ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED ILANGA TOWER 7 PROJECT, NEAR UPINGTON, NORTHERN CAPE PROVINCE

FAUNA & FLORA SPECIALIST ECOLOGICAL IMPACT ASSESSMENT REPORT

PRODUCED FOR SAVANNAH ENVIRONMENTAL

ON BEHALF OF

EMVELO HOLDINGS (PTY) LTD

BY

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JULY 2016

CONTENTS

NEMA 2014 CHECKLIST

Section		*NEMA 2014 Regulations for Specialist Studies*	Position in report (pg.)	check
1	1	A specialist report prepared in terms of these Regulations must contain—		
	(a)	details of-		
		(i) the specialist who prepared the report; and	4-5	✓
		(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	Annex 5	✓
	(b)	a declaration that the person is independent in a form as may be specified by the competent authority;		✓
	(c)	an indication of the scope of, and the purpose for which, the report was prepared;	8	✓
	(d)	a description of the methodology adopted in preparing the report or carrying out the specialised process;	14-17	✓
	(e)	a description of any assumptions made and any uncertainties or gaps in knowledge;	16-17	✓
	(f)	a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment;	18-25	✓
	(g)	recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority;	28-37	✓
	(h)	a description of any consultation process that was undertaken during the course of carrying out the specialist report;	See main EIA report	✓
	(i)	a summary and copies of any comments that were received during any consultation process; and	See main EIA report	✓
	(j)	any other information requested by the competent authority.	Offset considerations – see pages 20-21	✓
	2	Where a proposed development and the geographical area within which it is located has been subjected to a pre-assessment using a spatial development tool, and the output of the pre-assessment in the form of a site specific development protocol has been adopted in the prescribed manner, the content of a specialist report may be determined by the adopted site specific development protocol applicable to the specific proposed development in the specific geographical area it is proposed in.	N/A	✓

DECLARATION OF CONSULTANTS' INDEPENDENCE

- I Simon Todd, as the appointed independent 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, 2010 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, 2010 and any specific environmental management Act;
- am fully aware of and meet the responsibilities in terms of NEMA, the Environmental Impact Assessment Regulations, 2010 (specifically in terms of regulation 17 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 71 of GN No. R. 543.

Note: The terms of reference must be attached.

Simon Todd Pr.Sci.Nat 400425/11.
June 2016

PROFESSIONAL PROFILE OF CONSULTANT:

Simon Todd Consulting has extensive experience in the assessment of renewable energy developments, having provided ecological assessments for more than 80 different renewable energy developments. This includes a large number of developments in the immediate vicinity of the current site as well as in the broader Northern Cape Province. Simon Todd is a recognised ecological expert and is a past chairman of the Arid-Zone Ecology Forum and has 18 years' experience working throughout the country. Simon Todd is registered with the South African Council for Natural Scientific Professions (No. 400425/11).

Recent experience and relevant projects in the immediate vicinity of the current site include the following:

- Solis CSP 1 & CSP 2 Facilities on Van Roois Vley, near Upington. Botanical Specialist Assessment. WSP Environmental 2012.
- Dyasonsklip PV1, PV2 & PV3. Fauna and Flora Specialist Scoping and EIA Study. Cape EAPrac 2014.
- Bloemsmond PV1 & PV2 PV Facilities. Fauna and Flora Specialist Assessment. Savannah Environmental 2015.
- Karoshoek Solar Valley Development, Upington: Fauna & Flora Specialist Impact Assessment Report. Savannah Environmental. 2012.
- Upington Solar Park on Klipkraal. Specialist Fauna and Flora baseline assessment. Lidwala Consulting Engineers. 2014.
- SolarReserve Rooipunt CSP Plant, Upington. Preconstruction walk-through. SolarReserve 2014.
- SolarReserve Rooipunt grid connection and water supply pipeline. Fauna and Flora Basic Assessment. SiVest 2016.
- Joram Solar Vryheid PV Project, Northern Cape. Fauna & Flora Specialist Scoping & EIA Studies. CapeEAPrac 2015.
- Ephraim Sun Solar PV Development, Upington, Northern Cape: Fauna & Flora Specialist EIA and Scoping. CapeEAPrac 2015.

EXECUTIVE SUMMARY

Emvelo Holdings (Pty) Ltd ("Emvelo"), an independent power developer of concentrating solar power (CSP) plants in South Africa, is proposing the development of a Concentrated Solar Power (CSP) Facility and associated infrastructure to form part of the Karoshoek Solar Valley Development located approximately 30 km east of Upington. The proposed project is to be known as the Ilanga CSP 7 Project and is to make use of tower technology. The Ilanga CSP 7 Project is proposed to generate up to 150MW in capacity and will be constructed over an area of approximately 1519.19 ha in extent within the broader property. This Ecological Specialist Assessment Report forms part of the required Ecological Impact Assessment process for the development. The report details the ecological characteristics of the site and provides an assessment of the likely ecological impacts associated with the development of the solar energy facility. Impacts are assessed for the preconstruction, construction, operation, and decommissioning phases of the development.

The Ilanga Tower 7 site consists of *Schmidtia kalahariensis* and *Stipagrostis* mixed grassland and shrubland on flat open plains considered to be of low to moderate sensitivity. There are no highly sensitive features within the development footprint and the abundance of *Boscia albitrunca* is identified as the only significant feature of the site. As the development of the site would certainly lead to the loss of several hundred or even thousands of individuals of this species, an offset for the loss within the current as well as the other Karoshoek developments should be investigated. Although the development would result in the loss of fairly large numbers of *Boscia*, this is not a rare or threatened tree species and the development would not compromise the local populations of this species which remains widespread in the area.

Due to the large number of renewable energy developments in the Upington area, the development of the site will contribute significantly to cumulative impact. However, the affected Bushmanland Arid Grassland vegetation type is extensive and the extent of habitat loss (ca. 1500ha) resulting from the development would not significantly impact the remaining extent of this vegetation type at the national level, although some local impact on this vegetation type is likely given the large extent of development within this vegetation unit within the broader Karoshoek solar development area. Consequently the impact of the development on the future conservation potential of the area is considered moderate at a local level and low at the national level.

There are no highly sensitive features within the development footprint and while there are some protected species present, there are no species of high conservation concern present and no significant impacts can be expected on the local populations of the protected species. Overall and with the suggested mitigation measures implemented, the impacts of the development are likely to be of moderate to low significance and no impacts of high

significance are likely. As a result, there are no ecological fatal flaws or impacts that cannot be mitigated that should prevent the development from being approved.

1 INTRODUCTION

Emvelo Holdings (Pty) Ltd ("Emvelo"), an independent power developer of concentrating solar power (CSP) plants in South Africa, is proposing the development of a Concentrated Solar Power (CSP) Facility and associated infrastructure to form part of the Karoshoek Solar Valley Development located approximately 30 km east of Upington. The proposed project is to be known as the Ilanga CSP 7 Project and is to make use of tower technology. The Ilanga CSP 7 Project is proposed to generate up to 150MW in capacity and will be constructed over an area of approximately 1519.19 ha in extent within the broader property.

This ecological specialist study details the ecological characteristics of the site and provides an assessment of the likely ecological impacts associated with the development of the site as a solar energy facility. Impacts are assessed for the preconstruction, construction, operation, and decommissioning phases of the development for the solar facility. As there are several facilities adjacent to one another within the Karoshoek Solar Valley Development site, the current assessment is only for the Ilanga Tower 7 facility, but the other facilities are indicated on the maps in order to demonstrate the full development footprint at the site as well as integrate the potential cumulative effects of the whole development on the site. All proposed facilities within the study area will eventually form part of the proposed larger Karoshoek Solar Valley Development. A variety of avoidance and mitigation measures associated with each identified impact are recommended to reduce the likely impact of the development, which should be included in the EMPr for the development. The full scope of study is detailed below.

1.1 SCOPE OF STUDY

The scope of the study includes the following activities

- a description of the environment that may be affected by the activity and the manner in which the environment may be affected by the proposed project
- a description and evaluation of environmental issues and potential impacts (incl. using direct, indirect and cumulative impacts) that have been identified
- a statement regarding the potential significance of the identified issues based on the evaluation of the issues/impacts
- an indication of the methodology used in determining the significance of potential environmental impacts
- an assessment of the significance of direct indirect and cumulative impacts in terms of the following criteria :
    - the nature of the impact, which shall include a description of what causes the effect, what will be affected and how it will be affected
    - the extent of the impact, indicating whether the impact will be local (limited to

the immediate area or site of development), regional, national or international
- the duration of the impact, indicating whether the lifetime of the impact will be of a short-term duration (0-5 years), medium-term (5- 15 years), long-term (> 15 years, where the impact will cease after the operational life of the activity) or permanent
- the probability of the impact, describing the likelihood of the impact actually occurring, indicated as improbable (low likelihood) probable (distinct possibility), highly probable (most likely), or definite (Impact will occur regardless of any preventable measures)
- the severity/beneficial scale indicating whether the impact will be very severe/beneficial (a permanent change which cannot be mitigated/permanent and significant benefit with no real alternative to achieving this benefit) severe/beneficial (long-term impact that could be mitigated/long-term benefit) moderately severe/beneficial (medium- to long-term impact that could be mitigated/ medium- to long-term benefit), slight or have no effect
- the significance which shall be determined through a synthesis of the characteristics described above and can be assessed as low medium or high
- the status which will be described as either positive, negative or neutral
- the degree to 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

- a description and comparative assessment of all identified feasible alternatives
- recommendations regarding practical mitigation measures for potentially significant impacts, for inclusion in the Environmental Management Programme (EMPr)
- an indication of the extent to which the impact could be addressed by the adoption of mitigation measures
- a description of any assumptions, uncertainties and gaps in knowledge
- an environmental impact statement which contains :
  - a summary of the key findings of the environmental impact assessment;
  - an assessment of the positive and negative implications of the proposed activity;
  - a comparative assessment of the positive and negative implications of identified alternatives

General Considerations:

- Disclose any gaps in information or assumptions made.
- Identify recommendations for mitigatory measures to minimise impacts.
- Outline additional management guidelines.
- Provide monitoring requirements, mitigation measures and recommendations in a table format as input into the Environmental Management Plan (EMP) for faunal related issues.

A description of the potential impacts of the development and recommended mitigation measures are to be provided which will be separated into the following project phases:

- Preconstruction
- Construction
- Operational Phase
- Decommissioning

1.2 Assessment Approach & Philosophy

The assessment will be conducted according to the EIA Regulations, published by the Department of Environmental Affairs 2014) as well as within the best-practice guidelines and principles for biodiversity assessment as outlined by Brownlie (2005) and De Villiers et al. (2005).

This includes adherence to the following broad principles:

- That a precautionary and risk-averse approach be adopted towards projects which may result in substantial detrimental impacts on biodiversity and ecosystems, especially the irreversible loss of habitat and ecological functioning in threatened ecosystems or designated sensitive areas: i.e. Critical Biodiversity Areas (as identified by systematic conservation plans, Biodiversity Sector Plans or Bioregional Plans) and Freshwater Ecosystem Priority Areas.

- Demonstrate how the proponent intends complying with the principles contained in Section 2 of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended (NEMA), which, amongst other things, indicates that environmental management should.

    - In order of priority aim to: avoid, minimise or remedy disturbance of ecosystems and loss of biodiversity;
    - Avoid degradation of the environment;
    - Avoid jeopardising ecosystem integrity;

- Pursue the best practicable environmental option by means of integrated environmental management;
- Protect the environment as the people's common heritage;
- Control and minimise environmental damage; and
- Pay specific attention to management and planning procedures pertaining to sensitive, vulnerable, highly dynamic or stressed ecosystems.

These principles serve as guidelines for all decision-making concerning matters that may affect the environment. As such, it is incumbent upon the proponent to show how proposed activities would comply with these principles and thereby contribute towards the achievement of sustainable development as defined by the NEMA.

In order to adhere to the above principles and best-practice guidelines, the following approach forms the basis for the study approach and assessment philosophy:
The study will include data searches, desktop studies, site walkovers / field survey of the property and baseline data collection, describing:

- A description of the broad ecological characteristics of the site and its surrounds in terms of any mapped spatial components of ecological processes and/or patchiness, patch size, relative isolation of patches, connectivity, corridors, disturbance regimes, ecotones, buffering, viability, etc.

In terms of **pattern**, the following will be identified or described:

Community and ecosystem level

- The main vegetation type, its aerial extent and interaction with neighbouring types, soils or topography;
- Threatened or vulnerable ecosystems (*cf. SA vegetation map/National Spatial Biodiversity Assessment, fine-scale systematic conservation plans, etc*).

Species level

- Red Data Book species (giving location if possible using GPS)
- The viability of an estimated population size of the RDB species that are present (include the degree of confidence in prediction based on availability of information and specialist knowledge, i.e. High=70-100% confident, Medium 40-70% confident, low 0-40% confident)
- The likelihood of other RDB species, or species of conservation concern, occurring in the vicinity (include degree of confidence).

Fauna

- Describe and assess the terrestrial fauna present in the area that will be affected by the proposed development.
- Conduct a faunal assessment that can be integrated into the ecological study.

- Describe the existing impacts of current land use as they affect the fauna.
- Clarify species of special concern (SSC) and that are known to be:
    - endemic to the region;
    - that are considered to be of conservational concern;
    - that are in commercial trade (CITES listed species);
    - or, are of cultural significance.
- Provide monitoring requirements as input into the Environmental Management Programme (EMP) for faunal related issues.

Other pattern issues

- Any significant landscape features or rare or important vegetation associations such as seasonal wetlands, alluvium, seeps, quartz patches or salt marshes in the vicinity.
- The extent of alien plant cover of the site, and whether the infestation is the result of prior soil disturbance such as ploughing or quarrying (alien cover resulting from disturbance is generally more difficult to restore than infestation of undisturbed sites).
- The condition of the site in terms of current or previous land uses.

In terms of **process**, the following will be identified or described:

- The key ecological "drivers" of ecosystems on the site and in the vicinity, such as fire.
- Any mapped spatial component of an ecological process that may occur at the site or in its vicinity (i.e. *corridors* such as watercourses, upland-lowland gradients, migration routes, coastal linkages or inland-trending dunes, and *vegetation boundaries* such as edaphic interfaces, upland-lowland interfaces or biome boundaries)
- Any possible changes in key processes, e.g. increased fire frequency or drainage/artificial recharge of aquatic systems.
- Furthermore, any further studies that may be required during or after the EIA process will be outlined.
- All relevant legislation, permits and standards that would apply to the development will be identified.
- The opportunities and constraints for development will be described and shown graphically on an aerial photograph, satellite image or map delineated at an appropriate level of spatial accuracy.

1.3 RELEVANT ASPECTS OF THE DEVELOPMENT

The Ilanga CSP 7 facility is proposed to utilise the solar tower technology, using superheated steam, with a generation capacity of up to 150MW. The Ilanga CSP 7 Project will consist of a field of heliostats and a central receiver, known as a power tower. On-site storage using molten salts is proposed to extend the operating time of the facility into the night. The Ilanga CSP 7 Project is proposed to generate up to 150MW in capacity and will be constructed over an area of approximately 1519.19 ha in extent within the broader property.

The facility will include the following infrastructure:

- Central tower up to 270m with a molten salt receiver on top of the tower.
- Waste management infrastructure including evaporation dams and a wastewater treatment facility.
- Access roads to the site and internal access roads.
- On-site substation and associated 132kV power line linking the facility to the Karoshoek Solar Valley substation or to the national electricity grid.
- Karoshoek Solar Valley substation and associated power lines 132 – 400kV lines connecting to the National Grid.
- A water supply pipeline from the Orange River (including water treatment and storage reservoirs).
- Operational buildings, including offices and workshops.
- The solar collector field consisting of heliostats, all systems and infrastructure related to the control and operation of the heliostats.
- The power block/power island comprising of a conventional steam turbine generator with an ACC and associated feed water system.
- Molten Salt Circuit which includes the thermal storage tanks for storing low and high temperature liquid salt, a central solar thermal tower receiver, pipelines and molten salt to steam heat exchangers.
- Auxiliary facilities and infrastructure consisting of the switch yard, step up transformers, up to 132 kV power evacuation lines, access routes, water supplies and facility start up generators.

The following associated infrastructure will also be required for the proposed project: on-site substation and associated 132kV power line linking the facility to the national electricity grid; access roads (main and internal access roads); and a water pipeline from the Orange River (including water treatment and storage reservoirs). The above infrastructure will be **shared infrastructure** for all the proposed projects within the Karoshoek Solar Valley Development and will be assessed within a separate Basic Assessment process.

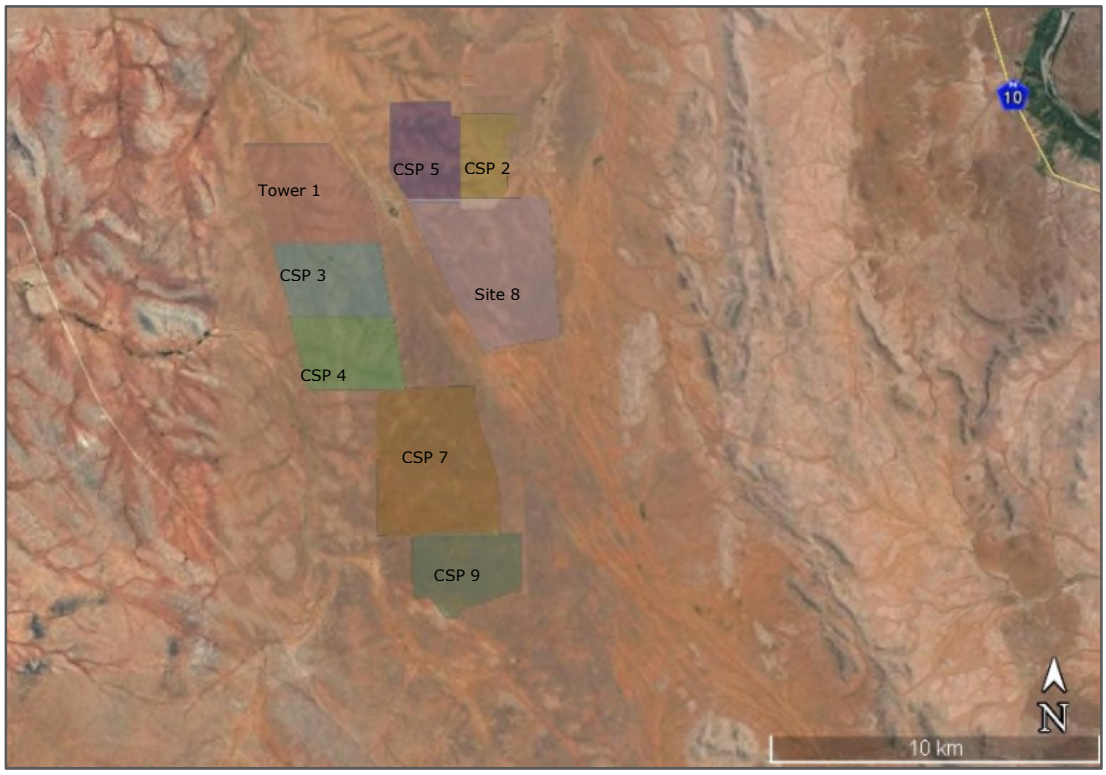

Figure 1. The proposed development area of Ilanga Tower 7 site, within the broader Karoshoek Solar Valley Development.

2 METHODOLOGY

2.1 DATA SOURCING AND REVIEW

Data sources from the literature consulted and used where necessary in the study includes 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.
- No Critical Biodiversity Areas (CBA) mapping or systematic conservation planning has been conducted for the area with the result that no detailed conservation priority area information is available for the area.
- Information on plant and animal species recorded for the Quarter Degree Square (QDS) 2821AD, BC, CB and DA 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 1) 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 (2014).
- Freshwater and wetland information was extracted from the National Freshwater Ecosystem Priority Areas assessment, NFEPA (Nel et al. 2011).
- Important catchments and protected areas expansion areas were extracted from the National Protected Areas Expansion Strategy 2008 (NPAES).

Fauna

- Lists of mammals, reptiles and amphibians which are likely to occur at the site were derived based on distribution records from the literature and various spatial databases (ADU, 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.
- The faunal species lists provided are based on species which are known to occur in the broad geographical area, as well as a preliminary assessment of the availability and quality of suitable habitat at the site.
- The conservation status of each species is also listed, based on the IUCN Red List Categories and Criteria version 2014.3 (See Figure 1) 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.

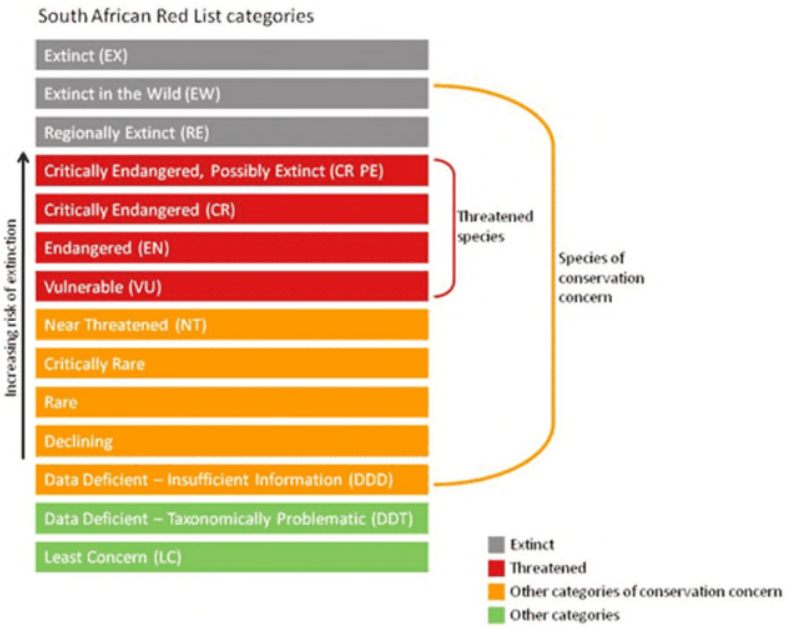

Figure 2. Schematic representation of the South African Red List categories. Taken from http://redlist.sanbi.org/redcat.php

2.2 Site Visit

The site was visited twice in April 2016 and July 2016. During the site visits, the different biodiversity features, habitat, and landscape units present at the site were identified and mapped in the field. Specific features visible on the satellite imagery of the site were also marked for field inspection and were verified and assessed during the site visit. This included features such as pans and rocky outcrops that were not visible from the access roads of the site and might have otherwise been missed. Walk-through-surveys were conducted within representative areas across the different habitats units identified and all plant and animal species observed were recorded. Active searches for reptiles and amphibians were also conducted within habitats likely to harbour or be important for such species. The presence of sensitive habitats such as wetlands or pans and unique edaphic environments such as rocky outcrops or quartz patches were noted in the field if present and recorded on a GPS and mapped onto satellite imagery of the site.

2.3 Sensitivity Mapping & Assessment

An ecological sensitivity map of the site was produced by integrating the information collected on-site with the available ecological and biodiversity information available in the literature and various spatial databases. This includes delineating the different habitat units identified in the field and assigning sensitivity values to the units based on their ecological properties, conservation value and the potential presence of species of conservation concern. The

ecological sensitivity of the different units identified in the mapping procedure was rated according to the following scale:

- **Low** – Areas of natural or transformed habitat with a low sensitivity where there is likely to be a negligible impact on ecological processes and terrestrial biodiversity. Most types of development can proceed within these areas with little ecological impact.
- **Medium**- Areas of natural or previously transformed land where the impacts are likely to be largely local and the risk of secondary impact such as erosion low. These areas usually comprise the bulk of habitats within an area. Development within these areas can proceed with relatively little ecological impact provided that appropriate mitigation measures are taken.
- **High** – Areas of natural or transformed land where a high impact is anticipated due to the high biodiversity value, sensitivity or important ecological role of the area. These areas may contain or be important habitat for faunal species or provide important ecological services such as water flow regulation or forage provision. Development within these areas is undesirable and should only proceed with caution as it may not be possible to mitigate all impacts appropriately.
- **Very High** – Critical and unique habitats that serve as habitat for rare/endangered species or perform critical ecological roles. These areas are essentially no-go areas from a developmental perspective and should be avoided as much as possible.

In some situations, areas were also classified between the above categories, such as Medium-High, where it was deemed that an area did not fit well into a certain category but rather fell most appropriately between two sensitivity categories.

2.4 SAMPLING LIMITATIONS AND ASSUMPTIONS

The major potential limitation associated with the sampling approach is the narrow temporal window of sampling. Ideally, a site should be visited several times during different seasons to ensure that the full complement of plant and animal species present are captured. However, this is rarely possible due to time and cost constraints and therefore, the representivity of the species sampled at the time of the site visit should be critically evaluated.

The vegetation at the time of the site visit was in a good condition for sampling. Although it was past the usual wet season, there had been late rains in the area and the grasses present were well grown out and forbs were abundant. The shrubs were largely in the growing phase and were therefore in a state that they could be identified. The sampling of the vegetation is therefore seen to be reliable, and it not likely that additional site visits would yield significant numbers of additional species.

The lists of amphibians, reptiles and mammals for the site are based on those observed at the site as well as those likely to occur in the area based on their distribution and habitat

preferences. Several site visits have also been conducted in the wider area on adjacent properties at different times of the year and information on fauna observed in these areas is included where relevant. This represents a sufficiently conservative and cautious approach which takes the study limitations into account.

3 DESCRIPTION OF THE AFFECTED ENVIRONMENT- BASELINE

3.1 BROAD-SCALE VEGETATION PATTERNS

While there are a number of vegetation types within the broad area around the site, Tower 7 is restricted to the Bushmanland Arid Grassland and Gordonia Duneveld vegetation types (Mucina & Rutherford 2006) (Figure 3). Bushmanland Arid Grassland is an extensive vegetation type, being the second most extensive vegetation type in South Africa occupying an area of 45 478 km^2. It extends from around Aggeneys in the east to Prieska in the west. It is associated largely with red-yellow apedal (without structure), freely drained soils, with a high base status and mostly less than 300mm deep. Due the arid nature of the unit which receives between 70 and 200 mm annual rainfall, it has not been significantly impacted by intensive agriculture and more than 99% of the original extent of the vegetation type is still intact. Mucina & Rutherford (2006) list 6 endemic species for the vegetation type which is a relatively low number given the extensive nature of the vegetation type. It is however poorly protected and less than 1% is within formal conservation areas. Although Mucina and Rutherford (2006) provide a list of typical and dominant species associated with this vegetation type, this is not repeated here and the actual vegetation as observed on the site is described in the next section.

According to Mucina and Rutherford (2006), Gordonia Duneveld occurs at an extent of 36 772 km^2 in the Northern Cape at an altitude of 800-1200m and consists of parallel dunes about 3-8m off the plains. It occurs south of the Molopo River border with Botswana and interleaves with Kalahari Karroid Shrubland in the west (south of Rietfontein to the Orange River area). In the South it occurs around Upington and north of Groblershoop. It also occurs as a number of loose dune cordons south of the Orange River near Keimoes and between Upington and Putsonderwater. This vegetation type occurs on aeolian sand underlain by superficial silcretes and calcretes of the Cenzoic Kalahari Group and forms fixed parallel sand dunes with Af land type almost exclusively. The vegetation type is considered Least Threatened, is very little transformed and is fairly well conserved with 14% statutorily conserved within the Kgalagadi Transfrontier Park.

Gordonia Duneveld is classified as Least Threatened and has been little impacted by transformation and more than 99% of the original extent is still intact. Gordonia Duneveld is Moderately Protected and occurs within several protected areas. According to Mucina & Rutherford (2006), no vegetation-type endemic species are known from Gordonia Duneveld

although several protected species are common within this vegetation unit including *Acacia haematoxylon*, *Acacia erioloba* and *Harpagophytum procumbens*. Gordonia Duneveld is widely distributed and is among the most extensive vegetation types in South Africa. Although this unit as mapped as being present within the site, the site visit revealed that this is incorrect and there are no dunes within the site. Although the substrate is sandy, the material is coarse and has not formed any dunes within the site with the result that the vegetation is more akin to Bushmanland Arid Grassland and does not well represent Gordonia Duneveld.

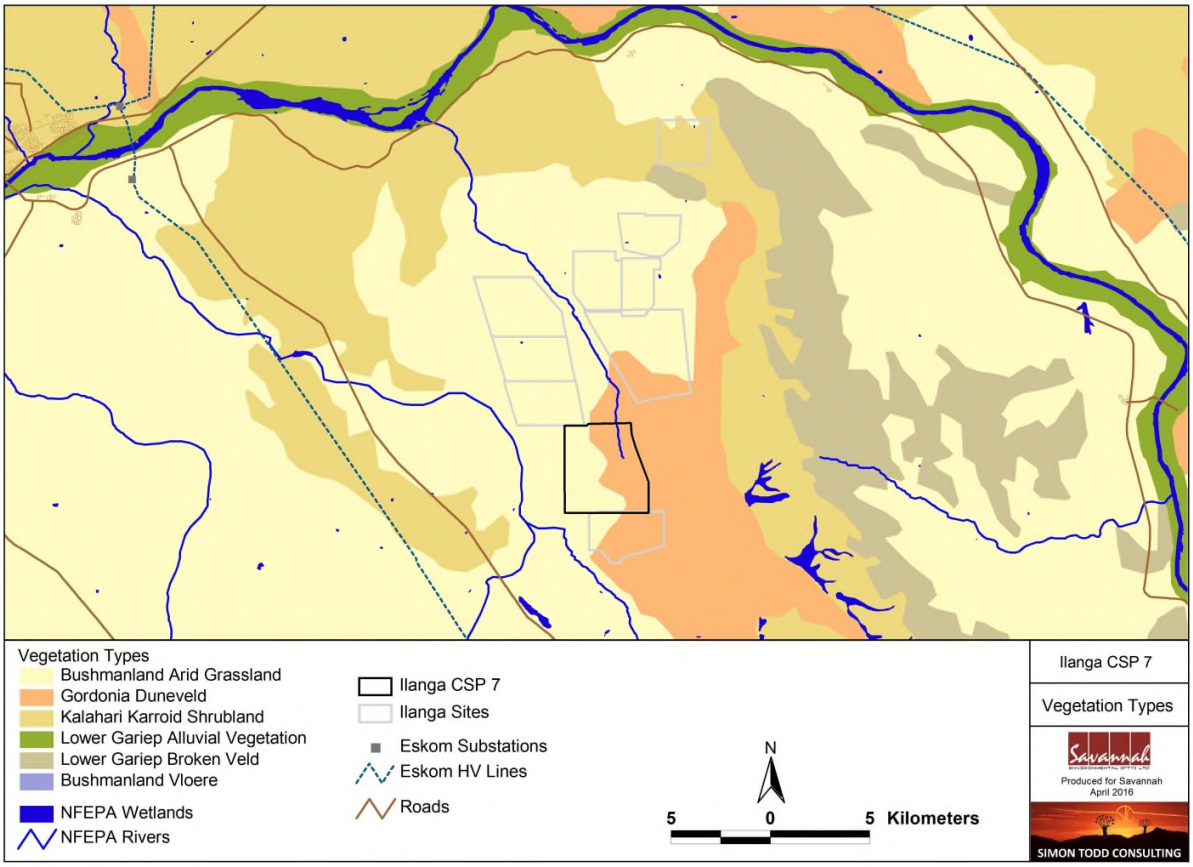

Figure 3. The vegetation in and around the Ilanga Tower 7 site, showing the other development areas within the Karoshoek Solar Development. The vegetation map is an extract of the National Vegetation Map as produced by Mucina and Rutherford (2006).

3.2 Site Description

The vegetation of the site is broadly homogenous, with no significant landscape features or drainage lines present. There is some variation in the density of bush across the site, with some areas having a fairly high density of *Rhigozum trichtotomum*, which is indicative of past overgrazing. There are also some areas with a fairly high density of the alien invasive tree

Prosopis glandulosa which has invaded parts of the site, especially in disturbed areas around watering points and livestock handling areas.

The vegetation of the site is homogenous and consists of mixed shrub and grassland on open plains. The vegetation is dominated by *Schmidtia kalahariensis* and *Stipagrostis* bushman-grasses with greater or lesser amounts of scattered taller woody species and trees present. The dominance of *Schmidtia* and *Rhigozum* are indicative of degradation and the vegetation of the site is considered to be in a relatively poor condition. Typically, this vegetation within the study area is dominated by grasses such as *Schmidtia kalahariensis, Stipagrostis ciliata*, *S.uniplumis*, *S.amabilis*, *S.obtusa*. Trees and shrubs of the open plains included *Boscia foetida*, *Barleria capensis*, *Boscia albitrunca*, *Parkinsonia africana*, *Phaeoptilum spinosum*, *Lycium schizocalyx*, *Monechma incanum*, *Rhigozum trichotomum* and *Aptosimum albomarginatum*. Forbs present include *Gisekia pharnacoides*, *Blepharis mitrata*, *Limeum sulcatum*, *Hypertelis salsoloides*, *Geigeria filifolia*, *Dicoma capensis*, *Grielum humifusum*, *Barleria lichtensteiniana* and *Arctotis leiocarpa*. Overall, the affected area is considered relatively low sensitivity, as there are few sensitive features present.

Typical vegetation near to the northern boundary of CSP 7, showing a relatively degraded area dominated by *Rhigozum trichotomum* with occasional *Phaeoptilum spinosum* and scattered *Prosopis* trees.

The vegetation of CSP 7 typically has a high density of *Rhigozum trichotomum* with an understorey of grass, largely *Schmidtia kalahriensis*. Scattered *Boscia albitrunca* and a *Parkinsonia africana* are also visible.

3.3 PROTECTED AND LISTED PLANT SPECIES

The diversity of protected species at the site is low. The only protected species observed on the site is *Boscia albitrunca*. Other protected species present in the area but not observed within the development area include *Acacia erioloba*, *Hoodia gordonii* and *Boscia foetida*. As the site is large, some individuals of these species may be present but at a low density or as small plants, as they were not observed during the site visit even though the site is flat and open. In terms of the actual likely numbers of individuals of protected species likely to be impacted by the development, the main impact would be on *Boscia albitrunca* and several hundred individuals of this species would be impacted by the development. This is certain to raise some concern from DAFF and should this site be development, engagement with DAFF and DENC regarding the loss of the trees will need to be entered into. The nature of the offset that would be required would be considered by DAFF following the walk-though of the final approved development footprint and the establishment of how many individuals of protected trees would be impacted. As the development is part of the larger Karoshoek development area, it would be advantageous for the developer to engage with DAFF at an early stage so that the required offsets can be negotiated and developed in a more holistic manner for the wider development and not on a case by case basis. This should include an evaluation of *Boscia albitrunca* and *Boscia foetida* population structure and abundance within the wider area and an evaluation of the significance of the affected individuals for the local populations. In most cases, the offset would entail the acquisition, protection and conservation of similarly sized or larger populations within adjacent areas. Alternatively the offset may involve research into the population dynamics or other aspects of the biology of the affected species, aimed at contributing to the future conservation of the affected species.

Red-listed species that are known to occur in the area, but which were not observed include *Brachystelma huttonii* (Rare) and *Pelargonium reniforme* subsp. *reniforme* (Data Deficient Data).

Table 1. Red-listed species which may occur within the Ilanga Tower 7 site, including their IUCN status and the likelihood that they occur at the site. This does not include provincially or nationally protected species which are present at the site.

Family	Species	IUCN Status	Likelihood
ASPHODELACEAE	*Aloe dichotoma*	VU	Low
MESEMBRYANTHEMACEAE	*Dinteranthus wilmotianus*	NT	Low
AMARYLLIDACEAE	*Crinum bulbispermum*	Declining	Low
FABACEAE	*Acacia erioloba*	Declining	Possible
APOCYNACEAE	*Hoodia gordonii*	DDD	Possible
GERANIACEAE	*Pelargonium reniforme subsp. reniforme*	DDD	Low

ASTERACEAE	*Gymnostephium ciliare*	DDT	Low
ASTERACEAE	*Senecio monticola*	DDT	Low

3.4 CUMULATIVE IMPACT & BROAD-SCALE PROCESSES

No fine-scale conservation planning has been done in the district and as a result, no Critical Biodiversity Areas have been defined. The site also does not fall within areas that have identified as focus areas under the National Protected Areas Expansion Strategy, indicating that the development areas do not occur within areas that have been identified as being important for biodiversity maintenance at a landscape scale.

There is however a large amount of solar development in the area, which raises the possibility of significant cumulative impact in the area. The DEA map available showing proposed projects does not however show the actual extent of development in most cases and shows the entire affected cadaster, which may have one or several solar developments on it. As a result, the actual extent of development is most likely significantly less than suggested by the DEA map. Nevertheless, cumulative impacts in the area are likely to increase significantly in the future should all projects be developed. The main cumulative impact of development in the area is likely to be habitat loss and the disruption of landscape connectivity for fauna. The contribution of development in the Karoshoek area to the impact on protected plant species is likely to be moderate as the open plains habitat in the area contains few species of conservation significance and the density of protected tree species is also relatively low and concentrated along the larger drainage lines.

The large amount of development in the Karoshoek area and beyond would potentially create a significant impact on landscape connectivity in the area. However, in reality, this is not likely to occur, as there are many ridges in the area that would not be developed, which would facilitate landscape connectivity. In addition, there are also some large drainage lines that would also not be developed and which would be used by species which avoid the upland areas. Therefore, development in the Karoshoek area is likely to impact on landscape connectivity at a local level only and there are still likely to be sufficient intact areas remaining at a broader scale to allow for broad-scale faunal movement. However, in order to facilitate this, it is important there are not extensive electrified fences in the area and each development should preferably be individually fenced.

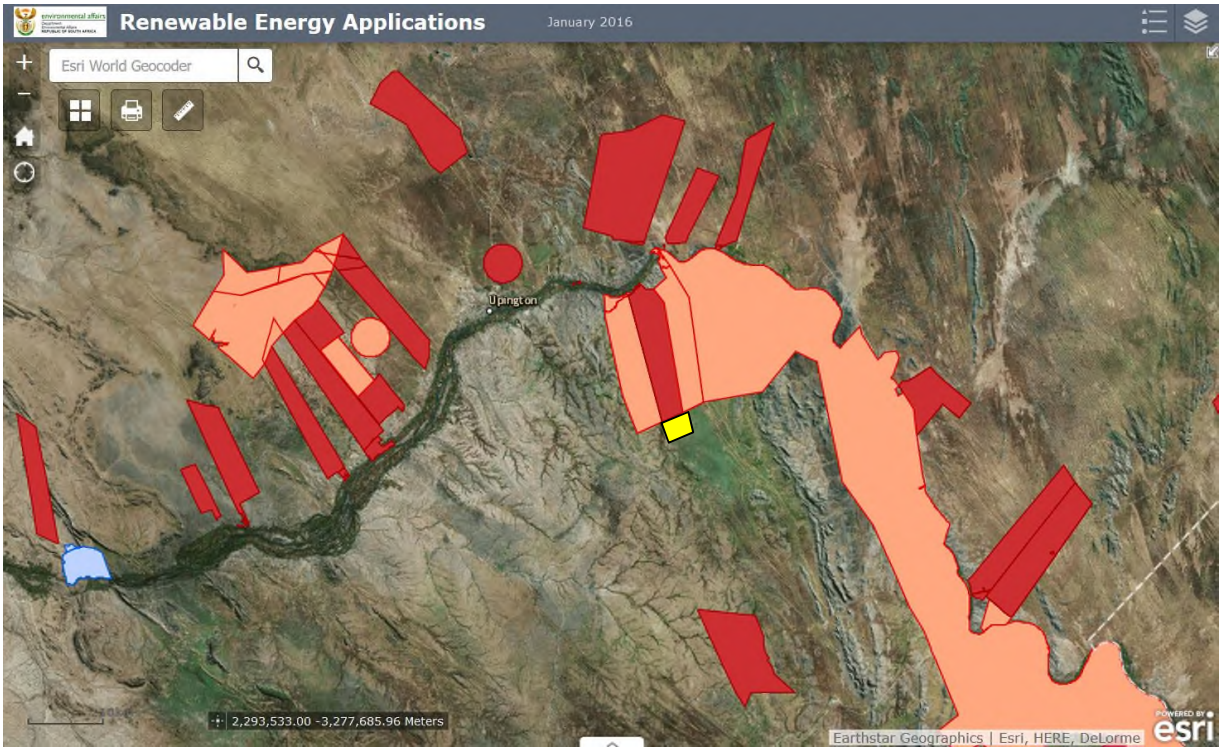

Figure 4. DEA-registered projects as at January 2016 for the Upington area, illustrating the very high density of proposed solar energy development in the area. Yellow block indicated location of the proposed Tower 7 development site.

3.5 FAUNAL COMMUNITIES

Mammals

The site falls within the distribution range of 46 terrestrial mammals, indicating that the mammalian diversity at the site is likely to be moderate to low. At a broad scale, it is likely that a large proportion of these species occur at the area. However, within the affected development area, mammalian diversity is likely to be quite low on account of the limited range of habitats available. No species associated with rocky outcrops are likely to occur within the proposed development area, which would significantly reduce the number of the species that would be directly affected. Mammal species observed at the site and in the area include Black-backed Jackal, African Wildcat, Cape Fox, Rock Hyrax, South African Ground Squirrel, Steenbok, Springbok, Gemsbok, Cape Porcupine, Yellow Mongoose, Cape Hare, Aardvark, and Round-eared Elephant Shrew.

As the typical arid grasslands and shrublands of the site are widely available in the area, as well as at a broader scale, the impacts would be local in nature and it is not likely that the long-term viability of any populations of terrestrial mammals would be compromised by the

development. Three listed terrestrial mammals may occur at the site, the Honey Badger *Mellivora capensis* (Endangered), Brown Hyaena *Hyaena brunnea* (Near Threatened) and Black-footed cat *Felis nigripes* (Vulnerable). Although the area is used for livestock production, human activity in the area is low and it is possible that all three listed species occur in the area. Some habitat loss for mammals is an inevitable consequence of the development but is not likely to be of broader significance. 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.

Reptiles

According to the SARCA database, 40 reptile species are known from the area suggesting that the reptile diversity within the site is likely to be moderate to low. Species observed in the wider area include the Karoo Girdled Lizard *Karusasaurus polyzonus*, Western Rock Skink *Trachylepis sulcata sulcata* and the Namaqua Mountain Gecko *Pachydactylus montanus* which are associated with rocky outcrops, and Ground *Agama aculeata aculeata*, Plain Sand Lizard *Pedioplanis inornata* and the Spotted Sand Lizard *Pedioplanis lineoocellata,* which are fairly widespread on the plains. As there are no large rocky outcrops within the proposed development area, species associated with rocky habitats are not likely to occur in the area and would not be impacted by the development. As with mammals, the development is likely to result in some local habitat loss for reptiles but as there are not range-restricted reptiles which would occur in the affected area, the impacts are not likely to be of broader significance. The development would be likely to create some novel habitats for reptiles, which would potentially benefit a limited number of species which could take advantage of the novel habitats created within the development area. This is likely to be restricted to species such as geckos and agamas, which would utilise the buildings and other vertical infrastructure of the development. This would however be a very limited number of species and is not considered an overall positive outcome.

Amphibians

The site lies within the distribution range of 10 amphibian species. The only listed species which may occur in the area is the Giant Bullfrog *Pyxicephalus adspersus* which is listed as Near Threatened. This species is associated with ephemeral pans as there are no pans within the development area, this species would not be affected. Those amphibians which require perennial water are likely to be restricted to the vicinity of the Orange River and the plains of the site are likely to contain low amphibian diversity and are not likely to be highly significant from an amphibian perspective. As there are no natural perennial water sources at the site, it is likely that amphibian abundance is generally low and restricted largely to those species which are relatively independent of water such as the Karoo Toad *Vandijkophrynus gariepensis*. Overall, given the low likely abundance of amphibians at the site, impacts on amphibians are likely to be local in extent and of low significance.

3.6 SITE SENSITIVITY ASSESSMENT

The sensitivity map of the Tower 7 site illustrated below in Figure 5. The majority of the site consists of open plains considered to be medium-low sensitivity on account of the low abundance of species and habitats of concern within these areas. The main issue of concern within these areas is the abundance of *Boscia albitrunca* which has a moderately high density across the site. This species aside, the site is otherwise considered favourable for development as there are few other species or features of concern present. There is a limited area that receives some occasional runoff along the western margin of the site, but it has not developed into a drainage line and is considered only marginally more sensitive than the surrounding plains. The sensitivity of the site is very homogenous and overall it contains no significant features of higher sensitivity and there are no areas within the site that are considered no go or of very high sensitivity. Although there is a NFEPA river mapped through the site, the site visit confirms that this feature is not present on the ground and is not discernible on satellite imagery either.

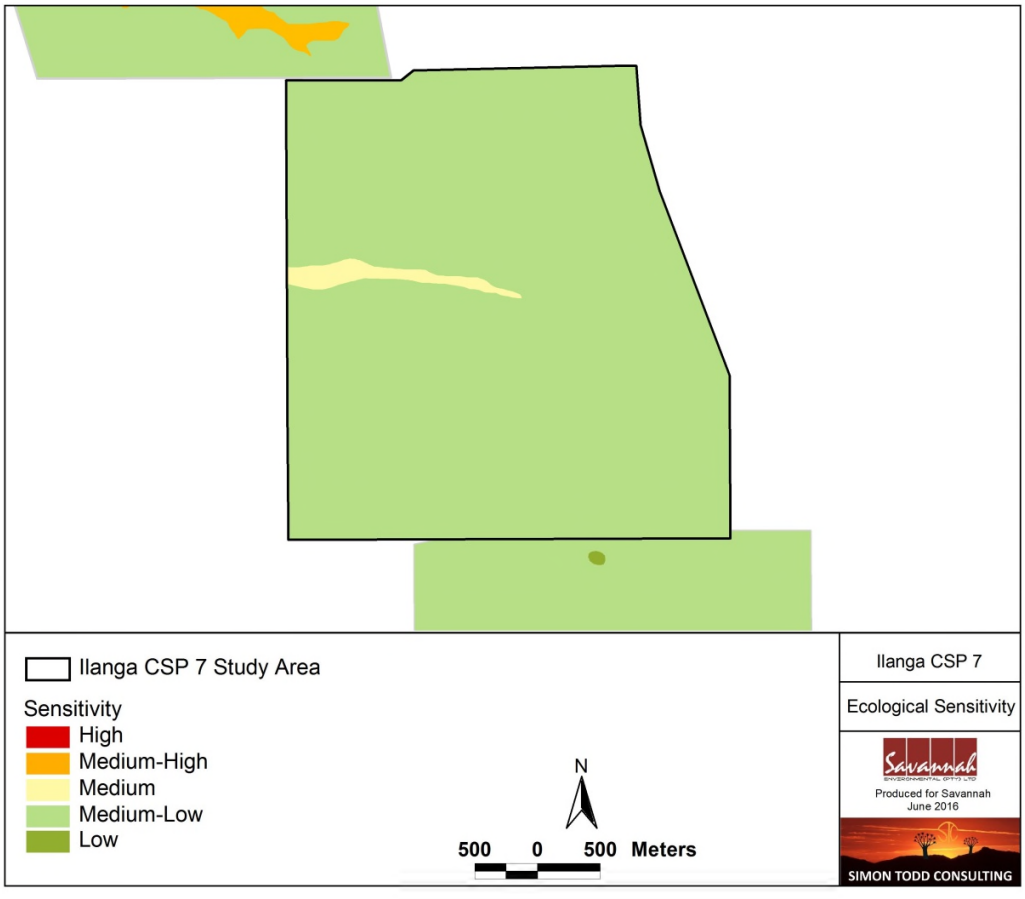

Figure 5. Ecological sensitivity map of the Tower 7 site, illustrating that the majority of the site is considered relatively low sensitivity.

4 IDENTIFICATION & NATURE OF IMPACTS

4.1 IDENTIFIED IMPACTS

The development of the Ilanga Tower 7 project is likely to result in a variety of impacts, associated largely with the disturbance, loss and transformation of intact vegetation and faunal habitat due to hard infrastructure. The site is however adjacent to and would be part of the larger Karoshoek development and as such, the impacts associated with the development would be lower than if the development was a stand-alone development within an area of no existing development. The contribution of the development to cumulative impacts is however potentially higher as a result of the presence of other approved developments in the immediate area. The following impacts are identified as the major impacts associated with the development and which are assessed for the preconstruction, construction and operational phases of the development.

Impacts on vegetation and protected plant species

Some loss of vegetation is an inevitable consequence of the development. The vegetation types within the affected area are however widespread and the loss of even a few thousand hectares of these vegetation types would be of relatively minor significance when considered at a broad scale. However, the potential impacts on protected plant species especially *Boscia albitrunca* is one of the main concerns with the development of the site.

Soil erosion and associated degradation of ecosystems

The large amount of disturbance created during construction will leave the site vulnerable to soil erosion. The large amount of hardened surface created by the development will generate significant amounts of runoff during occasional storm events and this will pose a potential erosion hazard to those areas receiving the runoff. As a result, the receiving areas would be vulnerable to erosion and regular monitoring to ensure that erosion problems are addressed would be required.

Increased Alien Plant Invasion Risk

The disturbance created during the construction phase of the project would leave the site highly vulnerable to invasion by alien plant species, which would impact diversity and ecological processes within the area. Alien species that were observed on site and which are likely increase in response to the disturbance include *Prosopis glandulosa*, *Salsola kali* and *Flaveria bidentis*.

Direct Faunal impacts

Construction and operational phase noise, pollution, disturbance and human presence will be detrimental to fauna. Sensitive and shy fauna would move away from the area as a result of the noise and human activities present, while some slow-moving species might not be able to avoid the construction activities and might be killed. Some mammals or reptiles such as tortoises 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. The development areas would also amount to habitat loss for most fauna, although there are some species which would potentially increase in the developed areas. Depending on how the development areas were fenced off, the fencing would probably also restrict animal movement and disrupt the connectivity of the landscape for fauna.

Impacts on Broad-Scale Ecological Processes and Loss of Landscape Connectivity

As there are several preferred bidder projects under development in the area as well as a number of approved renewable energy developments in the area, the development of the current site will contribute towards cumulative impacts, particularly the loss of landscape connectivity. The site is likely to be fenced and the cleared parts of the site are also likely to be hostile to many smaller fauna which will prevent or impede their movement across the landscape.

4.2 Assessment of Impacts

Planning & Construction Phase Impacts

Impact 1: Impacts on vegetation & protected plant species during construction

Impact Nature: Impacts on vegetation and protected plant species will occur due to vegetation clearing and disturbance associated with the construction of the facility.
There relatively large numbers of *Boscia albitrunca* within the development footprint that would be impacted. There are no highly sensitive habitat features present within the site and overall post-mitigation impacts are likely to be **Medium**.

	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Medium (5)	Medium (4)
Probability	Certain (5)	Probable (4)
Significance	**Medium (50)**	**Medium (36)**
Status	Negative	Negative
Reversibility	Low	Low

Irreplaceable loss of resources	No	No
Can impacts be mitigated?	Impacts on protected plant species can to some extent be mitigated through avoidance and translocation, but some impact on vegetation and habitat is inevitable and cannot be avoided.	
Mitigation	• Preconstruction walk-through of the facility in order to locate species of conservation concern that can be translocated prior to construction. • Vegetation clearing to commence only after walk through has been conducted and necessary permits obtained. • Preconstruction environmental induction for all construction staff on site to ensure that basic environmental principles are adhered to. This includes awareness as to no littering, appropriate handling of pollution and chemical spills, avoiding fire hazards, minimising wildlife interactions, remaining within demarcated construction areas etc. • ECO to provide supervision and oversight of vegetation clearing activities near sensitive areas. • Vegetation clearing to be kept to a minimum. No unnecessary vegetation to be cleared. • Construction activities are to be restricted to the development footprint. No disturbance of vegetation may occur outside of the demarcated development area. • All construction vehicles should adhere to clearly defined and demarcated roads. No off-road driving to be allowed. • Temporary lay-down areas should be located within the development footprint or within areas that have been identified as being of low sensitivity. These areas should be rehabilitated after use.	
Cumulative Impacts	The potential for cumulative impacts is high given the abundance of applications in the area. However, the affected vegetation type is very widespread and the direct loss of the vegetation type would not be highly significant. Therefore, cumulative impacts as a result of loss of vegetation are expected to be low. However, there are large numbers of protected tree species, especially *Boscia albitrunca* in the wider study area and within some of the other development sites within the Karoshoek area. Although the contribution of the current development to the loss of protected tree species would be relatively low, the cumulative impact in the area would be high should several of the developments become preferred bidders. In such a scenario, it is likely that DAFF would want to institute an offset to counter this impact. In this regard, the current development on its own is not sufficient to warrant an offset, but the total amount of development in the area is high and an offset seems likely to be required when several developments become preferred bidders.	

Residual Impacts	Some residual habitat loss will result from the development, equivalent to the operational footprint of the facility (1519ha).

Impact 2. Faunal Impacts During Construction.

Impact Nature: Disturbance, transformation and loss of habitat will have a negative effect on resident fauna during construction.

There are fauna resident within the site and these will be impacted during construction of the facility. However, faunal diversity and density within the site is low and post mitigation impacts are likely to be **Low** and of **Local** significance only.

	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	Medium (6)	Medium (4)
Probability	Highly Probable (4)	Highly Probable (4)
Significance	**Medium (36)**	**Low (28)**
Status	Negative	Negative
Reversibility	Medium	Medium
Irreplaceable loss of resources	No	No
Can impacts be mitigated?	Large amounts of noise and disturbance at the site during construction is largely unavoidable.	
Mitigation	• All personnel should undergo environmental induction with regards to fauna and in particular awareness about not harming or collecting species such as snakes, tortoises, and owls which are often persecuted out of superstition. • Any fauna threatened by the construction activities should be removed to safety by the ECO or appropriately qualified environmental officer. An appropriate permit must be obtained for the relocation of fauna. • Regular dust suppression during construction, especially along access roads which are used frequently. • All construction vehicles should adhere to a low speed limit to avoid collisions with susceptible species such as snakes and tortoises. • All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill.	
Cumulative Impacts	During the construction phase, the activity would contribute to cumulative fauna disturbance and disruption in the area, but the impact would be of local extent and not of high significance with mitigation.	

Residual Impacts	There will be some residual impact as the facility will persist past the construction phase.

Operational Phase Impacts

Impact 1. Increased alien plant invasion

Impact Nature: Alien plants are likely to invade the site as a result of the large amounts of disturbance created during operation.
Current levels of plant invasion at the site are moderate. Alien species such as *Prosopis* are already present and would potentially invade the site along with other typical weedy species such as *Salsola kali* and *Flaveria bidentis.*

	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Medium-term (3)
Magnitude	Medium (5)	Low (3)
Probability	Probable (4)	Improbable (3)
Significance	**Medium (40)**	**Low (21)**
Status	Negative	Negative
Reversibility	Moderate	High
Irreplaceable loss of resources	No	No
Can impacts be mitigated?	Yes	
Mitigation	• Due to the disturbance at the site as well as the increased runoff generated at the site, alien plant species are likely to be a long-term problem at the site and a long-term control plan will need to be implemented. • Rehabilitation of cleared areas with indigenous species after construction to reduce alien invasion potential. • Regular monitoring for alien plants within the development footprint. • Regular alien clearing should be conducted using the best-practice methods for the species concerned. The use of herbicides should be avoided as far as possible and should only be used for woody species which re-sprout following manual control.	
Cumulative Impacts	Alien invasion would contribute to cumulative habitat degradation in the area, but if alien species are controlled then cumulative impact from alien species would not be significant.	
Residual Impacts	If alien species at the site are controlled, then there will be very little residual impact.	

Impact 2. Direct Faunal Impacts During Operation.

Impact Nature: The operation and presence of the facility may lead to disturbance or persecution of fauna. It is likely that some fauna including Ground Squirrels, Yellow Mongoose and Gerbils are likely to increase or settle within the Tower 7 development area. These should be tolerated and allowed to move about the facility. In addition if the facility is to be fenced with electrical fencing, this should be on the inside and not the outside of the facility.		
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Medium (5)	Low (3)
Probability	Probable (3)	Probable (2)
Significance	**Medium (30)**	**Low (16)**
Status	Negative	Negative
Reversibility	Moderate	Moderate
Irreplaceable loss of resources	No	No
Can impacts be mitigated?	To some extent, but not that part related to the presence and operation of the facility.	
Mitigation	• No unauthorised persons should be allowed onto the site. • Undesirable and problem fauna such as snakes or fauna threatened by the maintenance and operational activities should be removed to a safe location. An appropriate permit must be obtained for the relocation of fauna. • The collection, hunting or harvesting of any plants or animals at the site should be strictly forbidden. • If parts of the site must be lit at night for security purposes, this should be done with low-UV type lights (such as most LEDs), which do not attract insects. • All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill. • All vehicles accessing or on the site should adhere to a low speed limit (40km/h max) to avoid collisions with susceptible species such as snakes and tortoises.	
Cumulative Impacts	The development would contribute towards habitat loss for fauna in the area as the development area would not be available to most fauna during operation. Although there are currently few preferred bidders in the immediate area, there are a number of active applications that would potentially contribute to cumulative habitat loss and disturbance in the area.	

	There is currently however still a large amount of intact habitat in the broader area which can be used by fauna and no highly significant impacts are therefore likely.
Residual Impacts	The facility will be operational for at least 20 years and impact sources such as disturbance will persist for the operational lifetime of the facility and cannot be mitigated, although many fauna would become habituated to these disturbance sources and this would operate only at a local level. The impact will be largely removed after decommissioning although some habitat degradation is likely to persist for some decades as it is not likely that the affected areas can be rehabilitated to their preconstruction state.

Impact 3. Impacts on Broad-Scale Ecological Processes and Loss of Landscape Connectivity

Impact Nature: As there are several other preferred bidders as well as authorised renewable energy developments in the area, the operation of the site will contribute towards the loss of landscape connectivity.
The facility will prevent fauna from moving through the area and decrease landscape connectivity at the site level. However, the surrounding landscape is still largely intact and the magnitude of impact would be moderate as a result although additional development will increasingly impact connectivity.

	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (2)
Duration	Long-term (4)	Long-term (4)
Magnitude	Medium (4)	Low (3)
Probability	Highly Probable (4)	Highly Probable (4)
Significance	**Medium (40)**	**Medium (36)**
Status	Negative	Negative
Reversibility	Moderate	Moderate
Irreplaceable loss of resources	No	No
Can impacts be mitigated?	Only partly as much of the impact stems from the presence and operation of the facility.	
Mitigation	• The development footprint should be kept to a minimum and natural vegetation should be encouraged to return to disturbed areas where possible. • An open space management plan should be developed for the site, which should include management of biodiversity within the fenced area, as well as that in the adjacent rangeland. • No fauna should be persecuted within the facility area and any problem animals should be humanely captured and released outside the facility area.	
Cumulative Impacts	The development will contribute to cumulative impact, but the contribution would be about 200ha which is not considered highly significant in context	

	of the largely intact surrounding landscape, but would add to the 1519ha associated with the approved 150MW facility. It is however also important to note that the development occurs within an area with a large number of other proposed developments, but at this point it is not possible to know which or how many of these would actually get built.
Residual Impacts	There will be some residual impact as it is the presence of the facility that generates the impact and this cannot be mitigated. However, after decommissioning the impact will be removed provided that the area is rehabilitated.

Impact 4. Reduced ability to meet conservation obligations & targets

Impact Nature: The loss of unprotected vegetation types on a cumulative basis from the broad area may impact the country's future ability to meet its conservation targets.
The Bushmanland Arid Grassland and Gordonia Duneveld vegetation types are extensive and the extent of habitat loss from the development would not significantly impact the remaining extent of this vegetation type. Even at a local scale, there are no features within or near the site that would be affected and which would be considered a conservation priority. Consequently the impact of the development on the future conservation potential of the area is considered **low**.

	Without Mitigation	**With Mitigation**
Extent	Regional (2)	Regional (2)
Duration	Long-term (2)	Long-term (2)
Magnitude	Medium (5)	Medium-Low (4)
Probability	Highly Probable (4)	Probable (3)
Significance	**Medium (36)**	**Low (27)**
Status	Negative	Negative
Reversibility	Moderate	Moderate
Irreplaceable loss of resources	No	No
Can impacts be mitigated?	Partly as the development will impact the site on a long-term basis and it is not likely that it can be fully rehabilitated.	
Mitigation	• The development footprint should be kept to a minimum and natural vegetation should be encouraged to return to disturbed areas as far as possible. • An open space management plan should be developed for the site, which should include management of biodiversity within the fenced area, as well as that in the adjacent rangeland.	
Cumulative Impacts	The development would contribute to cumulative habitat loss within the affected vegetation types. However, the Bushmanland Arid Grassland and Gordonia Duneveld are extensive vegetation types and cumulative impacts would be evident at a local level only. In addition, there are no sensitive	

	features within the development footprint that would be a high priority target for conservation.
Residual Impacts	The impact will last for as long as the facility is present and well after that as well because it is not likely that the full biodiversity value of the affected area can be fully restored after decommissioning.

Decommissioning & Closure

Impact 1. Faunal Impacts During Decommissioning

Impact Nature: Disturbance or persecution of fauna during the decommissioning phase may occur. The operation of heavy machinery and human presence at the site during decommissioning would impact fauna.		
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	Medium (4)	Low (2)
Probability	Probable (3)	Improbable (3)
Significance	**Low (21)**	**Low (15)**
Status	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources	No	No
Can impacts be mitigated?	Yes.	
Mitigation	• Site access to be controlled and no unauthorised persons should be allowed onto the site. • The collection, hunting or harvesting of any plants or animals at the site should be strictly forbidden. • Undesirable and problem fauna such as snakes or fauna threatened by the maintenance and operational activities should be removed to a safe location. An appropriate permit must be obtained for the relocation of fauna. • Any accidental chemical, fuel, and oil spills that occur at the site during decommissioning should be cleaned up in the appropriate manner as related to the nature of the spill. • No open excavations, holes or pits should be left at the site as fauna can fall in and become trapped. • All disturbed areas should be rehabilitated with a cover of indigenous grass.	
Cumulative Impacts	Cumulative impacts at the decommissioning phase are likely to be low.	

Residual Impacts	With avoidance measures there should be no residual impact on fauna.

Impact 2. Increased alien plant invasion following decommissioning

Impact Nature: Alien plants are likely to invade the site as a result of disturbance created during decommissioning.
This impact would be likely to persist from several years after decommissioning until such time as a cover of indigenous species has recovered. The area is however very arid and this limits which species would potentially invade the site.

	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Medium-term (3)
Magnitude	Medium (5)	Low (3)
Probability	Probable (3)	Improbable (3)
Significance	**Medium (30)**	**Low (21)**
Status	Negative	Negative
Reversibility	Moderate	High
Irreplaceable loss of resources	No	No
Can impacts be mitigated?	Yes	
Mitigation	• Due to the disturbance at the site during decommissioning, alien plant species are likely to invade the site and a long-term control plan will need to be implemented for several years after decommissioning • Regular monitoring (bi-annual) for alien plants within the development footprint for 2-3 years after decommissioning. • Regular alien clearing should be conducted using the best-practice methods for the species concerned. The use of herbicides should be avoided as far as possible. • Cleared and disturbed areas should be revegetated with a cover of indigenous grass or shrubs.	
Cumulative Impacts	Alien invasion would contribute to cumulative habitat degradation in the area, but if alien species are controlled then, then cumulative impacts from alien species would not be significant.	
Residual Impacts	If alien species at the site are controlled, then there will be very little residual impact	

Cumulative Impacts

Impact 1. Cumulative habitat loss and impacts on broad-scale ecological processes from solar development in the area

Impact Nature: The facility would contribute to cumulative habitat loss and broad-scale ecological processes in the area. There are a number of approved and planned facilities in the area and these will ultimately result in significant habitat loss in the area. However, currently, the location of these facilities is within lower sensitivity open plains and the important features of the area have not been significantly impacted to date. Due to the arid nature of the area, it is important that the mobility of fauna in the area is not impacted as many arid fauna respond to the unpredictability of these systems by moving extensively across the landscape. These impacts can be reduced by ensuring that fauna are still able to move about the landscape and are not impeded by extensive tracts of electrified fencing.		
	Cumulative Contribution of Proposed Project	**Cumulative Impact without Proposed Project**
Extent	Regional (2)	Regional (2)
Duration	Long-term (4)	Long-term (4)
Magnitude	Medium (4)	Low (3)
Probability	Probable (3)	Probable (3)
Significance	**Medium (30)**	**Low (27)**
Status	Negative	Negative
Reversibility	Moderate	Moderate
Irreplaceable loss of resources	No	No
Can impacts be mitigated?	Only partly as much of the impact stems from the presence and operation of the facility.	
Mitigation	• The development footprint should be kept to a minimum and natural vegetation should be encouraged to return to disturbed areas. • An open space management plan should be developed for the site, which should include management of biodiversity within the fenced area, as well as that in the adjacent rangeland. • No fauna should be persecuted within the facility area and any problem animals should be humanely captured and released outside the facility area. • It is important there are not extensive electrified fences in the area and each development should preferably be individually fenced so that fauna can pass between the different facilities.	

5 CONCLUSION & RECOMMENDATIONS

The Ilanga CSP Tower 7 site consists of open *Stipagrostis* grassland on flat open plains considered to be largely of low to moderate sensitivity. Within this habitat type there are few listed or protected plant species present and the significance of impacts on vegetation within

these areas would be low. The density of protected species, largely *Boscia albitrunca* is fairly high and a relatively large number would be affected by the development. Due to the homogenous nature of the habitat for fauna, faunal diversity is likely to be low and faunal species of concern are not likely to be abundant at the site. There are no features at the site considered to be very high sensitivity or present a no go area.

Due to the large amount of development proposed in the area, the development of the site will contribute to cumulative impact. However, the affected Bushmanland Arid Grassland vegetation type is extensive and the extent of habitat loss (ca. 1500ha) resulting from the development would not significantly impact the remaining extent of this vegetation type at the national level, although some local impact on this vegetation type is likely given the large extent of development within this vegetation unit within the broader Karoshoek solar development area. Consequently the impact of the development on the future conservation potential of the area is considered moderate at a local level and low at the national level.

There are no highly sensitive features within the development footprint and the abundance of *Boscia albitrunca* is identified as the only significant feature of the site. As the development of the site would certainly lead to the loss of several hundred individuals of this species, an offset for the loss within the current as well as the other Karoshoek developments should be investigated. However, this should take place in an integrated manner for all the Karoshoek developments and not on a piecemeal basis for each development and should consider the broader connectivity and landscape level processes in the area. Although the development would result in the loss of fairly large numbers of *Boscia*, this is not a rare or threatened tree species and the development would not compromise the local populations of this species which remains widespread in the area.

Overall, and with the suggested mitigation measures implemented, the impacts of the development are likely to be of moderate to low significance and no impacts of high significance are likely. As a result, there are no ecological fatal flaws or impacts that cannot be mitigated that should prevent the development from being approved.

6 ACTIVITIES FOR INCLUSION THE DRAFT EMP

An Environmental Management Programme (EMP) provides a link between the predicted impacts and mitigation measures recommended within the EIA and the implementation and operational activities of a project. As the construction and operation of the Ilanga Tower 7 Facility may impact the environment, activities which pose a threat should be managed and mitigated so that unnecessary or preventable environmental impacts do not result. The primary objective of the EMP is to detail actions required to address the impacts identified in the EIA during the establishment, operation and rehabilitation of the proposed infrastructure. The EMP provides an elaboration of how to implement the mitigation measures documented in the EIA. As such the purpose of the EMP can be outlined as follows:

- To outline mitigation measures and environmental specifications which are required to be implemented for the planning, establishment, rehabilitation and operation/maintenance phases of the project in order to minimise and manage the extent of environmental impacts.
- To ensure that the establishment and operation phases of the coal mining activities do not result in undue or reasonably avoidable adverse environmental impacts, and ensure that any potential environmental benefits are enhanced.
- To identify entities who will be responsible for the implementation of the measures and outline functions and responsibilities.
- To propose mechanisms for monitoring compliance, and preventing long-term or permanent environmental degradation.
- To facilitate appropriate and proactive response to unforeseen events or changes in project implementation that were not considered in the EIA process

In terms of this study, impacts on vegetation and fauna are of primary concern and the construction and operation of the plant may generate impact on vegetation and fauna through a number of different avenues including the following Direct, Indirect and Cumulative Impacts:

Direct impacts:

- Destruction or loss of protected or listed plant species;
- Direct impacts on fauna species including listed fauna;

Indirect Impacts:

- Ecological impacts around the facility due to erosion or alien plant invasion;

Cumulative Impacts:

- Impacts on surrounding habitat/ species due to environmental degradation resulting from erosion and alien plant invasion;

Below are the ecologically-orientated measures that should be implemented as part of the EMP for the development to reduce the significance or extent of the above impacts. The measures below do not exactly match with the impacts that have been identified, as certain mitigation measures, such as limiting the loss of vegetation may be effective at combating several different impacts, such as erosion, faunal impact etc.

6.1 CONSTRUCTION PHASE ACTIVITIES

Objective: Limit disturbance of vegetation and loss of protected flora during construction		
Project component/s	All infrastructure and activities which result in vegetation loss or clearing including: » Clearing and excavation for plant establishment; » Construction camps & other temporary infrastructure » Access roads.	
Potential Impact	Loss of plant cover leading to erosion as well as loss of faunal habitat and loss of specimens of protected plants.	
Activity/risk source	Vegetation clearing for the following » Clearing for plant establishment. » Access roads » Laydown areas » Construction Camps	
Mitigation: Target/Objective	» Low footprint and low impact on terrestrial environment. » Low impact on protected plant species	
Mitigation: Action/control	Responsibility	Timeframe
» Preconstruction walk-through of facility footprint and support structure positions and use micro-siting to reduce local impact where possible. » Obtain relevant permits from DAFF and DENC prior to any construction activities at the site. » Affected individuals of protected species which cannot be avoided should be translocated to a safe area on the site prior to	Management/ECO	Construction & Operation

construction. This does not include trees which cannot be translocated and where these are protected by DAFF and permit for their destruction would be required. » Erosion control measures should be implemented in areas where slopes have been disturbed. » Revegetation of cleared areas or monitoring to ensure that recovery is taking place » Alien plant clearing where necessary.		

Performance Indicator	» Vegetation loss restricted to infrastructure footprint. » Low impact on protected plant species. » Permit obtained to destroy or translocate affected individuals of protected species.
Monitoring	ECO to monitor construction to ensure that: » Vegetation is cleared only within essential areas. » Erosion risk is maintained at an acceptable level through flow regulation structures where appropriate and the maintenance of plant cover wherever possible.

Objective: Limit direct and indirect terrestrial faunal impacts during construction	
Project component/s	Construction activities especially the following: » Vegetation clearing » Human presence » Operation of heavy machinery
Potential Impact	Disturbance of faunal communities due to construction as well as poaching and hunting risk from construction staff.
Activity/risk source	» Habitat transformation during construction; » Presence of construction crews

	» Operation of heavy vehicles		
Mitigation: Target/Objective	Low faunal impact during construction.		
Mitigation: Action/control		Responsibility	Timeframe
» Environmental induction for all construction staff » ECO to monitor and enforce ban on hunting, collecting etc of all plants and animals or their products. » Any fauna encountered during construction should be removed to safety by the ECO or other suitably qualified person, » All vehicles to adhere to low speed limits (40km/h max) on the site, to reduce risk of faunal collisions as well as reduce dust. » All night-lighting should use low-UV type lights (such as most LEDs), which do not attract insects. The lights should also be of types which are directed downward and do not result in large amounts of light pollution.		Management/ECO	Construction
Performance Indicator	» Low mortality of fauna due to construction machinery and activities » No poaching etc of fauna by construction personnel during construction » Removal to safety of fauna encountered during construction		
Monitoring	Monitoring for compliance during the construction phase. All incidents to be noted.		

6.2 OPERATION PHASE ACTIVITIES

OBJECTIVE: Limit the ecological footprint of the Facility	
Project component/s	Presence and operation of the facility including • Movement of maintenance vehicles along the access and service roads

	• Vegetation management within the site • Faunal management within the facility

Potential Impact	» Alien plant invasion » Erosion » Pollution
Activity/risk source	» Alien plant invasion in and around the plant » Unregulated runoff from the facility area as well as access roads » Human presence during vegetation clearing or plant maintenance activities » Pollution from maintenance vehicles due to oil or fuel leaks etc » Maintenance activities which may lead to negative impacts such as pollution, herbicide drift etc.
Mitigation: Target/Objective	Low ecological footprint of the facility during operation

Mitigation: Action/control	Responsibility	Timeframe
Vegetation control should be by manual clearing and herbicides should not be used except to control alien plants in the prescribed manner	Management/Contractor	Operation
Annual monitoring for alien plant species - with follow up clearing	Management/Contractor	Operation
Annual site inspection for erosion or water flow regulation problems – with follow up remedial action where problems are identified	Management/Contractor	Operation

Performance Indicator	» No erosion problems within the facility or along access roads » Low abundance of alien plants within the site » Maintenance of a ground cover of perennial grasses and forbs that resist erosion.
Monitoring	• Annual monitoring with records of alien species presence and clearing actions • Annual monitoring with records of erosion problems and mitigation actions taken with photographs

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ANNEX 1. LIST OF PLANTS

List of plant species which have been recorded in the vicinity of the Karoshoek Solar Valley project site, based on the SANBI SIBIS database.

Family	Species	Family	Species
ACANTHACEAE	*Acanthopsis hoffmannseggiana*	ACANTHACEAE	*Barleria lichtensteiniana*
ACANTHACEAE	*Barleria rigida*	ACANTHACEAE	*Blepharis mitrata*
ACANTHACEAE	*Monechma desertorum*	ACANTHACEAE	*Monechma divaricatum*
ACANTHACEAE	*Monechma incanum*	ACANTHACEAE	*Monechma spartioides*
ACANTHACEAE	*Peristrophe cernua*	AIZOACEAE	*Aizoon asbestinum*
AIZOACEAE	*Aizoon schellenbergii*	AIZOACEAE	*Galenia africana*
AIZOACEAE	*Plinthus karooicus*	AIZOACEAE	*Trianthema parvifolia var. parvifolia*
AMARANTHACEAE	*Amaranthus praetermissus*	AMARANTHACEAE	*Amaranthus thunbergii*
AMARANTHACEAE	*Leucosphaera bainesii*	AMARANTHACEAE	*Sericocoma avolans*
APOCYNACEAE	*Adenium oleifolium*	APOCYNACEAE	*Brachystelma huttonii*
APOCYNACEAE	*Ceropegia sp.*	APOCYNACEAE	*Gomphocarpus tomentosus subsp. tomentosus*
APOCYNACEAE	*Huernia hystrix subsp. hystrix*	APOCYNACEAE	*Orbea variegata*
APOCYNACEAE	*Sarcostemma pearsonii*	ASPARAGACEAE	*Asparagus lignosus*
ASPHODELACEAE	*Aloe claviflora*	ASPHODELACEAE	*Aloe dichotoma*
ASTERACEAE	*Berkheya annectens*	ASTERACEAE	*Brachylaena ilicifolia*
ASTERACEAE	*Cineraria geraniifolia*	ASTERACEAE	*Cineraria saxifraga*
ASTERACEAE	*Cotula sericea*	ASTERACEAE	*Dicoma capensis*
ASTERACEAE	*Dimorphotheca cuneata*	ASTERACEAE	*Dimorphotheca sinuata*
ASTERACEAE	*Dimorphotheca zeyheri*	ASTERACEAE	*Eriocephalus microphyllus var. pubescens*
ASTERACEAE	*Euryops brachypodus*	ASTERACEAE	*Felicia echinata*
ASTERACEAE	*Felicia filifolia subsp. filifolia*	ASTERACEAE	*Felicia hyssopifolia subsp. hyssopifolia*
ASTERACEAE	*Felicia muricata subsp. cinerascens*	ASTERACEAE	*Felicia muricata subsp. muricata*
ASTERACEAE	*Felicia ovata*	ASTERACEAE	*Gazania leiopoda*
ASTERACEAE	*Geigeria ornativa*	ASTERACEAE	*Geigeria pectidea*
ASTERACEAE	*Gnaphalium capense*	ASTERACEAE	*Gnaphalium vestitum*
ASTERACEAE	*Gymnostephium ciliare*	ASTERACEAE	*Helichrysum sp.*
ASTERACEAE	*Ifloga sp.*	ASTERACEAE	*Kleinia longiflora*
ASTERACEAE	*Leysera tenella*	ASTERACEAE	*Matricaria sp.*
ASTERACEAE	*Metalasia pulcherrima forma pulcherrima*	ASTERACEAE	*Nidorella auriculata*
ASTERACEAE	*Nidorella sp.*	ASTERACEAE	*Osteospermum grandidentatum*
ASTERACEAE	*Osteospermum imbricatum*	ASTERACEAE	*Osteospermum junceum*
ASTERACEAE	*Othonna eriocarpa*	ASTERACEAE	*Pegolettia retrofracta*
ASTERACEAE	*Pentzia dentata*	ASTERACEAE	*Pentzia incana*
ASTERACEAE	*Pentzia pinnatisecta*	ASTERACEAE	*Pentzia spinescens*

Family	Species	Family	Species
ASTERACEAE	*Pteronia sordida*	ASTERACEAE	*Pteronia teretifolia*
ASTERACEAE	*Pteronia unguiculata*	ASTERACEAE	*Schistostephium crataegifolium*
ASTERACEAE	*Senecio asperulus*	ASTERACEAE	*Senecio erubescens var. erubescens*
ASTERACEAE	*Senecio hastatus*	ASTERACEAE	*Senecio juniperinus var. juniperinus*
ASTERACEAE	*Senecio macroglossus*	ASTERACEAE	*Senecio monticola*
ASTERACEAE	*Senecio othonniflorus*	ASTERACEAE	*Senecio puberulus*
ASTERACEAE	*Senecio retrorsus*	ASTERACEAE	*Senecio sp.*
ASTERACEAE	*Tarchonanthus camphoratus*	ASTERACEAE	*Tarchonanthus littoralis*
AYTONIACEAE	*Plagiochasma rupestre var. rupestre*	BIGNONIACEAE	*Rhigozum obovatum*
BIGNONIACEAE	*Rhigozum trichotomum*	BORAGINACEAE	*Ehretia rigida subsp. rigida*
BORAGINACEAE	*Heliotropium ciliatum*	BORAGINACEAE	*Lappula heteracantha*
BUDDLEJACEAE	*Buddleja saligna*	CAMPANULACEAE	*Wahlenbergia capillacea subsp. capillacea*
CAMPANULACEAE	*Wahlenbergia tenella var. tenella*	CAPPARACEAE	*Boscia foetida subsp. foetida*
CAPPARACEAE	*Cadaba aphylla*	CHENOPODIACEAE	*Salsola glabrescens*
CHENOPODIACEAE	*Salsola namibica*	CHENOPODIACEAE	*Salsola rabieana*
COLCHICACEAE	*Ornithoglossum viride*	CRASSULACEAE	*Cotyledon orbiculata var. orbiculata*
CRASSULACEAE	*Cotyledon woodii*	CUCURBITACEAE	*Coccinia rehmannii*
DIPSACACEAE	*Scabiosa angustiloba*	EBENACEAE	*Euclea undulata*
ERIOSPERMACEAE	*Eriospermum flagelliforme*	EUPHORBIACEAE	*Euphorbia avasmontana var. sagittaria*
EUPHORBIACEAE	*Euphorbia gariepina subsp. balsamea*	EUPHORBIACEAE	*Euphorbia glanduligera*
EUPHORBIACEAE	*Euphorbia inaequilatera var. inaequilatera*	EUPHORBIACEAE	*Euphorbia mauritanica var. mauritanica*
EUPHORBIACEAE	*Euphorbia rudis*	EUPHORBIACEAE	*Euphorbia spinea*
FABACEAE	*Acacia karroo*	FABACEAE	*Acacia mellifera subsp. detinens*
FABACEAE	*Amphithalea williamsonii*	FABACEAE	*Argyrolobium harveyanum*
FABACEAE	*Aspalathus subtingens*	FABACEAE	*Aspalathus tridentata subsp. staurantha*
FABACEAE	*Dipogon lignosus*	FABACEAE	*Indigastrum argyraeum*
FABACEAE	*Indigofera alternans var. alternans*	FABACEAE	*Indigofera angustata*
FABACEAE	*Indigofera auricoma*	FABACEAE	*Indigofera heterotricha*
FABACEAE	*Indigofera holubii*	FABACEAE	*Indigofera zeyheri*
FABACEAE	*Parkinsonia africana*	FABACEAE	*Pomaria lactea*
FABACEAE	*Prosopis glandulosa var. glandulosa*	FABACEAE	*Prosopis velutina*
FABACEAE	*Ptycholobium biflorum subsp. biflorum*	FABACEAE	*Tephrosia angulata*
FABACEAE	*Tephrosia capensis var. capensis*	FABACEAE	*Tephrosia dregeana var. dregeana*
FABACEAE	*Tephrosia grandiflora*	GERANIACEAE	*Monsonia burkeana*
GERANIACEAE	*Monsonia umbellata*	GERANIACEAE	*Pelargonium anethifolium*
GERANIACEAE	*Pelargonium inquinans*	GERANIACEAE	*Pelargonium reniforme subsp. reniforme*
GESNERIACEAE	*Streptocarpus sp.*	GISEKIACEAE	*Gisekia pharnacioides var. pharnacioides*
HYACINTHACEAE	*Albuca setosa*	HYACINTHACEAE	*Dipcadi ciliare*

Family	Species	Family	Species
HYACINTHACEAE	*Dipcadi viride*	HYACINTHACEAE	*Ledebouria undulata*
HYACINTHACEAE	*Ornithogalum tenuifolium subsp. tenuifolium*	IRIDACEAE	*Dierama pulcherrimum*
IRIDACEAE	*Tritonia strictifolia*	LOPHIOCARPACEAE	*Lophiocarpus polystachyus*
LORANTHACEAE	*Tapinanthus oleifolius*	MALPIGHIACEAE	*Triaspis hypericoides subsp. nelsonii*
MALVACEAE	*Hermannia abrotanoides*	MALVACEAE	*Hermannia flammea*
MALVACEAE	*Hermannia gracilis*	MALVACEAE	*Hermannia modesta*
MALVACEAE	*Hermannia mucronulata*	MALVACEAE	*Hermannia salviifolia var. grandistipula*
MALVACEAE	*Hermannia sp.*	MALVACEAE	*Hermannia spinosa*
MELIACEAE	*Nymania capensis*	MENISPERMACEAE	*Cissampelos capensis*
MESEMBRYANTHEMACEAE	*Lithops bromfieldii*	MESEMBRYANTHEMACEAE	*Psilocaulon coriarium*
MESEMBRYANTHEMACEAE	*Psilocaulon granulicaule*	MESEMBRYANTHEMACEAE	*Ruschia vulvaria*
MOLLUGINACEAE	*Limeum aethiopicum subsp. aethiopicum var. aethiopicum*	MOLLUGINACEAE	*Limeum myosotis var. confusum*
MOLLUGINACEAE	*Mollugo cerviana var. cerviana*	NEURADACEAE	*Grielum humifusum var. humifusum*
NYCTAGINACEAE	*Phaeoptilum spinosum*	OCHNACEAE	*Ochna arborea var. arborea*
OLEACEAE	*Olea capensis subsp. capensis*	ORCHIDACEAE	*Holothrix burchellii*
OROBANCHACEAE	*Hyobanche sanguinea*	OXALIDACEAE	*Oxalis bowiei*
OXALIDACEAE	*Oxalis imbricata var. violacea*	PASSIFLORACEAE	*Adenium repanda*
PEDALIACEAE	*Sesamum capense*	PHYLLANTHACEAE	*Phyllanthus incurvus*
PHYLLANTHACEAE	*Phyllanthus maderaspatensis*	PLANTAGINACEAE	*Plantago sp.*
POACEAE	*Anthephora pubescens*	POACEAE	*Aristida adscensionis*
POACEAE	*Aristida congesta subsp. barbicollis*	POACEAE	*Cenchrus ciliaris*
POACEAE	*Enneapogon desvauxii*	POACEAE	*Enneapogon scaber*
POACEAE	*Eragrostis annulata*	POACEAE	*Eragrostis biflora*
POACEAE	*Eragrostis echinochloidea*	POACEAE	*Eragrostis porosa*
POACEAE	*Eragrostis rotifer*	POACEAE	*Eragrostis sp.*
POACEAE	*Fingerhuthia africana*	POACEAE	*Panicum lanipes*
POACEAE	*Schmidtia kalahariensis*	POACEAE	*Setaria verticillata*
POACEAE	*Sporobolus nervosus*	POACEAE	*Stipagrostis anomala*
POACEAE	*Stipagrostis ciliata var. capensis*	POACEAE	*Stipagrostis obtusa*
POACEAE	*Stipagrostis uniplumis var. neesii*	POACEAE	*Stipagrostis uniplumis var. uniplumis*
POACEAE	*Tragus berteronianus*	POLYGALACEAE	*Polygala seminuda*
POLYGONACEAE	*Persicaria attenuata subsp. africana*	PORTULACACEAE	*Portulaca quadrifida*
PORTULACACEAE	*Talinum arnotii*	ROSACEAE	*Cliffortia linearifolia*
ROSACEAE	*Cliffortia serpyllifolia*	RUBIACEAE	*Kohautia caespitosa subsp. brachyloba*
RUBIACEAE	*Kohautia cynanchica*	RUBIACEAE	*Nenax microphylla*
RUBIACEAE	*Pavetta capensis subsp. capensis*	SANTALACEAE	*Thesium gnidiaceum var. gnidiaceum*
SCROPHULARIACEAE	*Aptosimum albomarginatum*	SCROPHULARIACEAE	*Aptosimum lineare var. lineare*
SCROPHULARIACEAE	*Aptosimum marlothii*	SCROPHULARIACEAE	*Aptosimum procumbens*
SCROPHULARIACEAE	*Aptosimum spinescens*	SCROPHULARIACEAE	*Jamesbrittenia atropurpurea subsp. pubescens*

Family	Species	Family	Species
SOLANACEAE	*Lycium oxycarpum*	SOLANACEAE	*Solanum capense*
SOLANACEAE	*Solanum nigrum*	THYMELAEACEAE	*Gnidia burchellii*
THYMELAEACEAE	*Gnidia nana*	THYMELAEACEAE	*Gnidia sp.*
THYMELAEACEAE	*Struthiola argentea*	VERBENACEAE	*Chascanum cuneifolium*
VERBENACEAE	*Chascanum incisum*	ZYGOPHYLLACEAE	*Tribulus terrestris*
ZYGOPHYLLACEAE	*Tribulus zeyheri subsp. zeyheri*	ZYGOPHYLLACEAE	*Zygophyllum dregeanum*
ZYGOPHYLLACEAE	*Zygophyllum flexuosum*	ZYGOPHYLLACEAE	*Zygophyllum lichtensteinianum*
ZYGOPHYLLACEAE	*Zygophyllum rigidum*		

ANNEX 2. LIST OF MAMMALS

List of mammals which are likely to occur in the vicinity of the Karoshoek Solar Valley. Habitat notes and distribution records are based on Skinner & Chimimba (2005), while conservation status is from the IUCN Red Lists 2012. Listed species are highlighted.

Scientific Name	Common Name	Status	Habitat	Likelihood
Macroscledidea (Elephant Shrews):				
Macroscelides proboscideus	Round-eared Elephant Shrew	LC	Species of open country, with preference for shrub bush and sparse grass cover, also occur on hard gravel plains with sparse boulders for shelter, and on loose sandy soil provided there is some bush cover	High
Elephantulus rupestris	Western Rock Elephant Shrew	LC	Rocky koppies, rocky outcrops or piles of boulders where these offer sufficient holes and crannies for refuge.	Low
Tubulentata:				
Orycteropus afer	Aardvark	LC	Wide habitat tolerance, being found in open woodland, scrub and grassland, especially associated with sandy soil	Definite
Hyracoidea (Hyraxes)				
Procavia capensis	Rock Hyrax	LC	Outcrops of rocks, especially granite formations and dolomite intrusions in the Karoo. Also erosion gullies	Definite
Lagomorpha (Hares and Rabbits):				
Lepus capensis	Cape Hare	LC	Dry, open regions, with palatable bush and grass	Definite
Lepus saxatilis	Scrub Hare	LC	Common in agriculturally developed areas, especially in crop-growing areas or in fallow lands where there is some bush development.	High
Rodentia (Rodents):				
Hystrix africaeaustralis	Cape Porcupine	LC	Catholic in habitat requirements.	Definite
Pedetes capensis	Springhare	LC	Occur widely on open sandy ground or sandy scrub, on overgrazed grassland, on the fringes of vleis and dry river beds.	High
Xerus inauris	South African Ground Squirrel	LC	Open terrain with a sparse bush cover and a hard substrate	Definite
Graphiurus ocularis	Spectacled Dormouse	LC	Associated with sandstones of Cape Fold mountains, which have many vertical and horizontal crevices.	Low
Rhabdomys pumilio	Four-striped Grass Mouse	LC	Essentially a grassland species, occurs in wide variety of habitats where there is good grass cover.	High
Mastomys coucha	Southern Multimammate Mouse	LC	Wide habitat tolerance.	High
Thallomys paedulcus	Acacia Tree Rat	LC	Associated with stands of Acacia woodland	Low
Thallomys nigricauda	Black-tailed Tree Rat	LC	Associated with stands of Acacia woodland	Low
Aethomys namaquensis	Namaqua Rock Mouse	LC	Catholic in their habitat requirements, but where there are rocky koppies, outcrops or boulder-strewn hillsides they use these preferentially	Definite
Parotomys brantsii	Brants' Whistling Rat	LC	Associated with a dry sandy substrate in more arid parts of the Nama-karoo and Succulent Karoo. Species selects areas of low percentage of plant cover and areas with deep sands.	High

Scientific Name	Common Name	Status	Habitat	Likelihood
Parotomys littledalei	Littledale's Whistling Rat	LC	Riverine associations or associated with Lycium bushes or Psilocaulon absimile	Low
Desmodillus auricularis	Cape Short-tailed Gerbil	LC	Tend to occur on hard ground, unlike other gerbil species, with some cover of grass or karroid bush	High
Gerbillurus paeba	Hairy-footed Gerbil	LC	Gerbils associated with Nama and Succulent Karoo preferring sandy soil or sandy alluvium with a grass, scrub or light woodland cover	High
Gerbilliscus leucogaster	Bushveld Gerbil	LC	Predominantly associated with light sandy soils or sandy alluvium	Low
Gerbilliscus brantsii	Higheld Gerbil	LC	Sandy soils or sandy alluvium with some cover of grass, scrub or open woodland	High
Saccostomus campestris	Pouched Mouse	LC	Catholic habitat requirements, commoner in areas where there is a sandy substrate.	High
Malacothrix typica	Gerbil Mouse	LC	Found predominantly in Nama and Succulent Karoo biomes, in areas with a mean annual rainfall of 150-500 mm.	High
Primates:				
Papio ursinus	Chacma Baboon	LC	Can exploit fynbos, montane grasslands, riverine courses in deserts, and simply need water and access to refuges.	Definite
Cercopithecus mitis	Vervet Monkey	LC	Most abundant in and near riparian vegetation of savannahs	Definite
Eulipotyphla (Shrews):				
Crocidura cyanea	Reddish-Grey Musk Shrew	LC	Occurs in relatively dry terrain, with a mean annual rainfall of less than 500 mm. Occur in karroid scrub and in fynbos often in association with rocks.	Low
Erinaceomorpha (Hedgehog)				
Atelerix frontalis	South African Hedgehog	LC	Generally found in semi-arid and subtemperate environments with ample ground cover	Moderate
Carnivora:				
Proteles cristata	Aardwolf	LC	Common in the 100-600mm rainfall range of country, Nama-Karoo, Succulent Karoo Grassland and Savanna biomes	Definite
Hyaena brunnea	Brown Hyaena	NT	Nama and Succulent Karoo and the drier parts of the Grassland and Savanna Biomes	Low
Caracal caracal	Caracal	LC	Caracals tolerate arid regions, occur in semi-desert and karroid conditions	High
Felis silvestris	African Wild Cat	LC	Wide habitat tolerance.	High
Felis nigripes	Black-footed cat	VU	Associated with arid country with MAR 100-500 mm, particularly areas with open habitat that provides some cover in the form of tall stands of grass or scrub.	High
Genetta genetta	Small-spotted genet	LC	Occur in open arid associations	High
Suricata suricatta	Meerkat	LC	Open arid country where substrate is hard and stony. Occur in Nama and Succulent Karoo but also fynbos	High
Cynictis penicillata	Yellow Mongoose	LC	Semi-arid country on a sandy substrate	Definite
Galerella sanguinea	Slender Mongoose	LC	Catholic habitat requirements but does not occur in the south.	Low

Scientific Name	Common Name	Status	Habitat	Likelihood
Herpestes pulverulentus	Cape Grey Mongoose	LC	Wide habitat tolerance	High
Atilax paludinosus	Marsh Mongoose	LC	Associated with well-watered terrain, living in close association with rivers, streams, marshes, etc.	Low
Vulpes chama	Cape Fox	LC	Associated with open country, open grassland, grassland with scattered thickets and coastal or semi-desert scrub	High
Canis mesomelas	Black-backed Jackal	LC	Wide habitat tolerance, more common in drier areas.	High
Otocyon megalotis	Bat-eared Fox	LC	Open country with mean annual rainfall of 100-600 mm	High
Aonyx capensis	African Clawless Otter	LC	Predominantly aquatic and do not occur far from permanenet water	Low
Ictonyx striatus	Striped Polecat	LC	Widely distributed throughout the sub-region	High
Mellivora capensis	Ratel/Honey Badger	IUCN LC/SA RDB EN	Catholic habitat requirements	High
Rumanantia (Antelope):				
Sylvicapra grimmia	Common Duiker	LC	Presence of bushes is essential	High
Raphicerus campestris	Steenbok	LC	Inhabits open country,	Definite
Chiroptera (Bats)				
Pipistrellus capensis	Cape Serotine Bat	LC	Wide habitat tolerances, but often found near open water	High
Tadarida aegyptiaca	Egyptian Free-tailed Bat	LC	In arid areas. often associated with water sources	High
Nycteris thebaica	Egyptian Slit-faced Bat	LC	Wide habitat tolerance	High
Rhinolophus denti	Dent's Horseshoe Bat	LC	Arid areas but require caves or rock crevices	High
Rhinolophus darlingi	Darling's Horsehoe Bat	LC	Savanna woodland species but requires caves	Low
Eidolon helvum	Straw-coloured fruit bat	LC	Occasional migratory visitors within southern Africa	Low

ANNEX 3. LIST OF REPTILES

List of reptiles which are likely to occur at vicinity of the Karoshoek Solar Valley. Habitat notes and distribution records are based on Branch (1988) and Alexander and Marais (2007), while conservation status is from the IUCN Red Lists 2012.

Scientific Name	Common Name	Distribution		Habitat	Likelihood
Tortoises and Terrapins:					
Psammobates oculiferus	Kalahari Tent Tortoise	Endemic	Data Deficient	Karoo and Kalahari shrublands	High
Snakes:					
Rhinotyphlops lalandei	Delalande's Beaked Blind Snake	Endemic	Data Deficient	Varied: semi-desert, coastal bush, fynbos & savannah	Low
Lamprophis capensis	Brown House Snake	Widespread	Data Deficient	Common in highveld grassland & arid karroid regions, but found everywhere & tolerant of urban sprawl	High
Lycophidion capense	Common Wolf Snake	Widespread	Data Deficient	Lowland forest and fynbos to moist savanna, grassland and karoo scrub	High
Pseudaspis cana	Mole Snake	Widespread	Data Deficient	Sandy scrubland in SW Cape, highveld grassland & mountainous & desert regions	High
Dipsina multimaculata	Dwarf Beaked Snake	Endemic	Data Deficient	Rocky, sandy areas. Cape karroid areas.	High
Psammophis notostictus	Karoo Sand or Whip Snake	Widespread	Data Deficient	Arid scrubland & karroid regions	High
Psammophis trinasalis	Kalahari Sand Snake	Widespread	Data Deficient	Mainly Kalahari thornveld but may also occur in savanna and grassland	High
Dasypeltis scabra	Common/Rhombic Egg Eater	Widespread	LC	Absent only from true desert & closed-canopy forest	High
Naja nivea	Cape Cobra	Widespread	Data Deficient	Arid karroid regions, particularly along river courses, entering well drained open areas along the southern coast	High
Bitis arietans	Puff Adder	Widespread	Data Deficient	Absent only from desert & mnt tops	High
Bitis caudalis	Horned Adder	Widespread	Data Deficient	Sandy regions, throughout Karoo	High
Worm Lizards					
Monopeltis infuscata	Dusky Spade-snouted Worm Lizard	Widespread	Data Deficient	Dry and moist savannah	High
Lizard and Skinks:					
Mabuya capensis	Cape Skink	Widespread	Data Deficient	Very varied: arid karroid veld, moist coastal bush, montane grassland, etc	High
Mabuya occidentalis	Western Three-Striped Skink	Widespread	Data Deficient	Arid Savanna karroid veld and desert	High
Mabuya spilogaster	Kalahari Tree Skink	Widespread		Arid Savannah	High
Mabuya sulcata	Western Rock Skink	Widespread	Data Deficient	Karroid areas	High

Scientific Name	Common Name	Distribution		Habitat	Likelihood
Mabuya striata	Striped Skink	Widespread	Data Deficient	Varied, except desert areas, succulent karoo and fynbos	High
Mabuya variegata	Variegated Skink	Widespread	Data Deficient	Extremely varied; desert, karroid veld, montane grassland, savanna, coastal bush & valley bushveld	High
Heliobolus lugubris	Bushveld Lizard	Widespread	Data Deficient	Arid and mesic savannah	High
Meroles suborbitalis	Spotted Desert Lizard	Endemic	Data Deficient	Varied, arid savanna to desert	High
Pedioplanis lineoocellata	Spotted Sand Lizard	Endemic	Data Deficient	Very varied: karroid veld, valley bushveld & arid & mesic savannah	High
Pedioplanis namaquensis	Namaqua Sand Lizard	Widespread	Data Deficient	Karroid veld	High
Gerrhosaurus flavigularis	Yellow-throated Plated Lizard	Widespread	Data Deficient	Montane grassland, savanna, bushveld and low open coastal forest	Low
Cordylus polyzonus	Karoo Girdled Lizard	Endemic	Data Deficient	Karroid regions, coastal renosterveld and succulent karoo	High
Varanus albigularis	Rock Monitor	Widespread	Data Deficient	Savanna and arid karroid areas	High
Varanus niloticus	Water Monitor	Widespread	Data Deficient	Rivers pans and major lakes	High
Agama aculeata	Ground Agama	Widespread	Data Deficient	Semi desert and savanna	High
Agama anchietae	Anchieta's Agama	Widespread	Data Deficient	Semi desert and arid savanna	High
Geckos:					
Chondrodactylus angulifer	Giant Ground Gecko	Endemic	LC	Gravel plains, interdune spaces & sandy flats	High
Chondrodactylus bibronii	Bibron's Tubercled Gecko	Endemic	Data Deficient	Rocky outcrops, cliffs and large trees	High
Pachydactylus capensis	Cape Thick-toed Gecko	Widespread	Data Deficient	Karroid veld, grassland and mesic savannah	High
Pachydactylus mariquensis	Marico Thick-toed Gecko	Endemic	Data Deficient	Flat sandy plains with sparse vegetation	High
Ptenopus garrulus	Common Barking Gecko	Endemic	Data Deficient	Desert and semi-desert on various soil types, preferring flat stable sandy soils with sparse vegetation cover	High

ANNEX 4. LIST OF AMPHIBIANS

List of amphibians which are likely to occur in the vicinity of the Karoshoek Solar Valley. Habitat notes and distribution records are based on Du Preez and Carruthers (2009), while conservation status is from the IUCN Red Lists 2012.

Scientific Name	Common Name	Status	Habitat	Distribution	Likelihood
Amietophrynus gutturalis	Guttural Toad	Not Threatened	Around open pools, dams, vleis and other semi-permanent or permanent water	Widespread	Low
Amietophrynus poweri	Western Olive Toad	Not Threatened	Around vleis and pans in thornveld savanna	Widespread	Low
Amietophrynus rangeri	Raucous Toad	Not Threatened	Rivers and stream in grassland and fynbos	Endemic	Low
Vandijkophrynus gariepensis	Karoo Toad	Not Threatened	Karoo Scrub	Widespread	High
Pyxicephalus adspersus	Giant Bullfrog	Near Threatened	Breed in shallow margins of rain-filled depressions.	Widespread	Low
Xenopus laevis	Common Platanna	Not Threatened	Any more or less permanent water	Widespread	High
Cacosternum boettgeri	Common Caco	Not Threatened	Marshy areas, vleis and shallow pans	Widespread	High
Amietia angolensis	Common River Frog	Not Threatened	Banks of slow-flowing streams or permanent bodies of water	Widespread	High
Tomopterna cryptotis	Tremelo Sand Frog	Not Threatened	Savanna and grassland	Widespread	High
Tomopterna tandyi	Tandy's Sand Frog	Not Threatened	Nama karoo grassland and savanna	Widespread	High