wetlands. Should the road construction proceed all other mitigation measures regarding building of roads, mentioned in the impact assessment (Sections 10 and 11), should be applied.



Case 5: The red areas mapped are cliffs. The road has been rerouted to follow the gap between the two cliffs. Should the road construction proceed all other mitigation measures regarding building of roads, mentioned in the impact assessment (Sections 10 and 11), should be applied.



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APPENDIX A

PLANT SPECIES CHECKLIST

CR = Critically Endangered; EN = Endangered; VU = Vulnerable; LC = Least concern; NT – Near Threatened; DD = Data Deficient; LC = Least Concern; Crit Rare = Critically Rare
Current study – refers to this report on the Kudusberg WEF
3220C – refers to the checklist for the 3220C quarter degree obtained from the NewPosa website of SANBI
NCNCA – Northern Cape Nature Conservation Act
WCNECO = Western Cape Nature and Environmental Conservation Ordinance
CITES = Convention on the International Trade in Endangered Species of Wild Fauna and Flora
ToPS = Threatened and Protected Species

Genus	Family	IUCN Threatened categories	Endemic or Near endemic	Current study	3220C	Van der Merwe *et al.* (2008a, 2008b)	Clark *et al.* (2011)	NCNCA	WCNECO	CITES	TOPS
Adenogramma glomerata	Crassulaceae	LC				x					
Adromischus humilis	Crassulaceae	RARE			x			2			
Adromischus marianiae var. immaculatus	Crassulaceae	NE			x			2			
Adromischus roaneanus	Crassulaceae	LC			x			2			
Aethephyllum pinnatifidum	Aizoaceae	LC					x	2			
Afroscirpoides dioeca	Cyperaceae	LC					x				
Agathosma sp. nov."roggeveldensis"	Rutaceae	-	End				x	2			
Albuca canadensis	Hyacinthaceae	LC		x							
Albuca concordiana	Hyacinthaceae	LC		x	x		x				
Albuca cooperi	Hyacinthaceae	LC					x				
Albuca namaquensis	Hyacinthaceae	LC			x		x				
Albuca sauveolens	Hyacinthaceae	LC					x				
Albuca setosa	Hyacinthaceae	LC					x				
Albuca spiralis	Hyacinthaceae	?		x							
Albuca viscosa	Hyacinthaceae	LC					x				
Allium synnotii	Alliaceae	LC					x				
Aloe microstigma	Asphodelaceae	LC		x				2	4	II	
Aloinopsis malherbei	Aizoaceae	LC	End				x	2	4		
Aloinopsis spathulata	Aizoaceae	LC	End				x	2	4		
Alonsoa unilabiata	Scrophulariaceae	LC		x	x		x				
Alyssum minutum	Brassicaceae	*		x			x				
Amellus strigosus	Asteraceae	LC					x				
Amellus tridactylus subsp. olivaceus	Asteraceae	LC			x						
Amphiglossa tomentosa	Asteraceae	LC		x							
Amsinckia retrorsa	Boraginaceae	*		x			x				
Anacampseros retusa	Anacampserotaceae	LC		x	x			2	4	II	
Anginon fruticosum	Apiaceae	LC					x	2			
Anginon verticillatum	Apiaceae	LC			x			2			
Anisodontea procumbens	Malvaceae	RARE			x						
Anisodontea triloba	Malvaceae	LC		x			x				
Annesorhiza altiscapa	Apiaceae	LC		x	x			2			
Anthospermum monticola	Rubiaceae	LC					x				
Anthospermum spathulatum subsp. spathulatum	Rubiaceae	LC CRIT					x				
Antimima androsacea	Aizoaceae	RARE	End				x	2	4		
Antimima cf. loganii	Aizoaceae	-					x	2	4		
Antimima dekenahi	Aizoaceae	LC	End				x	2	4		
Antimima distans	Aizoaceae	LC	Near End				x	2	4		
Antimima emarcescens	Aizoaceae	RARE	End				x	2	4		
Antimima granitica	Aizoaceae	LC				x		2	4		
Antimima ivori	Aizoaceae	LC	End				x	2	4		
Antimima lokenbergensis	Aizoaceae	LC	End				x	2	4		
Antimima prolongata	Aizoaceae	LC	End	x			x	2	4		
Antimima stayneri	Aizoaceae	LC	End		x			2	4		

Antimima subtruncata	Aizoaceae	DD	Near End				x	2	4	
Antimima viatorum	Aizoaceae	LC					x	2	4	
Aptosimum indivisum	Scrophulariaceae	LC		x			x			
Aptosimum spinescens	Scrophulariaceae	LC		x						
Arctotheca calendula	Asteraceae	LC		x		x	x			
Arctotheca prostrata	Asteraceae	LC					x			
Arctotis acaulis	Asteraceae	LC		x			x			
Arctotis arctotoides	Asteraceae	LC					x			
Arctotis diffusa	Asteraceae	LC					x			
Arctotis dregei	Asteraceae	LC		x	x					
Arctotis fastuosa	Asteraceae	LC		x						
Arctotis subacaulis	Asteraceae	LC		x	x					
Arctotis sulcocarpa	Asteraceae	LC	End		x		x			
Aristea cuspidata	Iridaceae	LC			x					
Aristida adscensionis	Poaceae	LC		x			x			
Aspalathus acicularis subsp. acicularis	Fabaceae	LC					x	2		
Asparagus asparagoides	Asparagaceae	LC		x			x			
Asparagus burchellii	Asparagaceae	LC					x			
Asparagus capensis	Asparagaceae	LC		x		x	x			
Asparagus declinatus	Asparagaceae	LC					x			
Asparagus exuvialis	Asparagaceae	NE		x			x			
Asparagus fasciculatus	Asparagaceae	LC			x					
Asparagus ferox	Asparagaceae	LC					x			
Asparagus juniperoides	Asparagaceae	LC		x						
Asparagus microraphis	Asparagaceae	LC					x			
Asparagus mollis	Asparagaceae	VU					x			
Asparagus mucronatus	Asparagaceae	LC					x			
Asparagus multituberosus	Asparagaceae	LC		x						
Asparagus retrofractus	Asparagaceae	LC		x	x		x			
Asparagus rubicundis	Asparagaceae	LC					x			
Asplenium cordatum	Aspleniaceae	LC		x	x		x			
Aster squamatus	Asteraceae	*					x			
Astroloba cf. foliolosa	Asphodelaceae	LC		x						
Astroloba bullulata	Asphodelaceae	LC			x			2		
Athanasia flexuosa	Asteraceae	LC			x					
Atriplex lindleyi	Chenopodiaceae	*				x				
Atriplex nummularia	Amaranthaceae	*		x						
Avena barbata	Poaceae	*					x			
Babiana cuneata	Iridaceae	LC		x	x			2	4	
Babiana flabellifolia	Iridaceae	LC	Near End				x	2	4	
Babiana mucronata subsp. mucronata	Iridaceae	LC			x			2	4	
Babiana praemorsa	Iridaceae	LC	End				x	2	4	
Babiana scariosa	Iridaceae	LC			x			2	4	
Babiana spathacea	Iridaceae	LC	End		x		x	2	4	
Babiana symmetrantha	Iridaceae	LC	End				x	2	4	
Babiana virginea	Iridaceae	RARE	End				x	2	4	
Ballota africana	Lamiaceae	LC		x	x		x			
Bartholina etheliae	Orchidaceae	LC			x			2	4	II
Berkheya cardopatifolia	Asteraceae	LC					x			
Berkheya carlinifolia	Asteraceae	LC					x			
Berkheya heterophylla	Asteraceae	LC		x						
Berkheya onobromoides	Asteraceae	LC		x						
Berkheya spinosa	Asteraceae	LC					x			
Berkheya spinosissima subsp. namaensis var. namaensis	Asteraceae	NE			x		x			
Bolandia elongata	Asteraceae	LC					x			
Bolandia cf pedunculosa	Asteraceae	-								
Bromus diandrus	Poaceae	*					x			
Bromus pectinatus	Poaceae	LC		x		x	x			
Bromus tectorum	Poaceae	*					x			
Brownanthus vaginatus	Aizoaceae	LC				x		2	4	
Brunsvigia bosmaniae	Amaryllidaceae	LC			x		x	2	4	
Brunsvigia comptonii	Amaryllidaceae	LC					x	2	4	
Brunsvigia sp.	Amaryllidaceae	-		x	x			2	4	
Buglossoides arvensis	Boraginaceae	*			x					
Bulbine abyssinica	Asphodelaceae	LC		x				2		
Bulbine asphodeloides	Asphodelaceae	LC					x	2		
Bulbine longifolia	Asphodelaceae	LC			x			2		
Bulbine praemorsa	Asphodelaceae	LC		x	x			2		
Bulbine succulenta	Asphodelaceae	LC		x		x		2		

Bulbine torta	Asphodelaceae	RARE		x	x		x	2	
Bulbinella elegans	Asphodelaceae	LC	Near End	x	x		x	2	
Bulbinella latifolia subsp. latifolia	Asphodelaceae	LC		x			x	2	
Bulbinella nutans	Asphodelaceae	LC		x			x	2	
Bulbinella triquetra	Asphodelaceae	LC			x			2	
Calobota pungens	Fabaceae	LC		x					
Capsella bursa-pastoris	Brassicaceae	*		x			x		
Carex acocksii	Cyperaceae	VU	End				x	2	
Carex divisa	Cyperaceae	*					x		
Cenchrus ciliaris	Poaceae	LC					x		
Cephalophyllum sp.	Aizoaceae	-		x		x		2	4
Cerastium capense	Caryophyllaceae	LC					x		
Chaenostoma caeruleum	Scrophulariaceae	LC		x					
Chaenostoma violaceum	Scrophulariaceae	LC					x		
Chaetobromus involucratus subsp. dregeanus	Poaceae	LC					x		
Chamarea sp.	Apiaceae	-			x			2	
Cheilanthes capensis	Pteridaceae	LC		x	x		x		
Cheilanthes hastata	Pteridaceae	LC			x		x		
Cheilanthes induta	Pteridaceae	LC					x		
Cheiridopsis namaquensis	Aizoaceae	LC		x	x		x	2	4
Chenopodium album	Chenopodiaceae	*					x		
Chenopodium murale	Chenopodiaceae	*					x		
Chlorophytum undulatum	Agavaceae	LC		x			x		
Chrysocoma ciliata	Asteraceae	LC		x	x	x	x		
Cineraria alchemilloides subsp alchemilloides	Asteraceae	LC					x		
Cineraria platycarpa	Asteraceae	LC			x				
Cineraria vallis-pacis	Asteraceae	LC					x		
Cleretum bellidiforme	Aizoaceae	LC					x	2	4
Cleretum booysenii	Aizoaceae	LC					x	2	4
Cleretum lyratifolium	Aizoaceae	RARE		x			x	2	4
Cleretum maughanii	Aizoaceae	LC				x		2	4
Cleretum papulosum subsp. papulosum	Aizoaceae	LC		x			x	2	4
Cliffortia arborea	Rosaceae	VU	End				x	1	
Cliffortia hantamensis	Rosaceae	LC					x		
Cliffortia ramosissima	Rosaceae	LC					x		
Codon royenii	Boraginaceae	LC					x		
Colchicum coloratum	Colchicaceae	?		x			x	2	
Colchicum coloratum subsp. burchellii	Colchicaceae	LC			x			2	
Colchicum crispum	Colchicaceae	LC	End				x	2	
Colchicum cuspidatum	Colchicaceae	LC	End	x			x	2	
Colchicum cf eucomoides	Colchicaceae			x				2	
Colchicum hantamense	Colchicaceae	LC	End				x	2	
Colchicum cf. latifolium	Colchicaceae	-		x				2	
Colchicum praeirroratum	Colchicaceae	LC	End				x	2	
Colchicum volutare	Colchicaceae	LC		x	x			2	
Conium sphaerocarpum	Apiaceae	LC					x	2	
Conophytum sp	Aizoaceae	-		x				2	4
Conyza scabrida	Asteraceae	NE					x		
Cotula coronopifolia	Asteraceae	LC		x			x		
Cotula leptalea	Asteraceae	LC		x					
Cotula microglossa	Asteraceae	LC		x		x	x		
Cotula nudicaulis	Asteraceae	LC		x		x			
Cotyledon orbiculata	Crassulaceae	LC		x			x	2	
Crassula alpestris	Crassulaceae	LC				x		2	
Crassula barbata	Crassulaceae	LC		x				2	
Crassula columnaris subsp. columnaris	Crassulaceae	LC		x	x			2	
Crassula corallina	Crassulaceae	LC					x	2	
Crassula cf. cotyledonis	Crassulaceae	LC		x				2	
Crassula cultrata	Crassulaceae	LC					x	2	
Crassula deltoidea	Crassulaceae	LC		x	x			2	
Crassula dependens	Crassulaceae	LC					x	2	
Crassula glomerata	Crassulaceae	LC		x				2	
Crassula muscosa	Crassulaceae	NE		x				2	
Crassula natans var. natans	Crassulaceae	LC					x	2	
Crassula nemorosa	Crassulaceae	LC					x	2	
Crassula pageae	Crassulaceae	LC		x	x			2	
Crassula pyramidalis	Crassulaceae	LC		x				2	

Crassula roggeveldii	Crassulaceae	RARE	End		x		x	2		
Crassula rupestris	Crassulaceae	LC		x				2		
Crassula sarcocaulis subsp. sarcocaulis	Crassulaceae	LC		x			x	2		
Crassula sebaeoides	Crassulaceae	LC		x				2		
Crassula subaphylla	Crassulaceae	LC		x				2		
Crassula thunbergiana subsp. thunbergiana	Crassulaceae	LC		x	x			2		
Crassula tomentosa var. glabrifolia	Crassulaceae	NE			x			2		
Crassula umbella	Crassulaceae	LC		x				2		
Crassula vestita	Crassulaceae	RARE	End				x	2		
Crassula cf. vaillantii	Crassulaceae	-		x				2		
Cromidon austerum	Scrophulariaceae	LC	Near End				x			
Cromidon corrigioloides	Scrophulariaceae	LC		x			x			
Cromidon decumbens	Scrophulariaceae	LC	Near End		x		x			
Cromidon plantaginis	Scrophulariaceae	LC	Near End				x			
Cromidon varicalyx	Scrophulariaceae	LC	End			x	x			
Cucumis sp.	Cucurbitaceae	-		x						
Curio radicans	Asteraceae	LC		x			x			
Cyanella hyacinthoides L.	Tecophilaeaceae	LC					x	2		
Cyanella lutea	Tecophilaeaceae	LC		x	x		x	2		
Cyphia digitata	Lobeliaceae	LC		x		x				
Cysticapnos vesicaria subsp. vesicaria	Fumariaceae	LC		x	x		x			
Daubenya alba	Hyacinthaceae	NE	End				x	2		
Daubenya aurea	Hyacinthaceae	EN	End				x	2	4	
Delosperma subincanum	Aizoaceae	LC					x	2	4	
Delosperma acocksii	Aizoaceae	LC	End				x	2	4	
Delosperma sp.	Aizoaceae	-			x			2	4	
Delosperma sphalmantoides	Aizoaceae	VU	End				x	2	4	
Deverra denudata	Apiaceaee	LC		x						
Devia xeromorpha	Iridaceae	RARE	End				x	2	4	
Dianthus laingsburgensis	Caryophyllaceae	LC					x			
Dianthus namaensis	Caryophyllaceae	LC		x						
Diascia cardiosepala	Scrophulariaceae	LC	End				x	2	4	
Diascia dissimulans	Scrophulariaceae	LC	End				x	2	4	
Diascia floribunda (unresolved name)	Scrophulariaceae	?	End				x	2	4	
Diascia fragrans	Scrophulariaceae	LC	End		x			2	4	
Diascia hexensis	Scrophulariaceae	LC			x			2	4	
Diascia lewisiae	Scrophulariaceae	VU	End				x	2	4	
Diascia macrophylla	Scrophulariaceae	LC	End	x	x			2	4	
Diascia nana	Scrophulariaceae	LC	End	x	x		x	2	4	
Diascia parviflora	Scrophulariaceae	LC		x	x		x	2	4	
Diascia sacculata	Scrophulariaceae	LC			x			2	4	
Diascia sp.	Scrophulariaceae	-			x			2	4	
Dicerothamnus rhinocerotis	Asteraceae	LC		x		x	x			
Dicoma capensis	Asteraceae	LC			x					
Dicoma picta	Asteraceae	LC		x						
Didelta spinosa	Asteraceae	LC				x				
Dimorphotheca cuneata	Asteraceae	LC		x		x	x			
Dimorphotheca sinuata	Asteraceae	LC				x				
Dipcadi brevifolium	Hyacinthaceae	LC		x						
Diospyros austro-africana	Ebenaceae	LC		x			x			
Disa conferta	Orchidaceae	LC			x			2	4	II
Dischisma sp.	Scrophulariaceae	-			x					
Disperis purpurata subsp. purpurata	Orchidaceae	LC		x	x		x	2	4	II
Dodonaea viscosa var. angustifolia	Sapindaceae	LC					x			
Drimia capensis	Hyacinthaceae	LC		x	x					
Drimia marginata	Hyacinthaceae	LC	Near End				x			
Drimia physodes	Hyacinthaceae	LC					x			
Drosanthemum eburneum	Aizoaceae	DD	End		x		x	2	4	
Drosanthemum floribundum	Aizoaceae	LC	End		x		x	2	4	
Drosanthemum hispidum	Aizoaceae	LC					x	2	4	
Drosanthemum latipetalum	Aizoaceae	LC				x		2	4	
Ehrharta calycina	Poaceae	LC		x			x			
Ehrharta delicatula	Poaceae	LC		x			x			
Ehrharta eburnea	Poaceae	NT	End				x			
Ehrharta longiflora	Poaceae	LC		x	x		x			
Ehrharta melicoides	Poaceae	LC		x		x	x			
Ehrharta triandra	Poaceae	LC					x			
Empodium plicatum	Hypoxidaceae	LC			x		x			
Enneapogon scaber	Poaceae	LC			x		x			

Erica sp.	Ericaceae	-			x					
Eriocephalus ericoides subsp. ericoides	Asteraceae	LC		x	x	x	x			
Eriocephalus africanus	Asteraceae	LC		x						
Eriocephalus decussatus	Asteraceae	LC		x		x				
Eriocephalus grandiflorus	Asteraceae	RARE		x	x					
Eriocephalus microphyllus	Asteraceae	LC		x		x				
Eriocephalus purpureus	Asteraceae	LC	End	x	x	x	x			
Eriospermum capense	Ruscaceae	?		x						
Eriospermum cf. alcicorne	Ruscaceae	-		x						
Eriospermum paradoxum	Ruscaceae	LC		x						
Eriospermum lanimarginatum	Ruscaceae	LC	End				x			
Erodium cicutarium	Geraniaceae	LC		x		x	x			
Erodium moschatum	Geraniaceae	*		x						
Eucomis regia	Hyacinthaceae	LC					x	2		
Euphorbia cylindrica	Euphorbiaceae	LC	Near End				x	2		II
Euphorbia loricata	Euphorbiaceae	LC		x			x	2		II
Euphorbia mauritanica	Euphorbiaceae	LC		x		x	x	2		II
Euphorbia multiceps	Euphorbiaceae	LC		x				2		II
Euphorbia muricata	Euphorbiaceae	LC			x		x	2		II
Euphorbia rhombifolia	Euphorbiaceae	LC		x				2		II
Euphorbia stolonifera	Euphorbiaceae	LC		x		x		2		II
Euphorbia tenax	Euphorbiaceae	LC			x			2		II
Euryops annuus	Asteraceae	LC				x				
Euryops imbricatus	Asteraceae	LC		x			x			
Euryops lateriflorus	Asteraceae	LC		x	x	x	x			
Euryops marlothii	Asteraceae	RARE	End				x			
Euryops multifidus	Asteraceae	LC		x	x					
Euryops sp. nov. (Nordenstam, pers. comm.)	Asteraceae	-					x			
Euryops trifidus	Asteraceae	LC					x			
Felicia australis	Asteraceae	LC		x		x	x			
Felicia dregei	Asteraceae	LC			x					
Felicia dubia	Asteraceae	LC			x					
Felicia filifolia	Asteraceae	LC		x		x	x			
Felicia hirsuta	Asteraceae	LC		x			x			
Felicia macrorhiza	Asteraceae	LC		x			x			
Felicia muricata	Asteraceae	LC		x						
Felicia odorata	Asteraceae	LC		x	x					
Felicia ovata	Asteraceae	LC					x			
Felicia scabrida	Asteraceae	LC					x			
Festuca scabra	Poaceae	LC				x				
Fingerhuthia africana	Poaceae	LC		x	x		x			
Fockea comaru	Apocynaceae	LC		x				2	4	
Forsskaolea candida	Urticaceae	LC					x			
Foveolina dichotoma	Asteraceae	LC		x		x				
Galenia affinis	Aizoaceae	LC			x			2	4	
Galenia africana	Aizoaceae	LC		x	x	x	x	2	4	
Galenia fruticosa	Aizoaceae	LC			x	x		2	4	
Galenia filiformis	Aizoaceae	LC		x				2	4	
Galenia sarcophylla	Aizoaceae	LC				x	x	2	4	
Galenia secunda	Aizoaceae	LC			x			2	4	
Galeomma oculus-cati	Asteraceae	LC	End	x			x			
Galium spurium subsp. africanum	Rubiaceae	LC		x			x			
Gazania heterochaeta	Asteraceae	LC		x						
Gazania lichtensteinii	Asteraceae	LC		x		x				
Gazania rigida	Asteraceae	LC		x		x				
Gazania serrata	Asteraceae	LC					x			
Geissorhiza cantharophila	Iridaceae	LC		x	x			2	4	
Geissorhiza heterostyla	Iridaceae	LC		x	x		x	2	4	
Geissorhiza karrooica	Iridaceae	NT		x			x	2	4	
Geissorhiza spiralis	Iridaceae	VU					x	2	4	
Gethyllis pectinata	Amaryllidaceae	VU	End				x	2	4	
Gethyllis roggeveldensis	Amaryllidaceae	LC	End		x		x	2	4	
Gethyllis uteana	Amaryllidaceae	DD			x			2	4	
Gladiolus dolichosiphon	Iridaceae	LC					x	2	4	
Gladiolus involutus	Iridaceae	LC			x			2	4	
Gladiolus karooica	Iridaceae	LC					x	2	4	
Gladiolus marlothii	Iridaceae	LC	End		x		x	2	4	
Gladiolus orchidiflorus	Iridaceae	LC					x	2	4	
Gladiolus permeabilis	Iridaceae	LC		x	x			2	4	

Gladiolus pritzelii	Iridaceae	LC	Near End				x	2	4
Gladiolus splendens	Iridaceae	LC	Near End	x	x		x	2	4
Gladiolus uysiae	Iridaceae	LC	Near End	x	x			2	4
Gladiolus venustus	Iridaceae	LC		x	x		x	2	4
Gnidia sp.	Thymelaeaceae	-			x				
Gomphocarpus cancellatus	Apocynaceae	LC					x	2	4
Gomphocarpus fruticosus	Apocynaceae	LC		x				2	4
Gomphostigma incomptum	Scrophulariaceae	LC					x		
Gomphostigma virgatum	Scrophulariaceae	LC					x		
Gorteria diffusa	Asteraceae	LC				x			
Haemanthus barkerae	Amaryllidaceae	LC					x	2	4
Haemanthus coccineus	Amaryllidaceae	LC		x	x		x	2	4
Hammeria gracilis	Aizoaceae	LC	End				x	2	4
Hammeria meleagris	Aizoaceae	LC			x		x	2	4
Haworthia arachnoidea var. arachnoidea	Asphodelaceae	NE			x			2	4
Haworthia semiviva	Asphodelaceae	LC	End				x	2	4
Haworthiopsis granulata	Asphodelaceae	LC			x			2	
Hebenstretia robusta	Scrophulariaceae	LC		x	x				
Helichrysum aureofolium	Asteraceae	IC		x					
Helichrysum asperum	Asteraceae	IC		x		x			
Helichrysum cf. tysonii	Asteraceae	-					x		
Helichrysum hamulosum	Asteraceae	LC		x			x		
Helichrysum hebelepis	Asteraceae	LC			x				
Helichrysum herniarioides	Asteraceae	LC			x				
Helichrysum leontonyx	Asteraceae	LC		x	x				
Helichrysum obtusum	Asteraceae	LC		x		x			
Helichrysum revolutum	Asteraceae	LC		x	x		x		
Helichrysum trilineatum	Asteraceae	LC					x		
Helictotrichon barbatum	Poaceae	VU	Near End				x		
Helictotrichon namaquense	Poaceae	VU	End				x		
Heliophila amplexicaule	Brassicaceae	LC		x					
Heliophila carnosa	Brassicaceae	LC		x			x		
Heliophila crithmifolia	Brassicaceae	LC			x				
Heliophila pectinata	Brassicaceae	LC			x		x		
Heliophila pubescens	Brassicaceae	LC	End				x		
Heliophila suavissima	Brassicaceae	LC					x		
Heliophila suborbicularis	Brassicaceae	LC					x		
Heliophila thunbergii	Brassicaceae	LC					x		
Heliophila variabilis	Brassicaceae	LC		x					
Hemimeris centrodes	Scrophulariaceae	LC	End	x	x		x		
Hemimeris racemosa	Scrophulariaceae	LC					x		
Hemimeris sabulosa	Scrophulariaceae	LC					x		
Hermannia althaeifolia	Malvaceae	LC		x			x		
Hermannia cernua	Malvaceae	LC					x		
Hermannia coccocarpa	Malvaceae	LC		x			x		
Hermannia cuneifolia	Malvaceae	LC		x	x	x	x		
Hermannia desertorum	Malvaceae	LC			x				
Hermannia grandiflora	Malvaceae	LC		x			x		
Hermannia incana	Malvaceae	LC			x				
Hermannia jacobeifolia	Malvaceae	LC					x		
Hermannia johanssenii	Malvaceae	LC	End				x		
Hermannia sp.	Malvaceae	-			x				
Hesperantha acuta	Iridaceae	LC			x			2	4
Hesperantha acuta subsp. acuta	Iridaceae	LC			x		x	2	4
Hesperantha bachmannii	Iridaceae	LC		x	x		x	2	4
Hesperantha cucullata	Iridaceae	LC	Near End	x	x		x	2	4
Hesperantha hantamensis	Iridaceae	VU	End				x	2	4
Hesperantha humilis	Iridaceae	LC			x		x	2	4
Hesperantha karooica	Iridaceae	DD	End				x	2	4
Hesperantha marlothii	Iridaceae	LC					x	2	4
Hesperantha palustris	Iridaceae	?			x			2	4
Hesperantha pilosa	Iridaceae	LC		x	x			2	4
Hesperantha pseudopilosa	Iridaceae	LC	Near End				x	2	4
Hesperantha purpurea	Iridaceae	VU	End				x	2	4
Hesperantha quadrangula	Iridaceae	LC	End				x	2	4
Hesperantha radiata	Iridaceae	LC					x	2	4
Hesperantha sp.	Iridaceae	-			x			2	4
Hesperantha teretifolia	Iridaceae	RARE	End				x	2	4
Hirpicium alienatum	Asteraceae	LC		x		x	x		

Holothrix aspera	Orchidaceae	LC		x	x			2	4	II
Holothrix secunda	Orchidaceae	LC		x				2	4	II
Holothrix villosa var. villosa	Orchidaceae	LC			x			2	4	II
Hoodia gordonii	Apocynaceae	DD					x	1	4	II
Hordeum murinum subsp. glaucum	Poaceae	*		x			x			
Hordeum murinum subsp. leporinum	Poaceae	*					x			
Huernia humilis	Apocynaceae	LC					x	2	4	
Hyobanche rubra	Orobanchaceae	LC					x			
Hyobanche sanguinea	Orobanchaceae	LC		x			x			
Hyparrhenia hirta	Poaceae	LC					x			
Ifloga decumbens	Asteraceae	LC					x			
Ifloga sp.	Asteraceae	-		x						
Indigofera heterophylla	Fabaceae	LC			x					
Indigofera meyeriana	Fabaceae	LC		x	x		x			
Isolepis angelica	Cyperaceae	LC					x			
Isolepis brevicaulis	Cyperaceae	LC			x					
Isolepis costata	Cyperaceae	LC					x			
Ixia brevituba	Iridaceae	RARE	End				x	2	4	
Ixia curvata	Iridaceae	LC	End				x	2	4	
Ixia lacerata	Iridaceae	LC			x			2	4	
Ixia marginifolia	Iridaceae	LC			x		x	2	4	
Ixia rapunculoides	Iridaceae	LC	End	x			x	2	4	
Ixia rivulicola	Iridaceae	VU	End				x	2	4	
Ixia sobolifera subsp. sobolifera	Iridaceae	LC					x	2	4	
Ixia thomasiae	Iridaceae	EN	End				x	2	4	
Ixia trifolia	Iridaceae	LC			x		x	2	4	
Jamesbrittenia incisa	Scrophulariaceae	VU	End				x	2		
Jamesbrittenia thunbergii	Scrophulariaceae	LC	Near End		x			2		
Lachenalia bolusii	Hyacinthaceae	LC		x				2	4	
Lachenalia comptonii	Hyacinthaceae	LC		x	x		x	2	4	
Lachenalia congesta	Hyacinthaceae	?	End				x	2	4	
Lachenalia isopetala	Hyacinthaceae	LC	End				x	2	4	
Lachenalia longituba	Hyacinthaceae	VU					x	2	4	
Lachenalia marlothii	Hyacinthaceae	LC	End	x			x	2	4	
Lachenalia multifolia	Hyacinthaceae	LC					x	2	4	
Lachenalia schelpei	Hyacinthaceae	VU	End				x	2	4	
Lachenalia sp. nov.	Hyacinthaceae	-					x	2	4	
Lachenalia whitehillensis	Hyacinthaceae	NT	End	x	x		x	2	4	
Lacomucina lineata	Santalaceae	LC		x		x	x			
Lampranthus sp.	Aizoaceae	-		x	x			2	4	
Lapeirousia montana	Iridaceae	LC	End		x		x	2	4	
Lapeirousia oreogena	Iridaceae	LC	End				x	2	4	
Lapeirousia plicata	Iridaceae	LC		x				2	4	
Lasiopogon muscoides	Asteraceae	LC		x						
Lasiospermum brachyglossum	Asteraceae	LC		x						
Lasiospermum pedunculare	Asteraceae	LC		x			x			
Lasiospermum poterioides	Asteraceae	LC	End				x			
Leipoldtia schultzei	Aizoaceae	LC		x	x	x	x	2	4	
Leipoldtia sp.	Aizoaceae	-		x	x			2	4	
Lepidium transvaalense	Brassicaceae	LC					x			
Lessertia annularis	Fabaceae	LC			x					
Lessertia falciformis	Fabaceae	LC			x					
Lessertia frutesens	Fabaceae	LC		x			x	1		
Leucospermum oleifolium	Proteaceae	LC			x					
Leysera gnaphaloides	Asteraceae	LC		x		x	x			
Leysera tenella	Asteraceae	LC		x	x	x	x			
Limosella sp.	Scrophulariaceae	-		x						
Lithospermum scabrum	Boraginaceae	LC		x			x			
Lobostemon echioides	Boraginaceae	LC					x			
Lolium temulentum var. temulentum	Poaceae	*					x			
Lophochloa pumila	Poaceae	NE			x					
Lotononis falcata	Fabaceae	LC			x					
Lotononis leptoloba	Fabaceae	LC		x	x					
Lotononis parviflora	Fabaceae	LC		x	x					
Lotononis pungens	Fabaceae	LC					x			
Lotononis sparsiflora	Fabaceae	LC			x					
Lotononis venosa	Fabaceae	VU	End				x			
Ludwigia octovalvis	Fabaceae	LC					x			
Lycium amoenum	Solanaceae	LC		x	x		x			
Lycium cinereum	Solanaceae	LC		x			x			

Lycium horridum	Solanaceae	LC		x	x		x		
Lycium oxycarpum	Solanaceae	LC		x	x		x		
Lycium pilifolium	Solanaceae	LC		x			x		
Lyperia tenuiflora	Scrophulariaceae	LC			x				
Lyperia tristis	Scrophulariaceae	LC		x			x		
Malephora crassa	Aizoaceae	LC				x	x	2	4
Malva parviflora	Malvaceae	*		x					
Manochlamys albicans	Amaranthaceae	LC		x					
Manulea cf. cheiranthus	Scrophulariaceae			x					
Manulea diandra	Scrophulariaceae	LC					x	2	
Manulea incana	Scrophulariaceae	DD	End				x	2	
Massonia depressa	Hyacinthaceae	LC		x			x		
Massonia echinata	Hyacinthaceae	LC		x					
Medicago laciniata var. laciniata	Fabaceae	*			x				
Medicago polymorpha	Fabaceae	*					x		
Melasphaerula graminea	Iridaceae	LC					x	2	4
Melianthus comosus	Melianthaceae	LC		x					
Melianthus major	Melianthaceae	LC					x		
Melolobium candicans	Fabaceae	LC			x		x		
Mentha longifolia subsp. capensis	Lamiaceae	LC			x		x		
Mesembryanthemum amabile	Aizoaceae	LC	End				x	2	4
Mesembryanthemum coriarium	Aizoaceae	LC			x			2	4
Mesembryanthemum crystallinum	Aizoaceae	LC					x	2	4
Mesembryanthemum dinteri	Aizoaceae	LC			x			2	4
Mesembryanthemum emarcidum	Aizoaceae	?		x	x			2	4
Mesembryanthemum eurycidum	Aizoaceae	LC			x			2	4
Mesembryanthemum granulicaule	Aizoaceae	LC					x	2	4
Mesembryanthemum guerichianum	Aizoaceae	LC				x		2	4
Mesembryanthemum junceum	Aizoaceae	LC			x			2	4
Mesembryanthemum nitidum	Aizoaceae	LC			x			2	4
Mesembryanthemum nodiflorum	Aizoaceae	LC		x	x	x		2	4
Mesembryanthemum splendens subsp pentagonum	Aizoaceae	LC			x			2	4
Mesembryanthemum subtruncatum	Aizoaceae	LC			x			2	4
Mesembryanthemum tenuiflorum	Aizoaceae	VU				x		2	4
Mesembryanthemum tetragonum	Aizoaceae	LC			x			2	4
Mesembryanthemum tortuosum	Aizoaceae	LC		x	x			2	4
Microloma sagittatum	Apocynaceae	LC		x	x		x	2	4
Mikaniopsis cissampelina	Asteraceae	LC			x				
Monechma spartioides	Acanthaceae	LC					x		
Monsonia crassicaulis	Geraniaceae	LC		x			x		
Monsonia cf. salmoniflora	Geraniaceae	LC		x					
Montinia caryophyllacea	Montiniaceae	LC			x	x	x		
Moraea amabilis	Iridaceae	LC		x	x			2	4
Moraea ciliata	Iridaceae	LC			x		x	2	4
Moraea contorta	Iridaceae	RARE		x	x			2	4
Moraea cookii	Iridaceae	LC					x	2	4
Moraea crispa	Iridaceae	LC		x	x			2	4
Moraea cuspidata	Iridaceae	LC		x	x			2	4
Moraea falcifolia	Iridaceae	LC		x				2	4
Moraea fenestrata	Iridaceae	RARE			x			2	4
Moraea fistulosa	Iridaceae	LC CRIT	End				x	2	4
Moraea marginata	Iridaceae	RARE	End				x	2	4
Moraea miniata	Iridaceae	LC		x	x		x	2	4
Moraea pritzeliana	Iridaceae	LC	Near End	x	x		x	2	4
Moraea reflexa	Iridaceae	LC	End				x	2	4
Moraea virgata subsp. karooica	Iridaceae	RARE	End				x	2	4
Muraltia horrida	Polygalaceae	LC					x		
Muraltia macrocarpa	Polygalaceae	LC			x				
Muraltia spinosa	Polygalaceae	LC			x				
Nemesia anisocarpa	Scrophulariaceae	LC		x	x			2	
Nemesia azurea	Scrophulariaceae	LC					x	2	
Nemesia platysepala	Scrophulariaceae	LC					x	2	
Nemesia leipoldtii	Scrophulariaceae	LC		x				2	
Nenax cinerea	Rubiaceae	LC		x			x		
Nenax microphylla	Rubiaceae	LC					x		
Octopoma nanum	Aizoaceae	VU					x	2	4
Oedera genistifolia	Asteraceae	LC		x		x	x		
Oncosiphon grandiflorum	Asteraceae	LC				x			

Oncosiphon piluliferum	Asteraceae	LC				x		
Oncosiphon suffruticosum	Asteraceae	LC		x		x		
Ophioglossum sp.				x				
Ornithogalum corticatum	Hyacinthaceae	LC	End		x	x	2	
Ornithogalum dubium	Hyacinthaceae	LC		x	x		2	
Ornithogalum hispidum subsp. hispidum	Hyacinthaceae	LC		x		x	2	
Ornithogalum maculatum	Hyacinthaceae	LC				x	2	
Ornithogalum multifolium	Hyacinthaceae	LC		x			2	
Ornithogalum niveum	Hyacinthaceae	DD				x	2	
Ornithogalum pruinosum	Hyacinthaceae	LC				x	2	
Ornithogalum pullatum	Hyacinthaceae	LC	End			x	2	
Ornithogalum rupestre	Hyacinthaceae	LC				x	2	
Ornithogalum strictum	Hyacinthaceae	LC				x	2	
Ornithoglossum undulatum	Colchicaceae	LC		x	x		2	
Ornithoglossum vulgare	Colchicaceae	LC		x			2	
Osteospermum aghillana	Asteraceae	LC		x				
Osteospermum incanum	Asteraceae	LC				x		
Osteospermum rigidum	Asteraceae	LC				x		
Osteospermum scariosum	Asteraceae	LC		x		x	x	
Osteospermum sinuatum	Asteraceae	LC		x	x	x		
Osteospermum sinuatum var lineare	Asteraceae	LC				x	x	
Osteospermum sp.	Asteraceae	-			x			
Osteospermum spinescens	Asteraceae	LC				x		
Othonna auriculifolia	Asteraceae	LC		x		x		
Crassothonna cylindrica	Asteraceae	LC		x				
Crassothonna rechingeri	Asteraceae	LC		x				
Crassothonna sedifolia	Asteraceae	LC		x				
Oxalis capillacea	Oxalidaceae	LC			x		2	
Oxalis heterophylla	Oxalidaceae	LC				x	2	
Oxalis hirsuta	Oxalidaceae	DD	End			x	2	
Oxalis lineolata	Oxalidaceae	EN			x		2	
Oxalis marlothii	Oxalidaceae	EN	End			x	2	
Oxalis melanosticta	Oxalidaceae	LC		x	x	x	2	
Oxalis neglecta (unresolved name)	Oxalidaceae	-	End			x	2	
Oxalis obtusa	Oxalidaceae	LC		x		x	x	2
Oxalis odorata	Oxalidaceae	LC	End			x	2	
Oxalis palmifrons	Oxalidaceae	LC		x		x	2	
Oxalis pardalis	Oxalidaceae	DD			x		2	
Oxalis pes-caprae var. pes-caprae	Oxalidaceae	LC		x		x	2	
Oxalis pocockiae	Oxalidaceae	LC				x	2	
Oxalis purpurea	Oxalidaceae	LC				x	2	
Oxalis sp. aff. strigosa	Oxalidaceae	-	End			x	2	
Oxalis sp. no. 1	Oxalidaceae	-				x	2	
Parapholis incurva	Poaceae	NE			x			
Pauridia alticola	Hypoxidaceae	NT				x		
Pauridia capensis	Hypoxidaceae	LC		x		x		
Pauridia sp.	Hypoxidaceae			x				
Pauridia ovata	Hypoxidaceae	LC			x			
Pauridia serrata	Hypoxidaceae	LC				x		
Pectinaria articulata	Apocynaceae	RARE	End	x		x	2	4
Pectinaria longipes subsp. longipes	Apocynaceae	LC	End			x	2	4
Peersia macradenia	Aizoaceae	LC			x		2	
Pelargonium abrotanifolium	Geraniaceae	LC		x	x	x	1	
Pelargonium carnosum subsp carnosum	Geraniaceae	LC		x	x		1	
Pelargonium crithmifolium	Geraniaceae	LC		x	x	x	1	
Pelargonium githagineum	Geraniaceae	LC	End			x	1	
Pelargonium grandicalcaratum	Geraniaceae	LC		x			1	
Pelargonium hystrix	Geraniaceae	LC			x		1	
Pelargonium karooicum	Geraniaceae	LC		x			1	
Pelargonium longiflorum	Geraniaceae	NE		x				
Pelargonium magenteum	Geraniaceae	LC		x	x	x	1	
Pelargonium minimum	Geraniaceae	LC		x			1	
Pelargonium punctatum	Geraniaceae	LC				x	1	
Pelargonium sp.	Geraniaceae	-			x		1	
Pelargonium torulosum	Geraniaceae	RARE				x	1	
Pellaea rufa	Pteridaceae	LC				x		
Pentameris airoides subsp. airoides	Poaceae	LC		x	x	x		
Pentameris sp.	Poaceae	-		x				

Pentameris triseta	Poaceae	LC					x				
Pentzia incana	Asteraceae	LC		x		x	x				
Pentzia sphaerocephala	Asteraceae	LC				x					
Pentzia spinescens	Asteraceae	LC				x	x				
Pharnaceum aurantium	Molluginaceae	LC		x		x	x				
Pharnaceum incanum	Molluginaceae	LC					x				
Phragmites australis subsp. altissimus	Poaceae	LC		x			x				
Phyllopodium anomalum	Scrophulariaceae	LC			x			2			
Piaranthus geminatus subsp. geminatus	Apocynaceae	LC			x			2	4		
Piaranthus parvulus	Apocynaceae	LC						2	4		
Plantago cafra	Plantaginaceae	LC		x	x		x				
Poa bulbosa	Poaceae	LC			x		x				
Polhillia involucrata	Fabaceae	EN	End				x	2			
Polycarena aurea	Scrophulariaceae	LC	Near End	x		x	x				
Polycarena sp.	Scrophulariaceae	-			x						
Polygala cf. ephedroides	Polygalaceae	-					x				
Polygala scabra	Polygalaceae	LC		x		x					
Polypogon monspeliensis	Poaceae	*					x				
Pseudognaphalium luteo-album subsp. luteo-album	Asteraceae	LC					x				
Pseudoschoenus inanis	Cyperaceae	LC					x				
Pteronia aspalatha	Asteraceae	LC		x							
Pteronia ciliata	Asteraceae	LC		x							
Pteronia divaricata	Asteraceae	LC					x				
Pteronia empetrifolia	Asteraceae	LC		x	x						
Pteronia glabrata	Asteraceae	LC				x					
Pteronia glauca	Asteraceae	LC		x							
Pteronia glomerata	Asteraceae	LC		x	x	x	x				
Pteronia incana	Asteraceae	LC		x	x		x				
Pteronia membranacea	Asteraceae	LC			x						
Pteronia oblanceolata	Asteraceae	LC		x	x						
Pteronia pallens	Asteraceae	LC		x	x	x	x				
Pteronia quinqueflora	Asteraceae	DD					x				
Pteronia sordida	Asteraceae	LC		x							
Pterygodium catholicum	Orchidaceae	LC		x						II	
Pterygodium deflexum	Orchidaceae	LC					x			II	
Pterygodium hallii	Orchidaceae	LC		x	x		x			II	
Pterygodium schelpei	Orchidaceae	LC			x		x			II	
Pterygodium volucris	Orchidaceae	LC			x					II	
Quaqua arenicola	Apocynaceae	LC	End				x	2	4		
Quaqua parviflora subsp. gracilis	Apocynaceae	LC	End		x			2	4		
Ranunculus aquatilis	Ranunculaceae	-					x				
Ranunculus multifidus	Ranunculaceae	LC					x				
Restio distractus	Restionaceae	LC					x				
Restio laniger	Restionaceae	LC					x				
Rhynchopsidium sessiliflorum	Asteraceae	LC		x	x						
Roepera pygmaea	Zygophyllaceae	LC		x			x				
Romulea alba	Iridaceae	-					x	2	4		
Romulea albiflora	Iridaceae	CR	End				x	2	4		Crit end
Romulea atrandra var. atrandra	Iridaceae	LC		x	x		x	2	4		
Romulea austinii	Iridaceae	LC		x				2	4		
Romulea diversiformis	Iridaceae	LC	End		x		x	2	4		
Romulea hallii	Iridaceae	VU	End				x	2	4		
Romulea hantamensis	Iridaceae	LC	End				x	2	4		
Romulea komsbergensis	Iridaceae	NT	End				x	2	4		
Romulea luteoflora	Iridaceae	LC					x	2	4		
Romulea membranacea	Iridaceae	VU	Near End				x	2	4		
Romulea monadelpha	Iridaceae	LC	Near End				x	2	4		
Romulea multifida	Iridaceae	VU	End				x	2	4		
Romulea subfistulosa	Iridaceae	NT	End				x	2	4		
Romulea syringodeoflora	Iridaceae	NT	End		x		x	2	4		
Romulea tetragona var. tetragona	Iridaceae	LC	Near End	x			x	2	4		
Romulea tortuosa	Iridaceae	LC			x		x	2	4		
Romulea unifolia	Iridaceae	NT	End				x	2	4		
Rosenia glandulosa	Asteraceae	LC	End	x			x				
Rosenia oppositifolia	Asteraceae	LC		x		x	x				
Rosenia spinescens	Asteraceae	LC		x			x				
Rumex cordatus	Polygonaceae	LC					x				
Ruschia acocksii	Aizoaceae	LC	End				x	2	4		

Ruschia altigena	Aizoaceae	LC					x	2	4	
Ruschia cf. crassa	Aizoaceae	-		x				2	4	
Ruschia cf. unca	Aizoaceae	-		x				2	4	
Ruschia campestris	Aizoaceae	LC	End				x	2	4	
Ruschia centrocapsula	Aizoaceae	LC		x			x	2	4	
Ruschia ceresiana	Aizoaceae	RARE			x			2	4	
Ruschia cradockensis	Aizoaceae	LC				x		2	4	
Ruschia divaricata	Aizoaceae	LC		x			x	2	4	
Ruschia hamata	Aizoaceae	LC					x	2	4	
Ruschia intricata	Aizoaceae	LC		x		x		2	4	
Ruschia putterillii	Aizoaceae	LC					x	2	4	
Ruschia sp.	Aizoaceae	-		x	x			2	4	
Ruschia spinosa	Aizoaceae	LC		x			x	2	4	
Salsola aphylla	Amaranthaceae	LC				x				
Salsola kali	Amaranthaceae	*		x			x			
Salsola tuberculata	Amaranthaceae	LC		x		x				
Salvia disermas	Lamiaceae	LC		x	x					
Salvia verbenaca	Lamiaceae	LC		x	x					
Schinus molle	Anacardiaceae	*		x						
Schismus barbatus	Poaceae	LC			x		x			
Schismus scaberrimus	Poaceae	LC					x			
Schismus schismoides	Poaceae	LC		x		x				
Scleranthus annuus	Caryophyllaceae	*		x			x			
Searsia burchellii	Ebenaceae	LC		x		x				
Searsia lancea	Ebenaceae	LC		x			x			
Searsia longispina	Anacardiaceae	*								
Searsia undulata	Ebenaceae	-		x						
Secale strictum subsp. africanum	Poaceae	CR	End				x	1	4	crit end
Selago albida	Scrophulariaceae	LC			x					
Selago centralis	Scrophulariaceae	LC			x					
Selago florifera	Scrophulariaceae	LC	End				x			
Selago gloiodes	Scrophulariaceae	LC			x					
Selago pinguicula	Scrophulariaceae	LC			x		x			
Selago polygala	Scrophulariaceae	LC		x	x		x			
Selago rigida	Scrophulariaceae	LC	End		x					
Selago sp.	Scrophulariaceae	-		x	x					
Selago spectabilis	Scrophulariaceae	LC	End				x			
Selago subspinosa	Scrophulariaceae	LC	End	x	x		x			
Senecio arenarius	Asteraceae	LC				x				
Senecio abbreviatus	Asteraceae	LC			x					
Senecio burchellii	Asteraceae	LC					x			
Senecio cardaminifolius	Asteraceae	LC		x		x				
Senecio cinerascens	Asteraceae	LC		x			x			
Senecio erosus	Asteraceae	LC				x				
Senecio erysimoides	Asteraceae	DD			x					
Senecio hastatus	Asteraceae	LC					x			
Septulina glauca	Loranthaceae	LC		x			x			
Silene cretica	Caryophyllaceae	*		x			x			
Sisymbrium orientale	Brassicaceae	*			x					
Solanum tomentosum	Solanaceae	LC					x			
Sonchus asper subsp. asper	Asteraceae	*					x			
Spiloxene sp. nov	Hypoxidaceae	-	End	x			x			
Stachys aurea	Lamiaceae	LC	Near End				x			
Stachys lamarckii	Lamiaceae	LC		x			x			
Stachys linearis	Lamiaceae	LC					x			
Stachys rugosa	Lamiaceae	LC		x	x	x	x			
Stapelia surrecta	Apocynaceae	LC	Near End				x	2	4	
Steirodiscus capillaceus	Asteraceae	LC			x					
Stellaria media	Caryophyllaceae	*					x			
Stilpnogyne bellidioides	Asteraceae	LC					x			
Stipagrostis namaquensis	Poaceae	LC		x			x			
Stoeberia utilis	Aizoaceae	LC		x	x			2	4	
Stomatium resedolens	Aizoaceae	LC	End				x	2	4	
Stomatium villetii	Aizoaceae	LC	End	x			x	2	4	
Strumaria discifera subsp. discifera	Amaryllidaceae	LC	Near End				x	2	4	
Strumaria karooica	Amaryllidaceae	RARE	End				x	2	4	
Strumaria picta	Amaryllidaceae	LC	End				x	2	4	
Syncarpha staehelina	Asteraceae	LC			x					
Tenaxia dura	Poaceae	LC	Near End				x			
Tenaxia stricta	Poaceae	LC		x			x			

Tetraena retrofracta	Zygophyllaceae	LC				x			
Tetragonia echinata	Zygophyllaceae	LC		x					
Tetragonia fruticosa	Aizoaceae	LC		x		x		2	4
Tetragonia glauca	Aizoaceae	LC			x			2	4
Tetragonia microptera	Aizoaceae	LC				x		2	4
Tetragonia spicata	Aizoaceae	LC					x	2	4
Themeda triandra	Poaceae	LC					x		
Thesium dissitiflorum	Santalaceae	LC		x					
Thesium imbricatum	Santalaceae	LC					x		
Trachyandra flexifolia	Asphodelaceae	LC		x	x			2	
Trachyandra jacquiniana	Asphodelaceae	LC			x			2	
Trachyandra thyrsoidea	Asphodelaceae	LC					x	2	
Trianthema parvifolia	Aizoaceae	LC		x					
Tribolium hispidum	Poaceae	LC				x			
Tribolium purpureum	Poaceae	LC					x		
Tribolium utriculosum	Poaceae	LC		x	x				
Trichodesma africanum	Boraginaceae	LC			x				
Trichodiadema setuliferum	Aizoaceae	LC					x	2	4
Trichogyne cf. polynemoides	Asteraceae	-		x					
Trigonocapnos lichtensteinii	Fumariaceae	LC		x	x				
Tritonia cf. karooica	Iridaceae	-		x				2	4
Troglophyton acocksianum	Asteraceae	LC	Near End				x	2	
Troglophyton capillaceum subsp. capillaceum	Asteraceae	LC					x		
Tromotriche thudichumii	Apocynaceae	LC	End				x	2	4
Tylecodon paniculatus	Crassulaceae	LC		x			x	2	
Tylecodon reticulatus	Crassulaceae	LC		x				2	
Tylecodon ventricosus	Crassulaceae	LC					x	2	
Tylecodon wallichii	Crassulaceae	LC		x		x		2	
Ursinia anthemoides	Asteraceae	LC		x	x				
Ursinia anthemoides subsp. versicolor	Asteraceae	LC			x				
Ursinia calenduliflora	Asteraceae	LC		x		x			
Ursinia chrysanthemoides	Asteraceae	LC		x					
Ursinia nana subsp. nana	Asteraceae	LC		x	x	x			
Ursinia pilifera	Asteraceae	LC		x	x	x			
Ursinia sp. nov. "roggeveldensis"	Asteraceae	-	End				x		
Urtica lobulata	Urticaceae	LC					x		
Vachellia karroo	Fabaceae	LC		x			x		
Vellereophyton dealbatum	Asteraceae	LC					x		
Veronica anagallis-aquatica	Plantaginaceae	LC					x		
Viscum capense	Santalaceae	LC		x					
Viscum hoolei	Santalaceae	LC					x		
Vulpia bromoides	Poaceae	NE			x				
Vulpia muralis	Poaceae	NE			x				
Vulpia myuros	Poaceae	*					x		
Wahlenbergia annularis	Campanulaceae	LC		x					
Wahlenbergia nodosa	Campanulaceae	LC		x			x		
Wiborgia sericea	Fabaceae	LC		x	x		x		
Xenoscapa fistulosa	Iridaceae	LC		x	x		x		
Zaluzianskya acutiloba	Scrophulariaceae	LC	End				x		
Zaluzianskya bella	Scrophulariaceae	LC			x		x		
Zaluzianskya capensis	Scrophulariaceae	LC					x		
Zaluzianskya chasmanthiflora	Scrophulariaceae	?	End				x		
Zaluzianskya cohabitans	Scrophulariaceae	LC	End	x			x		
Zaluzianskya inflata	Scrophulariaceae	RARE	End	x			x		
Zaluzianskya marlothii	Scrophulariaceae	DD	End				x		
Zaluzianskya minima	Scrophulariaceae	LC	End	x			x		
Zaluzianskya mirabilis	Scrophulariaceae	RARE	End	x	x				
Zaluzianskya nemesioides	Scrophulariaceae	?	End				x		
Zaluzianskya peduncularis	Scrophulariaceae	LC		x			x		
Zaluzianskya pumila	Scrophulariaceae	LC			x				
Zaluzianskya sutherlandica	Scrophulariaceae	DD	End				x		
Zantedeschia aethiopica	Araceae	LC					x		

APPENDIX B

ANIMAL SPECIES LISTS ACCORDING TO THE 3220 DEGREE GRID (ADU DATABASE)

Mammals

Scientific name	English common name	Habitat notes	Likelihood of occurrence	IUCN category*	NCNCA*	WCNECO
ORDER: Afrosoricida (Golden moles)						
FAMILY: Chrysochloridae						
Amblysomus corriae	Fynbos Golden Mole	Restricted to forest, fynbos and renosterveld.	Low	NT	PS	
ORDER: Macroscelidea (Elephant shrews)						
FAMILY: Macroscelididae						
Elephantulus edwardii	Cape rock Elephant-Shrew	Succulent and Nama-Karoo; rocky slopes, small rocky outcrops, and hard sandy ground.	High	LC	PS	
Elephantulus rupestris	Western Rock Elephant Shrew	Confined to rocky habitats with sufficient places for refuge.	High	LC	PS	
Macroscelides proboscideus	Round-eared Elephant-Shrew	Succulent and Nama-Karoo and Kalahari; preference for bush cover and sparse grass cover; boulders or bush cover is essential.	High	LC	PS	
ORDER: Tubulidentata						
FAMILY: Orycteropodidae						
Orycteropus afer	Aardvark	Wide habitat tolerance; open woodland, scrub and grassland; especially sandy habitats.	Confirmed	LC		PWA
ORDER: Hyracoidea (Hyraxes)						
FAMILY: Procaviidae						

Procavia capensis	Rock Hyrax	Rocky habitats; especially granite formations; also dolerite intrusions.	Confirmed	LC	PS	
ORDER: Lagomorpha (Hares and rabbits)						
FAMILY: Leporidae						
Bunolagus monticularis	Riverine Rabbit	Confined to riparian bush on the narrow alluvial fringe of seasonally dry water courses in the central Karoo.	Low	CR	SPS	EWA
Lepus capensis	Cape Hare	Open arid conditions in Nama-Karoo and Succulent Karoo; palatable bush and grass.	High	LC	PS	
Lepus saxatilis	Scrub Hare	Savanna woodland, scrub and grassland; common in agriculturally developed areas.	High	LC	PS	
Pronolagus rupestris	Smith's Red Rock rabbit	Confined to rocky habitats.	High	LC	PS	
ORDER: Rodentia (Rodents)						
FAMILY: Bathyergidae						
Cryptomys hottentotus	African Mole-rat	Sandy soils to more compact soils such as schists and stony soils. Common on granitic sands and alluvium.	High	LC	PS	
FAMILY: Gliridae						
Graphiurus ocularis	Spectacled Dormouse	Nocturnal and terrestrial; can move rapidly on rocks and even vertical faxes; sometimes arboreal; Associated with sandstones of Cape Fold Mountains.	High	NT	PS	
FAMILY: Hystricidae						
Hystrix africaeaustralis	Cape Porcupine	Occurring in most habitat types in South Africa; generally absent from forest.	Confirmed	LC	PS	
FAMILY: Muridae						
Acomys subspinosus	Cape Spiny Mouse	Associated with rocky areas on mountain slopes; fairly high altitudes; Fynbos endemics	Low	LC	PS	
Micaelamys granti	Grant's Rock Mouse	Restricted to the Karoo; associated with rocky terrain.	High	LC		
Micaelamys namaquensis	Namaqua Rock Mouse	All habitats, but preference for rocky outcrops and boulder-strewn hillsides	High	LC		
Gerbilliscus paeba	Hairy-footed Gerbil	Nama-Karoo and Succulent Karoo; preference for sandy soil or sandy alluvium; grass, scrub or open woodland.	High	LC	PS	
Otomys irroratus	Vlei Rat	Mostly grassland; abundant in damp soils of vleis, along streams and rivers or fringes of swamps.	Low to absent	LC	PS	
Otomys unisulcatus	Bush vlei rat	Shrub and fynbos; associated with rocky outcrops; generally avoid damp places; select medium soils.	Medium	LC	PS	
Parotomys brantsii	Brants's Whistling Rat	Nama-Karoo and Succulent Karoo; preference for deep sandy soil; annual rainfall < 300 mm.	High	LC	PS	
Rhabdomys pumilio	Four-striped Grass mouse	Wide variety of habitats; preferably grassland.	High	LC	PS	
FAMILY: Nesomyidae						

Dendromus melanotis	Grey Climbing Mouse	Associated with a dense cover of tall grasses such as *Hyparrhenia* spp. or *Merxmuellera* species	Medium	LC		
Petromyscus collinus	Pygmy Rock Mouse	Arid areas; associated with rocky outcrops or koppies, especially with rocky overhangs, crannies or cracks.	High	LC		
Saccostomus campestris	Pouched Mouse	Wide range of habitats	Low	LC	PS	
Steatomys krebsii	Kreb's Fat Mouse	Sandy substrate or alluvium; arid regions.	Low	LC	PS	
ORDER: Primates						
FAMILY: Cercopithecidae						
Chlorocebus pygerythrus	Vervet Monkey	Most abundant in savanna and associated with riverine habitat.	Low to absent	LC		
Papio hamadryas ursinus	Chacma Baboon	Fynbos, Savanna and Karoo Biomes.	Confirmed	LC		
ORDER: Eulipotyphla (Shrews)						
FAMILY: Soricidae						
Crocidura cyanea	Reddish-grey Musk Shrew	Arid to relatively arid regions; dense ground level vegetation and leaf litter.	High	LC		
Myosorex varius	Forest Shrew	Moist densely vegetated habitats; typically dense moist grassland.	Low	LC		
ORDER: Carnivora (Carnivores)						
FAMILY: Canidae						
Canis mesomelas	Black-backed Jackal	Wide habitat range; Savanna, Nama-Karoo and Succulent Karoo Biomes.	Confirmed	LC		
Otocyon megalotis	Bat-eared Fox	Open country; often in degraded, overgrazed areas.	High	LC	SPS	PWA
Vulpes chama	Cape Fox	Associated with open country; often in open scrub in Karoo regions.	Medium	LC	SPS	
FAMILY: Felidae						
Caracal caracal	Caracal	Semi-desert and karroid areas.	Confirmed by landowners	LC		
Felis nigripes	Black-footed Cat	Arid regions; open country with some scrub or grass for cover.	High	VU	SPS	PWA
Felis silvestris	African wild cat	Wide habitat tolerance, but always require some form of cover .	Confirmed by landowners	LC	SPS	
Panthera pardus	Leopard	Wide habitat tolerance; associated with rocky koppies, mountain ranges and forests.	Confirmed by landowners	VU	SPP	PWA
FAMILY: Herpestidae						
Atilax paludinosus	Marsh Mongoose	Close association with streams, rivers, marshes, swamps or vleis.	Low to absent	LC		

Cynictis penicillata	Yellow Mongoose	Arid Karoo; open country with sandy substrate.	High	LC		
Galerella pulverulentus	Cape Gray Mongoose	Wide habitat tolerance.	High	LC		
FAMILY: Mustelidae						
Aonyx capensis	Cape Clawless Otter	Always close to water; rivers, lakes, swamps, dams and move freely up tributaries into small streams.	Low	NT	PS	
Ictonyx striatus	Striped Polecat	Wide habitat tolerance; associated with drainage lines in desert.	High	LC	SPS	
Mellivora capensis	Honey Badger	Wide range of habitats.	High	LC	SPS	
Poecilogale albinucha	African Striped Weasel	Mostly Savanna species; associated with moist grassland.	Low	NT	SPS	
FAMILY: Viverridae						
Genetta genetta	Genets		High	LC	PS	
Genetta tigrina	South African large spotted genet	Fynbos and Savanna Biomes; Associated with riverine habitat particularly in arid regions.	Confirmed by landowners	LC	PS	
ORDER: Artiodactyla						
FAMILY: Bovidae						
Antidorcas marsupialis	Springbok	Arid regions; open grassland	Confirmed	LC	PS	PWA
Connochaetes taurinus taurinus	Blue wildebeest	Savanna woodland.	If present, then introduced	LC	PS	
Damaliscus pygargus phillipsi	Blesbok	Plateau grassland.	If present, then introduced	LC	PS	
Oreotragus oreotragus	Klipspringer	Confined to rocky habitats.	Confirmed by landowners	LC	PS	PWA
Oryx gazella	Gemsbok	Open arid country; open savanna or grassland.	If present, then introduced	LC	PS	
Pelea capreolus	Grey Rhebok	Rocky hills, rocky slopes and mountain plateaux with good grass cover.	Confirmed by landowners	NT	PS	PWA
Raphicerus campestris	Steenbok	Open vegetation with grass, scattered bush or scrub for cover and forbs for food.	Confirmed	LC	PS	PWA
Sylvicapra grimmia	Common Duiker	Presence of bushes is essential; they provide food and shelter.	Confirmed by landowners	LC	PS	PWA
Tragelaphus strepsiceros	Greater Kudu	Savanna woodland.	Confirmed by landowners	LC	PS	PWA
ORDER: Perissodactyla						
FAMILY: Equidae						
Equus quagga	Plains Zebra	Savanna habitat; partial to open woodland, open scrub and grassland.	If present, then introduced	LC	PS	

Some species that could additionally occur

FAMILY: Hyaenidae						
Para hyaena brunnea	Brown hyaena	Nama-Karoo, Succulent Karoo, desert in dry grassland and savanna	Low	NT	SPS	PWA
Proteles cristatus	Aardwolf	Nama-Karoo, Succulent Karoo in grassland and savanna	Medium	LC	SPS	PWA

Reptiles

Scientific name	English common name	Habitat notes	IUCN*	Occurrence #	NCNCA*	WCNECO *
ORDER: TESTUDINATA (CHELONIANS)						
FAMILY: Testudinidae						
Chersina angulata	Angulate Tortoise	Widespread and common in a variety of habitats	LC	2	PS	PWA
Chersobius boulengeri	Karoo Dwarf Tortoise	Dolerite ridges and rocky outcrops of the southern Succulent Karoo and Nama-Karoo biomes	NT	1	PS	PWA
Psammobates tentorius	Tent Tortoise	Widespread, but usually at low densities; occurs in arid regions.	LC	2	PS	PWA
ORDER: SQUAMATA SUB-ORDER:LACERTILIA (LIZARDS)						
FAMILY: Agamidae						
Agama atra	Southern Rock Agama	Widespread and common in a variety of rocky habitats	LC	2	PS	PWA
Agama hispida	Spiny Ground Agama	Found predominantly in sparse-vegetated areas of Fynbos and Succulent Karoo	LC	2	PS	PWA
FAMILY: Chamaeleonidae						
Bradypodion gutturale	Little Karoo Dwarf Chameleon	Occurs mainly in fynbos, renosterveld and karroid vegetation.	LC	1	PS	PWA
FAMILY: Cordylidae						
Cordylus cordylus	Cape Girdled Lizard	Rupicolous, occurring in diverse habitats from coastal rock to mountain top	LC	1	PS	PWA
Cordylus minor	Western Dwarf Girdled Lizard	Rocky outcrops	LC	1	PS	PWA
Karusasaurus polyzonus	Karoo Girdled Lizard	Widespread and common in a variety of habitats in the western and central karroid areas	LC	2	PS	PWA
Ouroborus cataphractus	Armadillo Girdled Lizard	Rock crevices, especially sandstone	LC	2	PS	PWA
Pseudocordylus microlepidotus namaquensis	Nuweveldberg Crag Lizard	Boulders on upper slopes and summits of Nuweveld- and Komsberge in Fynbos and montane grassland	LC	1	PS	PWA
FAMILY: Gekkonidae						
Chondrodactylus a. angulifer	Common Giant Ground Gecko	Burrows in loosely compacted sand in the sparsely vegetated, sandy valleys of the western arid region	LC	1	PS	PWA
Chondrodactylus bibronii	Bibron's Gecko	Widespread and common in rocky outcrops throughout the Karoo region	LC	2	PS	PWA
Goggia hewitti	Hewitt's Dwarf Leaf-toed Gecko	Rock outcrops and exfoliating flakes on shale and sandstone outcrops with low vegetation cover	LC	1	PS	PWA

Pachydactylus capensis	Cape Gecko	Widespread and common in a range of open habitats	LC	3	PS	PWA
Pachydactylus formosus	Southern Rough Gecko	Mesic habitats that provide rocky crevices for retreats, and especially common in montane habitats	LC	1	PS	PWA
Pachydactylus geitje	Ocellated Gecko	Widespread and common predominantly in Fynbos but also adjacent Succulent Karoo – present	LC	2	PS	PWA
Pachydactylus kladaroderma	Thin-skinned Gecko	Relatively broad range of habitats in largely inaccessible mountainous terrain – likely	LC	2	PS	PWA
Pachydactylus mariquensis	Marico Gecko	Widespread and common in sandy habitats with open vegetation	LC	2	PS	PWA
Pachydactylus oculatus	Golden Spotted Gecko	Widespread and common in rocky habitats with karroid vegetation	LC	2	PS	PWA
Pachydactylus purcelli	Purcell's Gecko	Rocky habitats in semi-arid regions	LC	2	PS	PWA
FAMILY: Gerrhosauridae						
Cordylosaurus subtessellatus	Dwarf Plated Lizard	Succulent and other karroid vegetation on small rocky outcrops in arid areas	LC	1	PS	PWA
Gerrhosaurus typicus	Karoo Plated Lizard	Succulent and Nama-Karoo Biomes and renosterveld part of the Fynbos Biome	LC	1	PS	PWA
Tetradactylus tetradactylus	Cape Long-tailed Seps	Widespread in fynbos, montane grassland and scrub vegetation often on mountain plateaux	LC	1	PS	PWA
FAMILY: Lacertidae						
Nucras tessellata	Western Sandveld Lizard	Wide distribution in rocky terrain	LC	1	PS	PWA
Pedioplanis burchelli	Burchell's Sand Lizard	Widespread and abundant in rocky areas	LC	2	PS	PWA
Pedioplanis laticeps	Karoo Sand Lizard	Compacted, well-vegetated soils in Succulent Karoo and montane grassland in open areas with stones	LC	1	PS	PWA
Pedioplanis lineoocellata pulchella	Common Sand Lizard	Widespread and abundant in a wide range of habitats	LC	2	PS	PWA
FAMILY: Scincidae						
Trachylepis capensis	Cape Skink	Widespread and abundant in a wide range of habitats	LC	2	PS	PWA
Trachylepis 108ulcate sulcata	Western Rock Skink	Widespread in western and central parts of South Africa. Found in arid savanna, karroid veld and desert	LC	2	PS	PWA
Trachylepis variegata	Variegated Skink	Widespread and common mainly in rocky areas	LC	2	PS	PWA
SUB-ORDER: SERPENTES (SNAKES)						
FAMILY: Leptotyphlopidae						
Leptotyphlops nigricans	Black Thread Snake	Endemic to Western and Eastern Cape	LC	1		

Namibiana gracilior	Slender Thread Snake	Succulent Karoo and Fynbos biomes	LC	2		
FAMILY: Typhlopidae						
Rhinotyphlops lalandei	Delalande's Beaked Blind Snake	Widespread and common	LC	2		
FAMILY: Colubridae						
Dasypeltis scabra	Rhombic Egg-eater	Widespread and abundant in a wide range of habitats	LC	2		
FAMILY: Lamprophiidae						
Boaedon capensis	Brown House Snake	Widespread and abundant in a wide range of habitats	LC	2		
Dipsina multimaculata	Dwarf Beaked Snake	Nama-Karoo, Succulent Karoo Savanna and Desert biomes	LC	1		
Lamprophis fiskii	Fisk's Snake	Wide variety of terrestrial habitats throughout western South Africa, especially rocky and sandy areas in arid regions	LC	1	SP	PWA
Lamprophis guttatus	Spotted Rock Snake	Widespread in rocky habitats	LC	2	SP	PWA
Lycodonomorphus rufulus	Brown Water Snake	Widespread and common associated with aquatic habitats	LC	1	SP	
Prosymna sundevallii	Sundevall's Shovel-snout	Widespread and common in a wide range of habitats	LC	1	SP	PWA
Psammophis crucifer	Cross-marked Grass Snake	Widespread and common in a wide range of habitats	LC	1		
Psammophis notostictus	Karoo Sand Snake	Widespread and common in arid scrubland, karroid bushveld and fynbos vegetation	LC	2		
Psammophylax rhombeatus rhombeatus	Spotted Skaapsteker	Widespread and common in a wide range of habitats	LC	2		
Pseudaspis cana	Mole Snake	Widespread and common in a wide range of habitats	LC	1	SP	PWA
FAMILY: Elapidae						
Aspidelaps lubricus lubricus	Coral Shield Cobra	Widespread and common in a variety of habitats from rocky outcrops to sandy plains	LC	2		
Naja nigricincta woodi	Black Spitting Cobra	Arid rocky regions	LC	1		
Naja nivea	Cape Cobra	Widespread and abundant in open grassland, fynbos and karroid vegetation	LC	1		
FAMILY: Viperidae						
Bitis arietans arietans	Puff Adder	Widespread and abundant in a wide range of habitats	LC	3		
Bitis rubida	Red Adder	Rocky mountain slopes in the Succulent Karoo and Fynbos biomes	LC	2		

*IUCN category: NT = Near Threatened; LC = Least Concern
NCNCA: PS = Protected species; SPS = Specially Protected Species
WCNECO: EWA = Endangered Wild Animal; PWA = Protected Wild Animal
1 = possible occurrence, but with low likelihood of actual occurrence; 2 = probable occurrence and high likelihood of actual occurrence. 3 = actual occurrence confirmed

Frogs

SCIENTIFIC NAME	ENGLISH COMMON NAME	HABITAT NOTES	Occurrence	IUCN CATEGORY*	NCNCA*	WCNECO*
FAMILY: Pyxicephalidae						
Amietia poyntoni	Poynton's River Frog	It is an adaptable species requiring permanent water for breeding. It occurs in grassland, forests, savanna and agricultural land. It prefers shallow water, including wetlands, ponds, dams, streams and rivers, and breeds in still water and on the edges of streams	1 (2 only if permanent waterbody is present)	LC	PS	PWA
Cacosternum karooicum	Karoo Caco	Arid regions; small streams and man-made dams.	2	LC	PS	PWA
Tomopterna delalandii	Cape Sand Frog	Lowlands in Fynbos and Succulent Karoo	2	LC	PS	PWA
FAMILY: Bufonidae						
Sclerophrys capensis	Raucous Toad	It is a species of fynbos, grassland, dry thicket forest, savanna and agricultural land. It breeds in dams, ponds, and pools in streams, tending to favour permanent water.	1	LC	PS	PWA
Vandijkophrynus gariepensis gariepensis	Karoo Toad	Karoo scrub	2	LC	PS	PWA
FAMILY: Pipidae						
Xenopus laevis	Common Platanna	Wide habitat tolerance more or less permanent water	1 (2 only if permanent waterbody is present)	LC	PS	PWA

*IUCN category: LC = Least Concern
NCNCA: PS = Protected species; SPS = Specially Protected Species
WCNECO: EWA = Endangered Wild Animal; PWA = Protected Wild Animal
1 = possible occurrence, but with low likelihood of actual occurrence; 2 = probable occurrence and high likelihood of actual occurrence. 3 = actual occurrence confirmed

Lacewings

Family	Scientific name
Ascalaphidae	*Bubomyiella pygmaea*
Ascalaphidae	*Melambrotus papio*
Ascalaphidae	*Neomelambrotus densinervis*
Ascalaphidae	*Proctolyra brincki*
Ascalaphidae	*Proctolyra hessei*
Chrysopidae	*Dichochrysa tacta*
Myrmeleontidae	*Centroclisis sp.*
Myrmeleontidae	*Centroclisis maligna*
Myrmeleontidae	*Creoleon sp.*
Myrmeleontidae	*Cymothales illustris*
Myrmeleontidae	*Myrmeleon sp.*
Myrmeleontidae	*Myrmeleon doralice*
Myrmeleontidae	*Myrmeleon obscurus*
Myrmeleontidae	*Nannoleon sp.*
Myrmeleontidae	*Nannoleon michaelseni*
Myrmeleontidae	*Nemoleon delicatus*
Myrmeleontidae	*Nesoleon boschimanus*
Myrmeleontidae	*Neuroleon chloranthe*
Myrmeleontidae	*Obus capensis*
Myrmeleontidae	*Palpares speciosus*
Myrmeleontidae	*Pamexis karoo*
Nemopteridae	*Nemia costalis*
Nemopteridae	*Nemia karrooa*
Nemopteridae	*Nemopterella sp.*
Psychopsidae	*Silveira jordani*

Butterflies

Family	Scientific name	Common name	Red list category
GEOMETRIDAE	*Drepanogynis* sp.		
GEOMETRIDAE	*Pseudomaenas intricata*		Not Threatened (NT)
GEOMETRIDAE	*Scotopteryx* sp.		
HESPERIIDAE	*Spialia agylla agylla*	Grassveld sandman	Least Concern (SABCA 2013)
HESPERIIDAE	*Spialia agylla bamptoni*	Grassveld sandman	Least Concern (SABCA 2013)
HESPERIIDAE	*Spialia ferax*	Common sandman	Least Concern (SABCA 2013)
HESPERIIDAE	*Spialia nanus*	Dwarf sandman	Least Concern (SABCA 2013)
HESPERIIDAE	*Spialia spio*	Mountain sandman	Least Concern (SABCA 2013)
LASIOCAMPIDAE	*Streblote sp.*		
LYCAENIDAE	*Aloeides apicalis*	Pointed copper	Least Concern (SABCA 2013)
LYCAENIDAE	*Aloeides aranda*	Aranda copper	Least Concern (SABCA 2013)
LYCAENIDAE	*Aloeides arida*	Arid copper	Least Concern (SABCA 2013)
LYCAENIDAE	*Aloeides damarensis damarensis*	Damara copper	Least Concern (SABCA 2013)
LYCAENIDAE	*Aloeides depicta*	Depicta copper	Least Concern (SABCA 2013)
LYCAENIDAE	*Aloeides juana*	Juana copper	Least Concern (SABCA 2013)
LYCAENIDAE	*Aloeides kaplani*	Kaplan's copper	Least Concern (SABCA 2013)
LYCAENIDAE	*Aloeides pallida pallida*	Giant copper	Least Concern (SABCA 2013)
LYCAENIDAE	*Aloeides pierus*	Dull copper	Least Concern (SABCA 2013)
LYCAENIDAE	*Aloeides thyra thyra*	Red copper	Least Concern (SABCA 2013)
LYCAENIDAE	*Aloeides vansoni*	Van Son's copper	Least Concern (SABCA 2013)
LYCAENIDAE	*Anthene definita definita*	Common hairtail	Least Concern (SABCA 2013)
LYCAENIDAE	*Argyraspodes argyraspis*	Warrior silver-spotted copper	Least Concern (SABCA 2013)
LYCAENIDAE	*Azanus jesous*	Topaz babul blue	Least Concern (SABCA 2013)
LYCAENIDAE	*Azanus ubaldus*	Velvet-spotted babul blue	Least Concern (SABCA 2013)
LYCAENIDAE	*Brephidium metophis*	Tinktinkie blue	Least Concern (SABCA 2013)
LYCAENIDAE	*Cacyreus dicksoni*	Dickson's geranium bronze	Least Concern (SABCA 2013)

LYCAENIDAE	*Cacyreus fracta fracta*	Water geranium bronze	Least Concern (SABCA 2013)
LYCAENIDAE	*Cacyreus lingeus*	Bush bronze	Least Concern (SABCA 2013)
LYCAENIDAE	*Chrysoritis azurius*	Azure opal	Least Concern (SABCA 2013)
LYCAENIDAE	*Chrysoritis beaufortia charlesi*	Beaufort opal	Least Concern (SABCA 2013)
LYCAENIDAE	*Chrysoritis beaufortia sutherlandensis*	Beaufort opal	Least Concern (SABCA 2013)
LYCAENIDAE	*Chrysoritis chrysantas*	Karoo opal	Least Concern (SABCA 2013)
LYCAENIDAE	*Chrysoritis chrysaor*	Burnished opal	Least Concern (SABCA 2013)
LYCAENIDAE	*Chrysoritis felthami dukei*	Feltham's opal	Least Concern (SABCA 2013)
LYCAENIDAE	*Chrysoritis midas*	Midas opal	Least Concern (SABCA 2013)
LYCAENIDAE	*Chrysoritis pan lysander*	Lysander opal	Least Concern (SABCA 2013)
LYCAENIDAE	*Chrysoritis turneri turneri*	Turner's opal	Least Concern (SABCA 2013)
LYCAENIDAE	*Chrysoritis turneri wykehami*	Wykeham's opal	Least Concern (SABCA 2013)
LYCAENIDAE	*Chrysoritis violescens*	Violescent opal	Least Concern (SABCA 2013)
LYCAENIDAE	*Eicochrysops messapus messapus*	Cupreous blue	Least Concern (SABCA 2013)
LYCAENIDAE	*Harpendyreus notoba*	Salvia mountain blue	Least Concern (SABCA 2013)
LYCAENIDAE	*Lampides boeticus*	Pea blue	Least Concern (SABCA 2013)
LYCAENIDAE	*Lepidochrysops bacchus*	Wineland blue	Least Concern (SABCA 2013)
LYCAENIDAE	*Lepidochrysops jamesi jamesi*	James's blue	Least Concern (SABCA 2013)
LYCAENIDAE	*Lepidochrysops ketsi ketsi*	Ketsi blue	Least Concern (SABCA 2013)
LYCAENIDAE	*Lepidochrysops mcgregori*	McGregor's blue	Least Concern (SABCA 2013)
LYCAENIDAE	*Lepidochrysops ortygia*	Koppie blue	Least Concern (SABCA 2013)
LYCAENIDAE	*Leptomyrina lara*	Cape black-eye	Least Concern (SABCA 2013)
LYCAENIDAE	*Leptotes pirithous pirithous*	Common zebra blue	Least Concern (SABCA 2013)
LYCAENIDAE	*Lycaena clarki*	Eastern sorrel copper	Least Concern (SABCA 2013)
LYCAENIDAE	*Phasis clavum erythema*	Namagua arrowhead	Least Concern (SABCA 2013)
LYCAENIDAE	*Phasis pringlei*	Pringle's arrowhead	Least Concern (SABCA 2013)
LYCAENIDAE	*Thestor pringlei*	Pringle's skolly	Least Concern (SABCA 2013)
LYCAENIDAE	*Thestor protumnus aridus*	Boland skolly	Least Concern (SABCA 2013)
LYCAENIDAE	*Trimenia argyroplaga argyroplaga*	Large silver-spotted copper	Least Concern (SABCA 2013)
LYCAENIDAE	*Trimenia macmasteri macmasteri*	McMaster's silver-spotted copper	Least Concern (SABCA 2013)
LYCAENIDAE	*Trimenia wykehami*	Wykeham's silver-spotted	Least Concern (SABCA 2013)

		copper	
LYCAENIDAE	*Tylopaedia sardonyx sardonyx*	King copper	Least Concern (SABCA 2013)
LYCAENIDAE	*Virachola antalus*	Brown playboy	Least Concern (SABCA 2013)
LYCAENIDAE	*Zizeeria knysna knysna*	African grass blue	Least Concern (SABCA 2013)
NYMPHALIDAE	*Melampias huebneri huebneri*	Boland brown	Least Concern (SABCA 2013)
NYMPHALIDAE	*Pseudonympha southeyi wykehami*	Southey's brown	Least Concern (SABCA 2013)
NYMPHALIDAE	*Pseudonympha trimenii namaquana*	Trimen's brown	Least Concern (SABCA 2013)
NYMPHALIDAE	*Stygionympha robertsoni*	Robertson's hillside brown	Least Concern (SABCA 2013)
NYMPHALIDAE	*Tarsocera dicksoni*	Dickson's widow	Least Concern (SABCA 2013)
NYMPHALIDAE	*Tarsocera fulvina*	Karoo widow	Least Concern (SABCA 2013)
NYMPHALIDAE	*Tarsocera namaquensis*	Namaqua widow	Least Concern (SABCA 2013)
NYMPHALIDAE	*Tarsocera southeyae*	Southey's widow	Least Concern (SABCA 2013)
NYMPHALIDAE	*Torynesis hawequas*	Hawequas widow	Least Concern (SABCA 2013)
NYMPHALIDAE	*Torynesis mintha mintha*	Mintha widow	Least Concern (SABCA 2013)
NYMPHALIDAE	*Vanessa cardui*	Painted lady	Least Concern (SABCA 2013)
PAPILIONIDAE	*Papilio demodocus demodocus*	Citrus swallowtail	Least Concern (SABCA 2013)
PIERIDAE	*Belenois aurota*	Brown-veined white	Least Concern (SABCA 2013)
PIERIDAE	*Colias electo electo*	African clouded yellow	Least Concern (SABCA 2013)
PIERIDAE	*Colotis euippe omphale*	Smoky orange tip	Least Concern (LC)
PIERIDAE	*Pontia helice helice*	Common meadow white	Least Concern (SABCA 2013)
SATURNIIDAE	*Imbrasia tyrrhea*		Not listed

Dragonflies

Family	Scientific name	Common name	Red list category
Aeshnidae	*Anax imperator*	Blue Emperor	LC
Aeshnidae	*Zosteraeschna minuscula*	Friendly Hawker	LC
Coenagrionidae	*Africallagma glaucum*	Swamp Bluet	LC
Coenagrionidae	*Ischnura senegalensis*	Tropical Bluetail	LC
Coenagrionidae	*Pseudagrion citricola*	Yellow-faced Sprite	LC
Libellulidae	*Crocothemis erythraea*	Broad Scarlet	LC
Libellulidae	*Orthetrum caffrum*	Two-striped Skimmer	LC
Libellulidae	*Orthetrum chrysostigma*	Epaulet Skimmer	LC
Libellulidae	*Orthetrum trinacria*	Long Skimmer	LC
Libellulidae	*Sympetrum fonscolombii*	Red-veined Darter or Nomad	LC
Libellulidae	*Trithemis arteriosa*	Red-veined Dropwing	LC
Libellulidae	*Trithemis kirbyi*	Orange-winged Dropwing	LC

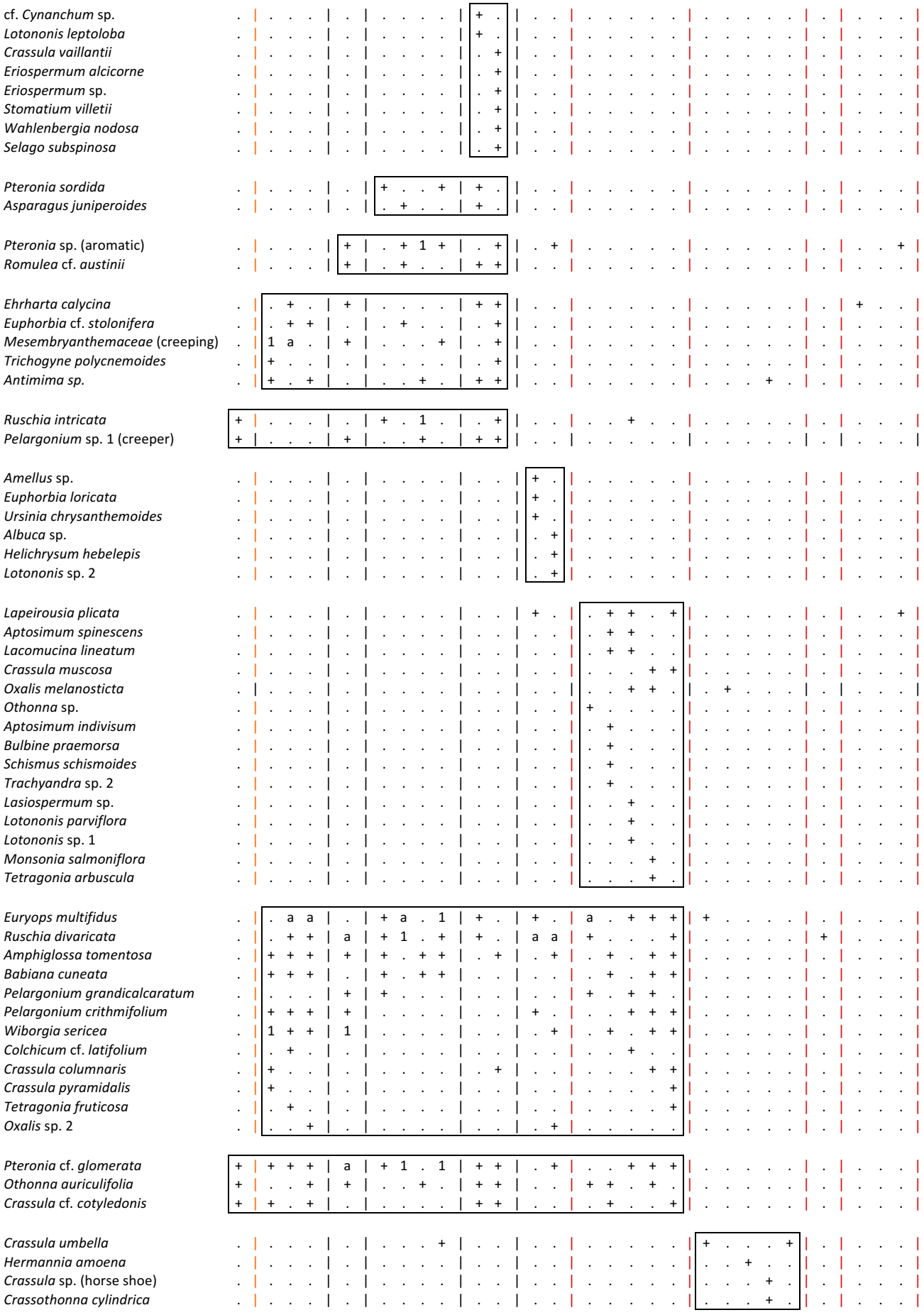
Scorpions

Family	Scientific name	NCNCA
BUTHIDAE	*Parabuthus capensis*	
BUTHIDAE	*Parabuthus granulatus*	
BUTHIDAE	*Uroplectes carinatus*	
HORMURIDAE	*Hadogenes weygoldti*	PS
SCORPIONIDAE	*Opistophthalmus sp.*	PS
SCORPIONIDAE	*Opistophthalmus pallipes*	PS

APPENDIX C

DIFFERENTIAL TABLE OF THE VEGETATION OF THE KUDUSBERG WEF

Vegetation unit numbers	1	2																3					4					5	6		
		2a									2b		2c																			
Sample plot numbers	1			2	2	1	1	1	1		1	1		2	1	2					1			2	2	2	2			1	
	7	3	8	0	1	2	4	6	9		3	5	9	6	0	3	1	2	1	4	5	4	5	7	2	6	7	8			
Massonia depressa	+	.	.	.	.	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.			
Crassula tomentosa	+	.	.	.	.	.	.	.	.		+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Berkheya onobromoides	+	.	.	.	.	.	.	.	.		+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Ehrharta melicoides	+	.	.	.	.	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Curio radicans	+	.	.	.	.	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Ursinia anthemoides	+	.	.	.	.	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Dianthus sp.	+	.	.	.	.	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Chaenostoma caerulea	+	.	.	.	.	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Ursinia calenduliflora	.	.	+	+	.	.	.	.	.		.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.			
Stoeberia cf. *utilis*	.	+	+	.	.	.	.	.	.		.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.			
Anacampseros cf retusa	.	+	.	.	.	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Helichrysum obtusum	.	+	.	.	.	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Conophytum sp.	.	+	.	.	.	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Arctotis acaulis	.	.	+	.	.	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Cleretum lyratifolium	.	.	+	.	.	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Galenia meziana	.	.	+	.	.	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Lycium amoenun	.	.	+	.	.	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Pelargonium carnosum	.	.	+	.	.	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Romulea atrandra	.	.	+	.	.	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Rosenia oppositifolia	.	.	+	.	.	.	.	.	.		1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Mesembryanthemum emarcidum	.	.	+	.	.	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Tetragonia sp.	.	.	1	.	.	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Cucumis sp.	.	.	+	.	.	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Asparagus cf. *africanus*	.	.	.	+	.	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Ruschia sp.	.	.	.	+	.	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Heliophila carnosa	+	.	+	+	.	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Tenaxia stricta	+	.	+	1	.	.	.	.	.		.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Crassula cf. *sarcocaulis*	.	.	.	.	+	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Gnidia sp.	.	.	.	.	+	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Hebenstretia robusta	.	.	.	.	+	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Lachenalia bolusii	.	.	.	.	+	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Cotula microglossa	.	.	.	.	+	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Lithospermum scabrum	+	+	+	+	+	.	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Eriocephalus africanus	+	.	+	.	+	.	.	.	.		.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Drimia capensis	.	.	.	.	.	+	.	+	+		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Felicia cf. *ovata*	.	.	.	.	.	.	+	+	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Crassothonna sedifolia	.	.	.	.	.	.	.	+	+		.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.			
Drimia sp.	.	.	.	.	.	+	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Calobota pungens	.	.	.	.	.	+	.	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Felicia hirsuta	.	.	.	.	.	.	+	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Oxalis palmifrons	.	.	.	.	.	.	+	.	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
cf. *Limosella* sp.	.	.	.	.	.	.	.	+	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Pauridia capensis	.	.	.	.	.	.	.	+	.		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Dicerothamnus rhinocerotis	+	+	b	a	a	+	.	+	+		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Pteronia incana	+	+	b	+	+	1	.	.	+		.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.			
Drosanthemum sp.	.	.	+	.	.	+	.	.	+		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			
Cephalophyllum sp.	.	.	.	.	+	.	.	.	+		.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.			


cf. Cynanchum sp.
Lotononis leptoloba
Crassula vaillantii
Eriospermum alcicorne
Eriospermum sp.
Stomatium villetii
Wahlenbergia nodosa
Selago subspinosa
Pteronia sordida
Asparagus juniperoides
Pteronia sp. (aromatic)
Romulea cf. austinii
Ehrharta calycina
Euphorbia cf. stolonifera
Mesembryanthemaceae (creeping)
Trichogyne polycnemoides
Antimima sp.
Ruschia intricata
Pelargonium sp. 1 (creeper)
Amellus sp.
Euphorbia loricata
Ursinia chrysanthemoides
Albuca sp.
Helichrysum hebelepis
Lotononis sp. 2
Lapeirousia plicata
Aptosimum spinescens
Lacomucina lineatum
Crassula muscosa
Oxalis melanosticta
Othonna sp.
Aptosimum indivisum
Bulbine praemorsa
Schismus schismoides
Trachyandra sp. 2
Lasiospermum sp.
Lotononis parviflora
Lotononis sp. 1
Monsonia salmoniflora
Tetragonia arbuscula
Euryops multifidus
Ruschia divaricata
Amphiglossa tomentosa
Babiana cuneata
Pelargonium grandicalcaratum
Pelargonium crithmifolium
Wiborgia sericea
Colchicum cf. latifolium
Crassula columnaris
Crassula pyramidalis
Tetragonia fruticosa
Oxalis sp. 2
Pteronia cf. glomerata
Othonna auriculifolia
Crassula cf. cotyledonis
Crassula umbella
Hermannia amoena
Crassula sp. (horse shoe)
Crassothonna cylindrica

Eriocephalus purpureus	.	.	.	.	.	.	.	.	.	.	.	.	.	+	1	.	.	.	+	.	.	+	.	.	.	.	.
Euphorbia mauritanica	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	a	.	+	.	.	.	.
Aloe microstigma	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	+	.	.	.	.
Pelargonium karooicum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	+	.	.	.	.	.
Pelargonium magenteum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+		.	.	.	.	.
Asparagus sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.
Lampranthus sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	+	.	.	.	.	.
Lotononis cf. *falcata*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+	.	.	.	.
Albuca spiralis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.
Felicia filifolia	.	.	+	.	.	.	.	.	.	.	.	a	+	+	.	+	+	+	+	+	+	+	+	.	.	.	.
Gazania heterochaeta	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+	.	+	.	.	.	+	.	.	.	.	.
Monsonia crassicaule	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+	+	.	.	.	+	.	.	.	.	.	.
Cotyledon orbiculata	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	.	+	.	+	.	.	.	.
Euphorbia rhombifolia	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	+	.	.	.	.
Heliophila cf. *carnosa*	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	+	+	.	.	.
Leysera gnaphalodes	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.
Hermannia coccocarpa	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.
Ruschia centrocapsula	.	.	.	.	.	.	+	+	+	+	+	.	+	.	1	.	1	.	+	.	.	.	.	.	.	.	.
Euphorbia cf. *tenax*	.	.	.	.	.	+	.	+	+	.	.	.	.	.	+	+	+	.	.	.	+	.	.	.	.	.	.
Eriocephalus decussatus	.	.	.	a	+	a	+	1	.	.	+	.	.	1	+	+	+	+	a	.	.	+	.	.	.	.	.
Hirpicium alienatum	.	+	.	+	+	.	.	+	+	+	.	+	+	.	+	+	+	.	.	.	+	+	+	.	.	.	.
Eriocephalus grandiflora	.	.	.	+	.	+	+	+	+	.	.	.	+	.	+	+	1	.	.	.	.	+	.	.	.	.	.
Eriospermum capense	.	.	+	.	.	+	.	+	.	.	+	.	.	+	+	+	+	+	+	.	+	.	.	.	.	.	.
Eriocephalus microphyllus	.	.	+	.	.	+	.	.	.	1	.	+	+	.	.	a	+	+	+	.	.	+	.	.	.	.	.
Pelargonium abrotanifolia	.	+	+	.	.	.	.	.	.	1	.	.	.	+	.	.	+	.	+	.	+	.	.	.	.	.	.
Selago polygala	.	+	+	.	.	.	.	.	.	+	.	+	+	.	.	.	+	.	.	.	.	.	+	.	.	.	.
Osteospermum sinuata	.	.	+	.	+	+	.	.	.	.	.	+	.	+	.	+	+	.	.	.	.	+	.	.	.	.	.
Crassula deltoidea	.	+	.	.	.	.	.	.	.	+	+	+	+	+	+	+	+	+	.	.	.	.	+	.	.	.	.
Ornithoglossum undulatum	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.	.	.	+	+	.	.	.	.
Roepera pygmaeum	.	.	.	+	.	.	.	.	.	+	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.
Crassula subaphylla	.	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.
Bulbine torta	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	+	.	.	.	.	.
Haemanthus coccineus	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.
Pteronia pallens	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	3	.	.	.
Bulbine sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Ifloga glomerata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Mesembryanthemum nodiflorum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Pelargonium sp. 2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Schismus barbatus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Tylecodon reticulatus	.	.	.	.	.	+	+	+	+	+	+	+	+	+	+	+	+	+	.	.	+	+	+	+	.	.	.
Cheiridopsis namaquensis	.	.	.	.	.	.	.	.	+	+	+	.	+	.	+	.	+	+	.	.	.	+	.	+	.	.	.
Microloma sagittatum	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	+	.	.	.	.	+	.	.	.	.	.	.
Ruschia spinosa	.	1	.	a	.	+	+	a	a	a	+	.	+	+	.	b	a	.	a	b	.	+	.	a	.	.	.
Tylecodon wallichii	.	+	+	+	+	+	.	+	+	.	.	+	+	+	+	+	+	.	1	+	+	.	.	+	.	.	.
Leipoldtia schultzei	.	+	+	+	.	+	+	+	a	.	+	+	a	.	1	+	1	+	b	.	a	a	1	+	.	.	.
Pteronia glauca	.	1	.	.	.	a	+	.	.	.	.	+	+	1	1	+	.	+	.	.	1	+	+	+	.	.	.
Othonna rechingeri	.	+	+	.	.	.	+	.	.	.	+	+	+	+	+	+	+	+	+	.	.	+	+	+	.	.	.
Felicia cf. *rogersii*	.	+	+	+	.	.	.	.	.	+	.	.	.	.	.	+	.	.	+	1	.	.	.	.	.	.	.
Tylecodon paniculatus	.	.	.	+	+	.	.	.	.	.	.	.	.	+	.	.	.	.	+	.	+	+	.	+	.	.	.
Euryops lateriflorus	+	.	+	1	+	+	1	1	.	+	+	1	+	.	+	.	+	.	.	.	+	+	.	.	.	.	.
Asparagus capensis	+	.	+	+	+	+	+	+	+	.	.	+	.	+	+	1	+	.	.	.	+	.	.	+	.	.	.
Searsia lancea	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	1	a
Salvia disermas	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	1	1	+
Melianthus comosus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+
Arctotheca calendula	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+
Stachys rugosa	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.
Berkheya heterophylla	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	+
Pteronia sp. 2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	+	.
Aristida adscensionis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Cotula coronopifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Cotula nudicaulis	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.

Cyperus sp.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Leysera tenella	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Selago cf. *albida*	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Wahlenbergia sp. 2	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Amsinckia retrorsa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Erodium cicutarium	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Ballota africana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Gomphocarpus fruticosus	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Lasiopogon micropoides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Senecio cardaminifolius	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Zaluzianskya minima	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Vachellia karroo	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	a	1
Lycium horridum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.
Ruschia barnardii	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.
Moraea miniata	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+
Oxalis sp. 1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	+	.
Chrysocoma ciliata	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	b	+	.	+	.	1	1	+
Searsia undulata	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	+	+	.	+	.	1	+
Oxalis pes-caprae	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+	+	+
Nenax microphylla	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	+	.	+	.	+	.	.
Nemesia anisocarpa	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	+	.
Crassula rupestris	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	+
Ehrharta delicatula	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	+	+
Rhynchopsidium sessiliflorum	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	+
Zaluzianskya cohabitans	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	+
Ehrharta longiflora	.	.	.	.	+	+	.	.	.	.	.	.	.	.	.	.	+	.	.	a	.	.	.	.	+	1	+
Pentzia incana	.	.	.	.	.	+	.	.	.	.	.	.	+	.	+	.	+	.	+	.	+	.	.	+	+	.	.
Oxalis obtusa	.	.	.	.	.	.	+	.	+	.	.	.	+	.	.	+	+	.	+	a	.	+	.	.	.	.	.
Eriospermum paradoxum	.	.	.	.	.	.	.	+	.	.	+	.	.	.	+	.	.	.	.	.	.	+	.	.	.	.	.
Helichrysum leontonyx	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.
Cyphia digitata	.	.	.	.	+	.	.	.	+	.	.	+	.	.	.	+	+	.	.	+	.	.	.	.	.	.	.
Galenia africana	.	+	+	.	.	+	.	.	+	.	.	+	1	+	.	+	1	.	+	+	+	+	.	+	1	a	1
Heliophila variabilis	.	+	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	+
Hermannia cuneifolia	.	+	+	+	+	.	.	.	+	.	.	+	+	.	.	+	.	.	.	.	.	+	+	.	+	.	+
Lessertia frutescens	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	+	+	.	.	.	.	.	.	.	+	.	.
Ursinia nana	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	+	+	+	.	+	.	.	+	.	+	+	.
Lycium cinereum	.	.	+	.	.	+	.	.	+	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	+	+
Tetragonia echinata	.	.	+	.	.	+	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	+	+	+	.
Cleretum papulosum	.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	+	+
Diospyros austro-africana	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	+	.	.	.	.	.	.	+	.	+
Asparagus retrofractus	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.
Helichrysum revolutum	+	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Cyanella sp.	.	+	.	.	.	.	.	.	.	.	.	+	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.
Manochlamys albicans	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.
Pelargonium minimum	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Colchicum cuspidata	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Ornithoglossum vulgare	.	.	.	+	.	.	.	.	.	.	.	+	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.
Plantago cafra	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Mesembryanthemum noctiflorum	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.
Colchicum volutare	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+
Asparagus asparagoides	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	+
Fingerhuthia africana	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	+	.	.
Stachys lamarckii	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+
Pentameris airoides	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.	.	.	.	.	+	.	.
Trachyandra sp. 1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.
Pteronia ovalifolia	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	+	.	.	.	.	.	.	.

APPENDIX D

TERRAIN OF SOME OF THE SUBSTATIONS AND CONSTRUCTION SITES

Figure D1: Terrain at Substation 1 (mid-plateau).

Figure D2: Terrain at Substation 2 (mid-plateau).

Figure D3: Near Substation 3 (upper-plateau).

Figure D4: Construction site 3 (plains).

Figure D5: Construction site 2 (plains).

Figure D6: Mountain crest with one of the four communication towers.

APPENDIX E

ACCESS ROAD TO KUDUSBERG SITE FROM THE NORTH

Pictures are taken every few hundred metres from the turn-off at the northern R356 road between Sutherland and Ceres, southwards towards the Koedoesberg and Oliviersberg mountain ranges. The current road ends at the communication tower. The road runs next to the drainage line on the plains with a few crossings of the line.

P1 Plain at start of proposed access road.

P2 Plain.

P3 Plain next to drainage line.

P4 Plain.

P5 Crossing of drainage line.

P6 Plain.

P7 Plain.

P8 Plain.

P9 Crossing of drainage line.

P10 Plain.

P11 Plain.

P12 Plain.

P13 Plain.

P14 Plain before crossing of drainage line.

P15 Plain.

P16 Lower slope.

P17 Midslope.

P18 Upper plateau.

P19 Upper slope and plateau.

P20 End of current access road to plateau with wind measurement mast.

APPENDIX F

SPECIALISTS CVs AND EXPERTISE

Curriculum vitae: Noel van Rooyen

1. Curriculum Vitae

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

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

2. Publications

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

Books

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

Author/co-author of various chapters on the Savanna and Grassland Biomes in: (1) LOW, B. & REBELO, A.R. 1996. ***Vegetation types of South Africa, Lesotho and Swaziland*,** Department of Environmental Affairs and Tourism, Pretoria. (2) KNOBEL, J. (Ed.) 1999, 2006. ***The Magnificent Natural Heritage of South Africa*.** (Chapters on the Kalahari and Lowveld). (3) VAN DER WALT, P.T. 2010. **Bushveld.** Briza, Pretoria. (Chapter on

Sour Bushveld). (4) BOTHMA, J. du P. & DU TOIT, J.G. (Eds). 2016**.** ***Game Ranch Management*****.** 5th edition**.** Van Schaik, Pretoria.

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

3. Ekotrust CC: Core Services

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

4. Examples of research projects

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

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

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

5. Selected references of projects done by Ekotrust CC

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

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

VAN ROOYEN, N. & VAN ROOYEN, M.W. 2008. Vegetation classification, habitat evaluation and wildlife management of the proposed Royal Big Six Nsubane-Pongola Transfrontier Park, Swaziland. Ekotrust cc.

VAN ROOYEN, N., VAN DER MERWE, H. & Van Rooyen, M.W. 2011. The vegetation of Vaalputs. Report to NECSA.

VAN ROOYEN, M.W. & VAN ROOYEN, N. 2013. Carbon in the woody vegetation in the Mayoko area, epublic of Congo. Report to Flora, Fauna & Man Ecological Consultants.

VAN ROOYEN, M.W. & VAN ROOYEN, N. 2013. Resource assessment of *Elephantorrhiza elephantina* on farms (or portions) of Abbey, Tweed, Concordia and Bellville, Northern Cape. Report to CSIR.

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VAN ROOYEN, N. & VAN ROOYEN, M.W. 2016. Ecological evaluation of the farm Springbokoog in the Van Wyksvlei region of Northern Cape, including a habitat assessment for the introduction of black

rhinoceros. Ekotrust cc.

1. Selected publications

VAN ROOYEN, N. 1978. A supplementary list of plant species for the Kruger National Park from the Pafuri area. *Koedoe* 21: 37 - 46.

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MATTHEWS, W.S., VAN WYK, A.E., VAN ROOYEN, N. & BOTHA, G.A. 2003. Vegetation of the Tembe Elephant Park, Maputaland, South Africa. *South African Journal of Botany* 67: 573-594.

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VAN ROOYEN, M.W., THERON, G.K., VAN ROOYEN, N., JANKOWITZ, W.J. & MATTHEWS, W.S. 2004. Mysterious circles in the Namib Desert: review of hypotheses on their origin. *Journal of Arid Environments* 57: 467-48.

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VAN DER MERWE, H., VAN ROOYEN, M.W. & VAN ROOYEN, N. 2008. Vegetation of the Hantam-Tanqua-Roggeveld subregion, South Africa Part 2. Succulent Karoo Biome-related vegetation. *Koedoe* 50: 160-183.

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VAN ROOYEN, M.W., LE ROUX, A., GELDENHUYS, C., VAN ROOYEN, N., BROODRYK, N. & VAN DER MERWE, H. 2015. Long-term vegetation dynamics (40 yr) in the Succulent Karoo South Africa: effects of rainfall and grazing. *Applied Vegetation Science* 18: 311-322.

VAN ROOYEN, M.W., VAN ROOYEN, N., ORBAN, B., GAUGRIS, B., MOUTSAMBOTÉ, J.M., NSONGOLA′ G. & MIABANGANA, E.S. 2016. Floristic composition, diversity and stand structure of the forest communities in the Kouilou Département, Republic of Congo. *Tropical Ecology*: 54: 805-824.

Curriculum vitae: Gretel van Rooyen

1. Biographical information

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First names	Margaretha Wilhelmine		
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Current position	Honorary Professor in Plant Ecology Scientific advisor - Ekotrust cc		
Academic qualifications	BSc; BSc (Hons), HNOD, MSc (Botany), PhD (Plant ecology)		

2. Publications

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

3. Projects

Over the past 40 years my research has centred around the population biology, vegetation dynamics and classification of the vegetation in the Succulent Karoo (Namaqualand, Tanqua, Hantam, Roggeveld), Kalahari (arid grassland) and Namib Desert in Namibia. All three regions are relevant to the current project area.

3. Selected project references

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VAN ROOYEN, M.W., VAN ROOYEN, N. & GAUGRIS, J.Y. 2018. Vegetation, plants and habitats of the Dish Mountain Project, Ethiopia. Biodiversity Baseline Report by FLORA FAUNA & MAN, Ecological Services Ltd.

4. Selected research publications

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