NOUPOORT CONCENTRATED SOLAR POWER (CSP) PROJECT

NOUPOORT
NORTHERN CAPE PROVINCE

ECOLOGICAL SCOPING REPORT

March 2016

Prepared for:

CRESCO Energy (Pty) Ltd
267 West Building
267 West Avenue
Centurion
South Africa

Prepared by:

Gerhard Botha (Pri Sci Nat: Ecology & Botany)

Eco-Care Consultancy (Pty) Ltd

PO BOX 12500, BRANDHOF 9324
CELL: 0842073454
EMAIL: GABOTAH11@GMAIL.COM

TABLE OF CONTENTS

FIGURES

DECLARATION OF CONSULTANT'S INDEPENDENCE

I, Gerhard Botha, as the appointed specialist hereby declare that I:

- » act/ed as the independent specialist in this application;
- » regard the information contained in this report as it relates to my specialist input/study to be true and correct, and
- » do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- » have and will not have no vested interest in the proposed activity proceeding;
- » have disclosed, to the applicant, EAP and competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- » am fully aware of and meet the responsibilities in terms of NEMA, the Environmental Impact Assessment Regulations, 2014 (specifically in terms of regulation 13 of GN No. R. 543) and any specific environmental management Act, and that failure to comply with these requirements may constitute and result in disqualification;
- » have provided the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not; and
- » am aware that a false declaration is an offence in terms of regulation 48 of GN No. R. 982.

Gerhard Botha Pr.Sci.Nat 400502/14 (Botanical and Ecological Science)
January 2016

NOUPOORT CONCENTRATED SOLAR POWER (CSP) PROJECT, NORTHERN CAPE PROVINCE
ECOLOGICAL SCOPING REPORT

1 INTRODUCTION

1.1 Applicant

CRESCO Energy (Pty) Ltd.

1.2 Project

The project will be known as Noupoort CSP Project.

1.3 Proposed Activity

The proposed facility is envisaged to have a generating capacity of up to 150 MW and would include the following infrastructure:

» Parabolic through technology (solar field).
» Energy Centre.
» Power Block.
» Water supply pipeline.
» Water Storage tanks.
» Packed water treatment plant.
» Lined evaporation ponds.
» Workshops and office buildings.
» Access roads and fencing around the development area.
» On-site substation and overhead power line (to connect to Eskom's electricity grid); and
» Temporary laydown areas.

The development footprint of the solar farm is anticipated to be approximately 3460 hectares in extent. At this stage the layouts of the proposed facilities have not been finalised, but will be determined once sensitivities on the farm have been identified and target areas have been delineated and described.

1.4 Terms of reference

To conduct an ecological desktop study for a scoping assessment of the target areas where the establishment of the Solar Energy Facilities and associated infrastructure is proposed to be located and provide a professional opinion on

ecological issues pertaining to the target area to aid in future decisions regarding the proposed projects.

1.5 Conditions of this report

Findings, recommendations and conclusions provided in this report are based on the authors' best scientific and professional knowledge and information available at the time of compilation. No form of this report may be amended or extended without the prior written consent of the author. Any recommendations, statements or conclusions drawn from or based on this report must clearly cite or make reference to this report. Whenever such recommendations, statements or conclusions form part of a main report relating to the current investigation, this report must be included in its entirety.

1.6 Relevant legislation

The following legislation was taken into account whilst compiling this report:

Provincial

» The Northern Cape Nature Conservation Act, No. 9 of 2009, in its entirety, with special reference to:
    - Schedule 1: Specially Protected Species
    - Schedule 2: Protected Species
    - Schedule 6: Invasive Species

The above mentioned Nature Conservation Act accompanied by all amendments is regarded by the Northern Cape Province as the legal binding, provincial documents, providing regulations, guidelines and procedures with the aim of protecting game and fish, the conservation of flora and fauna and the destruction of problematic (vermin and invasive) species.

National

» National Environmental Management Act / NEMA (Act No 107 of 1998), and all amendments and supplementary listings and/or regulations
» Environment Conservation Act (ECA) (No 73 of 1989) and amendments
» National Environmental Management Act: Biodiversity Act / NEMA:BA (Act No. 10 of 2004) and amendments
» National Forest Act 1998 / NFA (No 84 of 1998)
» National Veld and Forest Fire Act (Act No. 101 of 1998)
» Conservation of Agricultural Resources Act / CARA (Act No. 43 of 1983) and amendments

International

» Convention on International Trade in Endangered Species of Fauna and Flora (CITES)
» Convention on Biological Diversity, 1995

2 STUDY AREA

2.1 Locality

The proposed facility will be located on Portion 1 and 4 of the Farm Carolus Poort 167 and the Remaining Extent of Farm 207, situated approximately 4 km north west of Noupoort (Figure 1). The proposed site falls within the jurisdiction of the Umsobomvu Local Municipality and within the greater Pixley ka Seme District Municipality in the Northern Cape Province.

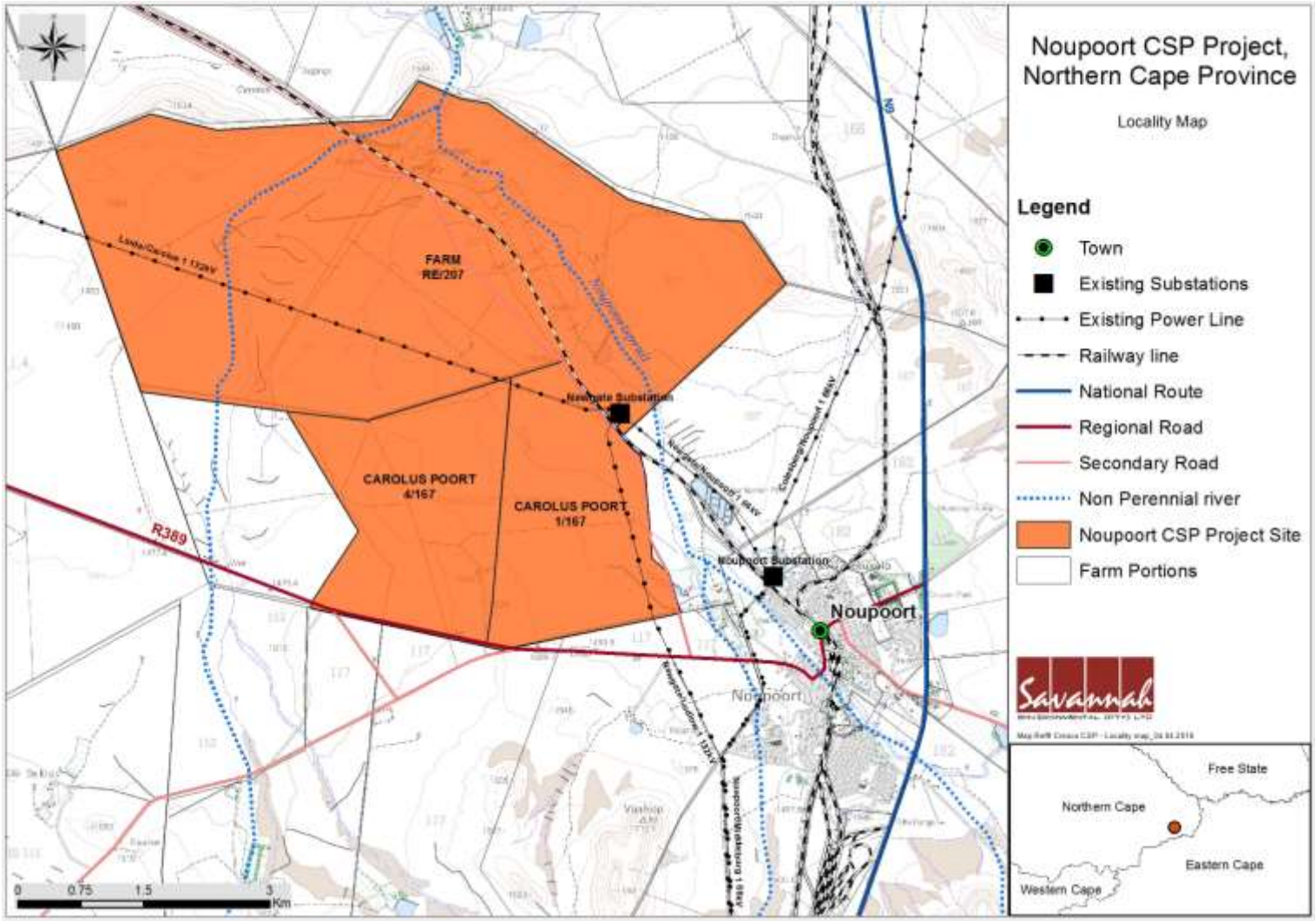

Figure 1: Locality map for the proposed Noupoort CSP Project development.

2.2 Climate and rainfall

The climate associated with the study area has been derived from recorded and extrapolated climatic data (http://en.climate-data.org/location/10843/) for Noupoort. Rainfall for the region is relative low (417 mm) and occurs mainly during late summer to early autumn with very dry winters. Mean annual rainfall is as mentioned about 417 mm with March being the wettest month, averaging about 72 mm, and July being the driest, with an average of only 11 mm. The average annual temperature in Noupoort is 13.6°C with January being the warmest (ave. 20.6°C) and July being the coldest (ave 5.2°C). Frost is frequent to very frequent in winter (mean frost days up to 50 days per year).

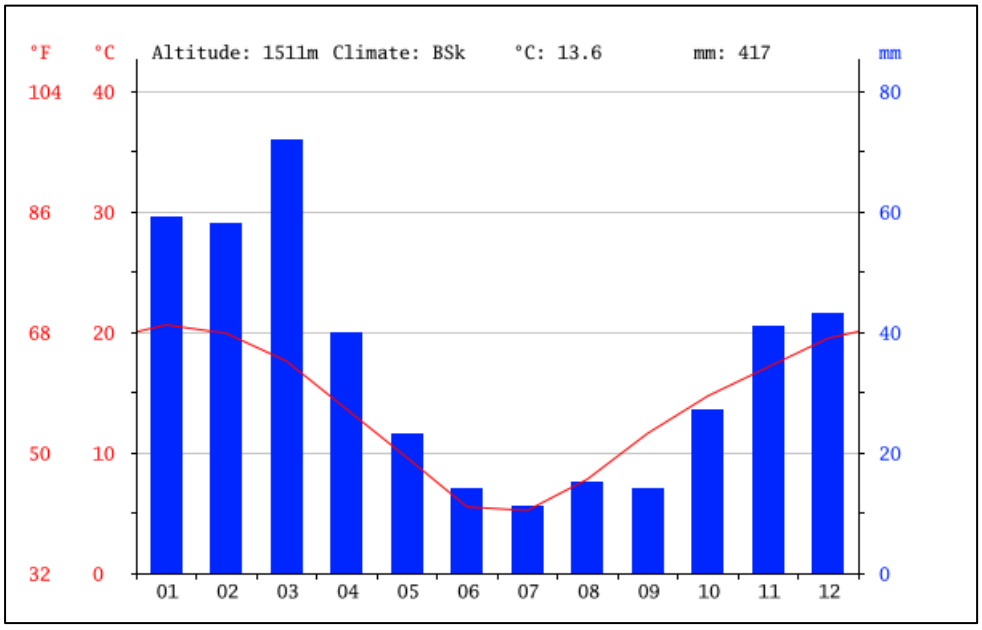

Figure 2: Climate graph of Noupoort (http://en.climate-data.org/location/10843/).

month	1	2	3	4	5	6	7	8	9	10	11	12
mm	59	58	72	40	23	14	11	15	14	27	41	43
°C	20.6	19.9	17.6	13.6	9.6	5.5	5.2	7.8	11.6	14.7	17.1	19.5
°C (min)	12.2	12.2	10.3	6.2	2.3	-1.8	-2.4	-0.4	3.2	6.2	8.6	10.9
°C (max)	29.0	27.7	24.9	21.0	17.0	12.9	12.8	16.1	20.1	23.2	25.6	28.1
°F	69.1	67.8	63.7	56.5	49.3	41.9	41.4	46.0	52.9	58.5	62.8	67.1
°F (min)	54.0	54.0	50.5	43.2	36.1	28.8	27.7	31.3	37.8	43.2	47.5	51.6
°F (max)	84.2	81.9	76.8	69.8	62.6	55.2	55.0	61.0	68.2	73.8	78.1	82.6

Figure 3: Climate table of Noupoort (http://en.climate-data.org/location/10843/).

2.3 Physiography and soils

Landscape Features

According to Mucina and Rutherford (2006) the region can be described as flats and gently sloping plains (interspersed with hills and rocky areas of Upper Karoo Hardeveld in the west, Besemkaree Koppies Shrubland in the northeast and Tarkastad Montane Shrubland in the southeast) dominated by dwarf microphyllous shrubs and "white" grasses of the genera *Aristida* and *Eragrostis*.

According to AGIS, 2007 the landscape can be described as a flat to slightly sloping footslope to valley bottom region with a straight to concave shape. Percentage slope is generally between 1 and 2%.

At a finer scale using a Google elevation profile for the study area and immediate surroundings the area can be described as a gradual, low sloping area (Avg. slope of study area: 14%). A watershed runs from north to south just east of the centre line of the affected properties. East of this watershed water drains mainly in a north-eastern direction towards the Noupoortspruit River and associated wetland system Figure 8), whereas the western portion drains west (top half of in a north-westerly direction and bottom half in a south-westerly direction) towards one of the Noupoortspruit Tributaries (associated with extensive areas of valley-bottom wetlands and drainage systems extending well beyond the property boundaries). Most of the affected areas are characterised by gentle gradient slopes. The south-western portion and far northern portion is more undulating characterised by low ridges and outcroppings. Running along the northern and eastern boundary of the Farm 207 (Remaining Extent) the border of the farm is demarcated by a high, steep sloping (26%) narrow dolerite ridge (refer to Figure 10). The highest point of the study area is associated with this range (1601m) whilst to lowest areas is associated with the valley-bottom wetland systems associated with the Tributary of the Noupoortspruit (1463m) as well as the Noupoortspruit valley (1468m). The affected farm portions is situated within the distal parts of the footslopes of the Afrikasberg Mountains, where it marks the transition into an extensive flat plains area extending to the north and west. To the east of the town of Noupoort the landscape becomes more rugged marking the western slopes of the Kikvarsberge Mountains. The study area as mentioned is situated within a gradual south-west to north-east sloping landscape, with only the south-western corner sloping gradually south-west.

Geology

The study area is dominated by mostly siliciclastic (sandstone) rocks and within limited areas mudstone and shale, all of which belonging to the Adelaide Super Group (Beaufort Group). A finger like intrusion of Karoo Dolerite Suite is present

in most of the central portion of the Farm 207 (Remaining extent) extending into north-western corner of Portion 4 of the Farm 167 (Carolus Poort) (refer to Figure 4). This intrusion is characterised by fine grained felsic rock and is absent from Portion 1 of the Farm 167 (Carolus Poort). Small Jurassic Karoo Dolerite dykes / sills are present in the south-west and northern sections of the study area. Pedisediments are frequent, especially to the eastern boundary of the study area.

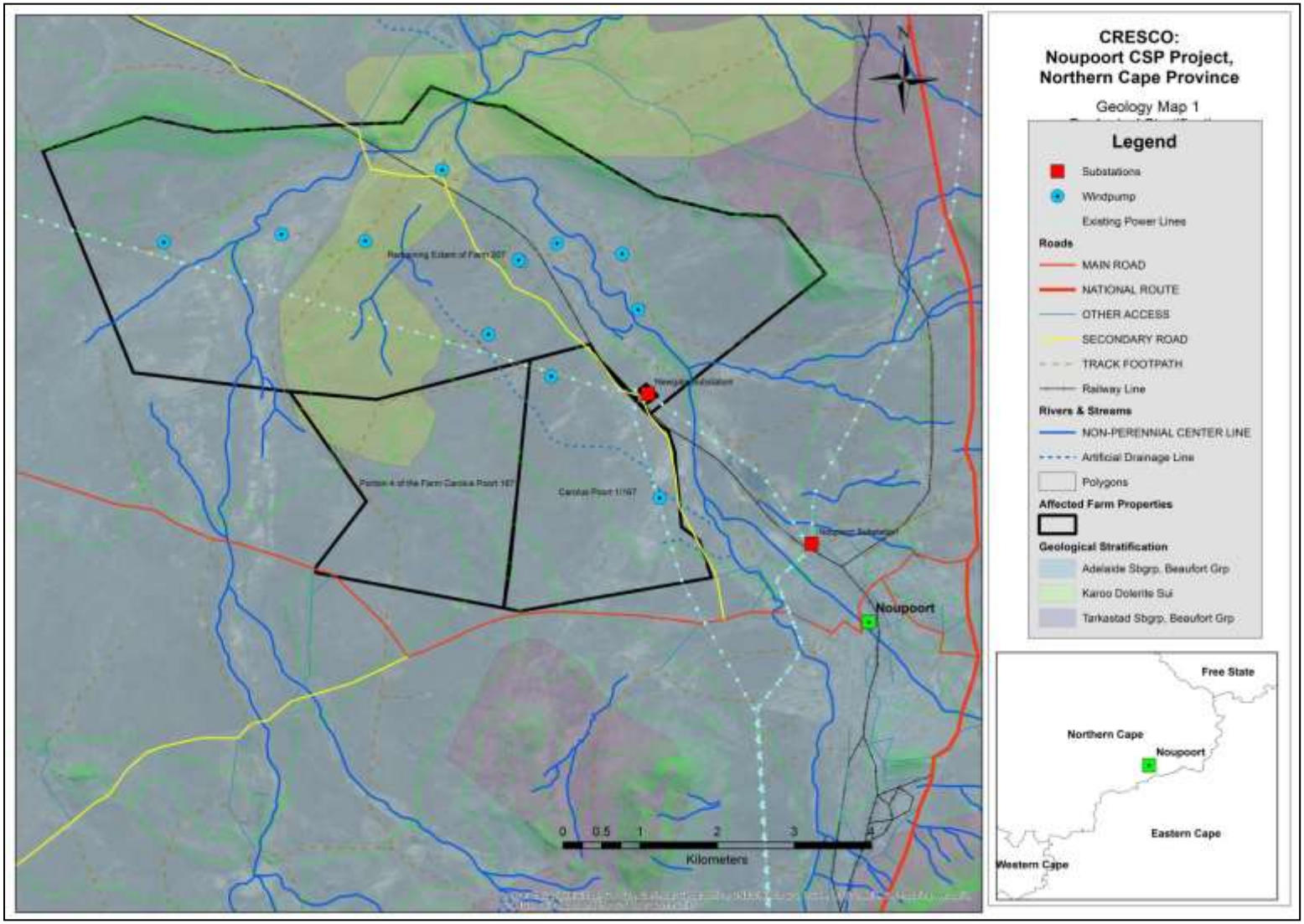

Figure 4: The geological stratification of the farm portion as well as surrounding environment.

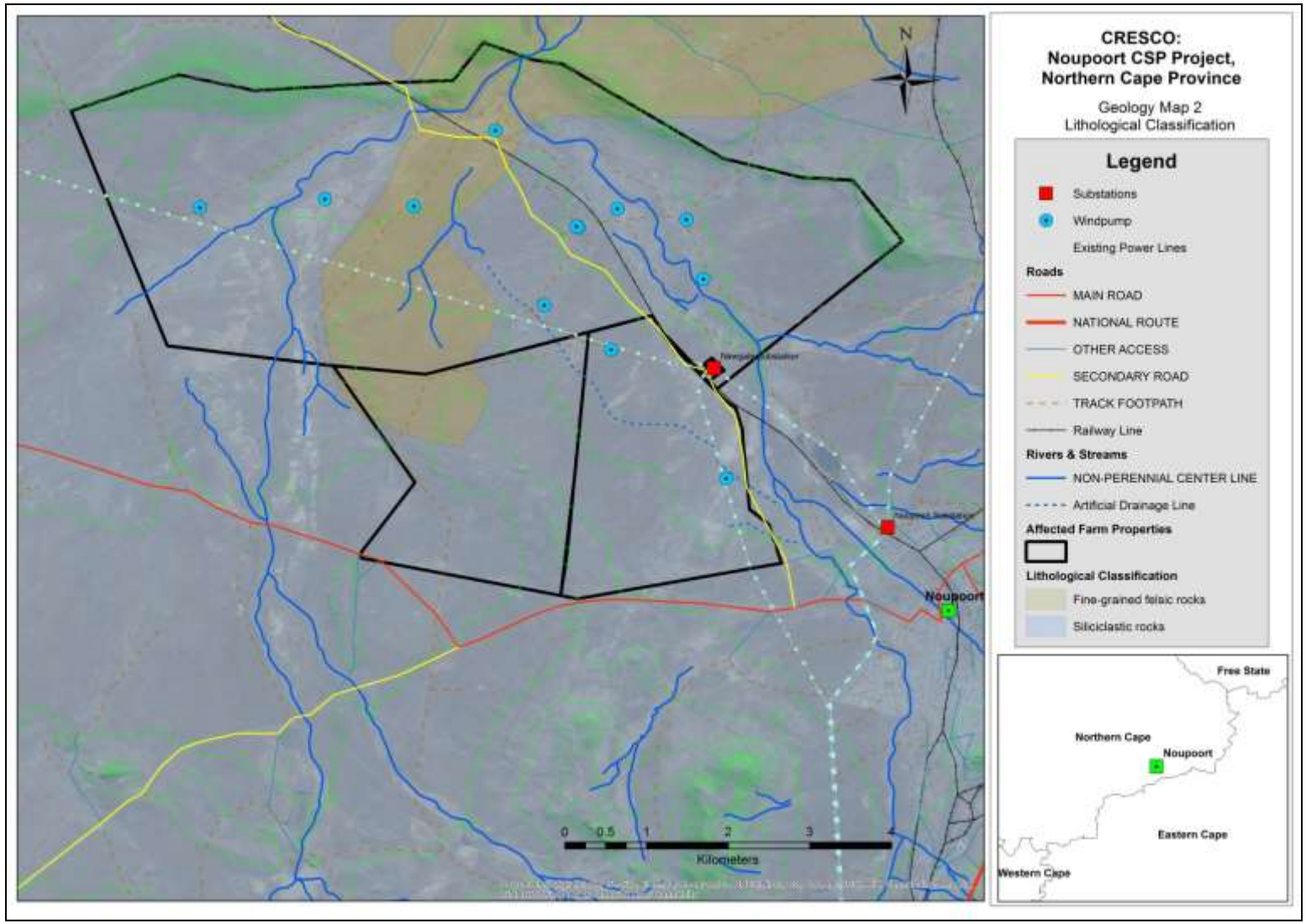

Figure 5: The lithological classification of the rock underlying the study area as well as the surrounding environment.

Soil and Land Types

Detailed soil information is not available for broad areas of the country. As a surrogate land type data was used to provide a general description of soil in the study area (land types are areas with largely uniform soils, typography and climate). The study area is primarily divided into two sections according to their land type units namely the Da14 to the north, east and west (largest portion) and Da77 nestled between the Da14 areas (in the south, extending northwards along the central portion of the study areas). The Da14 land type, as mentioned, covers the bulk of the study area (Land Type Survey Staff, 1987) (refer to Figure 6). Forming the northern boundary of the development property is a narrow ridge consistent with the Ib landtype (Ib316)

» The Da group of land types refer to soils where the red B-horizon (subsoil) has a strongly to very strongly developed structure, usually also with a high clay content. The soil is thus mostly imperfectly to poorly drained and the strong structure in the subsoil places a restriction on root development. Due to the fact that most of these soils have a sandier topsoil on a clay subsoil they are usually sensitive to erosion if poor management practices are exercised, specifically overgrazing (Land Type Survey Staff, 1987).
» The Ib group of land types refers to land types with a soil pattern difficult to accommodate elsewhere. These land types are characterised by exposed rock (exposed country rock, stones or boulders) covering 60 – 80% of the area.

Duplex Soils

Duplex soil are most common in the sub-humid and drier parts of South Africa. Duplex soils have in common the development of strong structure in the B horizons and a marked increase in clay compared to the overlying horizon from which it is separated by a clear or abrupt boundary. The B horizon is often sufficiently hard and dense to be an impediment to both root growth and water movement and these soils commonly exhibit a high susceptibility to erosion (Fey, 2010). The orthic A horizon often has a weak structure and when it contains sufficient fine particles (especially silt and fine sand with some clay) it may become hard or very hard when dry – a feature known as hard-setting (Fey, 2010). The textural horizon contrast ensures that permeability is often limited buy that of the B horizon (although surface crusting may also imped infiltration). Salinity may be evident in the more arid duplex soils, especially within or immediately below the B horizon. The amount of organic material is also generally low for this group.

Hydrology and Geohydrology

The study area is located within the distal (southern) portion of the Upper Orange River Water Management Area (Vanderkloof Sub Catchment area) and within the D32G sub-quaternary catchment area (Seekoei River). The most prominent river system within region is the ephemeral Noupoortspruit River which is a tributary of the Seekoei River. According to the Present Ecological State (DWS PES, 1999) the condition of the Noupoortspruit River is classified as Class C, which indicates that the river has undergone moderate levels of modifications.

Due to the geomorphological setting of the study area, the area is characterised by a complex of wetland systems. This area is situated within a valley / low lying section along the distal parts of numerous mountainous footslopes, where the landscape starts to even out into a flat outstretched plain (refer to Figure 8). Most of these wetlands are channelled and unchannelled valley-bottom wetlands. The channelled valley-bottom wetlands are mostly associated with the Noupoortspruit River and its tributary. Apart from these channelled wetlands, most are unchannelled valley-bottom wetlands and due to the gradual and low slope of the area water rather flows slowly as a sheet of outstretched water within these wetland systems towards the Noupoortspruit and tributary where they join up to form channelled drainage lines. Rainfall in the Karoo is usually erratic and associated with thunderstorms and short spells of flashfloods where most of the water flows as surface water towards the lower lying areas and therefore a good cover of plants is important in preventing erosion during such downpours. Apart from the main channels of the Noupoortspruit and its tributary, other smaller channels associated with these wetlands can either be natural due to the natural acceleration of water where slopes increase resulting in channel beds being formed or unnatural. Natural channels usually have a shallow and narrow morphology with overspill or flooding sections adjacent to these channels. Unnatural channels have formed in areas where the vegetation cover has been removed and the exposed soils subject to the effects of erosion. Especially along the ridge systems and towards the dolerite outcroppings where there is an increase in slope and the soils are characterised by sandy colluvial soils, erosion gullies and rills have formed (visible from satellite imagery). Trampling and overgrazing has most likely contributed to the accelerated effect of erosion noted in the study area. Although these gullies and rills are relative restricted, an increase in stocking rates and continual overgrazing may lead to the spread of these channels and gullies, losing valuable grazing land and causing a change in the hydrological dynamics of the study area. The morphology and hydrological regime of these wetlands have however already been greatly altered and transformed by numerous anthropogenic activities, including numerous dam structures of various sizes, artificial channels, channelling surface flow from the surrounding wetlands towards the dams, gravel pits and ploughing for cultivation.

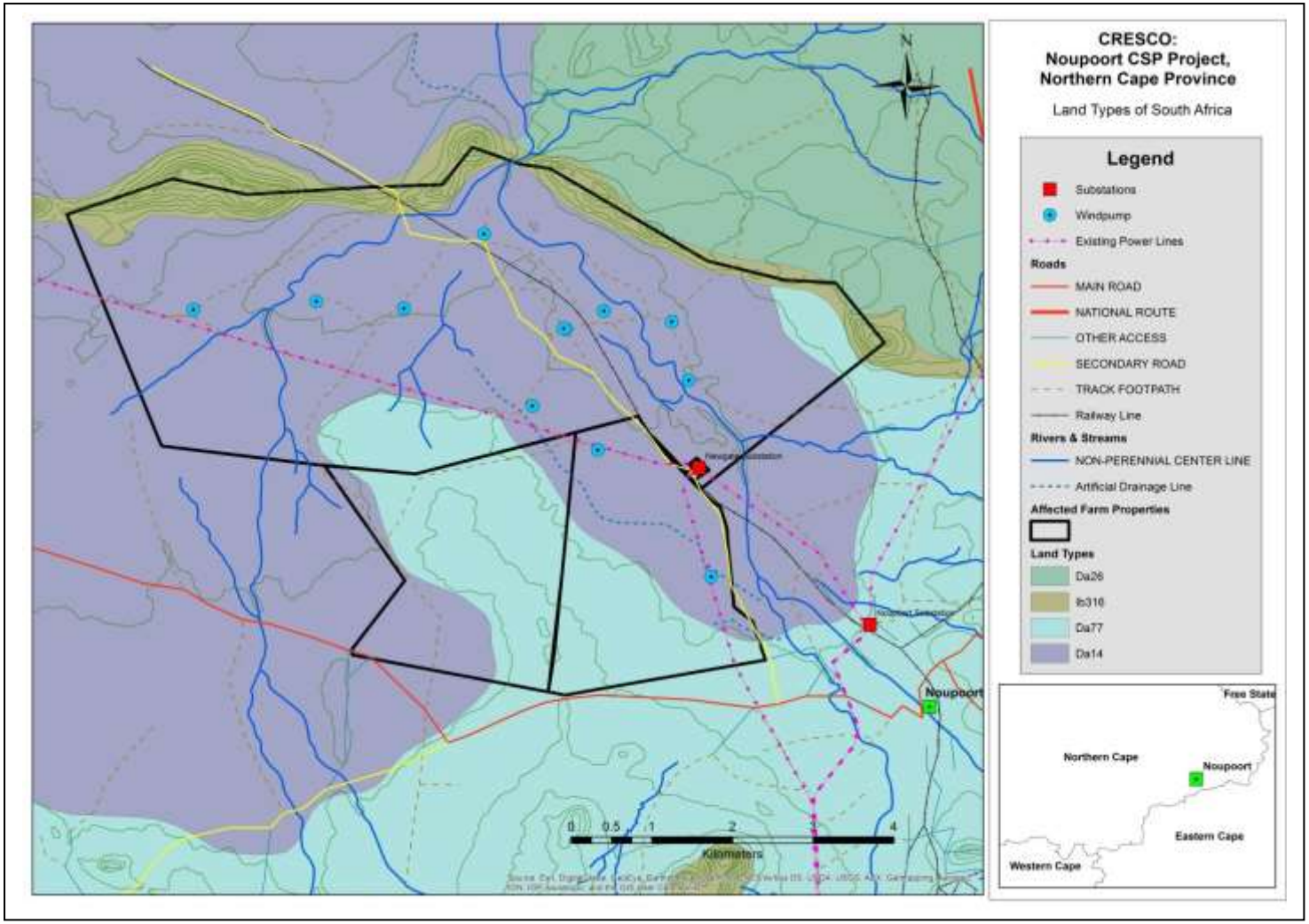

Figure 6: Land types found within the study area as well as the surrounding environment.

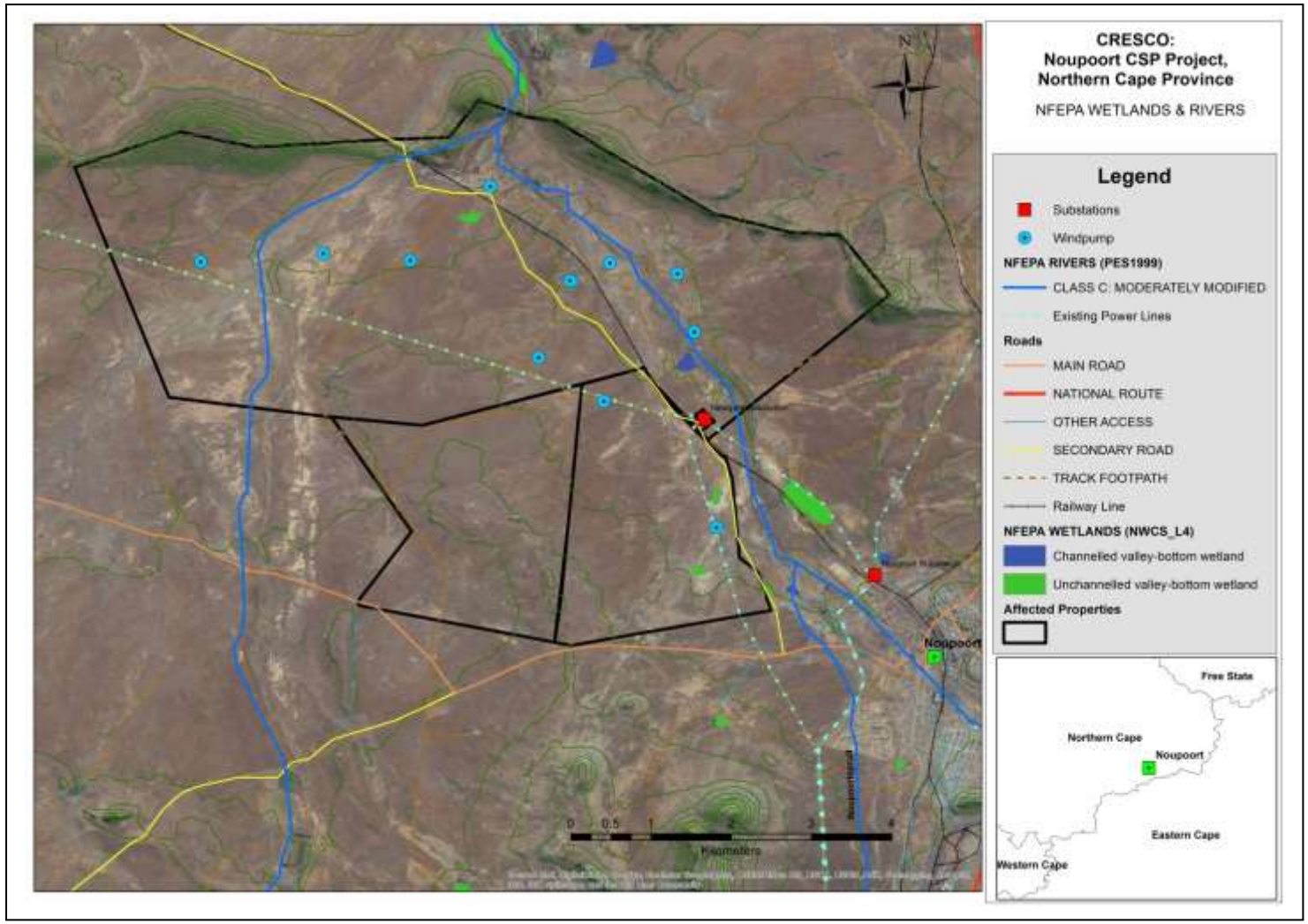

Figure 7: NFEPA wetlands and streams.

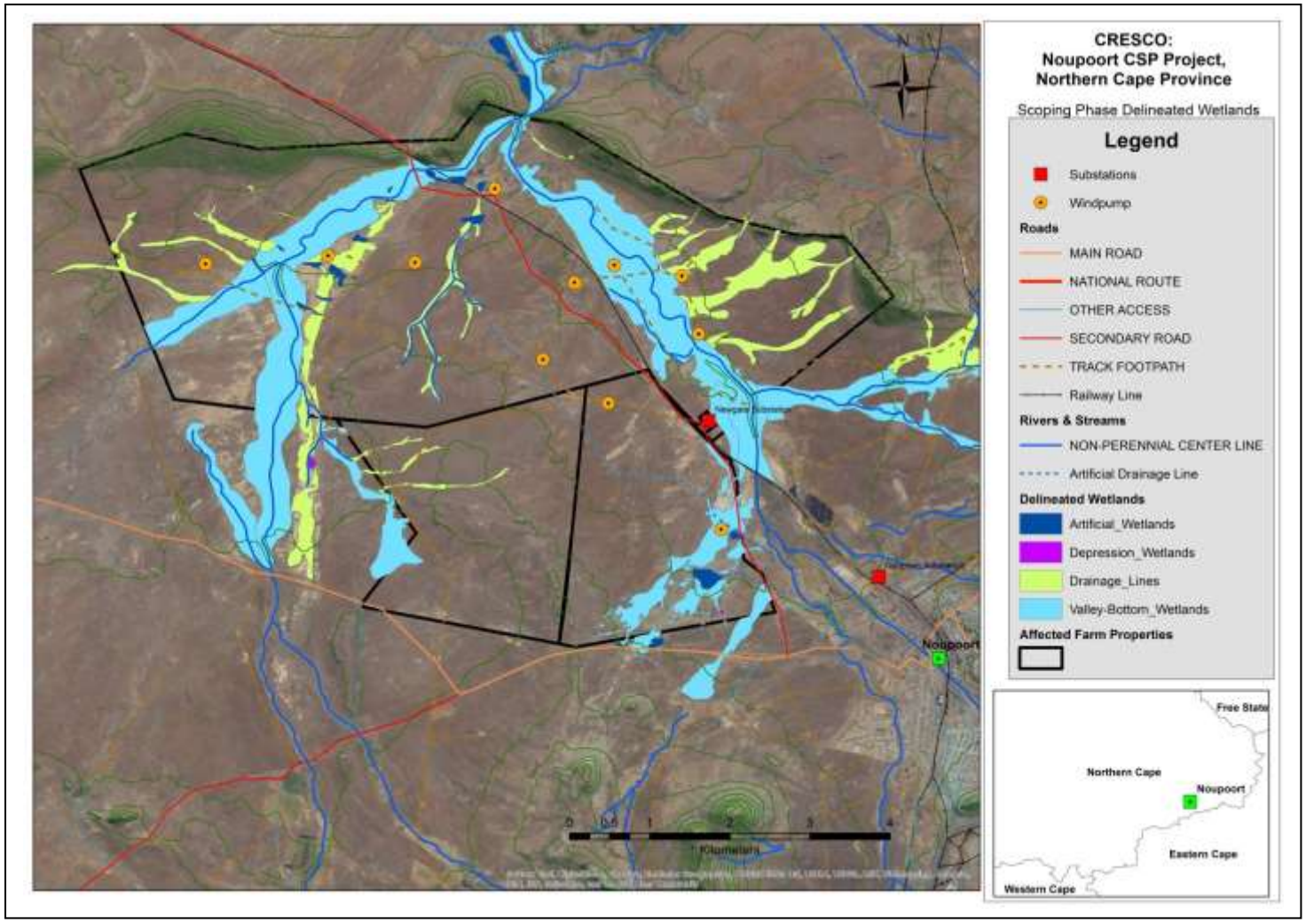

Figure 8: Desktop delineated wetlands and drainage lines (no buffers).

2.4 Existing Land Use

The mixed karroid shrubland is predominantly used for livestock and game farming. Little infrastructure is present within the boundaries of the study area and include a few boreholes and wind pumps, feeding and water troughs, border fences a gravel pit and 132kV overhead power lines (Linde/Carolus1 132kV- and Newgate/Ludlow 1 132kV power lines). The most notable anthropogenic impacts are firstly the farm roads which simply consist out of twin tracks and shallow graded areas (only topsoil and vegetation removed with some levelling), as well as numerous gravel dams located especially towards the north-west and west as well as to the south-east. Associated with the medium sized dam located to the south west (Portion 1 of the Farm 167) is a primitive manmade furrow that stretches over a relative long distance (in a south-east to north-west direction). The construction of these furrows is widely practised to improve drainage and can be subsurface stone filled. Smaller man made channels is also present throughout most of the wetland systems, draining the waters of these wetland into the small gravel dam. Notable infrastructure located outside of the study area are the R389 (Hanover Road) running parallel to the southern boundary of the site, a unknown secondary road running parallel to the eastern boundary of the study site (access to the site gained from this road), and the Newgate Substation (east of the study area).

2.5 Contamination risk

The wetland systems located within the south-eastern, eastern, western and northern portions of the study area is vulnerable to contamination. Furthermore, most of these wetland and drainage systems are connected to the Noupoortspruit River, thus making downstream environments also vulnerable to potential contamination. Regarding groundwater, aquifers located along fractures within subsurface dolerite intrusions may also be at risk for potential contamination. However, due to the nature of the development, few sources are present posing a contamination to these areas. Meticulous planning of the site layout, regular monitoring and service of infrastructure and machinery, appropriate buffers in place (around all sensitive areas) and with thorough mitigation measures in place, any impacts on groundwater and surface water can be kept to an absolute minimum largely avoiding any possibility of contamination of these areas.

2.6 Erosion Risk

As mentioned, erodibility and the impediment presented by the B horizon to water and plant roots are the most notable concerns relating to duplex soils. The main cause of erosion is clay dispersion, which give rise to surface crusting, which in turn reduces the infiltration of rainwater and intensifies surface runoff. Gully

erosion can become especially severe in the cumulic forms derived from deep pedisediments on concave footslopes (as appears to be present along the south-eastern boundary of the study area) once the main solum is breached and highly unstable subsoil clay is exposed. Slaking and spalling of the subsoil leads to undercutting and eventual collapse of the topsoil. Duplex soils on level typography such as that of river and coastal plain terraces do not carry the same erosion risk. A wetness hazard is also associated with the eluvic forms and with the achromic forms (bleached orthic A) families. Continual traffic and construction activities within these wet areas may create compacted and downtrodden areas which may be prone to erosion. By planning the layout within the central portion of the study area and excluding the western portion (in particular the south western and north western portion) and the eastern portion (especially the south-western portion and the property west of the municipal gravel road of the study area and with a sufficient erosion and rehabilitation plan in place the potential for erosion to occur can be maintained to an absolute minimum and localised.

3 METHODOLOGY

3.1 Data scouring and review

Data sources from the literature were consulted and used where necessary in the study and include the following:

Vegetation:

» Vegetation types and their conservation status were extracted from the South African National Vegetation Map (Mucina and Rutherford 2006) as well as the National List of Threatened Ecosystems (2011), where relevant.
» Critical Biodiversity Areas for the site and surroundings were extracted (CBA Map for North West Province obtained from http://bgis.sanbi.org/fsp/project.asp).
» Information on plant and animal species recorded for the Quarter Degree Squares (QDS) 3124BB and 2324BD was extracted from the SABIF/SIBIS database hosted by SANBI. This is a considerably larger area than the study area, but this is necessary to ensure a conservative approach as well as counter the fact that the site itself has probably not been well sampled in the past.
» The IUCN conservation status (Table 2) of the species in the list was also extracted from the database and is based on the Threatened Species Programme, Red List of South African Plants (2013).
» Freshwater and wetland information was extracted from the National Freshwater Ecosystem Priority Areas assessment, NFEPA (Nel et al. 2011). This includes rivers, wetlands and catchments defined under the study.

Fauna

» Lists of mammals, reptiles and amphibians which are likely to occur in the study area were derived based on distribution records from the literature and various spatial databases (SANBI's SIBIS and BGIS databases).
» Literature consulted includes Branch (1988) and Alexander and Marais (2007) for reptiles, Du Preez and Carruthers (2009) for amphibians, Friedmann and Daly (2004) and Skinner and Chimimba (2005) for mammals.
» Apart from the literature sources, additional information on reptiles were extracted from the SARCA web portal, hosted by the ADU, http://vmus.adu.org.za
» The conservation status of each species is also listed, based on the IUCN Red List Categories and Criteria 2014 (See Figure 3) and where species have not been assessed under these criteria, the CITES status is reported where possible. These lists are adequate for mammals and amphibians, the majority of which have been assessed, however the majority of reptiles have not been assessed and therefore, it is not adequate to assess the potential impact of the development on reptiles, based on those with a listed conservation status alone. In order to address this shortcoming, the distribution of reptiles was also taken into account such that any narrow endemics or species with highly specialized habitat requirements occurring at the site were noted.

3.2 Plant survey methods to be followed during the EIA phase

As part of the EIA process, a detailed field survey of the vegetation will be undertaken, preferably between mid-November to April, and results will include:

» A phytosociological classification of the vegetation found in the study area according to vegetation survey data and its TWINSPAN / PC ORD analysis
» A corresponding description of all defined plant communities and their typical habitats, including a full species list for each plant community and a representative photographic record taken on site of each community
» A map of all plant communities within the boundaries of the study area
» A description of the sensitivity of each plant community, based on sensitivity criteria outlined in section 3.3
» A full assessment of impacts according to section 3.4

3.3 Criteria used to assess sites

The broad-scale scoping phase ecological sensitivity map of the site was produced by integrating information acquired during the desktop survey including available ecological and biodiversity information available in the literature and various spatial databases (SIBIS, BGIS) as well as the North West Provinces' Critical Biodiversity Areas (CBA) (status and conditions determined during scoping phase

site visit of CBAs). The ecological sensitivity of the different units identified in the mapping procedure was rated according to the following scale:

Table 1: Explanation of sensitivity rating

Sensitivity	Factors contributing to sensitivity	Examples of qualifying features
VERY HIGH	Indigenous natural areas that are highly positive for any of the following: ▪ presence of threatened species (Critically Endangered, Endangered, Vulnerable) and/or habitat critical for the survival of populations of threatened species. ▪ High conservation status (low proportion remaining intact, highly fragmented, habitat for species that are at risk). ▪ Protected habitats (areas protected according to national/provincial legislation, e.g. National Forests Act, Draft Ecosystem List of NEM:BA, Integrated Coastal Zone Management Act, Mountain Catchment Areas, Lake Areas Development Act) May also be positive for the following: ▪ High intrinsic biodiversity value (high species richness and/or turnover, unique ecosystems) ▪ High value ecological goods and services (e.g. water supply, erosion control, soil formation, carbon storage, pollination, refugia, food production, raw materials, genetic resources, cultural value) ▪ Low ability to respond to disturbance (low resilience, dominant species very old).	▪ CBA 1 areas ▪ Remaining areas of vegetation type listed in Draft Ecosystem List of NEM:BA as Critically Endangered, Endangered or Vulnerable. ▪ Protected forest patches. ▪ Confirmed presence of populations of threatened species.
HIGH	Indigenous natural areas that are positive for any of the following: ▪ High intrinsic biodiversity value (moderate/high species richness and/or turnover). ▪ presence of habitat highly suitable for threatened species (Critically Endangered, Endangered Vulnerable species).	▪ CBA 2 "critical biodiversity areas". ▪ Habitat where a threatened species could potentially occur (habitat is suitable, but no confirmed records). ▪ Confirmed habitat

Sensitivity	Factors contributing to sensitivity	Examples of qualifying features
	▪ Moderate ability to respond to disturbance (moderate resilience, dominant species of intermediate age). ▪ Moderate conservation status (moderate proportion remaining intact, moderately fragmented, habitat for species that are at risk). ▪ Moderate to high value ecological goods & services (e.g. water supply, erosion control, soil formation, carbon storage, pollination, refugia, food production, raw materials, genetic resources, cultural value). May also be positive for the following: ▪ Protected habitats (areas protected according to national/provincial legislation, e.g. National Forests Act, Draft Coastal Zone Management Act, Mountain Catchment Areas Act, Lake Areas Development Act)	for species of lower threat status (near threatened, rare). ▪ Habitat containing individuals of extreme age. ▪ Habitat with low ability to recover from disturbance. ▪ Habitat with exceptionally high diversity (richness or turnover). ▪ Habitat with unique species composition and narrow distribution. ▪ Ecosystem providing high value ecosystem goods and services.
MEDIUM-HIGH	Indigenous natural areas that are positive for one or two of the factors listed above, but not a combination of factors.	▪ CBA 2 "corridor areas". ▪ Habitat with high diversity (richness or turnover). ▪ Habitat where a species of lower threat status (e.g. near threatened, rare) could occur (habitat is suitable but no confirmed records).
MEDIUM-LOW	Degraded or disturbed indigenous natural vegetation	
LOW	No natural habitat remaining	

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

» Areas classified into the VERY HIGH class are vital for the survival of species or ecosystems. They are either known sites for threatened species or are ecosystems that have been identified as being remaining areas of vegetation of critical conservation importance. CBA1 areas would qualify for inclusion into this class.
» Areas classified into the HIGH class are of high biodiversity value, but do not necessarily contain features that would put them into the VERY HIGH class. For example, a site that is known to contain a population of a threatened species would be in the VERY HIGH sensitivity class, but a site where a threatened species could potentially occur (habitat is suitable), but it is not known whether it does occur, is classified into the HIGH sensitivity class. The class also includes any areas that are not specifically identified as having high conservation status but, have high local species richness, unique species composition, low resilience or provide very important inclusion into this class, if there were no other factors that would put them into the highest class.
» Areas classified into the MEDIUM-HIGH sensitivity class are natural vegetation in which there are one or two features that make them of biodiversity value, but not to the extent that they would be classified into one of the other two higher categories. CBA2 "corridor areas" would qualify for inclusion into this class.

3.4 Assessment of impacts

The Environmental Impact Assessment methodology assists in the evaluation of the overall effect of a proposed activity on the environment. This includes an assessment of the significant direct, indirect, and cumulative impacts. The significance of environmental impacts are to be assessed by means of the criteria of extent (scale), duration, magnitude (severity), probability (certainty) and direction (negative, neutral or positive).

» The **nature**, which includes a description of what causes the effect, what will be affected and how it will be affected.
» The **extent**, wherein it is indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 was assigned as appropriate (with 1 being low and 5 being high).
» The **duration**, wherein it was indicated whether:
  - the lifetime of the impact will be of a very short duration (0 – 1 years) – assigned a score of 1;
  - the lifetime of the impact will be of a short duration (2 – 5 years) – assigned a score of 2;
  - medium-term (5 -15 years) – assigned a score of 3;
  - long term (> 15 years) – assigned a score of 4; or
  - permanent – assigned a score of 5;

- The **magnitude**, quantified on a scale from 0 – 10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
- The **probability** of occurrence, which describes the likelihood of the impact actually occurring. Probability was estimated on a scale of 1 -5, where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).
- The **significance**, was determined through a synthesis of the characteristics described above and can be assessed as **LOW**, **MEDIUM** or **HIGH**; and
- the **status**, which was described as either positive, negative or neutral.
- the degree of which the impact can be reversed,
- the degree to which the impact may cause irreplaceable loss of resources,
- the degree to which the impact can be mitigated.

The significance was calculated by combining the criteria in the following formula:

S=(E+D+M)P where;

- S = Significance weighting
- E = Extent
- D = Duration
- M = Magnitude
- P = Probability

The significance weightings for each potential impact are as follows;

- < 30 points: **LOW** (i.e. where the impact would not have a direct influence on the decision to develop in the area),
- 30 – 60 points: **MEDIUM** (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),
- > 60 points: **HIGH** (i.e. where the impact must have an influence on the decision process to develop in the area).

4 RESULTS

4.1 Vegetation overview

Broad vegetation types

The study area is situated in the Nama-Karoo biome and Upper Karoo Bioregion. The vegetation in and surrounding the study area is Eastern Upper Karoo (NKu 4).

The distribution of the vegetation type is spread across the Northern Cape, Eastern Cape and Western Cape Provinces, between Carnarvon and Loxton in the west, De Aar, Petrusville and Venterstad in the north, Burgersdorp, Hofmeyr and Cradock in the east and the Great Escarpment as well as Sneeuberge-Coetzeesberge mountain chain in the south. This vegetation type has been described by Mucina and Rutherford (2006) as a flats and gently sloping plains dominated by dwarf microphyllous shrubs, with 'white' grasses of the genera *Aristida* and *Eragrostis*. The grass cover increases along a gradient from southwest to northeast.

Important taxa found within this vegetation unit include:

» Tall Shrubs: *Lycium cinereum, L. horridum, L. oxycarpum.*

» Low Shrubs: *Chrysocoma ciliata, Eriocephalus ericoides subsp. ericoides, E. spinescens, Pentzia globosa, P. incana, Phymaspermum parvifolium, Salsola calluna, Aptosimum procumbens, Felicia muricata, Gnidia polycephala, Helichrysum dregeanum, Pteronia glauca* and *Rosenia humilis.*

» Succulent Shrubs: *Euphorbia hypogaea, Ruschia intricata*.

» Herbs: *Indigofera alternans, Pelargonium minimum, Tribulus terrestris*

» Geophytic Herbs: *Moraea pallida, Moraea polystachya, Syringodea bifucata, S. concolor*

» Succulent Herbs: *Psilocaulon coriarium, Tridentata jucunda, T. virescens*

» Graminoids: *Aristida congesta, A. diffusa, Cynodon incomplectus, Eragrostis bergiana, E. bicolor, E. lehmanniana, E. obtusa, Sporobolus fimbriatus, Stipagrostis ciliata, Tragus koelerioides, Aristida adscensionis, Chloris virgata, Cyperus usitatus, Digitaria eriantha, Eragrostis curvula, Fingerhuthia africana, Themeda triandra*.

A species list from POSA (http://posa.sanbi.org, Degree Grid; 3124 with special emphasis on Quarter Degree Grids; 3124BB and 3124BD) containing the species that have been recorded to date within the surroundings of the study area have been extracted. POSA generated species lists also contain updated Red Data species status according to the Red List of South African Plants published by SANBI in Strelitzia 25 (Raimondo *et al*. 2009, updated 2013). Only protected and red data species that may potentially occur in the study area have been listed under results. The actual field survey will confirm which of the species already recorded will actually occur in the study area, and may reveal the presence of additional species that may not have been recorded in official databases to date.

A total of 592 species have been recorded within the 3124 Degree Grid with Quarter Degree Grids; 3124BB and 3124BD being severely underrepresented (likely due to lack of sampling in these grids) with only 66 species being recorded. It is highly unlikely that all of these species will occur within the project area. Ten Red Data species were noted within the degree grid, whilst none of these species were recorded within the quarter degree grids. A number of alien invasive species (total of 34 species) have been recorded within the degree grid.

Conservation status of broad vegetation types

The vegetation types of South Africa have been categorised according to their conservation status which is, in turn, assessed according to the degree of transformation and rates of conservation. The status of a habitat or vegetation type is based on how much of its original area still remains intact relative to various thresholds. On a national scale these thresholds are as depicted in the table below, as determined by best available scientific approaches (Driver *et al*. 2005). The level at which an ecosystem becomes Critically Endangered differs from one ecosystem to another and varies from 16% to 36% (Driver *et al*. 2005).

Table 2: Determining ecosystem status (from Driver et al. 2005). *BT = biodiversity target (the minimum conservation requirement.

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

The National List of Ecosystems that are Threatened and in need of protection (GN1002 of 2011), published under the National Environment Management: Biodiversity Act (Act No. 10 of 2004), lists national vegetation types that are

afforded protection on the basis of rates of transformation. The threshold for listing in this legislation is higher than in the scientific literature, which means there are fewer ecosystems listed in the National Ecosystem List versus in the scientific literature.

Table 3: Conservation status of the vegetation type occurring in and around the study area.

Vegetation Type	Target (%)	Transformed (%)	Erosion (%)		Conservation Status	
			Moderate	High	Driver *et al*., 2005; Mucina & Rutherford, 2006	National Ecosystem List (NEM:BA)
Eastern Upper Karoo	21%	2%	60%	38%	Least Threatened	Least Threatened

According to Mucina and Rutherford (2006) only 2% of the unit has been transformed, largely due to building of dams. The alien plant *Medicago laciniata* is a very common and widespread alien plant within this unit.

Red List and protected plant species of the study area

As previously mentioned, a species list was obtained from POSA for the relevant degree grid as well as quarter degree grids. The species on this list were evaluated to determine the likelihood of any of them occurring in the study area. Of the species that are considered to occur within the geographical area under consideration, there are 10 species which are regarded conservation worthy. Three species recorded in the quarter degree grids are listed on the Red List plant species. According to the South African Red List Categories, one is listed as Critically Endangered (*Gnaphalium simii*), one species as Endangered (*Brunsvigia litoralis*), 5 species as rare (*Euryops petraeus, Gethyllis longistyla, Syringodea pulchella, Kogelbergia verticillata* and *Selago retopilosa*) and one species as declining (*Boophane disticha*). The remaining two species (*Howorthia bolusii var. bolussi* and *Trichodiadema rogersiae*) are regarded as data deficient.

According to Mucina and Rutherford (2006) 8 species are known to be endemic to the Eastern Upper Karoo namely; *Chasmatophyllum rouxii, Hertia cluytiifolia, Rabiea albinota, Salsola tetrandra, Phymaspermum scoparium, Aspalathus acicularis subsp. planifolia, Selago persimilis* and *Selago walpersii*. None of these endemic species or species endemic to South Africa has been recorded within the POSA Species List for the relevant degree grid.

Apart from the Red Data species a further 124 species are protected within the Northern Cape Nature Conservation Act, Act 9 of 2009 (NCNCA). No tree species

were recorded within the Quarter Degree Grids that are protected according to the National Forest Act (NFA).

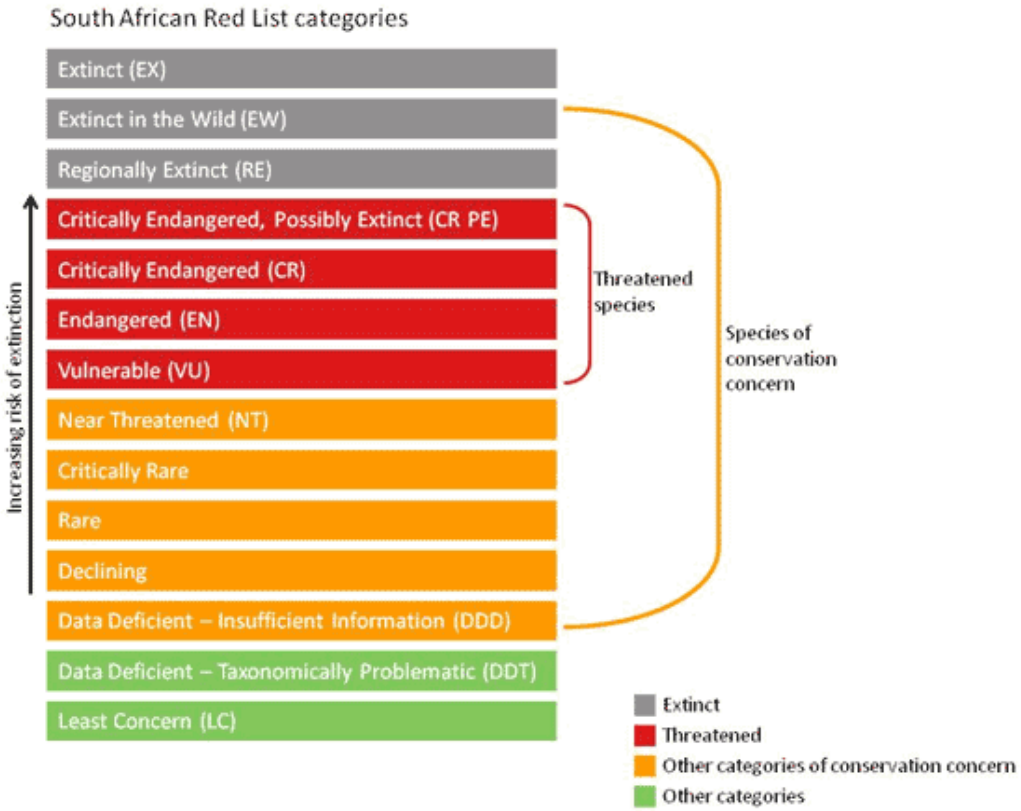

Figure 9: Schematic representation of the South African Red List categories. Taken from http://redlist.sanbi.org/redcat.php

4.2 Critical Biodiversity Areas and broad scale ecological processes

No fine-scale conservation planning has been done for the Northern Cape Province and as a result, no Critical Biodiversity Areas have been defined for the province.

4.3 Fauna Survey

Mammals

The potential diversity of mammals within the study area is moderate with as many as 58 terrestrial mammals potentially occurring within the area. The diversity of habitat types found within the greater area, as well as within the study area itself provide a wide spectrum of niches that may potentially be occupied by these species. Habitat diversity within the greater environment includes slopes, escarpments and plateaus of mountains to the south and east,

plains to the north and west, dolerite and sandstone outcrops and various forms of wetlands (most are ephemeral). Within the study area itself habitat diversity include the dolerite and sandstone outcrop to the south (various micro-niches created within these outcroppings), sloping plains (these plains contain both elements of karroid shrublands as well as grasslands, contributing furthermore to the potential biodiversity), ephemeral wetlands and artificial water bodies (e.g. dams and water points).

A number of antelope species have been recorded by the ADU (Animal Demographic Unit) within the 3124 Degree Grid. Most of these antelope species are confined by fences and occur only where farmers have introduced them or allow them to persist and should be considered as part of the farming system rather than as wildlife per se. Some of these South African indigenous antelope species do not have a natural distribution within the specific region but as mentioned have been introduced by farmers. Such antelope species include; Black Wildebeest (*Connochaetes gnou*) Blesbuck (*Damaliscus dorcas* subsp. *phillipsi*), Grey Rhebok (*Pelea capreolus*), Mountain Reedbuck (*Redunca fulvorufula*), Greater Kudu (*Tragelaphus strepsiceros*) and Springbok (*Antidorcas marsupialis*). Both Duiker (*Sylvicapra grimmia*) and Steenbok (*Raphicerus campestris*) are adaptable species that are able to tolerate high levels of human activity and are not likely to be highly sensitive to the disturbance associated with the development.

There are, however, several factors which will reduce the actual number of species present with the study area. This includes fractured landscape (fences of small grazing camps, roads etc.), surrounding agricultural practices (e.g. cultivation), the presence of large roads (such as R389) and other anthropogenic activities.

Table 4: Species listed as conservation worthy within the South African Red Data Base (SA RDB) as well as IUCN Red List.

Species	Common Name	Status
Chlorotalpa sclateri	Sclaters Golden Mole	SA RDB: Protected
Atelerix frontalis	South African Hedgehog	SA RDB: Protected
Smutsia temminckii	Ground Pangolin	IUCN: VU and SA RDB: VU
Hyanena brunnea	Brown Hyena	IUCN: NT and SA RDB: Protected
Felis nigripes	Black-footed cat	IUCN: VU and SA RDB: Protected
Mellivora capensis	Honey Badger	SA RDB: Protected
Vulpes chama	Cape Fox	SA RDB: Protected
Connochaetes gnou	Black Wildebeest	SA RDB: Protected
Neoromicia capensis	Cape Serotine Bat	SA RDB: Protected & NCNCA

Reptiles and Amphibians

Of the 36 reptilian species that have been recorded within the 3124 degree grid, six species have been recorded within the quarter degree grid (3124 BB). None of these species (recorded within the relevant degree grid) are listed as Red Data species. Of the 36 reptilian species 11 are regarded as region endemic (See below).

Regional Endemic Reptile Species: *Cordylus cordylus* (Cape Girdled Lizzard), *Pseudocordylus microlepidotus* subsp. *fasciatus* (Karoo Crag Lizzard), *Afroedura karroica* (Karoo Flat Gecko), *Pachycactylus mariquensis* (Marico Gecko), *Pachydactylus oculatus* (Golden Spotted Gecko), *Tetradactylus tetradactylus* (Cape Long-tailed Seps), *Pedioplanis burchelli* (Burchell's Sand Lizard), *Duberria lutrix* subsp. *lutrix* (South African Slug-eater), *Acontias breviceps* (Short-headed Legless Skink), *Trachylepis homalocephala* (Red-sided Skink), *Homopus femoralis* (Greater Padloper).

Of the 11 amphibian species that have been recorded within the 3124 degree grid, seven species have been recorded within the quarter degree grid (3124BB). None of these species (recorded within the relevant quarter degree grids) are listed as Red Data species. One species, however, has been recorded within the expanded (degree grids) area with red data status. The Giant Bull Frog (*Pyxicephalus adspersus*) is classified as Near Threatened within the Atlas and Red Data book of the frogs of South Africa, Lesotho and Swaziland (2004). These species prefer and breed in the shallows of temporary rain filled depressions in grassland and dry savannah. The wetland systems identified within the study area may potentially (although likelihood is low) be a suitable habitat for these species and will be confirmed during the EIA Phase.

4.4 Desktop Sensitivity Analysis

The following sensitivity map (Figure 10) has been compiled using existing information such as NFEPA Wetlands, Desktop Delineated Wetlands, Threatened Ecosystem Status, current land use (visible from areal and satellite images) and previous accounts of threatened and protected species (fauna and flora) as well as potential habitat suitability within the study area. This is only a preliminary map and information obtained during the site visit in the EIA Phase will be used to fine-tune and ground-truth the map.

Very High Sensitivity: Wetland systems located to the south-east and west of the study area
These primarily ephemeral valley-bottom wetlands play a critical role within the ecosystem providing ecological functions such as surface flow reduction and flood

attenuation, stream flow augmentation, erosion control, ground water recharge, chemical cycling, biodiversity conservation and water supply in an otherwise arid environment.

A well-developed vegetation cover is vital to protect the soils associated with these areas and which is potentially highly dispersive and erodible.

The wetland system located along the eastern portion of the study area, including the associated complex of drainage systems (all forming part of the tributary of the Noupoortspruit River), flows through an area characterised by highly dispersive soils. Due to this vulnerability to erosion as well as the fact that these wetlands form part of a larger complex expanding well beyond the study area and providing valuable ecosystem functions such as water provision, flood attenuation and reduction, as well as valuable grazing, it is recommended that the entire eastern portion of the study area is excluded from the development.

The complex of valley-bottom wetland systems located to the south-east and along the eastern portion of the study area forms part of the Noupoortspruit River system and as in the case of the described wetland systems located to the west of the study area, these wetlands provide pivotal ecological functions well beyond the study area. As such it is recommended that all these areas are excluded. It is furthermore recommended that all of the Farm 207 (Remaining Extent) located east of the municipal gravel road should be deemed as highly unsuitable (due to the extensive area covered by the Noupoortspruit River and associated wetlands and drainage systems) and should therefore be excluded from any further planning.

Due to the above mentioned information it can be concluded that these areas should be classified as Highly Sensitive areas and should furthermore be regarded as No-Go areas.

Very High Sensitivity: High dolerite ridge

The high dolerite ridge running mostly in an east to west direction along the northern boundary of Farm 207 (Remaining Extent) is deemed highly unsuitable for the proposed development and should therefore be excluded as a potential area. This ridge or low mountain is narrow with steep slopes, especially along the southern aspects (aspect of the ridge falling within the study area). This southern aspect creates a cooler micro-climate and it is expected that this aspect will contain a species composition differing from the surrounding low lying areas as well as the northern aspect. As such this area will contribute to species diversity within the greater environment (Beta and Gamma diversity).

High Sensitivity: Dolerite outcropping and ridges.

These habitat types contribute to the general habitat diversity (Beta diversity) of the area, creating habitats for species that do not inhabit the plains. Furthermore, various micro-niches are created within these outcroppings and ridges. Examples of such micro-niches include deep crevices, secluded areas between boulders, gravel plains and deep shaded areas, allowing for a wide spectrum of fauna and flora to inhabit a relative small area. As in the case of the wetland vegetation, a good vegetation covering is paramount to the protection of the soils against erosion.

As such these areas are regarded as High Sensitive and should be regarded as No-Go Areas.

High Sensitivity: Buffers around the wetland types.

Wetland buffers are areas that surround a wetland and reduce adverse impacts to wetland functions and values from adjacent developments. Buffers reduce wetland impacts by moderating the effects of storm water runoff including stabilizing soil to prevent erosion, filtering suspended solid, nutrients, and harmful or toxic substances, and moderating water level fluctuations. Buffers also provide essential habitat for wetland-associated species for use in feeding, roosting, breeding and rearing of young, and cover for safety, mobility, and thermal protection. Finally, buffers reduce the adverse impacts of human disturbance on wetland habitats including blocking noise and glare; reducing sedimentation and nutrient input; reducing direct human disturbance from dumped debris, cut vegetation, and trampling; and providing visual separation. Wetland buffers are essential for wetlands protection.

Presently there are no prescribed aquatic buffers other than those proposed in the Northern Cape, thus a modified version of the Eastern Cape Biodiversity Plan (ECBCP) (Desmet and Berliner, 2007) recommendation will be applied as these recommendation are becoming more widely accepted (Table 5).

For all natural to near-natural valley-bottom wetlands a buffer of 80 m have been recommended as this was deemed sufficient to allow the development and associated activities to occur without affecting or modifying the morphology or functioning of the wetland. The developable remaining land within the study area (outside these wetlands and associated buffers as well as outcrops and ridges) is characterised by mostly flat plains, thus erosion potential and potential contamination affecting these wetland systems can be regarded as low and can affectively be contained within the area of origin. The recommended buffer area is therefore deemed sufficient to allow the wetland to function as normal.

For the drainage lines located in the western portion of the study area, a buffer of 35m has been recommended in accordance with the recommendation provided within the ECBCP. The most likely threat to these drainage channels are erosion and the recommended buffer of 35m is deemed sufficient to protect these drainage lines from erosion.

For the depression wetland present in the southern part of the study are a buffer of 50m is recommended. This was deemed sufficient as the open space recommended as suitable for the development is situated outside of the catchment of the depression wetland. Furthermore, this depression is surrounded by the boundaries and buffer areas of the valley bottom-wetlands and the "no-go" areas of these wetlands extend well beyond the boundaries of the buffers of the depression wetland. Thus, indirectly a much larger area, than the 50 m buffer around the depression wetland is regarded as No-Go.

The vegetation of these buffer areas should be maintained in good condition and regular monitoring of these areas should be done to determine the presence and spread of potential erosion (may occur due to increase runoff from hard surfaces and CSP mirrors from development area or due to overgrazing by livestock).

Table 5: Recommended buffers for rivers according to the Eastern Cape Biodiversity Plan (ECBCP).

River criterion used	Buffer width (m)	Rationales
Mountain streams and upper foothills of all 1:500 000 rivers	50 m	These longitudinal zones generally have more confined riparian zones than lower foothills and lowland rivers and are generally less threatened by agricultural practices.
Lower foothills and lowland rivers of all 1:500 000 rivers	100 m	These longitudinal zones generally have less confined riparian zones than mountain streams and upper foothills and are generally more threatened by development practices
All remaining 1:50 000 streams	32 m	Generally smaller upland streams corresponding to mountain streams and upper foothills, smaller than those designated in the 1:500 000 rivers layer. They are assigned the riparian buffer required under South African legislation. Additionally all artificial wetlands providing ecological functions consistent with the functions provided by natural wetlands.

Medium Sensitivity: Artificial wetland buffer.

Artificial wetlands include mostly gravel dams of various sizes of which most are found within the drainage lines to the north and south of the development footprint area. Other artificial wetlands include those created by leaking water pipes. Especially the gravel dams are regarded as sensitive due to the prolonged provision of water and fodder (especially around the edges of these dams valuable resources for biota such as Blue Cranes (*Anthropoides paradiseus*), smaller mammals and other vertebrate species. Furthermore according to the National Water Act (Act No 36 of 1998), a wetland is: "*land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil*." This definition does not stipulate if the wetland should be natural or man-made (artificial). However, most of these conditions are present within artificial-wetland and subsequently is included within this definition. Furthermore, these artificial wetlands provide valuable functions corresponding with those of natural wetlands. Within the definition provided, however, by the Ramsar Convention (of which South Africa is a Contracting Party) provision is made for these artificial wetlands. The definition of a wetland provided by the Ramsar Convention are as follows: wetlands are defined as: "*areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres*". Thus taking the above mentioned statement as well as their ecological functions into consideration these artificial wetlands (small to medium size gravel dams) are regarded as a High Sensitivity and a Medium Sensitive buffer of 35m is recommended.

Medium Sensitivity: Natural Eastern Upper Karoo Vegetation.

From Google Imagery it appears that the bulk of the study area, apart from the wetland areas and ridges is covered by vegetation typically consistent with natural Eastern Upper Karoo. This area appears to be in a relative natural state with small disturbances present within this area, and include grazing, roads, power line and feeding areas (feeding and watering troughs). Small areas surrounding these livestock feeding areas are in a trampled and overgrazed state. As this is the largest vegetation type classified by Mucina and Rutherford (2006) with large areas still in natural condition, this development will not affect the conservation status of this vegetation type.

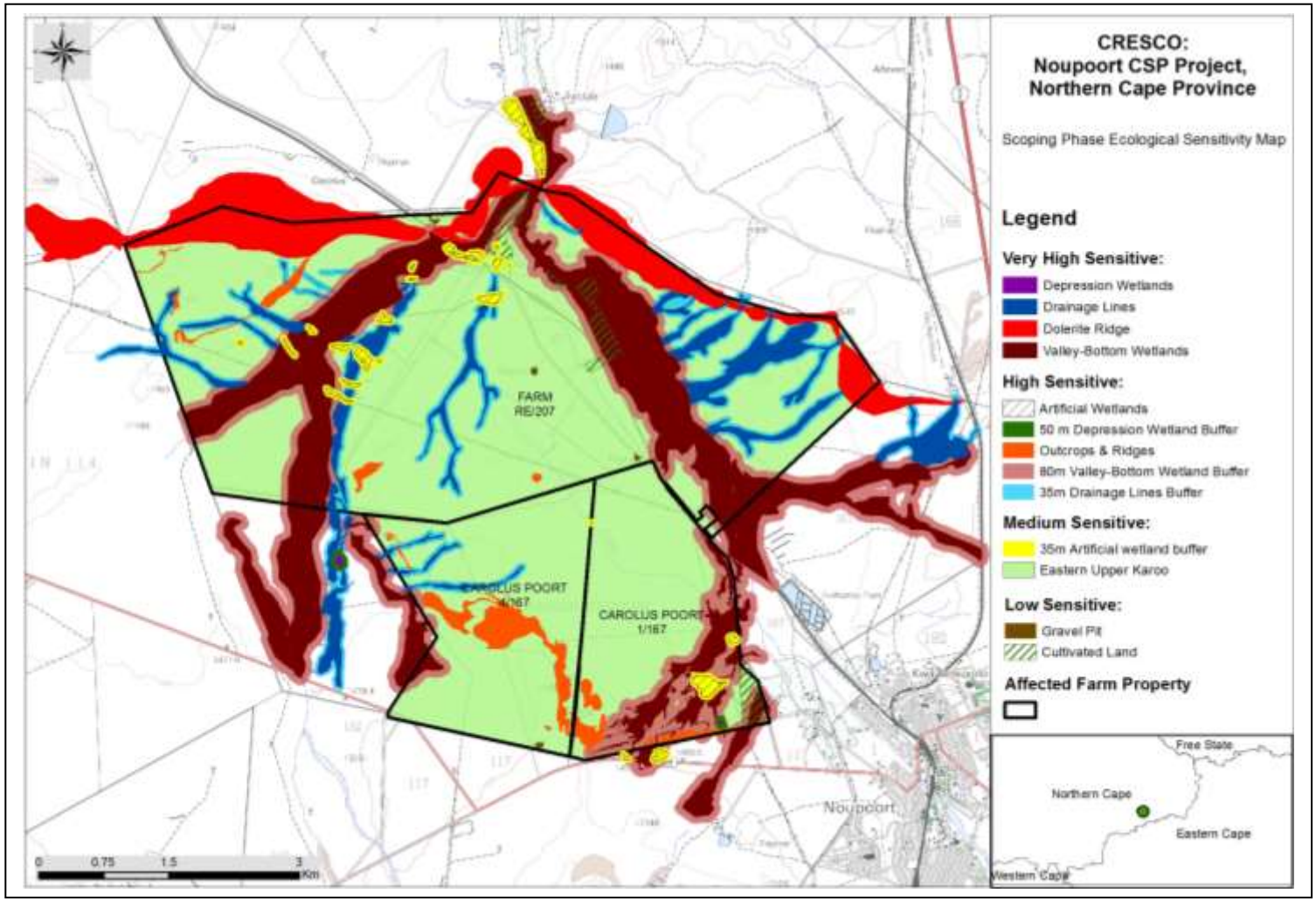

Figure 10: Sensitivity Map compiled for the study area.

5 SCOPING PHASE IMPACT ASSESSMENT

5.1 Potential impact of the proposed developments

Expected impacts of the proposed development will be mostly on the vegetation and supporting substrate. Possible impacts could also be expected on bird species or small mammals and invertebrates. Potential expected impacts on the biodiversity are listed below, but it must be stressed that this evaluation is preliminary and will only be finalised after a field study of the area.

Overview of the most significant effects of the proposed development

» *Impacts on vegetation and protected plant species*

At Vegetation Level:

As mentioned above the most likely and significant impact will be on the vegetation. The proposed development may lead to direct loss of vegetation. Consequences of the impact occurring may include:

- general loss of habitat for sensitive species;
- loss in variation within sensitive habitat due to loss of portions of it;
- general reduction in biodiversity;
- increased fragmentation (depending on location of impact);
- disturbance to processes maintaining biodiversity and ecosystem goods and services; and
- loss of ecosystem goods and services

The largest portion of the study area is covered by Near-Natural to Natural Eastern Upper Karoo vegetation which is classified as Least Threatened (Mucina & Rutherford, 2006). Although the development will impact some elements of this vegetation type at a local scale, it is highly unlikely that this development will impact the status of this vegetation type (impact on a regional scale) as the development will occur, as mentioned, within a relative small restricted area when compared to the extent of this vegetation type (largest vegetation type) and the amount of natural vegetation still available. Furthermore the development will be, although long-term, not permanent.

The vegetation within the ridgelines, outcroppings and wetlands as well as a buffer area surrounding these habitats on the other hand is regarded sensitive due to the function a natural covering of vegetation provide within these habitats. Natural vegetation is vital for protection against the effects of erosion which is potential risk within these areas.

At species level:

Several protected and red data species as well as species protected within the relevant provincial legislation (NCNCA) occur within the Degree Grid Square, although none of these species were recorded within the quarter degree grid square (3124BB) encompassing the study site. There is however a potential for some of these species, present within the degree grid, to be present within the study area. Such species are especially vulnerable to infrastructure development due to the fact that they cannot move out of the path of the construction activities, but are also affected by overall loss of habitat. Threatened species (red data species) include those listed as critically endangered, endangered or vulnerable. For any other species a loss of individuals or localised populations is unlikely to lead to a change in the conservation status of the species. However, in the case of threatened plant species, loss of a population or individuals could lead to a direct change in the conservation status of the species, possible extinction. This may arise if the proposed infrastructure is located where it will impact on such individual or populations. Consequences may include:

- fragmentation of populations of affected species;
- reduction in area of occupancy of affected species; and
- loss of genetic variation within affected species

These may all lead to a negative change in conservation status of the affected species, which implies a reduction in the chances of the species' overall survival chances.

The nature and extent of such impacts can be evaluated, and the impacts can be largely mitigated through avoidance of identified sensitive areas and listed species, by allowing a minimum clearance of vegetation (restricted to the absolute necessary areas), or allowing for search and rescue of individuals where this is viable.

» *Direct Faunal impacts*

Faunal species will primarily be affected by the overall loss of habitat. Increased levels of noise, pollution, disturbance and human presence will be detrimental to fauna. Sensitive and shy fauna would move away from the area during the construction phase as a result of the noise and human activities present, while some slow-moving species and species confined and dependant on specified habitats would not be able to avoid the construction activities and might be at risk. Some mammals and reptiles would be vulnerable to illegal collection or poaching during the construction phase as a result of the large number of construction personnel that are likely to be present. This impact is highly likely to occur during the construction-phase and would also potential occur with resident fauna within the facility after construction.

Threatened species (red data species) include those listed as critically endangered, endangered or vulnerable. For any other species a loss of individuals or localised populations is unlikely to lead to a change in the conservation status of the species. However, in the case of threatened animal species, loss of a population or individuals could lead to a direct change in the conservation status of the species, possible extinction. This may arise if the proposed infrastructure is located where it will impact on such individual or populations. Consequences may include:

- fragmentation of populations of affected species;
- reduction in area of occupancy of affected species; and
- loss of genetic variation within affected species

These may all lead to a negative change in conservation status of the affected species, which implies a reduction in the chances of the species' overall survival chances.

Disturbance of faunal species can be maintained to a minimum and low significance by implementing effective mitigation measures.

» *Impacts on wetlands and watercourses*

Construction may lead to some direct or indirect loss of or damage to wetlands and drainage lines. This will lead to localised loss of wetland habitat and may lead to downstream impacts that affect a greater extent of wetlands or impact on wetland function and biodiversity. Where these habitats are already stressed due to degradation and transformation, the loss may lead to increased vulnerability (susceptibility to future damage) of the habitat. Physical alteration to wetland can have an impact on the functioning of those wetlands. Consequences may include:

- increased loss of soil;
- loss of or disturbance to indigenous wetland vegetation;

- loss of sensitive wetland habitats;
- loss or disturbance to individuals of rare, endangered, endemic and/or protected species that occur in wetlands;
- fragmentation of sensitive habitats;
- impairment of wetland function;
- change in channel morphology in downstream wetlands, potentially leading to further loss of wetland vegetation; and
- reduction in water quality in wetlands downstream.

By implementing mitigation measures, including the exclusion of wetlands and drainage lines, along with determined buffer areas, from the proposed development footprint area, these habitat types can retain their character and functionality.

» *Soil erosion and associated degradation of ecosystems*

This impact along with the loss of vegetation is probably the most significant impacts that may occur due to the proposed development. Soil erosion is a frequent risk associated with CSP facilities on account of the vegetation clearing and disturbance associated with the construction phase of the development and may continue occurring throughout the operational phase. Service roads and installed infrastructure will generate increased direct runoff during intense rainfall events and may exacerbate the loss of topsoil and the effects of erosion. These eroded materials may enter the nearby streams and rivers and may potentially impact these systems through siltation and change in chemistry and turbidity of the water.

With effective mitigation measures in place including regular monitoring the occurrence, spread and potential cumulative effects of erosion may be limited to an absolute minimum.

» *Alien Plant Invasions*

Major factors contributing to invasion by alien invader plants includes habitat disturbance and associated destruction of indigenous vegetation. Consequences of this may include:

- further loss and displacement of indigenous vegetation;
- change in vegetation structure leading to change in various habitat characteristics;
- change in plant species composition;

- change in soil chemistry properties;
- loss of sensitive habitats;
- loss or disturbance to individuals of rare, endangered, endemic and/or protected species;
- fragmentation of sensitive habitats;
- change in flammability of vegetation, depending on alien species;
- hydrological impacts due to increased transpiration and runoff; and
- impairment of wetland function.

Although the potential severity of this impact may be high, it can be easily mitigated through regular alien control.

» *Cumulative Impacts*

There is a relative high density of proposed renewable energy facilities in the area and the potential for cumulative impacts is consequently high, both at a broad landscape scale as well as more locally.

- The loss of unprotected vegetation types on a cumulative basis from the broad area may impact the countries' ability to meet its conservation targets.
- Transformation of intact habitat could potentially compromise ecological processes as well as ecological functioning of important habitats and would contribute to the fragmentation of the landscape and would potentially disrupt the connectivity of the landscape for fauna and flora and impair their ability to respond to environmental fluctuations. This is especially of relevance for larger drainage lines and wetlands serving as important groundwater recharge and floodwater attenuation zones, important microhabitats for various organisms and important corridor zones for faunal movement. Due to the extent of the impacted vegetation type and the amount of intact habitat still present the cumulative impact is regarded as low.

Issue	**Nature of Impact during the Construction Phase**	**Extent of Impact**	**No-Go Areas**
Disturbance to and loss of indigenous natural vegetation	Construction of infrastructure will lead to direct loss of vegetation, causing a localised or more extensive reduction in the overall extent of vegetation. Consequences of the clearing and loss of indigenous natural vegetation occurring may include:	Local	The only No-Go Areas identified are the valley-bottom wetland system and associated buffer areas as well as the dolerite outcrops and ridges.

	» Increased vulnerability of remaining vegetation to future disturbance, including extreme climatic events; » General loss of habitat for sensitive fauna and flora species; » Loss in variation within sensitive habitats due to loss of portions of it; » General reduction in biodiversity; » Increased fragmentation (depending on the location of the impact) and associated reduced viability of species populations; » Alteration of the habitat suitable for plant populations by altering surface structure. This will change species composition and associated species interactions. » Disturbance to processes maintaining biodiversity and ecosystem goods and services; and » Loss of ecosystem goods and services.		
Description of expected significance of impact: The area seems to be generally homogenous and given the extensive amount of potentially intact vegetation in the area, there is likely to be little overall disruption to the broad-scale connectivity of the landscape, and that sufficient intact habitat in the broader area to retain the overall ecological functioning of the landscape. The impacts can be largely mitigated through avoidance of potential sensitive areas and listed species, by allowing a minimum clearance of vegetation (restricted to the absolute necessary areas).			
Disturbance or loss of threatened / protected plants	Several Red-Data plant species could potentially occur in the study area. Flora is affected by overall loss or alteration of habitat and due to its limited ability to extend or change its distribution range. Where the location of infrastructure will impact on individuals or populations of threatened plant species, consequences may include:	Local	None identified at this stage.

	» Fragmentation and decline of populations of affected species; » Reduction in area of occupancy of affected species; » Loss of genetic variation within affected species; » Alteration of the habitat suitable for plant associations by altering surface structure. This will change species composition and associated species interactions and species ability to persist; These may all lead to a negative change in conservation status of the affected species, which implies a reduction in the chance of survival of the species.		
Description of expected significance of impact: The nature of the development which includes the partial clearance of vegetation within the development footprint will result in a localised loss of habitat as well as a loss of localised populations of protected and/or listed plants. Vegetation will be permitted to remain underneath the trough system, although this will be maintained throughout the operation phase. The extent, nature and subsequently the significance of this impact can be reduced with the implementation of mitigation measures, including avoidance were possible, a vegetation rehabilitation plan, or a plan for search and rescue of protected and listed plants prior to construction commencing. Due to the extent and availability of habitat surrounding the proposed development area, this localised impact will most likely not have a significant impact on the greater area of occupancy of affected species as well as a loss of genetic variation. Therefore, the significance regarding a potential change in status and/or the overall survival of the species can be regarded as low and unlikely.			
Loss of habitat for fauna species of conservation concern	Fauna species of conservation concern are indirectly affected primarily by loss of or alteration of habitat and associated resources. Animals are mobile and, in most cases, can move away from a potential threat, unless they are bound to a specific habitat that is also spatially limited and will be negatively impacted by a development. Nevertheless, the proposed development will reduce the extent of habitat	Local	The only no-go areas identified up to date due to possible habitat for fauna species of conservation concern are the wetland habitat types. The ridge and dolerite outcropping may also serve as a habitat for some of these protected species and should provisionally be classified as a No-Go area (shall be confirmed during EIA phase).

	available to fauna. For any species, a loss of individuals or localised populations is unlikely to lead to a change in the conservation status of the species. However, in the case of threatened animal species, loss of a suitable habitat, population, or individuals could lead to a direct change in the conservation status of the species. This may arise if the proposed infrastructure is located where it will impact on such individuals or populations or the habitat that they depend on. Consequences may include: » Loss of populations of affected species; » Reduction in area of occupancy of affected species; » Loss of genetic variation within affected species; There are a number of red data species that have been recorded for the wider area within which the study area is located. Their presence and the necessity to keep their habitats intact in the study area need to be confirmed during a field survey.		Other possible no-go areas must be verified during a detailed investigation as part of the EIA phase.
Description of expected significance of impact: Some habitat loss for faunal species is an inevitable consequence of the development but is not likely to be of broader significance (to be confirmed during EIA phase). Faunal disturbance and human presence would be highest during the construction phase and terrestrial faunal impacts are also likely to be largely concentrated to this phase of the development.			
Disturbance to migration routes and associated impacts to	Site preparation and construction activities may interfere with current migration routes of fauna species. This may lead to:	Site and surroundings	The only no-go areas identified up to date due to important fauna populations of conservation concern are the identified wetlands.

species populations	» Reduced ability of species to move between breeding and foraging grounds, reducing breeding success rates; » Increased mortality rates due to fatal collisions with infrastructure; » Reduced genetic variation due to reduced interaction amongst individuals or populations as a result of fragmentation effects caused by the proposed developments		Other possible no-go areas must be verified during a detailed investigation as part of the EIA phase.
Description of expected significance of impact: Some habitat loss for faunal species is an inevitable although due to the extent of the development and the location, the development will most likely not affect important migration routes and populations			
Impacts on wetlands	NFEPA along with available Google imagery show that numerous wetlands may be present within the study area. » The nature of the site preparation and construction activities for the proposed development will change surface characteristics, rainfall interception patterns and runoff characteristics of the area; » This may affect the geohydrology, susceptibility to erosion and potential erosion rates of the landscape, which may lead to a significant alteration to or loss of habitat for fauna and flora species, especially those that depend on riparian and wetland habitats; » A decline in ecosystem functionality of smaller wetlands and riparian areas will impact lower-lying larger wetlands, whilst also reducing the ability of the environment to buffer effects of	Local and regional	Valley-bottom wetland identified within the study area should be regarded as No-Go areas.

	» extreme climatic events.		
Description of expected significance of impact: The proposed development is unlikely to affect catchment integrity and functionality of habitats as these can be avoided by the development footprint. The extent of the impact will be local and regional. The extent, nature and subsequently the significance of this impact can be reduced by avoidance of valley-bottom wetland and associated buffer areas.			
Establishment and spread of declared weeds and alien invader plants.	Major factors contributing to invasion by alien invader plants include excessive disturbance to vegetation, creating a window of opportunity for the establishment of alien invasive species. In addition, regenerative material of alien invasive species may be introduced to the site by machinery traversing through areas with such plants or materials that may contain regenerative materials of such species. Consequences of the establishment and spread of invasive plants include: » Loss of indigenous vegetation; » Change in vegetation structure leading to change in or loss of various habitat characteristics; » Change in plant species composition; » Altered and reduced food resources for fauna; » Change in soil chemical properties; » Loss or disturbance to individuals of rare, endangered, endemic and/or protected species; » Fragmentation of sensitive habitats; » Change in flammability of vegetation, depending on alien species; » Hydrological impacts due to increased transpiration and runoff; » Increased production and associated dispersal potential of alien invasive plants, especially to	Local and regional	None identified at this stage, but the potential for alien invasive species present in or around the study area is regarded as high. A high number of alien invasive species has been recorded in the wider area according to the SANBI database. The extent to which the site contains alien plants will be determined in the EIA phase.

	lower-lying wetland areas, and » Impairment of wetland function.		

Description of expected significance of impact: With mitigation measures including regular monitoring and effective eradication and management methods in place the significance of impact associated with Invasive Alien Plants is expected to be low and local. With the absence of these mitigation measures the significance of invasion of invasive alien plants may potentially be high and may furthermore extend outside the boundary of the development footprint area affecting natural vegetation. Although this is a potential worst case scenario in the absence of mitigation measures as mentioned.

Gaps in knowledge & recommendations for further study

» The initial desk-top investigation of the study area indicates that a few protected and red-data species as well as sensitive habitats potentially occur on the site. However, once the final layout has been designed in accordance to findings of a field investigation, the likelihood that the development will compromise the survival of any species of conservation concern is expected to be limited.
» **Plant species of conservation concern will only be identifiable during the EIA phase.**
» Although previous collection records from the Noupoort area exist, the study area itself may not have been previously surveyed and there may be additional species that have not yet been captured in the existing species databases for the area. A detailed ecological survey and sensitivity assessment will be undertaken during the EIA phase according to the methods outlined in section 3.

Issue	Nature of Impact during the Operational Phase	Extent of Impact	No-Go Areas
Disturbance or loss of indigenous natural vegetation	The solar field will be installed a set of rails with no need for land levelling and minimal ground disturbance. No clearance of vegetation will be conducted underneath the trough mirrors, but will be trimmed to an acceptable height. The remaining infrastructure (i.e. access roads, buildings) will create areas of altered surface characteristics, rainfall interception patterns, and intensive shade that will not be tolerated by most of the species present on site, as these have	Local	The No-Go Areas identified are the valley-bottom wetland areas as well as the dolerite outcrop and ridge.

	evolved with a high daily irradiance. Consequently, it can be expected that within the Solar Energy Facility footprint, species composition and topsoil characteristics will change significantly. No equivalent experiments have been undertaken in similar environments up to date, thus the nature and density of vegetation that may persist cannot be predicted at this stage. A sparser or less stable vegetation beneath the CSP mirrors, together with the altered surface and runoff characteristics may lead to: » Increased vulnerability of remaining vegetation to future disturbance, including erosion; » General loss or significant alteration of habitats for sensitive species; » Loss in variation within sensitive habitats due to loss of portions of it; » General reduction in biodiversity; » Increased fragmentation (depending on location of impact); » Disturbance to processes maintaining biodiversity and ecosystem goods and services; and » Loss of ecosystem goods and services.		
Description of expected significance of impact: The area seems to be generally homogenous and given the extensive amount of potentially intact vegetation in the area, there is likely to be little overall disruption to the broad-scale connectivity of the landscape (to be confirmed during the EIA phase). Given the large amount of potential developments which is planned for the area, a significant local impact is likely to occur, but it is			

expected that there would remain sufficient intact habitat in the broader area to retain the overall ecological functioning of the landscape. The impacts can be largely mitigated through avoidance of potential sensitive areas and listed species, by allowing a minimum clearance of vegetation (restricted to the absolute necessary areas) etc.			
Altered runoff patterns due to rainfall interception by trough infrastructure and compacted areas	The CSP mirrors create large surfaces of rainfall interception, where rainfall is collected and concentrated at the edges from where it then moves onto the ground in larger, concentrated quantities opposed to small drops being directly intercepted and raindrop impact dispersed by vegetation, then absorbed by the ground. This may lead to a localised increase in runoff during rainfall events, which may result in localised accelerated erosion. Likewise, access roads and areas where soils have been compacted during construction will have a low rainfall infiltration rate, hence creating more localised runoff from those surfaces. This runoff will thus have to be monitored and channelled where necessary to prevent erosion over larger areas.	Site and surroundings	The only No-Go Areas identified are the valley-bottom wetland areas as well as the dolerite outcrops and ridge.
Description of expected significance of impact: With effective mitigation measures in place, including implementation of an appropriate storm water management plan, as well as regular monitoring of the occurrence, spread and potential cumulative effects of erosion may be limited to an absolute minimum.			
Disturbance to migration routes and associated impacts to species populations.	All components of the proposed development may interfere with current migration routes of especially fauna species. This may lead to: » Reduced ability of species to move between breeding an foraging grounds, reducing	Site and surroundings	The only no-go areas identified up to date due to potential important fauna populations of conservation concern are the identified wetlands as well as their buffer areas. Other possible no-go areas must be verified during a detailed investigation as part of the EIA phase.

	breeding success rates; » Increased mortality rates due to fatal collisions with infrastructure; » Reduced genetic variation due to reduced ability of especially smaller organisms to have individual interaction; »		
Description of expected significance of impact: Some habitat loss for faunal species is an inevitable consequence of the development but is not likely to be of broader significance (to be confirmed during EIA phase). From the desktop survey, no important faunal migratory routes (usually along extensive and well wooded valley floors and ephemeral streams) appear to be present within the development footprint areas. This will however be confirmed during the EIA phase.			
Impacts on wetlands	NFEPA Maps and available Google imagery show that a number of wetlands and drainage lines may be present within the study area. Beyond the study area is the Noupoortspruit River and other tributaries, which could be influenced by the proposed development if mitigation measures are not adequately implemented. » Accidental spills of harmful/toxic substances from other associated infrastructures, if not contained and mitigated immediately, may result in these substances ending up in wetlands or polluting ground water resources. Spillage into larger drainage lines and wetlands may result in adverse effects along the Noupoortspruit and associated ecosystems; » The nature of the proposed developments, especially the CSP mirrors and new hard	Local to regional	The only no-go areas identified up to date are the valley-bottom wetland system as well as the recommended buffer areas surrounding these wetlands.

	surfaces, will change surface characteristics, rainfall interception patterns and hence runoff characteristics of the project area; » This may affect the geohydrology, susceptibility to erosion and potential erosion rates of the landscape, which may lead to a significant alteration to or loss of habitat for fauna and flora species that depend on wetland habitats; » Altered runoff patterns may influence infrequent filling of possible wetlands on site, which may eliminate localised populations of water-dwelling organisms that depend on occasional small areas of standing water to breed out and regenerate; » A decline in ecosystem functionality of wetlands will impact lower-lying larger wetland areas and river systems.		
Description of expected significance of impact: The proposed development is unlikely to affect the catchment integrity and functionality of surrounding ecosystems or groundwater resources, or be detrimental to the functioning of habitats as these can be avoided by the development footprint. The extent of the impact will be local and regional. The extent, nature and subsequently the significance of this impact can be reduced by avoidance of valley-bottom wetland and associated buffer areas.			
Establishment and spread of declared weeds and alien invader plants.	The envisaged altered vegetation cover after construction and during the operation phase of the proposed development will create a window of opportunity for the establishment of alien invasive species. In addition, regenerative material of alien invasive species may be introduced to the site by machinery or persons traversing through areas with such plants or	Local to regional	None identified at this stage, but the potential for alien invasive species present in or around the study area is regarded as high. A high number of alien invasive species has been recorded in the wider area according to the SANBI database. The extent to which the site contains alien plants will be determined in the EIA phase.

	materials that may contain regenerative materials of such species. Consequences of the establishment and spread of invasive plants include: » Loss of indigenous vegetation or change in vegetation structure leading to an even more significant change in or loss of various habitat characteristics; » Loss of plant resources available to fauna; » Change in soil chemical properties; » Loss or fragmentation of sensitive or restricted habitats; » Loss or disturbance to individuals of rare, endangered, endemic and/or protected species; » Change in flammability of vegetation, depending on alien species; » Hydrological impacts due to increased transpiration and runoff; » Increased production and associated dispersal potential of alien invasive plants, especially to lower-lying wetland areas, and » Impairment of wetland function.		
Description of expected significance of impact: With mitigation measures including regular monitoring and effective eradication and management methods in place, the significance of impacts associated with Invasive Alien Plants is expected to be low and local. With the absence of these mitigation measures the significance of invasion of invasive alien plants may potentially be high and may furthermore extend outside the boundary of the development footprint area affecting natural vegetation. Although this is a potential worst case scenario in the absence of mitigation measures as mentioned.			

Gaps in knowledge & recommendations for further study

» The largest opportunity for mitigating any negative impacts exists during the design phase, if layouts adhere to the findings and recommendations of detailed field studies carried out during the EIA phase
» Limited knowledge does, however exist on the potential and ease with which vegetation can be re-established after construction given the variable rainfall regime of the region; which species would be able to persist in the altered environment on and around the proposed development; and what effect will this altered species composition and –density will have on ecosystem intactness and –functionality
» Regular monitoring of a minimum set of environmental parameters throughout the operational phase, coupled with an adaptive environmental management program, will thus be essential to prevent any environmental degradation and any cumulative effects of the development beyond its periphery.

The significance of the proposed development in terms of Duration, Magnitude, Probability as well as cumulative impacts

» Most of the above mentioned impacts are probable, although the extent, duration, and magnitude of these impacts can be minimalized, by having the necessary mitigation measures in place, to levels where these impacts can be regarded as low significance. By exclusion of certain sensitive areas (e.g. valley-bottom wetlands and other sensitive habitats) from the development footprint area, the probability of some of these above mentioned impacts occurring within these habitats can be avoided.
» The duration of the project is expected to be long term and subsequently most of the impacts are also expected to be long term. However, some impacts are expected to be of short term confined to the construction phase. For example the disturbance of some animal species will be confined to the construction phase and as human movement decrease some species may return to the site. Furthermore, impacts such as erosion and invasion of alien invasive species, with effective mitigation measures including regular monitoring in place, can be retained to a medium to short duration although monitoring and implementation of mitigation measures will have to be implemented throughout the lifespan of the proposed development.
» Although most impacts associated with the proposed development is expected to be local, affecting mainly the immediate environment, the potential do exist for some impacts to be exacerbate and even spread outside the development footprint area if left unattended, eventually posing a potential threat to important environmental processes and functionality. Impacts that my potentially pose a threat to this magnitude and duration, if left unattended or not mitigated accordingly include invasion by invasive alien species, soil erosion, significant disturbance and alterations of important wetland habitats and watercourses.
» Probably the most significant cumulative impacts that the proposed development will have are:
    - The potential impacts on Broad-Scale Ecological Processes, although this is regarded as unlikely.

6 DISCUSSION AND CONCLUSION

A preliminary site sensitivity map has been compiled through this desk-top scoping study (refer to Figure 10). After completion of the field study in the EIA phase of the process, areas with high sensitivity, based on confirmed localised species composition and habitat configuration will be identified and mapped.

A high proportion of the plant species of conservation concern that potentially could occur on the study area will only be identifiable during the growing season as they will be dormant (in underground storage organs) and not visible otherwise.

The most significant potential impacts expected are:

» Reduction of a stable vegetation cover and associated below-ground biomass that currently increases soil surface porosity, water infiltration rates and thus improves the soil moisture availability. Without this vegetation, the soil will be prone to extensive surface capping, leading to accelerated erosion and further loss of organic material and soil seed reserves from the local environment.
» A loss of portions of potential sensitive habitats, should the ecological state and conservation value of the vegetation, as well as the presence of protected plant species be found to be significant during the EIA field study. Such study will also reveal possible changes in the species composition and thus erosion protection by vegetation (and erosion risks) that will occur as the result of the development.
» Disturbed vegetation in the study area carries a high risk of invasion by alien invasive plants, which may or may not be present in the study area or nearby. The control and continuous monitoring and eradication of alien invasive plants will form and integral part of the environmental management of the facility from construction up to decommissioning.
» Possible impacts on the wetlands and drainage lines that are present on the site, as well as larger wetland and drainage systems beyond the study area due to altered surface hydrology of the surrounding plains. This may influence species dependant on these parts of the ecosystem, as well as downstream wetland ecosystems.

7 REFERENCES

Apps, P. (ed.). 2012. *Smither's Mammals of Southern Africa*. A field guide. Random House Struik, Cape Town, RSA

Alexander, G. & Marais, J. 2007. *A Guide to the Reptiles of Southern Africa*. Struik Nature, Cape Town.

Anhaeusser, C.R., Johnson, M.R., Thomas, R.J. (2008). The Geology of South Africa. Council for Geosciences.

Bates, M.F., Branch, W.R., Bauer, A.M., Burger, M., Marais, J., Alexander, G.J. & de Villiers, M. S. 2014. A*tlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland*. Strelitzia 32. SANBI, Pretoria.

Branch W.R. 1998. *Field guide to snakes and other reptiles of southern Africa*. Struik, Cape Town.

CRITICAL BIODIVERSITY AREAS MAPS (PER MUNICIPALITY) AND GIS DATA AVAILABLE FROM: Biodiversity GIS (BGIS), South African National Biodiversity Institute, Tel. +27 21 799 8739 or CapeNature, Tel. +27 21 866 8000. Or on the web at: http://bgis.sanbi.org/fsp/project.asp

Department of Environmental Affairs and Tourism, 2007. National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004): Publication of lists of Critically Endangered, Endangered, Vulnerable and Protected Species. Government Gazette, Republic of South Africa

Du Preez, L. & Carruthers, V. 2009. *A Complete Guide to the Frogs of Southern Africa*. Struik Nature., Cape Town.

Friedmann, Y. & Daly, B. 2004. Red data book of the mammals of South Africa, a conservation assessment. Johannesburg, Endangered Wildlife Trust.

Hoare, D. 2012. David Hoare Consulting cc. 2012. Impact Assessment Report: Specialist ecological study on the potential impacts of the proposed Hidden Valley Wind Energy Facility Project near Matjiesfontein, Northern Cape.

Marais, J. 2004. *Complete Guide to the Snakes of Southern Africa.* Struik Nature, Cape Town.

Mucina L. & Rutherford M.C. (eds) 2006. *The Vegetation of South Africa, Lesotho and Swaziland*. Strelitzia 19. South African National Biodiversity Institute, Pretoria

Minter LR, Burger M, Harrison JA, Braack HH, Bishop PJ & Kloepfer D (eds). 2004. *Atlas and Red Data book of the frogs of South Africa, Lesotho and Swaziland.* SI/MAB Series no. 9. Smithsonian Institution, Washington, D.C.

Raimondo, D., Von Staden, L., Foden, W., Victor, J.E., Helme, N.A., Turner, R.C. Kamundi, D.A. & Manyama, P.A. (Eds.). 2009. *Red list of South African plants* 2009. Strelitzia 25:1-668

Skinner, J.D. & Chimimba, C.T. 2005. The mammals of the Southern African Subregion. Cambridge University Press, Cambridge.

Strohbach, M. 2013. Mitigation of ecological impacts of renewable energy facilities in South Africa. The Sustainable Energy Resource Handbook (Renewable Energy) South Africa 4: 41 – 47.

Strohbach, M. 2013. Savannah Environmental. 2013. Ecological Scoping Report: Proposed Gihon Solar Energy Facility South of Bela-Bela, Limpopo Province.

Tessema, A & Nzotta, U. 2014. Multi-Data Integration Approach in Groundwater Resource Potential Mapping: A Case Study from the North West Province, South Africa. WRC Report No. 2055/1/13. Water Research Commision.

Todd, S. 2015. Simon Todd Consulting. 2015. Terrestrial Fauna & Flora Specialist Impact Assessment: Proposed Wolmaransstad 75 MW Solar Energy Facility in the North West Province.

Websites:

AGIS, 2007. Agricultural Geo-Referenced Information System, accessed from www.agis.agric.za

ADU, 2012. Animal Demography Unit, Department of Zoology, University of Cape Town. http://www.adu.org.za

BGIS: http://bgis.sanbi.org/website.asp

SANBI databases:

http://posa.sanbi.org/searchspp.php

http://SIBIS.sanbi.org

Climate:

http://en.climate-data.org/location/10658/

8 APPENDICES:

Appendix 1. Listed Plant Species

List of plant species of conservation concern which are known to occur in the vicinity of study area. The list is derived from the POSA website (*NE – Note Evaluated).

Colours Relate as follow:
Threatened Status: Critically (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Critically Rare, Rare, Declining and Data Deficient (DDD), NE (NE)

- Protected according to National Forest Act 1998 / NFA (No 84 of 1998).
- Protected according to Northern Cape Nature Conservation Act, Act 9 of 2009 (Schedule 1: Specially Protected Species), and
- Protected according to the Northern Cape Nature Conservation Act, Act 9 of 2009 (Schedule 2: Specially Protected Species).
- Invasive Alien Plant

Family	Species	Threat Status
ACANTHACEAE	Blepharis mitrata	LC
ACAROSPORACEAE	Sarcogyne clavulus	
ACHARIACEAE	Guthriea capensis	LC
AGYRIACEAE	Trapelia obtegens	
AIZOACEAE	Galenia prostrata	LC
AIZOACEAE	Galenia pubescens	LC
AIZOACEAE	Galenia secunda	LC
AIZOACEAE	Galenia subcarnosa	LC
AIZOACEAE	Tetragonia acanthocarpa	LC
AMARANTHACEAE	Amaranthus capensis subsp. capensis	LC
AMARYLLIDACEAE	Boophone disticha	Declining
AMARYLLIDACEAE	Brunsvigia litoralis	EN
AMARYLLIDACEAE	Gethyllis longistyla	Rare
AMARYLLIDACEAE	Gethyllis transkarooica	LC
AMARYLLIDACEAE	Haemanthus humilis subsp. humilis	LC
ANACARDIACEAE	Searsia divaricata	LC
ANACARDIACEAE	Searsia dregeana	LC
ANACARDIACEAE	Searsia erosa	LC
ANACARDIACEAE	Searsia pyroides var. pyroides	LC
ANDREAEACEAE	Andreaea rupestris	
APIACEAE	Chamarea capensis	LC
APIACEAE	Chamarea longipedicellata	LC
APIACEAE	Conium chaerophylloides	LC
APIACEAE	Heteromorpha arborescens var. arborescens	LC
APIACEAE	Polemannia grossulariifolia	LC
APOCYNACEAE	Cordylogyne globosa	LC
APOCYNACEAE	Gomphocarpus cancellatus	LC
APOCYNACEAE	Gomphocarpus fruticosus subsp. fruticosus	LC
APOCYNACEAE	Huernia barbata subsp. barbata	LC
APOCYNACEAE	Huernia humilis	LC
APOCYNACEAE	Microloma armatum var. armatum	LC

Family	Species	Threat Status
APOCYNACEAE	Orbea verrucosa	LC
APOCYNACEAE	Sarcostemma viminale subsp. viminale	LC
APOCYNACEAE	Schizoglossum aschersonianum var. aschersonianum	LC
APOCYNACEAE	Schizoglossum bidens subsp. bidens	LC
APOCYNACEAE	Schizoglossum linifolium var. linifolium	LC
APOCYNACEAE	Stapelia grandiflora var. grandiflora	LC
APOCYNACEAE	Xysmalobium gomphocarpoides var. gomphocarpoides	LC
APOCYNACEAE	Xysmalobium undulatum var. undulatum	LC
ARALIACEAE	Cussonia spicata	LC
ASPARAGACEAE	Asparagus acocksii	LC
ASPARAGACEAE	Asparagus asparagoides	LC
ASPARAGACEAE	Asparagus capensis var. capensis	LC
ASPARAGACEAE	Asparagus concinnus	LC
ASPARAGACEAE	Asparagus glaucus	LC
ASPHODELACEAE	Aloe aristata	LC
ASPHODELACEAE	Aloe broomii var. broomii	LC
ASPHODELACEAE	Bulbine abyssinica	LC
ASPHODELACEAE	Bulbine frutescens	LC
ASPHODELACEAE	Haworthia bolusii var. blackbeardiana	LC
ASPHODELACEAE	Haworthia bolusii var. bolusii	DDT
ASPHODELACEAE	Haworthia marumiana var. marumiana	LC
ASPHODELACEAE	Haworthia nigra var. nigra	LC
ASPHODELACEAE	Haworthia venosa subsp. tessellata	LC
ASPHODELACEAE	Kniphofia linearifolia	LC
ASPHODELACEAE	Kniphofia stricta	LC
ASPHODELACEAE	Trachyandra asperata var. asperata	LC
ASPLENIACEAE	Asplenium rutifolium	LC
ASTERACEAE	Amellus strigosus subsp. strigosus	LC
ASTERACEAE	Arctotheca calendula	LC
ASTERACEAE	Arctotis adpressa	LC
ASTERACEAE	Arctotis arctotoides	LC
ASTERACEAE	Arctotis erosa	LC
ASTERACEAE	Arctotis microcephala	LC
ASTERACEAE	Athanasia microcephala	LC
ASTERACEAE	Athanasia minuta subsp. minuta	LC
ASTERACEAE	Berkheya buphthalmoides	LC
ASTERACEAE	Berkheya cardopatifolia	LC
ASTERACEAE	Centaurea calcitrapa	NE
ASTERACEAE	Centaurea melitensis	NE
ASTERACEAE	Centaurea solstitialis	NE
ASTERACEAE	Chrysocoma ciliata	LC
ASTERACEAE	Cineraria aspera	LC
ASTERACEAE	Cineraria lyratiformis	LC
ASTERACEAE	Cineraria mollis	LC
ASTERACEAE	Conyza scabrida	LC
ASTERACEAE	Cotula anthemoides	LC
ASTERACEAE	Cotula australis	LC
ASTERACEAE	Cotula burchellii	NE
ASTERACEAE	Dicerothamnus rhinocerotis	NE
ASTERACEAE	Dimorphotheca caulescens	LC
ASTERACEAE	Dimorphotheca cuneata	LC
ASTERACEAE	Dimorphotheca zeyheri	LC
ASTERACEAE	Eriocephalus ericoides subsp. ericoides	LC
ASTERACEAE	Eriocephalus eximius	LC
ASTERACEAE	Eriocephalus glandulosus	LC

Family	Species	Threat Status
ASTERACEAE	Eriocephalus tenuifolius	LC
ASTERACEAE	Eumorphia dregeana	LC
ASTERACEAE	Euryops annae	LC
ASTERACEAE	Euryops anthemoides subsp. astrotrichus	LC
ASTERACEAE	Euryops candollei	LC
ASTERACEAE	Euryops floribundus	LC
ASTERACEAE	Euryops galpinii	LC
ASTERACEAE	Euryops lateriflorus	LC
ASTERACEAE	Euryops oligoglossus subsp. oligoglossus	LC
ASTERACEAE	Euryops petraeus	Rare
ASTERACEAE	Euryops subcarnosus subsp. vulgaris	LC
ASTERACEAE	Euryops trilobus	LC
ASTERACEAE	Felicia filifolia subsp. bodkinii	LC
ASTERACEAE	Felicia filifolia subsp. filifolia	LC
ASTERACEAE	Felicia hirsuta	LC
ASTERACEAE	Felicia muricata subsp. muricata	LC
ASTERACEAE	Felicia ovata	LC
ASTERACEAE	Garuleum pinnatifidum	LC
ASTERACEAE	Gazania krebsiana subsp. arctotoides	LC
ASTERACEAE	Gnaphalium confine	LC
ASTERACEAE	Gnaphalium simii	CR
ASTERACEAE	Helichrysum albo-brunneum	LC
ASTERACEAE	Helichrysum anomalum	LC
ASTERACEAE	Helichrysum asperum var. appressifolium	LC
ASTERACEAE	Helichrysum cerastioides var. cerastioides	LC
ASTERACEAE	Helichrysum dasycephalum	LC
ASTERACEAE	Helichrysum hamulosum	LC
ASTERACEAE	Helichrysum lineare	LC
ASTERACEAE	Helichrysum pentzioides	LC
ASTERACEAE	Helichrysum pumilio subsp. pumilio	LC
ASTERACEAE	Helichrysum rosum var. arcuatum	LC
ASTERACEAE	Helichrysum rosum var. rosum	LC
ASTERACEAE	Helichrysum rugulosum	LC
ASTERACEAE	Helichrysum rutilans	LC
ASTERACEAE	Helichrysum scitulum	LC
ASTERACEAE	Helichrysum subglomeratum	LC
ASTERACEAE	Helichrysum trilineatum	LC
ASTERACEAE	Helichrysum tysonii	LC
ASTERACEAE	Helichrysum zeyheri	LC
ASTERACEAE	Hertia cluytiifolia	LC
ASTERACEAE	Hertia pallens	LC
ASTERACEAE	Ifloga decumbens	LC
ASTERACEAE	Kleinia longiflora	LC
ASTERACEAE	Lactuca serriola	NE
ASTERACEAE	Lasiopogon muscoides	LC
ASTERACEAE	Lasiospermum bipinnatum	LC
ASTERACEAE	Lasiospermum pedunculare	LC
ASTERACEAE	Leysera gnaphalodes	LC
ASTERACEAE	Metalasia cephalotes	LC
ASTERACEAE	Nolletia ciliaris	LC
ASTERACEAE	Oncosiphon piluliferum	LC
ASTERACEAE	Osteospermum leptolobum	LC
ASTERACEAE	Othonna pavonia	LC
ASTERACEAE	Pegolettia retrofracta	LC
ASTERACEAE	Pentzia cooperi	LC
ASTERACEAE	Pentzia dentata	LC
ASTERACEAE	Pentzia globosa	LC

Family	Species	Threat Status
ASTERACEAE	Pentzia incana	LC
ASTERACEAE	Pentzia punctata	LC
ASTERACEAE	Pentzia quinquefida	LC
ASTERACEAE	Pentzia sphaerocephala	LC
ASTERACEAE	Pentzia tortuosa	LC
ASTERACEAE	Phymaspermum parvifolium	LC
ASTERACEAE	Phymaspermum scoparium	LC
ASTERACEAE	Pseudognaphalium luteo-album	
ASTERACEAE	Pteronia bolusii	LC
ASTERACEAE	Pteronia glomerata	LC
ASTERACEAE	Pteronia tricephala	LC
ASTERACEAE	Rosenia humilis	LC
ASTERACEAE	Rosenia oppositifolia	LC
ASTERACEAE	Senecio achilleifolius	LC
ASTERACEAE	Senecio erubescens var. crepidifolius	LC
ASTERACEAE	Senecio erubescens var. erubescens	LC
ASTERACEAE	Senecio gramineus	LC
ASTERACEAE	Senecio harveianus	LC
ASTERACEAE	Senecio inornatus	LC
ASTERACEAE	Senecio junceus	LC
ASTERACEAE	Senecio leptophyllus	LC
ASTERACEAE	Senecio niveus	LC
ASTERACEAE	Senecio othonniflorus	LC
ASTERACEAE	Senecio polyodon var. subglaber	LC
ASTERACEAE	Senecio reptans	LC
ASTERACEAE	Senecio tanacetopsis	LC
ASTERACEAE	Tripteris aghillana var. aghillana	LC
ASTERACEAE	Tripteris sinuata var. sinuata	LC
ASTERACEAE	Troglophyton capillaceum subsp. capillaceum	LC
ASTERACEAE	Ursinia montana subsp. apiculata	LC
AYTONIACEAE	Plagiochasma rupestre var. rupestre	
AZOLLACEAE	Azolla filiculoides	NE
BARTRAMIACEAE	Bartramia hampeana	
BIGNONIACEAE	Rhigozum brevispinosum	LC
BORAGINACEAE	Anchusa capensis	LC
BORAGINACEAE	Anchusa riparia	LC
BORAGINACEAE	Lappula heteracantha	NE
BORAGINACEAE	Lithospermum cinereum	LC
BORAGINACEAE	Lithospermum hirsutum	LC
BORAGINACEAE	Lobostemon stachydeus	LC
BORAGINACEAE	Trichodesma africanum	LC
BRASSICACEAE	Capsella bursa-pastoris	NE
BRASSICACEAE	Coronopus integrifolius	NE
BRASSICACEAE	Erucastrum strigosum	LC
BRASSICACEAE	Heliophila carnosa	LC
BRASSICACEAE	Heliophila cornuta var. squamata	LC
BRASSICACEAE	Heliophila subulata	LC
BRASSICACEAE	Lepidium africanum subsp. divaricatum	LC
BRASSICACEAE	Lepidium schinzii	LC
BRASSICACEAE	Sisymbrium capense	LC
BRASSICACEAE	Sisymbrium officinale	NE
BRUCHIACEAE	Cladophascum gymnomitrioides	
BRYACEAE	Bryum argenteum	
BRYACEAE	Bryum dichotomum	
BRYACEAE	Bryum pycnophyllum	
BUDDLEJACEAE	Buddleja glomerata	LC
BUDDLEJACEAE	Buddleja salviifolia	LC

Family	Species	Threat Status
BUDDLEJACEAE	Gomphostigma virgatum	LC
CAMPANULACEAE	Wahlenbergia androsacea	LC
CAMPANULACEAE	Wahlenbergia nodosa	LC
CAMPANULACEAE	Wahlenbergia undulata	LC
CAPPARACEAE	Cadaba aphylla	LC
CARYOPHYLLACEAE	Dianthus micropetalus	LC
CARYOPHYLLACEAE	Silene burchellii var. angustifolia	NE
CARYOPHYLLACEAE	Silene undulata	LC
CARYOPHYLLACEAE	Spergularia hanoverensis	LC
CELASTRACEAE	Maytenus undata	LC
CHENOPODIACEAE	Atriplex lindleyi subsp. inflata	NE
CHENOPODIACEAE	Atriplex semibaccata var. appendiculata	LC
CHENOPODIACEAE	Atriplex suberecta	LC
CHENOPODIACEAE	Chenopodium foliosum	NE
CHENOPODIACEAE	Chenopodium hederiforme var. undulatum	LC
CHENOPODIACEAE	Exomis microphylla var. microphylla	
CHENOPODIACEAE	Salsola aphylla	LC
CHENOPODIACEAE	Salsola calluna	LC
CHENOPODIACEAE	Salsola glabrescens	LC
CONVOLVULACEAE	Convolvulus dregeanus	LC
CONVOLVULACEAE	Convolvulus sagittatus	LC
CONVOLVULACEAE	Falkia oblonga	LC
CRASSULACEAE	Adromischus cooperi	LC
CRASSULACEAE	Adromischus cristatus var. cristatus	LC
CRASSULACEAE	Adromischus sphenophyllus	LC
CRASSULACEAE	Adromischus trigynus	LC
CRASSULACEAE	Cotyledon campanulata	LC
CRASSULACEAE	Cotyledon orbiculata var. dactylopsis	LC
CRASSULACEAE	Cotyledon orbiculata var. oblonga	LC
CRASSULACEAE	Cotyledon orbiculata var. orbiculata	LC
CRASSULACEAE	Cotyledon papillaris	LC
CRASSULACEAE	Crassula campestris	LC
CRASSULACEAE	Crassula capitella subsp. thyrsiflora	LC
CRASSULACEAE	Crassula corallina subsp. corallina	LC
CRASSULACEAE	Crassula cotyledonis	LC
CRASSULACEAE	Crassula dependens	LC
CRASSULACEAE	Crassula expansa subsp. fragilis	LC
CRASSULACEAE	Crassula lanceolata subsp. lanceolata	LC
CRASSULACEAE	Crassula muscosa var. muscosa	LC
CRASSULACEAE	Crassula natans var. natans	LC
CRASSULACEAE	Crassula sarcocaulis subsp. rupicola	LC
CRASSULACEAE	Crassula sarcocaulis subsp. sarcocaulis	LC
CRASSULACEAE	Crassula umbellata	LC
CRASSULACEAE	Crassula vaillantii	NE
CUCURBITACEAE	Cucumis myriocarpus subsp. leptodermis	LC
CUCURBITACEAE	Cucumis zeyheri	LC
CUCURBITACEAE	Kedrostis africana	LC
CYPERACEAE	Bulbostylis humilis	LC
CYPERACEAE	Carex glomerabilis	LC
CYPERACEAE	Cyperus marginatus	LC
CYPERACEAE	Eleocharis dregeana	LC
CYPERACEAE	Ficinia compasbergensis	LC
CYPERACEAE	Ficinia gracilis	LC
CYPERACEAE	Fuirena coerulescens	LC
CYPERACEAE	Isolepis angelica	LC
CYPERACEAE	Isolepis sepulcralis	LC
CYPERACEAE	Pseudoschoenus inanis	LC

Family	Species	Threat Status
CYPERACEAE	Schoenoxiphium lanceum	LC
CYPERACEAE	Schoenoxiphium rufum var. dregeanum	LC
CYPERACEAE	Scirpoides dioeca	LC
DRYOPTERIDACEAE	Polystichum monticola	LC
EBENACEAE	Diospyros austro-africana var. microphylla	LC
EBENACEAE	Diospyros lycioides subsp. lycioides	LC
ENCALYPTACEAE	Encalypta ciliata	
ENCALYPTACEAE	Encalypta vulgaris	
ERIOSPERMACEAE	Eriospermum corymbosum	LC
EUPHORBIACEAE	Euphorbia arida	LC
EUPHORBIACEAE	Euphorbia brachiata	LC
EUPHORBIACEAE	Euphorbia clavarioides var. clavarioides	LC
EUPHORBIACEAE	Euphorbia clavarioides var. truncata	LC
EUPHORBIACEAE	Euphorbia mauritanica var. mauritanica	LC
EUPHORBIACEAE	Seidelia triandra	LC
FABACEAE	Argyrolobium argenteum	LC
FABACEAE	Argyrolobium filiforme	LC
FABACEAE	Argyrolobium harveyanum	LC
FABACEAE	Indigofera alternans var. alternans	LC
FABACEAE	Indigofera burchellii	LC
FABACEAE	Indigofera disticha	LC
FABACEAE	Indigofera meyeriana	LC
FABACEAE	Lessertia depressa	LC
FABACEAE	Lessertia sneeuwbergensis	LC
FABACEAE	Lotononis caerulescens	LC
FABACEAE	Lotononis divaricata.	NE
FABACEAE	Lotononis laxa	LC
FABACEAE	Lotononis lenticula	LC
FABACEAE	Lotononis pungens	LC
FABACEAE	Lotononis sericophylla	LC
FABACEAE	Medicago laciniata	NE
FABACEAE	Melolobium candicans	LC
FABACEAE	Melolobium exudans	LC
FABACEAE	Melolobium humile	LC
FABACEAE	Melolobium microphyllum	LC
FABACEAE	Podalyria calyptrata	LC
FABACEAE	Sutherlandia frutescens	LC
FABACEAE	Sutherlandia humilis	LC
FABACEAE	Sutherlandia microphylla	LC
FABACEAE	Trifolium africanum var. africanum	LC
FISSIDENTACEAE	Fissidens rufescens	
FRANKENIACEAE	Frankenia pulverulenta	LC
GENTIANACEAE	Sebaea compacta	LC
GENTIANACEAE	Sebaea pentandra var. pentandra	LC
GENTIANACEAE	Sebaea ramosissima	LC
GERANIACEAE	Erodium cicutarium	NE
GERANIACEAE	Geranium caffrum	LC
GERANIACEAE	Geranium harveyi	LC
GERANIACEAE	Pelargonium alchemilloides	LC
GERANIACEAE	Pelargonium althaeoides	LC
GERANIACEAE	Pelargonium aridum	LC
GERANIACEAE	Pelargonium dichondrifolium	LC
GERANIACEAE	Pelargonium glutinosum	LC
GERANIACEAE	Pelargonium griseum	LC
GERANIACEAE	Pelargonium grossularioides	LC
GERANIACEAE	Pelargonium minimum	LC
GERANIACEAE	Pelargonium multicaule subsp. multicaule	LC

Family	Species	Threat Status
GERANIACEAE	Pelargonium myrrhifolium var. myrrhifolium	LC
GERANIACEAE	Pelargonium proliferum	LC
GERANIACEAE	Pelargonium reniforme subsp. velutinum	NE
GERANIACEAE	Pelargonium sibthorpiifolium	LC
GERANIACEAE	Pelargonium sidoides	LC
GERANIACEAE	Pelargonium tragacanthoides	LC
GERANIACEAE	Sarcocaulon camdeboense	LC
GIGASPERMACEAE	Gigaspermum repens	
GRIMMIACEAE	Grimmia laevigata	
GRIMMIACEAE	Grimmia pulvinata	
GRIMMIACEAE	Schistidium apocarpum	
HYACINTHACEAE	Albuca exuviata	LC
HYACINTHACEAE	Albuca setosa	LC
HYACINTHACEAE	Albuca tenuifolia	LC
HYACINTHACEAE	Daubenya comata	LC
HYACINTHACEAE	Drimia macrantha	LC
HYACINTHACEAE	Eucomis autumnalis subsp. autumnalis	NE
HYACINTHACEAE	Lachenalia campanulata	LC
HYACINTHACEAE	Lachenalia ensifolia	LC
HYACINTHACEAE	Ledebouria socialis	LC
HYACINTHACEAE	Ledebouria undulata	LC
HYACINTHACEAE	Ornithogalum capillare	LC
HYACINTHACEAE	Ornithogalum graminifolium	LC
HYACINTHACEAE	Ornithogalum tenuifolium subsp. tenuifolium	NE
HYPOXIDACEAE	Empodium elongatum	LC
IRIDACEAE	Dierama robustum	LC
IRIDACEAE	Freesia andersoniae	LC
IRIDACEAE	Gladiolus longicollis subsp. longicollis	LC
IRIDACEAE	Hesperantha radiata	LC
IRIDACEAE	Lapeirousia plicata subsp. plicata	LC
IRIDACEAE	Moraea crispa	LC
IRIDACEAE	Moraea falcifolia	LC
IRIDACEAE	Moraea pallida	LC
IRIDACEAE	Moraea polystachya	LC
IRIDACEAE	Romulea macowanii var. macowanii	LC
IRIDACEAE	Syringodea concolor	LC
IRIDACEAE	Syringodea pulchella	Rare
JUNCACEAE	Juncus inflexus	LC
JUNCACEAE	Juncus rigidus	LC
LAMIACEAE	Mentha longifolia subsp. capensis	LC
LAMIACEAE	Ocimum burchellianum	LC
LAMIACEAE	Salvia repens var. repens	LC
LAMIACEAE	Salvia stenophylla	
LAMIACEAE	Salvia verbenaca	LC
LAMIACEAE	Stachys aethiopica	LC
LAMIACEAE	Stachys albiflora	LC
LAMIACEAE	Stachys cymbalaria	LC
LAMIACEAE	Stachys hyssopoides	LC
LAMIACEAE	Stachys rugosa	LC
LAMIACEAE	Teucrium trifidum	LC
LECANORACEAE	Carbonea latypizodes	
LECIDEACEAE	Lecidea sarcogynoides	
LESKEACEAE	Pseudoleskea leskeoides	
LINACEAE	Linum thunbergii	LC
LOBELIACEAE	Cyphia triphylla	LC
LOBELIACEAE	Lobelia dregeana	LC
LOBELIACEAE	Lobelia thermalis	LC

Family	Species	Threat Status
MALVACEAE	Anisodontea	LC
MALVACEAE	Hermannia coccocarpa	LC
MALVACEAE	Hermannia cuneifolia var. cuneifolia	LC
MALVACEAE	Hermannia cuneifolia var. glabrescens	LC
MALVACEAE	Hermannia depressa	LC
MALVACEAE	Hermannia erodioides	LC
MALVACEAE	Hermannia filifolia var. filifolia	LC
MALVACEAE	Hermannia jacobeifolia	LC
MALVACEAE	Hermannia linearifolia	LC
MALVACEAE	Hermannia pulchella	LC
MALVACEAE	Hermannia pulverata	LC
MALVACEAE	Malva parviflora var. parviflora	NE
MARSILEACEAE	Marsilea burchellii	LC
MELIANTHACEAE	Melianthus comosus	LC
MENISPERMACEAE	Cissampelos capensis	LC
MESEMBRYANTHEMACEAE	Chasmatophyllum musculinum	LC
MESEMBRYANTHEMACEAE	Delosperma lootsbergense	LC
MESEMBRYANTHEMACEAE	Delosperma multiflorum	LC
MESEMBRYANTHEMACEAE	Hereroa calycina	LC
MESEMBRYANTHEMACEAE	Mestoklema tuberosum	LC
MESEMBRYANTHEMACEAE	Rabiea albinota	LC
MESEMBRYANTHEMACEAE	Ruschia cradockensis subsp. cradockensis	LC
MESEMBRYANTHEMACEAE	Stomatium mustellinum	LC
MESEMBRYANTHEMACEAE	Trichodiadema pomeridianum	LC
MESEMBRYANTHEMACEAE	Trichodiadema rogersiae	DDT
MNIACEAE	Mielichhoferia bryoides	
MOLLUGINACEAE	Hypertelis salsoloides var. salsoloides	LC
MOLLUGINACEAE	Limeum aethiopicum var. aethiopicum	NE
MOLLUGINACEAE	Limeum humifusum	LC
MOLLUGINACEAE	Psammotropha frigida	LC
MOLLUGINACEAE	Psammotropha mucronata var. mucronata	LC
MYRSINACEAE	Myrsine africana	LC
ORTHOTRICHACEAE	Orthotrichum diaphanum	
PAPAVERACEAE	Argemone ochroleuca subsp. ochroleuca	NE
PAPAVERACEAE	Papaver aculeatum	LC
PARMELIACEAE	Karoowia insipida	
PARMELIACEAE	Karoowia perspersa	
PARMELIACEAE	Namakwa exornata	
PARMELIACEAE	Xanthoparmelia chlorea	
PARMELIACEAE	Xanthoparmelia colorata	
PARMELIACEAE	Xanthoparmelia domokosii	
PARMELIACEAE	Xanthoparmelia marroninipuncta	
PARMELIACEAE	Xanthoparmelia perplexa	
PARMELIACEAE	Xanthoparmelia schenckiana	
PARMELIACEAE	Xanthoparmelia subdomokosii	
PHYSCIACEAE	Buellia aethalea	
PHYTOLACCACEAE	Phytolacca heptandra	LC
PLANTAGINACEAE	Plantago major	
PLUMBAGINACEAE	Limonium dregeanum	LC
POACEAE	Aristida canescens subsp. ramosa	LC
POACEAE	Aristida congesta subsp. congesta	LC
POACEAE	Aristida diffusa subsp. burkei	LC
POACEAE	Bothriochloa radicans	LC
POACEAE	Brachiaria eruciformis	LC
POACEAE	Bromus catharticus	NE
POACEAE	Bromus commutatus	NE
POACEAE	Bromus diandrus	NE

Family	Species	Threat Status
POACEAE	Bromus leptoclados	LC
POACEAE	Bromus madritensis	NE
POACEAE	Bromus pectinatus	LC
POACEAE	Chaetobromus involucratus subsp. dregeanus	LC
POACEAE	Chloris virgata.	LC
POACEAE	Cymbopogon pospischilii	NE
POACEAE	Cymbopogon prolixus	LC
POACEAE	Cynodon incompletus	LC
POACEAE	Digitaria eriantha	LC
POACEAE	Ehrharta calycina	LC
POACEAE	Ehrharta pusilla	LC
POACEAE	Enneapogon cenchroides	LC
POACEAE	Enneapogon desvauxii	LC
POACEAE	Eragrostis bergiana	LC
POACEAE	Eragrostis bicolor	LC
POACEAE	Eragrostis chloromelas	LC
POACEAE	Eragrostis cilianensis	LC
POACEAE	Eragrostis curvula	LC
POACEAE	Eragrostis lehmanniana var. lehmanniana	LC
POACEAE	Eragrostis obtusa	LC
POACEAE	Eragrostis procumbens	LC
POACEAE	Eragrostis truncata	LC
POACEAE	Eustachys paspaloides	LC
POACEAE	Festuca scabra	LC
POACEAE	Fingerhuthia sesleriiformis	LC
POACEAE	Helictotrichon longifolium	LC
POACEAE	Helictotrichon turgidulum	LC
POACEAE	Heteropogon contortus	LC
POACEAE	Hordeum murinum subsp. glaucum	NE
POACEAE	Hordeum stenostachys	NE
POACEAE	Hyparrhenia hirta	LC
POACEAE	Koeleria capensis	LC
POACEAE	Lolium multiflorum	NE
POACEAE	Melica decumbens	LC
POACEAE	Melica racemosa	LC
POACEAE	Melinis nerviglumis	LC
POACEAE	Pennisetum sphacelatum	LC
POACEAE	Pentameris pallida	LC
POACEAE	Pentaschistis pallida	NE
POACEAE	Phragmites australis	LC
POACEAE	Poa pratensis	NE
POACEAE	Schismus barbatus	LC
POACEAE	Schismus inermis	LC
POACEAE	Schismus scaberrimus	LC
POACEAE	Sporobolus fimbriatus	LC
POACEAE	Sporobolus ludwigii	LC
POACEAE	Sporobolus tenellus	LC
POACEAE	Stipa dregeana var. dregeana	LC
POACEAE	Stipagrostis namaquensis	LC
POACEAE	Stipagrostis obtusa	LC
POACEAE	Tetrachne dregei	LC
POACEAE	Themeda triandra	LC
POACEAE	Tragus berteronianus	LC
POACEAE	Tragus koelerioides	LC
POACEAE	Vulpia myuros	NE
POLYGALACEAE	Muraltia macrocarpa	LC
POLYGALACEAE	Muraltia saxicola	LC

Family	Species	Threat Status
POLYGALACEAE	Polygala ephedroides	LC
POLYGALACEAE	Polygala leptophylla var. leptophylla	LC
POLYGALACEAE	Polygala scabra	LC
POLYGALACEAE	Polygala seminuda	LC
POLYGALACEAE	Polygala virgata var. virgata	LC
POLYGONACEAE	Polygonum plebeium	LC
POLYGONACEAE	Rumex lanceolatus	LC
POLYPODIACEAE	Polypodium vulgare	LC
PORTULACACEAE	Anacampseros arachnoides	LC
PORTULACACEAE	Avonia ustulata	LC
POTAMOGETONACEAE	Potamogeton pusillus	LC
POTTIACEAE	Bryoerythrophyllum recurvirostrum	
POTTIACEAE	Didymodon australasii	
POTTIACEAE	Didymodon tophaceus	
POTTIACEAE	Didymodon umbrosus	
POTTIACEAE	Didymodon xanthocarpus	
POTTIACEAE	Pseudocrossidium crinitum	
POTTIACEAE	Syntrichia austro-africana	
POTTIACEAE	Syntrichia laevipila	
POTTIACEAE	Tortula atrovirens	
POTTIACEAE	Trichostomum brachydontium	
POTTIACEAE	Weissia controversa	
PTYCHOMITRIACEAE	Ptychomitrium cucullatifolium	
RANUNCULACEAE	Ranunculus multifidus	
RANUNCULACEAE	Ranunculus rionii	LC
RANUNCULACEAE	Thalictrum minus	LC
RESEDACEAE	Oligomeris dipetala var. dipetala	LC
RICCIACEAE	Riccia albornata	
RICCIACEAE	Riccia pottsiana	
RICCIACEAE	Riccia pulveracea	
RICCIACEAE	Riccia simii	
RICCIACEAE	Riccia volkii	
ROSACEAE	Cliffortia nitidula subsp. pilosa Weim.	NE
ROSACEAE	Cliffortia ramosissima	LC
ROSACEAE	Rubus ludwigii subsp. ludwigii	LC
ROSACEAE	Rubus rigidus.	LC
RUBIACEAE	Anthospermum spathulatum subsp. spathulatum	LC
RUBIACEAE	Galium capense subsp. capense	LC
RUBIACEAE	Galium capense subsp. garipense var. garipense	LC
RUBIACEAE	Galium tomentosum	LC
RUBIACEAE	Rubia petiolaris	LC
SANTALACEAE	Thesium durum	LC
SANTALACEAE	Thesium gnidiaceum var. gnidiaceum	LC
SANTALACEAE	Thesium hystrix	LC
SANTALACEAE	Thesium imbricatum	LC
SANTALACEAE	Thesium lineatum	LC
SANTALACEAE	Thesium namaquense	LC
SANTALACEAE	Thesium scandens	LC
SANTALACEAE	Thesium triflorum	LC
SCROPHULARIACEAE	Aptosimum marlothii	LC
SCROPHULARIACEAE	Aptosimum procumbens	LC
SCROPHULARIACEAE	Chaenostoma halimifolium	LC
SCROPHULARIACEAE	Chaenostoma macrosiphon	LC
SCROPHULARIACEAE	Chaenostoma rotundifolium	LC
SCROPHULARIACEAE	Cromidon corrigioloides	LC

Family	Species	Threat Status
SCROPHULARIACEAE	Diascia alonsooides	LC
SCROPHULARIACEAE	Diascia capsularis	LC
SCROPHULARIACEAE	Hebenstretia dura	LC
SCROPHULARIACEAE	Hebenstretia robusta	LC
SCROPHULARIACEAE	Jamesbrittenia filicaulis	LC
SCROPHULARIACEAE	Limosella grandiflora	LC
SCROPHULARIACEAE	Manulea crassifolia subsp. crassifolia	LC
SCROPHULARIACEAE	Manulea plurirosulata	LC
SCROPHULARIACEAE	Nemesia cynanchifolia	LC
SCROPHULARIACEAE	Nemesia fruticans	LC
SCROPHULARIACEAE	Nemesia linearis	LC
SCROPHULARIACEAE	Selago acocksii	LC
SCROPHULARIACEAE	Selago albida	LC
SCROPHULARIACEAE	Selago bolusii	LC
SCROPHULARIACEAE	Selago corymbosa	LC
SCROPHULARIACEAE	Selago crassifolia	LC
SCROPHULARIACEAE	Selago divaricata	LC
SCROPHULARIACEAE	Selago dolosa	LC
SCROPHULARIACEAE	Selago galpinii	LC
SCROPHULARIACEAE	Selago geniculata	LC
SCROPHULARIACEAE	Selago glabrata	LC
SCROPHULARIACEAE	Selago persimilis	LC
SCROPHULARIACEAE	Selago retropilosa	Rare
SCROPHULARIACEAE	Selago saxatilis	LC
SCROPHULARIACEAE	Selago speciosa	LC
SCROPHULARIACEAE	Veronica anagallis-aquatica	LC
SCROPHULARIACEAE	Veronica persica	NE
SCROPHULARIACEAE	Zaluzianskya karrooica	LC
SCROPHULARIACEAE	Zaluzianskya ovata	LC
SCROPHULARIACEAE	Zaluzianskya peduncularis	LC
SINOPTERIDACEAE	Cheilanthes quadripinnata	LC
SOLANACEAE	Lycium arenicola	LC
SOLANACEAE	Lycium cinereum	LC
SOLANACEAE	Lycium horridum	LC
SOLANACEAE	Lycium oxycarpum	LC
SOLANACEAE	Physalis viscosa	NE
SOLANACEAE	Solanum retroflexum	LC
SOLANACEAE	Solanum triflorum	NE
SOLANACEAE	Withania somnifera	LC
STILBACEAE	Kogelbergia verticillata	Rare
TELOSCHISTACEAE	Caloplaca haematodes	
THELOTREMATACEAE	Diploschistes actinostomus var. actinostomus	
THYMELAEACEAE	Gnidia polycephala	LC
THYMELAEACEAE	Gnidia wikstroemiana	LC
THYMELAEACEAE	Passerina corymbosa	LC
THYMELAEACEAE	Passerina montana	LC
THYMELAEACEAE	Passerina obtusifolia	LC
URTICACEAE	Obetia tenax	LC
URTICACEAE	Urtica dioica L.	NE
URTICACEAE	Urtica lobulata	LC
VITACEAE	Rhoicissus tridentata subsp. tridentata	NE
ZYGOPHYLLACEAE	Zygophyllum incrustatum	LC

Appendix 2. List of Mammals

List of Mammals which may potentially occur within the surrounding area. Taxonomy notes are derived from Skinner & Chimimba (2005), while conservation status is according to the IUCN 2010.

Colours Relate as follow:

» Protected according to The Northern Cape Nature Conservation Act, Act 9 of 2009: Schedule 1 (Specially Protected Species)
* Take note that species listed in Schedule 2 (Protected Species) are not illustrated within the table. The reason being that virtually all indigenous fauna which do not fall under Schedule 1 are classified under Schedule 2, except those species classified as pests. In terms of mammals most rodents, shrews, elephant shrews, bats, hares and rabbits, carnivores such as mongoose, genets, and meerkat, antelope such as klipspringer, steenbok and duiker are included. The full list is contained within the Schedule and it not repeated here.

» National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004); Threatened or Protected Species Regulations
- Endangered Species
- Vulnerable Species
- Protected Species

Scientific Name	Common Name	IUCN Status	Likelihood	ADU Database Noted within relevant Degree Grids (3124)
Afrosoricida (Golden Moles):				
Chlorotalpa sclateri	Sclater's Golden Mole	LC	Low	Yes
Macroscledidea (Elephant Shrews):				
Elephantulus myurus	Eastern Rock Elephant Shrew	LC	Low	Yes
Tubulidentata:				

Orycteropus afer	Aardvark	LC	High	Yes
Hyracoidea (Hyraxes)				
Procavia capensis	Rock Hyrax	LC	Low	Yes
Lagomorpha (Hares and Rabbits):				
Lepus saxatilis	Scrub Hare	LC	High	Yes
Rodentia (Rodents):				
Graphiuris ocularis	Spectacled African Dormouse	LC	Moderate	Yes
Hystrix africaeaustralis	Cape Porcupine	LC	High	Yes
Pedetes capensis	Springhare	LC	Moderate	Yes
Xerus inauris	South African Ground Squirrel	LC	High	Yes
Aethomys namaquensis	Namaqua Rock Mouse	LC	High	Yes
Gerbilliscus paeba	Paeba Hairy-footed Gerbil	LC	Low	
Otomys irraratus	Vlei Rat	LC	Moderate	Yes
Otomys unisulcatus	Karoo Bush rat	LC	Low	Yes
Rhabdomys pumillio	Xeric Four striped Grass Rat	LC	High	Yes
Saccostomus campestris	South African Pouched Mouse	LC	High	Yes
Primates				
Papio ursinus	Chacma Baboon	LC	Moderate	Yes

Eulipotyphla (Shrews):				
Crocidura fuscomurina	Bi-coloured Musk Shrew	LC	Low	
Erinaceomorpha (Hedgehog)				
Atelerix frontalis	South African Hedgehog	LC	High	Yes
Carnivora:				
Proteles cristatus	Aardwolf	LC	High	Yes
Caracal caracal	Caracal	LC	High	Yes
Felis silvestris	African Wild Cat	LC	Moderate	
Felis nigripes	**Black-footed cat**	**VU**	**High**	Yes
Suricata suricatta	Meerkat	LC	High	Yes
Mellivora capensis	Honey Badger	LC	Low	Yes
Cynictis penicillata	Yellow Mongoose	LC	High	Yes
Canis mesomelas	Black-backed Jackal	LC	High	Yes
Otocyon megalotis	Bat-eared Fox	LC	High	
Lutra maculicolis	Spotted-necked Otter	LC	Moderate	
Ictonyx striatus	Striped Polecat	LC	High	Yes
Rumanantia (Antelope):				
Connochaetes gnou	Black Wildebeest	LC	Low	Yes
Damaliscus pygargus phillipsi	Blesbok	LC	Moderate	Yes

Tragelaphus strepsiceros	Greater Kudu	LC	Low	
Pelea capreolus	Grey Rhebok	LC	Low	Yes
Sylvicapra grimmia	Common Duiker	LC	High	Yes
Antidorcas marsupialis	Springbok	LC	Low	Yes
Raphicerus campestris	Steenbok	LC	High	Yes
Equus quagga	Plains Zebra	LC	Low	
Chiroptera (Bats)				
Neoromicia capensis	Cape Serotine Bat	LC	High	Yes

Appendix 3. List of Reptiles.

List of reptiles which are known from the broad area (3124 Degree Grids) according to the SARCA database. All species that have been noted within the Quarter Degree Grids of the study site (3124 BB) are indicated in **green**. All species listed as red data species, highlighted in red.

Family	Species	Common Name	Threat Status
Agamidae	***Agama atra***	**Southern Rock Agama**	**LC**
Colubridae	*Crotaphopeltis hotamboeia*	Red-lipped Snake	LC
Colubridae	*Dasypeltis scabra*	Rhombic Egg-eater	LC
Colubridae	*Dispholidus typus*	Boomslang	LC
Cordylidae	*Cordylus cordylus*	Cape Girdled Lizard	LC
Cordylidae	*Cordylus vittifer*	Common Girdled Lizard	LC
Cordylidae	***Karusasaurus polyzonus***	**Karoo Girdled Lizard**	**LC**
Cordylidae	*Pseudocordylus microlepidotus fasciatus*	Karoo Crag Lizard	LC
Cordylidae	*Pseudocordylus microlepidotus*	Cape Crag Lizard	LC
Elapidae	*Naja nivea*	Cape Cobra	LC
Gekkonidae	*Afroedura karroica*	Karoo Flat Gecko	LC
Gekkonidae	*Pachydactylus maculatus*	Spotted Gecko	LC
Gekkonidae	*Pachydactylus mariquensis*	Marico Gecko	LC
Gekkonidae	***Pachydactylus oculatus***	**Golden Spotted Gecko**	**LC**
Gerrhosauridae	*Tetradactylus tetradactylus*	Cape Long-tailed Seps	LC
Lacertidae	*Pedioplanis*		LC
Lacertidae	***Pedioplanis burchelli***	**Burchell's Sand Lizard**	**LC**
Lacertidae	*Pedioplanis lineoocellata*	Common Sand Lizard	LC
Lacertidae	*Pedioplanis namaquensis*	Namaqua Sand Lizard	LC

Family	Species	Common Name	Threat Status
Lamprophiidae	*Boaedon capensis*	Brown House Snake	LC
Lamprophiidae	*Duberria lutrix*	South African Slug-eater	LC
Lamprophiidae	*Lamprophis guttatus*	Spotted House Snake	LC
Lamprophiidae	*Lycodonomorphus rufulus*	Brown Water Snake	LC
Lamprophiidae	*Lycophidion capense*	Cape Wolf Snake	LC
Lamprophiidae	*Psammophis crucifer*	Cross-marked Grass Snake	LC
Lamprophiidae	*Psammophis notostictus*	Karoo Sand Snake	LC
Lamprophiidae	*Psammophylax rhombeatus*	Spotted Grass Snake	LC
Scincidae	*Acontias breviceps*	Short-headed Legless Skink	LC
Scincidae	*Trachylepis homalocephala*	Red-sided Skink	LC
Scincidae	***Trachylepis sulcata***	**Western Rock Skink**	**LC**
Scincidae	***Trachylepis variegata***	**Variegated Skink**	**LC**
Testudinidae	*Homopus femoralis*	Greater Padloper	LC
Testudinidae	*Stigmochelys pardalis*	Leopard Tortoise	LC
Typhlopidae	*Rhinotyphlops lalandei*	Delalande's Beaked Blind Snake	LC
Varanidae	*Varanus albigularis*	Rock Monitor	LC
Viperidae	*Bitis arietans*	Puff Adder	LC

Appendix 4. List of Amphibians.

List of amphibians which are known from the broad area (3124 Degree Grid) according to the SARCA database. All species that have been noted within the Quarter Degree Grids of the study site (3124BB) are indicated in **green**. All species listed as red data species, highlighted in red.

Family	Species	Common Name	Threat Status
BUFONIDAE	*Amietophrynus rangeri*	Raucous Toad	LC
BUFONIDAE	*Poyntonophrynus vertebralis*	Southern Pygmy Toad	LC
BUFONIDAE	*Vandijkophrynus gariepensis*	Karoo Toad	LC
Hyperoliidae	*Kassina senegalensis*	Bubbling Kassina	LC
Pipidae	*Xenopus laevis*	Common Platanna	LC
Pyxicephalidae	*Amietia fuscigula*	Cape River Frog	LC
Pyxicephalidae	*Cacosternum boettgeri*	Common Caco	LC
Pyxicephalidae	*Pyxicephalus adspersus*	Giant Bull Frog	NT
Pyxicephalidae	*Strongylopus grayii*	Clicking Stream Frog	LC
Pyxicephalidae	*Tomopterna delalandii*	Cape Sand Frog	LC
Pyxicephalidae	*Tomopterna tandyi*	Tandy's Sand Frog	LC