BASIC ASSESSMENT FOR THE ILANGA PV SOLAR 1 FACILITY AND ASSOCIATED INFRASTRUCTURE, UPINGTON, NORTHERN CAPE:

FAUNA & FLORA SPECIALIST BA REPORT

PRODUCED FOR SAVANNAH ENVIRONMENTAL

BY

3Foxes Biodiversity Solutions

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EXECUTIVE SUMMARY

Emvelo Capital Projects (Pty) Ltd, an independent power developer of solar power plants in South Africa proposes the development of Ilanga PV1, a 100MW photovoltaic (PV) solar energy facility and associated infrastructure on a site located 28km south-east of the town of Upington in the Northern Cape Province. As part of the required Basic Assessment, 3Foxes Biodiversity Solutions has been appointed to provide a specialist terrestrial biodiversity (including fauna and flora) impact assessment study of the development area as part of the BA process.

A field assessment as well as a desktop review of the available ecological information for the area was conducted in order to identify and characterise the ecological features of the site. The vegetation of the development area consists of Kalahari Karroid Shrubland with some Bushmanland Arid Grassland on deeper soils across the site. In terms of sensitive features, the vegetation of the development area is considered generally moderate to low sensitivity with few plant species of concern present. There is however a relatively high density of the protected tree species *Boscia albitrunca* within the development footprint and as many as 3000 individuals would be impacted. An offset analysis for this species should be conducted to investigate the need and quantum of an offset to account for the loss of individuals from the current and other proposed Ilanga PV facilities.

In terms of fauna, there are few species of conservation concern that are likely to be present or abundant at the site and the primary impact of the development on fauna would be some habitat loss for the more common resident species. As such, no high long-term post-mitigation impacts on fauna are expected to occur as a result of the development. Consequently, the impacts of the development on fauna and flora are considered acceptable and would be of low significance after mitigation.

Cumulative impacts within the broader study area are of potential concern due to the proliferation of solar energy development in the wider Upington area. As there are no features contributing significantly to maintaining ecological connectivity within the development footprint, the contribution of the proposed development to cumulative impacts on habitat loss and fragmentation in the area would be moderate and acceptable. In terms of habitat loss, the affected vegetation and habitat types are widespread in the area and have not experienced significant levels of transformation to date. As a result, the loss of approximately up to 330ha of currently intact habitat likely to result from the development is not considered highly significant. Cumulative impacts associated with the development are therefore considered acceptable.

Ilanga PV Impact Statement

The development area identified for the establishment of Ilanga PV is restricted largely to low and moderate sensitivity habitat typical of the Upington/Karoshoek area. The affected

area is considered largely suitable for development. Although there are no impacts associated with the establishment of Ilanga PV that cannot be mitigated to a medium or low significance, the impact of the development on the protected tree, *B. albitrunca* should be further investigated in terms of the potential for the establishment of an offset to counter the impact on this species. Although cumulative impacts in the area are a concern due to the high density of renewable energy developments in the Upington area, the proximity of Ilanga PV to the existing developments is seen as a positive aspect of the development and overall cumulative impacts associated with the Ilanga PV development are considered acceptable. In terms of the three grid alternatives, all three are considered acceptable and there are no significant ecological differences between them. As such, there are no fatal flaws or high post-mitigation impacts that should prevent the development from proceeding. Based on the layout provided for the assessment and assuming the implementation of an offset for *B. albitrunca*, the Ilanga PV 1 development can be supported from a terrestrial ecology point of view.

CONTENTS

COMPLIANCE WITH APPENDIX 6 OF THE EIA REGULATIONS, 2014 AS AMENDED

Requirements of Appendix 6 – GN R326 2014 EIA Regulations, 7 April 2017	**Addressed in the Specialist Report**
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	6
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	7
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1
(cA) an indication of the quality and age of base data used for the specialist report;	Section 2
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 3
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 2.3
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 2
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 3
g) an identification of any areas to be avoided, including buffers;	Section 3
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 3
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 2.3
j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 3
k) any mitigation measures for inclusion in the EMPr;	Section 7
l) any conditions for inclusion in the environmental authorisation;	Section 5
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 7
n) a reasoned opinion- i. whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 6
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	See Main Report
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	See Main Report
q) any other information requested by the competent authority.	
2) Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	N/A

SHORT CV/SUMMARY OF EXPERTISE – SIMON TODD

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Ecological Solutions for People & the Environment

Simon Todd is Director and principal scientist at 3Foxes Biodiversity Solutions and has over 20 years of experience in biodiversity measurement, management and assessment. He has provided specialist ecological input on more than 200 different developments distributed widely across the country. This includes input on the Wind and Solar SEA (REDZ) as well as the Eskom Grid Infrastructure (EGI) SEA and Karoo Shale Gas SEA. He is on the National Vegetation Map Committee as representative of the Nama and Succulent Karoo Biomes. Simon Todd is a recognised ecological expert and is a past chairman and current deputy chair of the Arid-Zone Ecology Forum. He is registered with the South African Council for Natural Scientific Professions (No. 400425/11).

A selection of recent work is as follows:

Strategic Environmental Assessments

Co-Author. Chapter 7 - Biodiversity & Ecosystems - Shale Gas SEA. CSIR 2016.
Co-Author. Chapter 1 Scenarios and Activities – Shale Gas SEA. CSIR 2016.
Co-Author – Ecological Chapter – Wind and Solar SEA. CSIR 2014.
Co-Author – Ecological Chapter – Eskom Grid Infrastructure SEA. CSIR 2015.
Contributor – Ecological & Conservation components to SKA SEA. CSIR 2017.

Recent Specialist Ecological Studies in the Vicinity of the Current Site

- Bloemsmond Solar 1 and Solar 2. Fauna and Flora EIA Process. Savannah Environmental 2015.
- Karoshoek CSP Development. Fauna and Flora EIA Process. Savannah Environmental 2016.
- Rooipunt 132kV Line, Upington. Fauna and Flora BA study. SiVest 2016.
- Dyason's Klip Solar PV Facility, Upington. Fauna and Flora EIA Process. Cape EAPrac 2015.
- RE Capital 11 Solar PV Facility, Upington. Fauna and Flora EIA Process. Cape EAPrac 2015.
- Joram Solar Plant, Upington. Fauna and Flora EIA Process. Cape EAPrac 2015.

- Adams PV Project – EIA process and follow-up vegetation survey. Aurora Power Solutions. 2016.
- Solis 2 CSP Facility, van Roois Vley, Upington. Flora EIA process. WSP. 2014.

SPECIALIST DECLARATION

I, ..Simon Todd....., as the appointed independent specialist, in terms of the 2014 EIA Regulations, hereby declare that I:

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

Signature of the specialist: _____

Name of Specialist: ____Simon Todd_____

Date: ____06 April 2020_____

1 INTRODUCTION

Emvelo Capital Projects (Pty) Ltd, an independent power developer of solar power plants in South Africa proposes the development of Ilanga PV1, a 100MW photovoltaic (PV) solar energy facility and associated infrastructure on a site located 28km south-east of the town of Upington in the Northern Cape Province. The project and associated infrastructure is proposed within Portion 3 of the farm Matjesrivier 41 and Lot 944 and will form part of the Upington Ilanga Solar Park located approximately 30 km east of Upington. The site falls within the jurisdiction of the Dawid Kruiper and the greater ZF Mgcawu District Municipality. The development area is located within Focus Area 7 of the Renewable Energy Development Zones (REDZ), which is known as the Upington REDZ. Due to the location of the study area and development area within a REDZ, a Basic Assessment (BA) process is required for the application of an environmental authorisation. Savannah Environmental is conducting the required BA process for the Ilanga PV 1 development and has appointed 3Foxes Biodiversity Solutions to provide a specialist terrestrial biodiversity (fauna and flora) impact assessment study of the proposed development as part of the BA process.

The purpose of the Ilanga PV 1 Terrestrial Biodiversity Basic Assessment Report is to describe and detail the ecological features of the proposed PV project site, provide an assessment of the ecological sensitivity of the affected area, and identify the likely impacts associated with the development of the proposed Ilanga PV facility. A field assessment as well as a desktop review of the available ecological information for the area were conducted in order to identify and characterise the ecological features of the site and the affected area. Impacts are assessed for the pre-construction, construction, operation, and decommissioning phases of the 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 Environmental Management Programme (EMPr) for the development. The full scope of study is detailed below.

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; and

- 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; and
    - the degree to which the impact can be mitigated.

- a description and comparative assessment of all 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 issue could be addressed by the adoption of mitigation measures;
- a description of any assumptions uncertainties and gaps in knowledge; and
- 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; and
    - 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 Programme (EMPr) 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:

- Pre-construction
- Construction
- Operational Phase
- Decommissioning

1.1 ASSESSMENT APPROACH & PHILOSOPHY

This assessment is conducted according to the EIA Regulations, 2014 (Government Notice Regulation 326) as well as Notice 320 (2020), procedures for the assessment and minimum criteria for reporting on identified environmental themes published in terms of the National Environmental Management Act (Act 107 of 1998), as amended (NEMA). 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 included data searches, desktop studies, site walkovers / field survey of the affected properties and baseline data collection, describing:

- 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 (RDB) 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 (EMPr) 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 within the development area or within 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 BA 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.

1.2 RELEVANT ASPECTS OF THE DEVELOPMENT

The proposed project will have a contracted capacity of up to 100MW, and will make use of PV solar technology for the generation of electricity. The project will comprise the following key infrastructure and components:

- Solar PV panels with a maximum height of 2.2m utilising Single axis tracking; Fixed axis tracking; Dual axis tracking or Fixed Tilt mounting structures.
- On-site inverter (step up facility) to convert power from Direct Current (DC) to an Alternative (AC) and step up the electricity current from 33kV to 132kV that will connect to the on-site substation at the authorised site with underground cables to connect to the on-site substations at authorised site 1.4 and authorised grid connection (DEA Ref:. 14/12/16/3/3/2/299) to the Ilanga substation for PV facilities located at site 1.
- A step-up facility (inverter) to step up the electricity current from 33kV to 132kV.
- A temporary laydown area.
- Cabling between the panels, to be laid underground where practical.
- An access road to the development area no more than 6m wide.
- Internal access roads within the PV panel array area with a maximum width of 4m.
- Perimeter security fencing around the development area.
- Operation and Maintenance buildings including a gate house and security building, control centre, offices, warehouses, a workshop and visitors centre.

The electricity current from the Upilanga PV1 PV facility will be converted and evacuated via an inverter and with the aid of underground cables connect to the authorised Ilanga CSP site 1.4 on-site substation (DEA Ref:. 14/12/16/3/3/2/299). The onsite substation at Site 1.4 will connect to the existing Ilanga substation which ultimately feeds into the national grid via the following possible alternatives that were assessed in this report:

1. On-site inverter (step up facility) to convert power from Direct Current (DC) to an Alternative (AC) and step up the electricity current from 33kV to 132kV that will connect via underground cables to the on-site substations at authorised site 1.3. The electricity will be evacuated via the authorised grid connection (DEA Ref: 14/12/16/3/3/2/294) to the existing Ilanga substation.
2. An onsite 11kV/22kV/33kV collector substation to receive, convert and step up electricity from the PV facility directly to the existing 132kV Ilanga Substation via underground cables (The on-site collector substation at authorised site 1.3 connects to the Ilanga substation)
3. Loop in and loop out the 132kV lines connecting existing Ilanga Substation to Gordonia Substation

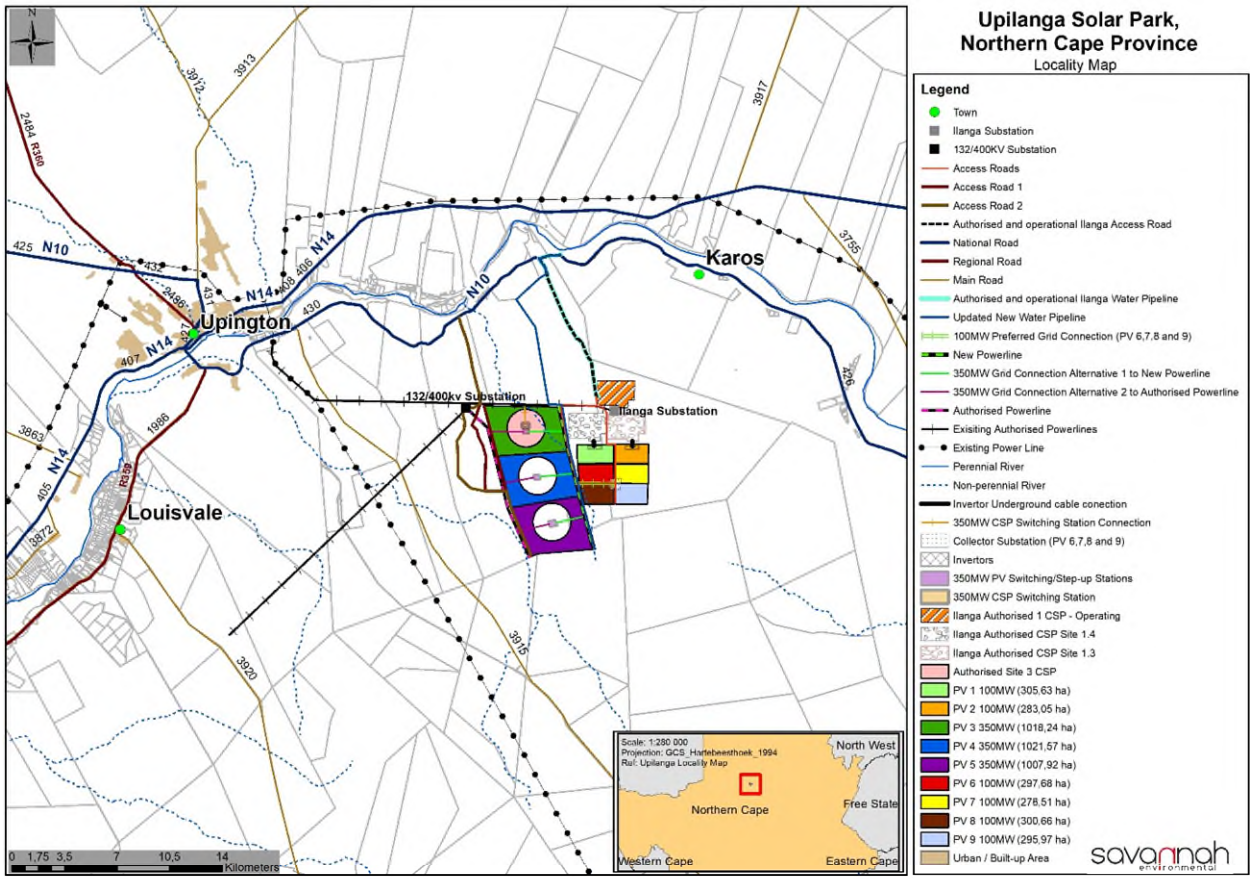

Figure 1. Layout of the Ilanga Solar Park, showing the relative location of Ilanga PV 1, illustrating the study area and the Ilanga PV 1 development area in light green.

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 & Rutherford 2006 and 2016 update) as well as the National List of Threatened Ecosystems (2011), where relevant.
- Information on plant species recorded for the broad area around the site was extracted from the SANBI POSA database hosted by the South African Biodiversity Institute (SANBI). The species list was derived from a considerably

larger area than the study site, but this is necessary to ensure a conservative approach as well as counter the fact that the site itself or the immediate area has not been well sampled in the past.

- The International Union for Conservation of Nature (IUCN) conservation status 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 (2020).

Ecosystem

- Critical Biodiversity Areas (CBAs) were extracted from the Northern Cape Critical Biodiversity Areas Map (Oosthuysen & Holness 2016).
- Freshwater and wetland information was extracted from the National Freshwater Ecosystem Priority Areas (NFEPA) Assessment (Nel *et al*., 2011).
- Important catchments and protected areas expansion areas were extracted from the National Protected Areas Expansion Strategy (NPAES), 2008.

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 Animal Demography Unit (ADU) Virtual Museum spatial database (http://vmus.adu.org.za/).
- Literature consulted includes Branch (1988) and Alexander and Marais (2007) for reptiles, Du Preez and Carruthers (2009) for amphibians, Friedmann and Daly (2004) and Skinner and Chimimba (2005) for mammals.
- Apart from the literature sources, additional information on fauna was extracted from the ADU web portal http://vmus.adu.org.za.
- 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 mammals is based on the IUCN Red List Categories (EWT/SANBI 2016), while reptiles are based on the South African Reptile Conservation Assessment (Bates *et al*., 2013) and amphibians on Minter *et al* (2004) as well as the IUCN (2018).

2.2 SENSITIVITY MAPPING & ASSESSMENT

An ecological sensitivity map of the development area was produced by integrating the available ecological and biodiversity information available in the literature and various spatial databases with mapping based on the satellite imagery and personal knowledge of the area. This includes delineating different habitat units identified on the satellite imagery and assigning likely 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 developments 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 the 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.

2.3 SAMPLING LIMITATIONS AND ASSUMPTIONS

The study is based on a field assessment conducted on the 15th of April 2016 as well as a previous field assessment from the 26-28th April 2012. No additional field assessment was conducted for the current study as the development falls within areas previously assessed. As both site visits took place during the late wet season, conditions during the field assessments were good and considered acceptable for the field assessment. As such, the field assessment is considered to provide a reliable indication of the sensitivity of the development area, without major limitations.

In terms of the fauna present within the development area, several steps were taken to reduce the uncertainty associated with the assessment of the faunal communities present. Apart from the active searches that were conducted for reptiles and amphibians during the site visit, additional species presence is inferred based on the numerous previous studies the consultant has conducted in the immediate area. In order to further ensure a conservative approach, the species lists derived for the development area from the literature were obtained from an area significantly larger than the study area and are likely to include a much wider array of species than actually occur within the development area and the site as a whole. This is a cautious and conservative approach which takes the study limitations into account.

3 DESCRIPTION OF THE AFFECTED ENVIRONMENT- BASELINE

3.1 SITE VEGETATION DESCRIPTION

According to the National Vegetation Map (Mucina & Rutherford 2006 and 2018 update), there are several vegetation types within the broader study area including Bushmanland Arid Grassland, Gordonia Duneveld, Kalahari Karroid Shrubland and Lower Gariep Broken Veld (Figure 2). However, the Ilanga PV 1 footprint is restricted to the Bushmanland Arid Grassland vegetation type.

The Bushmanland Arid Grassland vegetation type is an extensive vegetation type and is the second most extensive vegetation type in South Africa, occupying an area of 45 478 km^2. It extends from the study area 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 to 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 and Rutherford (2006) list 6 endemic species for the vegetation type, which is a relatively low number given the extensive nature of the vegetation type.

In reality, the Vegmap provides a relatively coarse representation of the vegetation of the site and it is clear that there are areas with stony soils within the site that are representative of Kalahari Karroid Shrubland. Although it has not been mapped as such, in the study area, Kalahari Karroid Shrubland and Bushmanland Arid Grassland form a mosaic across the area reflecting substrate conditions especially soil depth and texture. Areas of deeper sands are dominated by grasses typical of Bushmanland Arid Grassland while areas of shallow soils with exposed calcrete or quartzite are dominated by shrubby vegetation typical of Kalahari Karroid Shrubland.

The vegetation on the deeper red sands of the site represent typical Bushmanland Arid Grassland. Common and dominant species include the grasses *Stipagrostis ciliata*, S.obtusa, *S.uniplumis* and *S.amabilis* and shrubs such as *Rhigozum trichotomum*, *Phaeoptilum spinosum*, *Monechma incanum* and *Monechma genistifolium*. Species of conservation concern were not abundant in this habitat and it is considered to be of a low sensitivity. Protected species which occur in this habitat type include *Boscia foetida* and occasional *Acacia erioloba*. Numbers of these species are however low and the local populations of these species would be not be compromised. This habitat type is illustrated below in Figure 4.

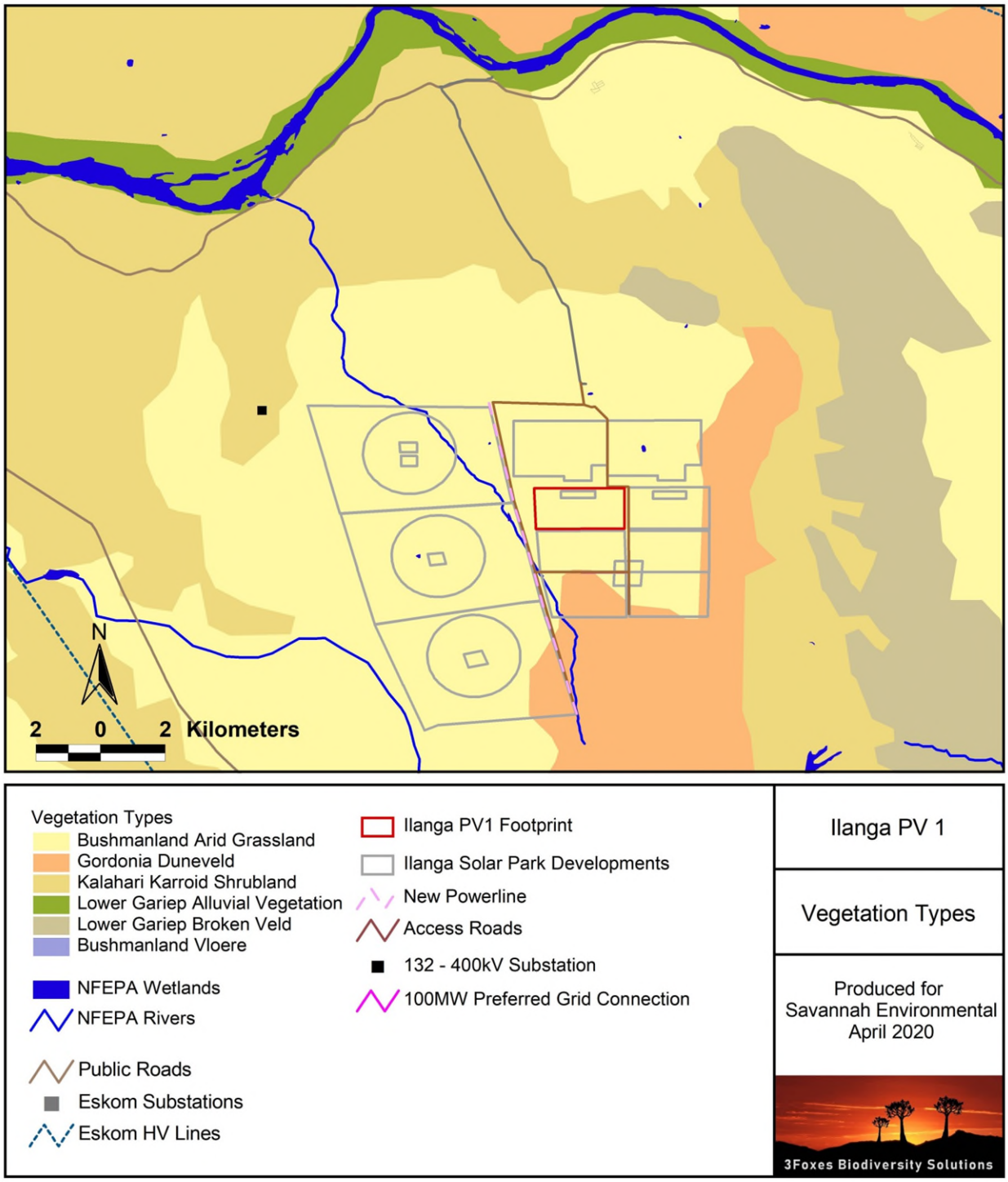

Figure 2. Broad-scale overview of the vegetation in and around the Ilanga PV development area. The vegetation map is an extract of the National Vegetation Map (Mucina & Rutherford 2006 & 2016 update), and also includes drainage lines delineated by the NFEPA Assessment (Nel *et al*., 2011).

Species observed within the areas of Kalahari Karroid Shrubland include shrubs such as *Leucosphaera bainesii*, *Hermannia spinosa*, *Monoechma genistifoilium*, *Salsola rabieana*, *Aptosimum albomarginatum*, *A.spinecens*, *Kleinia longiflora*, *Limeum argute-carinatum*, *Phyllanthus maderaspatensis*, *Zygophyllum dregeanum* and grasses such as *Stipagrostis anomala*, *S.ciliata*, *S.uniplumis*, *S.hochstetteriana* and *Schmidtia kalariensis*. The proportion of shrubs in this vegetation type is usually related to soil depth and texture, with the proportion of grass increasing as the soils become deeper or more sandy. Species of conservation concern that may be present include *Adenium oleifolium*, *Aloe claviflora* and *Hoodia gordonii*, although none of these species were observed within the development area. The typical state of this vegetation type is illustrated below in Figure 3.

Figure 3. The vegetation on the more stony parts of the site represents Kalahari Karroid Shrubland and is considered to be of low to moderate sensitivity.

Figure 4. Typical vegetation on more sandy soils within the Ilanga PV development footprint, with *Rhigozum trichotomum* prominent in the foreground with a dense grass layer dominated by various *Stipagrostis* species, mostly *S.ciliata* and *S.uniplumis*.

Although there are no well-developed drainage lines within the footprint, there are some wash areas where runoff water collects during larger showers and which are characterised by taller more dense vegetation. Typical and common species in these areas include the large shrubs *Phaeoptilum spinosum*, *Rhigozum trichotomum*, *Monechma incanum* and *Lycium oxycarpum* with occasional *Boscia foetida* and *Boscia albitrunca* Grasses in these areas include *Cenchus ciliaris* and *Stipagrostis namaquensis*. Typically, there are no large trees in the washes although *Vachellia erioloba* may occasionally be present.

Figure 5. The lower-lying parts of the site consist of broad sand-filled basins between the low quartzite hills of the site. The low shrubs are largely *Rhigozum trichotomum* while the trees in the middle ground are *Boscia albitrunca*.

The current veld condition of the development area can be considered to be fair and while there are some areas that have clearly suffered some degradation in the past, the vegetation cover and composition can be considered typical for the study area. There are some localised areas of *Prosopis* invasion, usually around watering points, but in general there are few alien species present across most of the development area and it can be considered to be largely intact and in moderate

3.2 Listed and Protected Plant Species

Two National Forest Act (Act No. 84 of 1998) of 1998 (NFA) protected tree species occur at the site; *Vachellia* (*Acacia) erioloba* and *Boscia albitrunca*. Both of these species are associated mostly with the larger drainage lines and deeper soils of the area. Within the Ilanga PV 1 footprint, *Boscia albitrunca* is relatively common and the density of this species at the site is estimated at 10 trees/ha with the result that the development would result in the loss of approximately 3000 individuals of this species. This far exceeds the guideline amount of trees that DEFF finds acceptable for loss without an offset. As such, it is clear that DEFF are highly likely to object to the development on these grounds and will require some sort of offset. The nature of this offset is not clear, but could involve formally protecting some nearby land with similar numbers of trees or encouraging the developer to

provide urban greening in a local township. The developer has indicated that the remainder of the Ilanga site, that part which does not fall within one of the proposed solar development areas, could be used to provide an offset for the cumulative impact of development on protected tree species. This would amount to a potentially acceptable offset solution, but a specific study to address the offset calculation and whether this could be met by the proposed offset area would need to be conducted. In terms of evaluating the actual ecological impact of the loss these trees, it is important to note that the loss of these individuals from the site would generate a local impact, but would not compromise the wider *Boscia* population in the Upington area which is orders of magnitude larger.

Although there are quartz patches in the area which are home to several local endemics or specialised species such as *Lithops*, no quartz patches home to such species were observed within the development area.

3.3 FAUNAL COMMUNITIES

Mammals

The site falls within the distribution range of 46 terrestrial mammals, indicating that the mammalian diversity of the area is of a moderate potential. The variety of habitats present at the site is however fairly low and the overall mammalian diversity at the site is likely to be lower than the richness of the study area. The lack of rocky hills or outcrops within the development area would preclude a variety of species from the affected area. Mammal species that can be confirmed present based on observations or are known from adjacent sites in the immediate area include, the Black-backed Jackal, African Wildcat, Cape Fox, South African Ground Squirrel, Springhare, Steenbok, Duiker, Springbok, Gemsbok, Cape Porcupine, Yellow Mongoose, Slender Mongoose, Cape Hare and Aardvark. Species such as Cape Clawless Otter and Water Mongoose may also occasionally be present in the rainy season when they apparently make forays from the Orange River to visit some of the larger pans of the area. For such species, the drainage lines represent important movement corridors.

Two listed terrestrial mammals may occur at the site, these include, the Brown Hyaena *Hyaena brunnea* (Near Threatened) and Black-footed cat *Felis nigripes* (Vulnerable). While it is possible that both species occur at the , it is least likely that the Brown Hyaena *Hyaena brunnea* is present as this species is often purposely or inadvertently persecuted within farming areas. As these two species have a wide national distribution, the development of Ilanga PV 1 would not create a significant extent of habitat loss for these species.

Overall, there are no significant issues regarding mammals and the development of Ilanga PV 1. In general, the major impact associated with the development of Ilanga PV 1 for mammals would be habitat loss and the disruption of the broad-scale connectivity of the landscape. Due to the large number of renewable energy developments in the area, the

cumulative impacts on landscape connectivity are a potential concern that is addressed in greater detail in the specific section dealing with cumulative impacts.

Reptiles

According to the Southern African Reptile Conservation Assessment (SARCA) database, 39 reptile species are known from the broader study area suggesting that the reptile diversity within the site is likely to be moderate to low. As there are no significant rocky outcrops within the development area, only species associated with sandy substrates or trees are likely to be present. Species observed within the development area or in the vicinity include the Namaqua Mountain Gecko *Pachydactylus montanus*, Ground Agama *Agama aculeata aculeata*, Spotted Sand Lizard *Pedioplanis lineoocellata* and the Spotted Desert Lizard *Meroles suborbitalis*. No reptile species of conservation concern are known from the area and there do not appear to be any broad habitats at the site which would be of high significance for reptiles. As with mammals, the development of Ilanga PV 1 is likely to result in local habitat loss for reptiles but as there are no listed or range-restricted reptiles that are likely to occur within the development area, the impacts are not likely to be of broader significance.

Amphibians

The site lies within the distribution range of 10 amphibian species. The only listed species which may occur at the site is the Giant Bullfrog *Pyxicephalus adspersus* which is listed as Near Threatened. No suitable breeding sites were observed in or near the development area and it is not likely that this species is present or would be affected by the development of Ilanga PV 1. As there are no natural perennial water sources within the development area, it is likely that amphibian abundance is generally low and restricted largely to those species that are relatively independent of water such as the Karoo Toad *Vandijkophrynus gariepensis*. Overall, given the low likely abundance of amphibians within the area, impacts on amphibians are likely to be localised and of a low significance.

3.4 CRITICAL BIODIVERSITY AREAS & BROAD-SCALE PROCESSES

An extract of the Northern Cape Critical Biodiversity Areas Map for the study area is depicted below in Figure 6. The site lies within an area classified as “Other natural areas” and has not been classified as a Critical Biodiversity Area (CBA) or an Ecological Support Area (ESA). Although there is a CBA in close proximity to the development area, this is not within the development footprint indicating that the establishment of Ilanga PV 1 does not pose a threat to any CBAs or other areas considered to be of significance from a broad-scale conservation planning perspective. Furthermore, the site does not lie within an area identified as a priority area for future conservation expansion under the Northern Cape Protected Area Expansion Strategy.

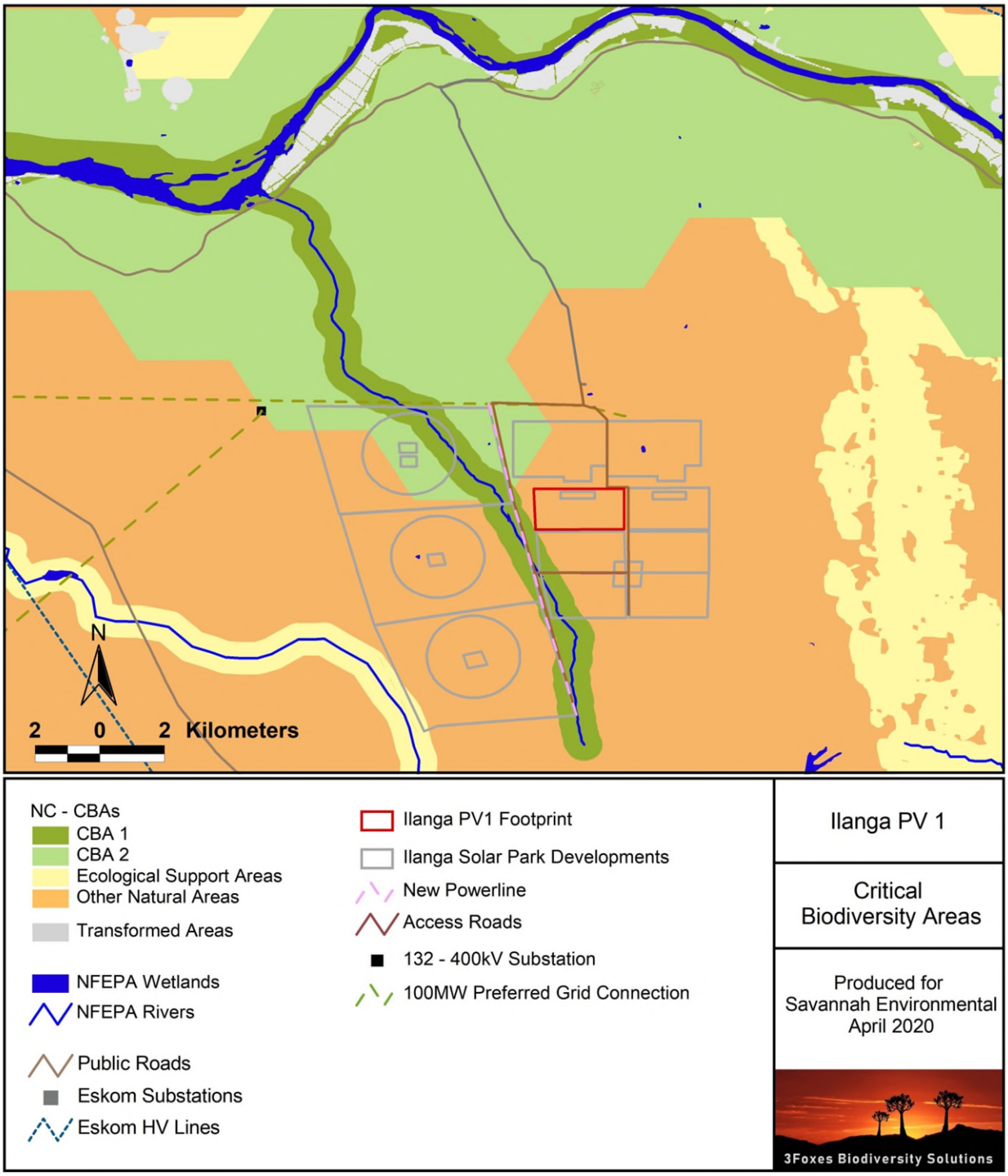

Figure 6. Extract of the Northern Cape Critical Biodiversity Areas Map for the broader study area, showing that there are no CBAs within the development area identified for the establishment of Ilanga PV 1.

3.5 CURRENT BASELINE & CUMULATIVE IMPACT

There is a large amount of renewable energy development in the Upington area. This is concentrated in two main areas, west of Upington along the N14 and then southeast of Upington in the Karoshoek area (Figure 7). The Ilanga PV 1 project would potentially contribute approximately up to 330ha of additional habitat loss and fragmentation to the area. On the one hand, concentrating development within certain areas can be seen as positive, as it reduces the overall level of fragmentation, but on the other hand, local impacts (such as on protected trees) may increase. Which is ultimately preferable in terms of reducing fragmentation versus increased local impacts is context dependent. In the current case, the addition of several solar PV development areas adjacent to the existing Ilanga CSP 1 facility is seen as preferable to development further away from the existing concentration of existing and proposed development. However, in order to ensure the long-term maintenance of ecological processes in the broader study area, it is important that ecological connectivity between the Orange River and the areas south of the river is maintained. In the long-term specific corridors free from development should be identified and kept free from major development.

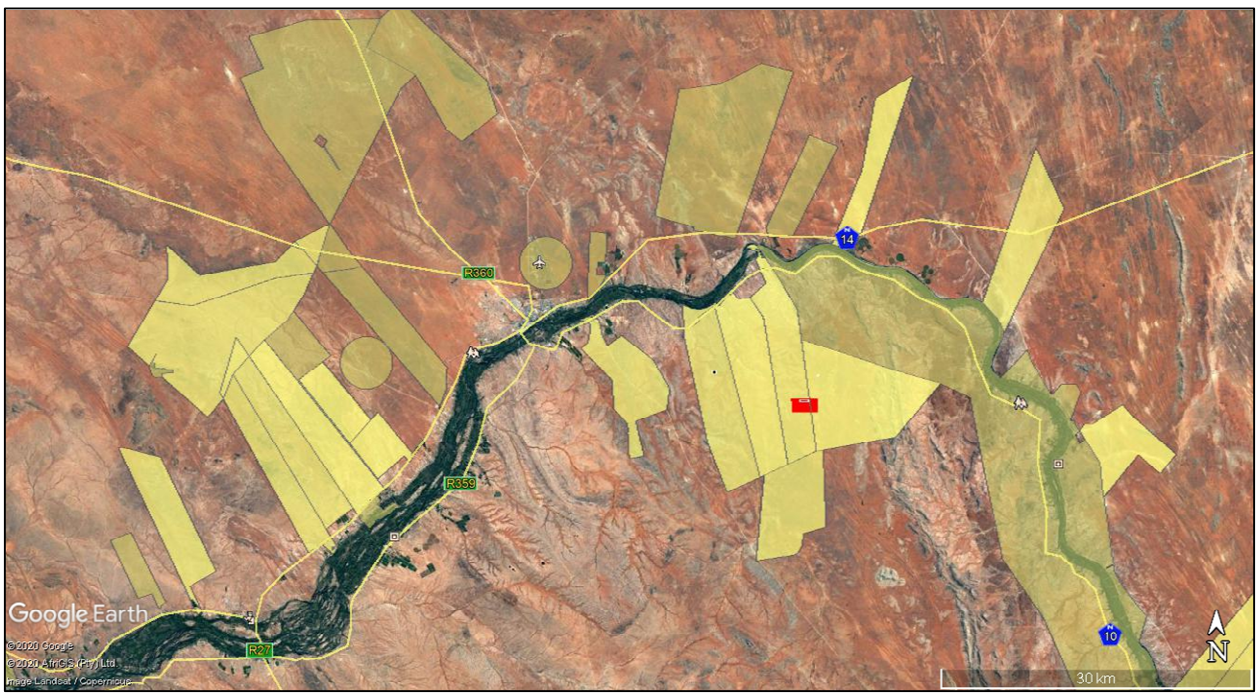

Figure 7. Map of the Department of Environment, Forestry and Fisheries (DEFF) of registered and/or approved renewable energy applications as at Q2 2019, showing the Ilanga PV development area in orange. Note that in the majority of cases, the map indicates the whole property boundary and not the actual extent of the development footprint.

3.6 SITE SENSITIVITY ASSESSMENT

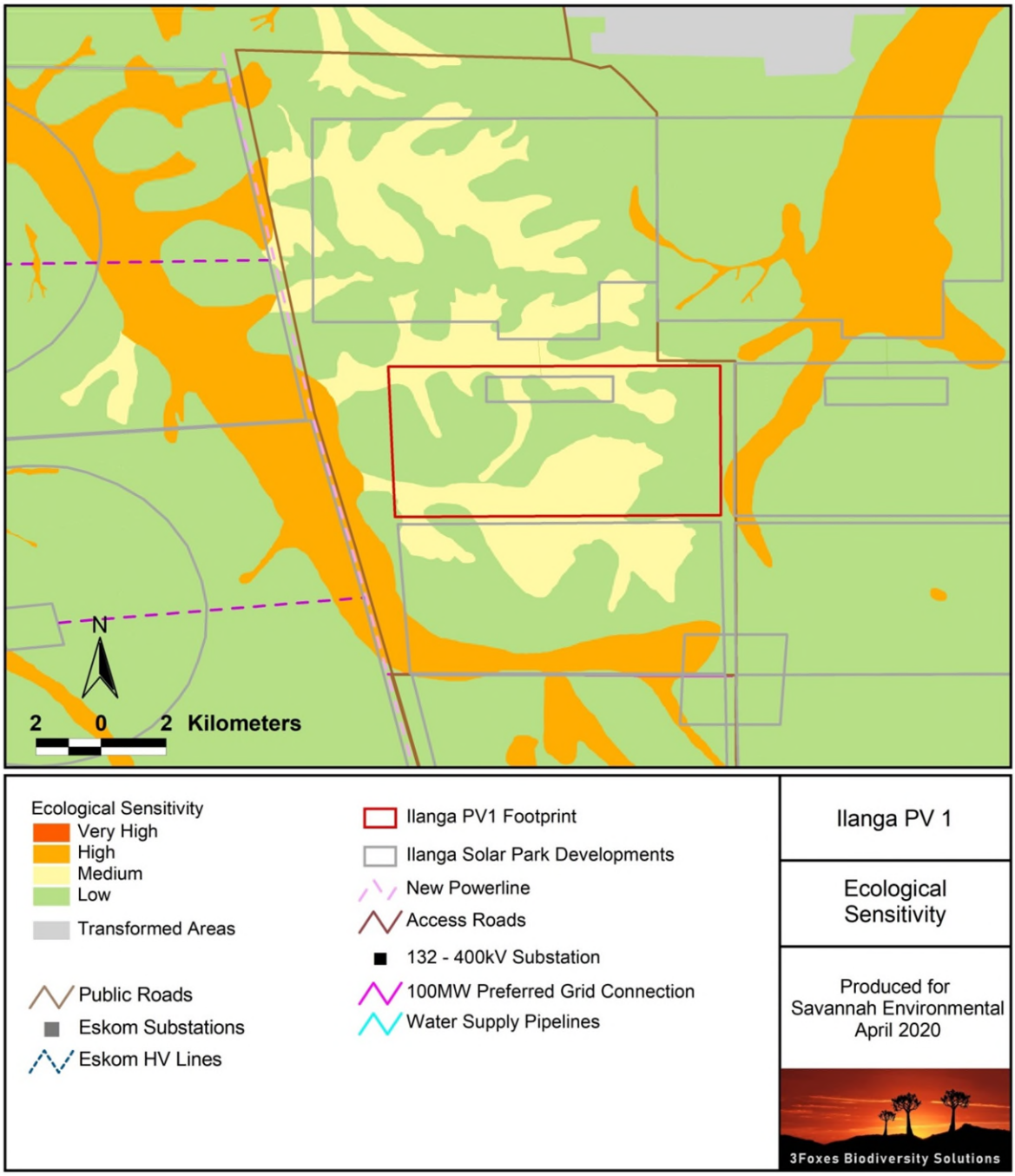

Figure 8. Sensitivity map for the study area and the Ilanga PV development area.

The sensitivity map for the study area is illustrated above in Figure 8. The vegetation of the site consists of grassy shrubland on shallow soils, alternating with deeper soils with a higher proportion of larger woody species. Despite being classified as Bushmanland Arid Grassland, the vegetation of the site is closer to Kalahari Karroid Shrubland in composition

and structure. However, both are considered to be low sensitivity vegetation types that have experienced little transformation to date. In terms of sensitivity, there are no highly sensitive features within the development footprint that should be avoided. However, the development would result in the loss of a relatively large number of protected tree species and based on the DEFF thresholds for protected trees, an offset to account for this loss would likely be required.

4 IDENTIFICATION & NATURE OF IMPACTS

In this section, the potential impacts and associated risk factors that may be generated by the development are identified and discussed before being assessed in the next section.

4.1 IDENTIFICATION OF IMPACTS

In this section the potential impacts associated with the establishment of Ilanga PV are explored in context of the features and characteristics of the development area, the likelihood and extent to which each impact would occur given the characteristics of the development area, and the extent and nature of the development.

Impacts on vegetation and protected plant species

Several protected species occur at the site which may be impacted by the development of Ilanga PV, most notably *Boscia albitrunca*, *Vachellia erioloba* and *Boscia foetida* subsp. *foetida.* The density of these species within the development area is relatively high for *B.albitrunca* and relatively low for both *Vachellia erioloba* and *Boscia albitrunca*. Vegetation clearing during the construction phase will lead to the loss of currently intact habitat within the development area and is an inevitable consequence of the establishment of Ilanga PV. As this impact is certain to occur during the construction phase, it is assessed for the construction phase only, although the consequences will persist for a long time after construction has been completed.

Direct faunal impacts

Increased levels of noise, pollution, disturbance and human presence during the construction phase will be detrimental to fauna. Sensitive and shy fauna would move away from the development area during the construction phase as a result of the noise and human activities present, while some slow-moving species would not be able to avoid the construction activities and might be killed. Some impact on fauna is highly likely to occur during the construction and operation phase and this impact is therefore assessed for the construction phase and operation phase.

Habitat Degradation due to Erosion and Alien Plant Invasion

Disturbance within the development area generated during the construction phase will leave the area vulnerable to erosion and alien plant invasion, which would lead to the degradation of the local environment. Although, the disturbance would be created during the construction phase, the major impacts would manifest during the operation phase.

Reduced ability to meet conservation obligations & targets

The loss of unprotected vegetation types on a cumulative basis from the broader study area may impact the country's ability to meet its conservation targets. The development area is however not within an NPAES Focus Area, indicating that it has not been identified as being of high significance for conservation expansion. Kalahari Karroid Shrubland is however a relatively restricted vegetation type for an arid area and is therefore vulnerable to cumulative impacts. This impact is therefore assessed in light of the proposed development as well as any other developments in the surrounding area which would also contribute to cumulative impacts.

Impact on broad-scale ecological processes

Transformation of intact habitat due to Ilanga PV alone as well as on a cumulative basis would contribute to the fragmentation of the landscape and would potentially disrupt the connectivity of the landscape for fauna and flora and impair their ability to respond to environmental fluctuations. These impacts are assessed for Ilanga PV alone as well as on a cumulative basis considering other existing or proposed developments in the wider area.

5 ASSESSMENT OF IMPACTS

The various identified impacts are assessed below for the different phases of the development.

5.1 PLANNING & CONSTRUCTION PHASE

Impact 1. Impacts on vegetation and listed or protected plant species resulting from construction activities

Impact Nature: Impacts on vegetation will occur due to disturbance and vegetation clearing associated with the construction of the facility. In addition, it is likely that some loss of individuals of protected trees will occur.		
	Without Mitigation	**With Mitigation**

Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (4)	Low (3)
Probability	Definite (5)	Definite (5)
Significance	Medium (45)	Medium (40)
Status	Negative	Negative
Reversibility	Moderate	Moderate
Irreplaceable loss of resources	Low	Low
Can impacts be mitigated?	This impact cannot be well mitigated because the loss of vegetation is unavoidable and is a certain outcome of the development.	
Mitigation	• A protected tree offset strategy report should be developed to inform the potential need for an offset for the loss of protected trees within the current as well as other Ilanga PV footprint areas. • Pre-construction walk-through of the facility's final layout in order to locate species of conservation concern that can be translocated as well as comply with the Northern Cape Nature Conservation Act and DENC/DEFF permit conditions. • Search and rescue for identified species of concern before construction. • Vegetation clearing to commence only after walk-through and search and rescue has been conducted and necessary permits obtained. • Pre-construction environmental induction for all construction staff on site to ensure that basic environmental principles are adhered to. This includes awareness of no littering, appropriate handling of pollution and chemical spills, avoiding fire hazards, minimising wildlife interactions, and remaining within demarcated construction areas etc. • Contractor's Environmental Officer (EO) to provide supervision and oversight of vegetation clearing activities within sensitive areas such as near the pans. • Vegetation clearing to be kept to a minimum. No unnecessary vegetation to be cleared. • All construction vehicles should adhere to clearly defined and demarcated roads. No off-road driving to be allowed outside of the construction area. • Temporary laydown areas should be located within previously transformed areas or areas that have been identified as being of low sensitivity. These areas should be rehabilitated after use.	
Cumulative Impacts	The development will contribute to cumulative impacts on habitat loss and transformation in the area.	

Residual Risks	As the loss of currently intact vegetation is an unavoidable consequence of the development, the habitat loss associated with the development remains a moderate residual impact even after mitigation and avoidance of more sensitive areas.

Impact 2. Direct Faunal Impacts Due to Construction Activities

Impact Nature: Disturbance, transformation and loss of habitat will have a negative effect on resident fauna during the construction phase. Due to noise and the operation of heavy machinery, faunal disturbance will extend well beyond the footprint and extend into adjacent areas. This will however be transient and restricted to the construction phase.		
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	Low to Medium (5)	Low (4)
Probability	Highly Probable (4)	Highly Probable (4)
Significance	Medium (32)	Low (28)
Status	Negative	Negative
Reversibility	Moderate	Moderate
Irreplaceable loss of resources	No	No
Can impacts be mitigated?	Although, the large amounts of noise and disturbance generated within the development area during the construction phase is largely unavoidable, impacts such as those resulting from the presence of construction personnel within the development area can be easily mitigated.	
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 an appropriately qualified environmental officer. • All construction vehicles should adhere to a low speed limit (40km/h for light vehicles and 30km/h for heavy vehicles) 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 development area. 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. • If trenches need to be dug for electrical cabling, these should not be left open for extended periods of time as fauna may fall in and become trapped in them. Trenches that are standing open should have places where there are soil ramps allowing fauna to escape the trench. Larger fauna can be excluded with barrier nets.
Cumulative Impacts	During the construction phase, the activity would contribute to cumulative fauna disturbance and disruption in the area, but there are still large tracts of intact habitat in the area, it is likely that displaced fauna will have space to move about the site to avoid areas of high activity.
Residual Risks	It is probable that some individuals of susceptible species will be lost to construction-related activities despite mitigation. However, this is not likely to impact the viability of the local population of any fauna species.

5.2 OPERATIONAL PHASE IMPACTS

Impact 1. Faunal Impacts due to Operation

Impact Nature: The operation and presence of the facility may lead to disturbance or persecution of fauna within or adjacent to the facility.		
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low (4)	Minor (2)
Probability	Probable (3)	Probable (3)
Significance	Low (27)	Low (21)
Status	Negative	Negative
Reversibility	Moderate	Moderate
Irreplaceable loss of resources	No	No
Can impacts be mitigated?	To a large extent, but some low-level residual impact due to noise and human disturbance during maintenance is likely.	
Mitigation	• Any potentially dangerous fauna such as snakes or fauna threatened by the maintenance and operational activities should be removed to a safe location. • If the site must be lit at night for security purposes, this should be done with downward-directed low-Ultraviolet (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 the site should adhere to a low speed limit (30km/h max for heavy vehicles and 40km/h max for light vehicles) to avoid collisions with susceptible species such as snakes and tortoises. • If the facility is to be fenced, then no electrified strands should be placed within 30cm of the ground as some species such as tortoises are susceptible to electrocution from electric fences because they do not move away when electrocuted, but rather adopt defensive behaviour and are killed by repeated shocks. Alternatively, the electrified strands should be placed on the inside of the fence and not the outside as is the case on the majority of already constructed PV plants.
Cumulative Impacts	The development would contribute to cumulative disturbance for fauna, but the contribution would be low for most species and is not considered highly significant.
Residual Risks	Disturbance from maintenance activities will occur at a low level with the result that disturbance would be largely restricted to the site.

Impact 2. Habitat Degradation due to Erosion and Alien Plant Invasion

Impact Nature: Disturbance created during the construction phase will leave the development area vulnerable to erosion and alien plant invasion for several years into the operation phase.		
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (3)
Magnitude	Medium (4)	Low (3)
Probability	Likely (4)	Likely (3)
Significance	Medium (36)	Low (21)
Status	Negative	Negative
Reversibility	Low	High
Irreplaceable loss of resources	Moderate	Low
Can impacts be mitigated?	Yes, with proper management and avoidance, this impact can be mitigated to a low level.	
Mitigation	• Erosion management within the development area should take place according to the Erosion Management Plan and Rehabilitation Plan. • Access roads should have run-off control features which redirect water flow and dissipate any energy in the water which may pose an erosion	

	risk. • Regular monitoring for erosion during operation to ensure that no erosion problems have developed as a result of the disturbance, as per the Erosion Management and Rehabilitation Plans for the project. • All erosion problems observed should be rectified as soon as possible, using the appropriate erosion control structures and revegetation techniques. • There should be follow-up rehabilitation and re-vegetation of any remaining bare areas with indigenous perennial shrubs and succulents from the local area. • Alien management at the site should take place in accordance with the Alien Invasive Management Plan. • Regular monitoring for alien plant proliferation during the operation phase to ensure that no erosion problems have developed as result of the disturbance, as per the Alien Management Plan for the project. • Woody alien plant species should be controlled on at least an annual basis using the appropriate alien control techniques as determined by the species present.
Cumulative Impacts	Erosion and alien plant invasion would contribute to degradation in the area, but as this can be well-mitigated, the contribution can be minimised.
Residual Risks	Some erosion and alien plant invasion is likely to occur even with the implementation of control measures, but would have a low impact.

5.3 DECOMMISSIONING PHASE

Decommissioning Phase Impact 1. Habitat Degradation due to Erosion and Alien Plant Invasion

Impact Nature: Disturbance created during decommissioning will leave the development area vulnerable to erosion and alien plant invasion for several years.		
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (3)
Magnitude	Medium (4)	Low (3)
Probability	Likely (4)	Likely (3)
Significance	Medium (36)	Low (21)
Status	Negative	Negative
Reversibility	Low	High
Irreplaceable loss of resources	Moderate	Low

Can impacts be mitigated?	Yes, with proper management and avoidance, this impact can be mitigated to a low level.
Mitigation	• Erosion management within the development area should take place in accordance with the Erosion Management and Rehabilitation Plan. This should make provision for monitoring of the development area for at least 5 years after the decommissioning phase. • All erosion problems observed should be rectified as soon as possible, using the appropriate erosion control structures and revegetation techniques. • There should be follow-up rehabilitation and revegetation of any remaining bare areas with indigenous perennial shrubs, grasses and trees from the local area. • Alien management at the site should take place according to the Alien Invasive Management Plan. This should make provision for alien monitoring and management for at least 5 years after decommissioning. • Regular (annual) monitoring for alien plants during operation to ensure that no erosion problems have developed as result of the disturbance, as per the Alien Management Plan for the project. • Woody aliens should be controlled on at least an annual basis using the appropriate alien control techniques as determined by the species present. This might include the use of herbicides where no practical manual means are available.
Cumulative Impacts	Erosion and alien plant invasion would contribute to degradation in the area, but as this can be well-mitigated, the contribution can be minimised.
Residual Risks	Some erosion and alien plant invasion is likely to occur even with the implementation of control measures, but would have a low impact if effectively managed.

Decommissioning Phase Impact 2. Direct Faunal Impacts Due to Decommissioning Activities

Impact Nature: Due to disturbance, noise and the operation of heavy machinery, faunal disturbance due to decommissioning will extend beyond the footprint and impact adjacent areas to some degree. This will however be transient and restricted to the period while machinery is operational. In the long term, decommissioning should restore the ecological functioning and at least some habitat value to the affected areas.

	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Short-term (2)	Short-term (2)

Magnitude	Low (4)	Low (3)
Probability	Highly Probable (4)	Probable (3)
Significance	Low (28)	Low (18)
Status	Negative	Negative
Reversibility	Moderate	Moderate
Irreplaceable loss of resources	No	No
Can impacts be mitigated?	Although the noise and disturbance generated at the site during decommissioning is probably largely unavoidable, this will be transient and ultimately, the habitat should be restored to something useable by the local fauna.	
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 decommissioning activities should be removed to safety by an appropriately qualified environmental officer. • All vehicles should adhere to a low speed limit (30km/h for heavy vehicles and 40km/h for light vehicles) 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 and ultimately removed from the site as part of decommissioning. 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. • The site should be rehabilitated with locally occurring species to restore ecosystem structure and function.	
Cumulative Impacts	During the decommissioning, the associated disturbance would contribute to cumulative fauna disturbance and disruption in the area, but this would be transient and not of long-term impact.	
Residual Risks	Although some components of disturbance cannot be avoided, the site itself would have low faunal abundance at decommissioning and no significant residual impacts are likely.	

5.4 CUMULATIVE IMPACTS

The following are the cumulative impacts assessed as being a likely consequence of the development of the Ilanga PV facility. This is assessed in context of the extent of the proposed development area, other developments in the area, as well as general habitat loss and transformation resulting from agriculture and other activities in the area.

Cumulative Impact 1. Reduced ability to meet conservation obligations & targets due to cumulative habitat loss

Nature: The development of Ilanga PV will potentially contribute to cumulative habitat loss and other cumulative impacts in the wider Upington area.		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects in the area**
Extent	Local (1)	Local (2)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low (4)	Medium (6)
Probability	Improbable (2)	Probable (3)
Significance	Low (18)	Medium (36)
Status	Negative	Negative
Reversibility	Moderate	Moderate
Irreplaceable loss of resources	Low	Low
Can impacts be mitigated	To some degree, but the majority of the impact results from the presence of the facility which cannot be mitigated.	

Mitigation:

- Ensure that sensitive habitats such as drainage features, pans and quartz patches are not within the development footprint.
- Ensure that the fencing around each facility is friendly with fauna and avifauna. This includes not having any electrified strands within 30cm of the ground as well as implementing a design that prevents fauna and avifauna from becoming trapped between the inner and out layer of the fence as this has been demonstrated to be a common impact associated with existing PV plants.
- Ensure that an alien management plan and erosion management plan compiled for each project are effectively implemented at the site.

Cumulative Impact 2. Negative impact on broad-scale ecological processes.

Impact Nature: Development of Ilanga PV may impact on broad-scale ecological processes such as the ability of fauna to disperse.		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects in the area**
Extent	Local (1)	Local (2)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low (3)	Medium (5)
Probability	Probable (3)	Probable (3)
Significance	Low (24)	Medium (33)
Status	Negative	Negative
Reversibility	Moderate	Moderate
Irreplaceable loss of resources	No	No
Can impacts be mitigated?	Only partly as a significant proportion of the impact results from the presence and operation of the facility which cannot be well mitigated.	
Mitigation	• Ensure that faunal movement corridors such as drainage lines are not developed, but if these are fenced into the facility that the fence should be adequately permeable to fauna so as to reduce impacts on faunal habitat loss and movement. • Ensure that the mitigation hierarchy is applied with a particular emphasis on reducing the development footprint, rehabilitating disturbed areas and minimising degradation around the site. • An open space management plan should be developed for the development area, which should include management of biodiversity within the affected areas, as well as that in the adjacent veld.	
Cumulative Impacts	The development would potentially contribute to habitat degradation and the loss of landscape connectivity and ecosystem function within the area, but this is likely to be relatively low as most species are likely to be able to avoid the facility as there are still relatively large intact corridors present in the area.	
Residual Risks	The presence of the facility will represent an obstacle for some fauna which would contribute to fragmentation in the area.	

6 CONCLUSION & RECOMMENDATIONS

The vegetation of the broader Ilanga PV study area consists largely of Kalahari Karroid Shrubland despite the fact that the VegMap has the area classified as Bushmanland Arid Grassland. In terms of sensitive features, the vegetation of the development area is considered generally low or medium sensitivity with no features of significant concern. The abundance of protected tree species, especially *Boscia albitrunca* within the development footprint is relatively high and as many as 3000 individuals of this species would be lost to the development. An offset analysis for this species should be conducted to investigate the need and quantum of an offset to account for the loss of individuals from the current and other proposed Ilanga PV facilities.

In terms of fauna, there are few species of conservation concern that are likely to be present or abundant at the site and the primary impact of the development on fauna would be some habitat loss for the more common resident species. As such, no high long-term post-mitigation impacts on fauna are expected to occur as a result of the development. Consequently, apart from the impact on *B.albitrunca*, the impacts of the development on fauna and flora are considered acceptable and would be of low significance after mitigation.

Cumulative impacts within the broader study area are of potential concern due to the proliferation of solar energy development in the wider Upington area. As there are no features contributing significantly to maintaining ecological connectivity within the development footprint, the contribution of the proposed development to cumulative impacts on habitat loss and fragmentation in the area would be moderate and acceptable. In terms of habitat loss, the affected vegetation and habitat types are widespread in the area and have not experienced significant levels of transformation to date. As a result, the loss of approximately up to 330ha of currently intact habitat likely to result from the development is not considered highly significant. Cumulative impacts associated with the development are therefore considered acceptable.

Impact Statement

The development area identified for the establishment of Ilanga PV is restricted largely to low and moderate sensitivity habitat typical of the Upington/Karoshoek area. The affected area is considered largely suitable for development. Although there are no impacts associated with the establishment of Ilanga PV that cannot be mitigated to a medium or low significance, the impact of the development on the protected tree, *B.albitrunca* should be further investigated in terms of the potential for the establishment of an offset to counter the impact on this species. Although cumulative impacts in the area are a concern due to the high density of renewable energy developments in the Upington area, the proximity of Ilanga PV to the existing developments is seen as a positive aspect of the development and overall cumulative impacts associated with the Ilanga PV development are considered

acceptable. In terms of the three grid alternatives, all three are considered acceptable and there are no significant ecological differences between them. As such, there are no fatal flaws or high post-mitigation impacts that should prevent the development from proceeding. Based on the layout provided for the assessment, Ilanga PV can be supported from a terrestrial ecology point of view.

7 Activities for Inclusion the Draft EMPr

An Environmental Management Programme (EMPr) provides a link between the predicted impacts and mitigation measures recommended within the BA and the implementation and operational activities of a project. As the construction and operation of the Ilanga PV facility may impact the environment, activities that pose a threat should be managed and mitigated so that unnecessary or preventable environmental impacts do not result. The primary objective of the EMPr is to detail actions required to address the impacts identified in the BA during the construction, operation and rehabilitation of the proposed infrastructure. The EMPr provides an elaboration of how to implement the mitigation measures documented in the BA. As such the purpose of the EMPr 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 construction and operation phases of the solar facility 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 BA process

Below are the ecologically-orientated measures that should be implemented as part of the EMPr 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 impacts etc.

Construction Phase Activities

Objective: Limit disturbance of vegetation and loss of protected flora during construction			
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 infrastructure 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 the development footprint. » Obtain relevant permits from the Department of Agriculture, Forestry and Fisheries (DAFF) and the Northern Cape Department of Environment and Nature Conservation (DENC) prior to any construction activities at the site. » Affected individuals of selected protected species which cannot be avoided should be translocated to a safe area on the site prior to construction. This does not include woody species which cannot be translocated and where these are protected by DAFF a 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.		Management/ECO	Construction & Operation
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, or allowed to passively vacate the area. » All vehicles to adhere to low speed limits (40km/h max for light vehicles and 30km/h max for heavy vehicles) 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.		

Operational Phase Activities

OBJECTIVE: Limit the ecological footprint of the PV Plant

Project component/s	Presence and operation of the facility including » Movement of vehicles to and from the site. » Presence of the PV infrastructure and site fencing.		
Potential Impact	» Alien plant invasion » Erosion » Pollution » Faunal Impacts		
Activity/risk source	» Alien plant invasion in and around the road. » Unregulated runoff from the access road. » Human presence during road 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 PV Plant 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 as needed – or as per the frequency stated in the alien invasive management plan to be developed for the site.		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 at the site. » Low abundance of alien plants.		
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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9 Annex 1. List of Plants

List of plant species which have been recorded in the vicinity of the Ilanga PV 1 project site, based on the SANBI POSA 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*		

10 Annex 2. List of Mammals

List of mammals which are likely to occur in the vicinity of the project site. Habitat notes and distribution records are based on Skinner & Chimimba (2005), while conservation status is from the IUCN Red Lists 2014.2 and South African Red Data Book for Mammals (Friedmann & Daly 2004).

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	Confirmed
Hyracoidea (Hyraxes)				
Procavia capensis	Rock Hyrax	LC	Outcrops of rocks, especially granite formations and dolomite intrusions in the Karoo. Also erosion gullies	Possible
Lagomorpha (Hares and Rabbits):				
Lepus capensis	Cape Hare	LC	Dry, open regions, with palatable bush and grass	Confirmed
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.	Confirmed
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.	Confirmed
Xerus inauris	South African Ground Squirrel	LC	Open terrain with a sparse bush cover and a hard substrate	Confirmed
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	Black-tailed Tree Rat	LC	Associated with stands of Acacia woodland	Low

nigricauda				
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	Medium
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
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.	Low
Cercopithecus mitis	Vervet Monkey	LC	Most abundant in and near riparian vegetation of savannahs	Low
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	VU	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	Confirmed
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.	Confirmed

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	Confirmed
Cynictis penicillata	Yellow Mongoose	LC	Semi-arid country on a sandy substrate	Confirmed
Galerella sanguinea	Slender Mongoose	LC	Catholic habitat requirements but does not occur in the south.	Low
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.	Moderate
Vulpes chama	Cape Fox	LC	Associated with open country, open grassland, grassland with scattered thickets and coastal or semi-desert scrub	Confirmed
Canis mesomelas	Black-backed Jackal	LC	Wide habitat tolerance, more common in drier areas.	Confirmed
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 permanent water	Low
Ictonyx striatus	Striped Polecat	LC	Widely distributed throughout the sub-region	Confirmed
Mellivora capensis	Ratel/Honey Badger	LC	Catholic habitat requirements	High
Rumanantia (Antelope):				
Sylvicapra grimmia	Common Duiker	LC	Presence of bushes is essential	Confirmed
Raphicerus campestris	Steenbok	LC	Inhabits open country,	Confirmed
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

11 Annex 3. List of Reptiles

List of reptiles which are likely to occur at the vicinity of the project site, based on the SARCA database. Conservation status is from Bates et al. (2014).

Family	Genus	Species	Subspecies	Common name	Red list category	No. records
Agamidae	*Agama*	*aculeata*	*aculeata*	Common Ground Agama	Least Concern	3
Agamidae	*Agama*	*anchietae*		Anchieta's Agama	Least Concern	2
Agamidae	*Agama*	*atra*		Southern Rock Agama	Least Concern	6
Colubridae	*Boaedon*	*capensis*		Brown House Snake	Least Concern	3
Colubridae	*Dasypeltis*	*scabra*		Rhombic Egg-eater	Least Concern	2
Colubridae	*Dipsina*	*multimaculata*		Dwarf Beaked Snake	Least Concern	1
Colubridae	*Prosymna*	*frontalis*		Southwestern Shovel-snout	Least Concern	2
Colubridae	*Psammophis*	*trinasalis*		Fork-marked Sand Snake	Least Concern	2
Colubridae	*Telescopus*	*beetzii*		Beetz's Tiger Snake	Least Concern	2
Cordylidae	*Karusasaurus*	*polyzonus*		Karoo Girdled Lizard	Least Concern	11
Elapidae	*Aspidelaps*	*lubricus*	*lubricus*	Coral Shield Cobra	Not listed	2
Elapidae	*Naja*	*nivea*		Cape Cobra	Least Concern	1
Gekkonidae	*Chondrodactylus*	*angulifer*	*angulifer*	Common Giant Ground Gecko	Least Concern	6
Gekkonidae	*Chondrodactylus*	*bibronii*		Bibron's Gecko	Least Concern	6
Gekkonidae	*Chondrodactylus*	*turneri*		Turner's Gecko	Least Concern	5
Gekkonidae	*Lygodactylus*	*bradfieldi*		Bradfield's Dwarf Gecko	Least Concern	1
Gekkonidae	*Lygodactylus*	*capensis*	*capensis*	Common Dwarf Gecko	Least Concern	1
Gekkonidae	*Pachydactylus*	*latirostris*		Quartz Gecko	Least Concern	6
Gekkonidae	*Pachydactylus*	*punctatus*		Speckled Gecko	Least Concern	2
Gekkonidae	*Pachydactylus*	*purcelli*		Purcell's Gecko	Least Concern	6
Gekkonidae	*Ptenopus*	*garrulus*	*garrulus*	Common Barking Gecko	Least Concern	1
Gekkonidae	*Ptenopus*	*garrulus*	*maculatus*	Spotted Barking Gecko	Least Concern	1
Lacertidae	*Heliobolus*	*lugubris*		Bushveld Lizard	Least Concern	1
Lacertidae	*Meroles*	*suborbitalis*		Spotted Desert Lizard	Least Concern	3
Lacertidae	*Pedioplanis*	*inornata*		Plain Sand Lizard	Least Concern	3
Lacertidae	*Pedioplanis*	*namaquensis*		Namaqua Sand Lizard	Least Concern	3

Scincidae	*Acontias*	*kgalagadi*	*kgalagadi*	Striped Blind Legless Skink	Least Concern	1
Scincidae	*Acontias*	*lineatus*		Striped Dwarf Legless Skink	Least Concern	4
Scincidae	*Trachylepis*	*occidentalis*		Western Three-striped Skink	Least Concern	3
Scincidae	*Trachylepis*	*sparsa*		Karasburg Tree Skink	Least Concern	3
Scincidae	*Trachylepis*	*spilogaster*		Kalahari Tree Skink	Least Concern	1
Scincidae	*Trachylepis*	*striata*		Striped Skink	Least Concern	4
Scincidae	*Trachylepis*	*sulcata*	*sulcata*	Western Rock Skink	Least Concern	4
Scincidae	*Typhlosaurus*	*lineatus*		Striped Blind Legless Skink	Not listed	1
Testudinidae	*Psammobates*	*tentorius*	*verroxii*	Verrox's Tent Tortoise	Not listed	16
Typhlopidae	*Rhinotyphlops*	*schinzi*		Schinz's Beaked Blind Snake	Least Concern	2
Varanidae	*Varanus*	*albigularis*	*albigularis*	Rock Monitor	Least Concern	1
Varanidae	*Varanus*	*niloticus*		Water Monitor	Least Concern	4
Viperidae	*Bitis*	*arietans*	*arietans*	Puff Adder	Least Concern	1

12 Annex 4. List of Amphibians

List of amphibians which are likely to occur in the vicinity of the project site. Habitat notes and distribution records are based on Du Preez and Carruthers (2009), while conservation status is from the IUCN Red Lists 2014 and Minter et al. (2004).

Scientific Name	Common Name	Status	Habitat	Distribution	Likelihood
Amietophrynus gutturalis	Guttural Toad	Not Threatened	Around open pools, dams, vleis and other semi-permanent or permenent water	Widespread	Medium
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	Medium
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	Low
Cacosternum boettgeri	Common Caco	Not Threatened	Marshy areas, vleis and shallow pans	Widespread	Low
Amietia angolensis	Common River Frog	Not Threatened	Banks of slow-flowing streams or permanent bodies of water	Widespread	Very Low
Tomopterna cryptotis	Tremelo Sand Frog	Not Threatened	Savanna and grassland	Widespread	Low
Tomopterna tandyi	Tandy's Sand Frog	Not Threatened	Nama karoo grassland and savanna	Widespread	Low