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**AN ECOLOGICAL IMPACT ASSESSMENT REPORT FOR  
THE PROPOSED RENEWABLE ENERGY GENERATION  
PROJECT ON PORTION 2 AND THE REMAINDER OF  
THE FARM EAST 270, NORTHERN CAPE PROVINCE**

A 3D rendering of a globe with a splash of water, symbolizing sustainability and environmental impact.

**Innovation in  
Sustainability**

The logo for EOH, consisting of the letters 'EOH' in a bold, white, sans-serif font with a small triangle above the 'O'.

Prepared for: **PALUS ENERGY (PTY) LTD**

Prepared by: **Exigo Sustainability**

# AN ECOLOGICAL IMPACT ASSESSMENT REPORT FOR THE PROPOSED RENEWABLE ENERGY GENERATION PROJECT ON PORTION 2 AND THE REMAINDER OF THE FARM EAST 270, NORTHERN CAPE PROVINCE

## ECOLOGICAL REPORT

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April 2016

**Conducted on behalf of:**  
PALUS ENERGY (PTY) LTD

**Compiled by:**

Dr. BJ Henning (PhD plant Ecology; M.Sc Botany - Soil Science related Pr.Sci.Nat)

**Reviewed by:**

Ms. E. Grobler (EAP.)

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## East 2 & 3 Solar Park Ecological Study

### 1. ASSIGNMENT

Exigo Sustainability was appointed by AGES Limpopo on behalf of Palus Energy (Pty) Ltd to conduct an EIA phase study on the ecological components (fauna and flora) for the proposed establishment of two solar energy generation facilities, East Solar Park 2 (East 2) and East Solar Park 3 (East 3) with associated structures on a footprint of approximately 250 hectares for each of the two solar parks. East 2 is located on the remainder of the farm East 270, while East 3 will be located on portion 2 of the farm East 270, in Joe Morolong Local Municipality, John Taolo Gaetsewe District Municipality, Northern Cape Province.

This report includes detailed impact assessment of the proposed development on biodiversity of the site. The assessment is essential as it will contribute to meeting requirements of the National Environmental Management Act, 1998 (Act No. 107 of 1998).

The assignment is interpreted as follows: Compile an ecological study on the flora (vegetation units), fauna and general ecology of the site and determine potential impacts of the proposed development on fauna and flora of the area and mitigation measures. The study was done according to guidelines and criteria set by Northern Cape (NC) Department of Environmental Affairs and Nature Conservation (DENC) for biodiversity studies. The study includes an impact assessment and mitigation measures to limit potential negative impacts. In order to comply, the following was done:

#### 1.1 INFORMATION SOURCES

The following information sources were obtained:

1. All relevant topographical maps, aerial photographs and information (previous studies and environmental databases) related to the ecological components in study area;
2. Requirements regarding the fauna and flora survey as requested by the NCDENC;
3. Legislation pertaining to the fauna and flora study as relevant;
4. Red data species list from the South African National Biodiversity Institute (SANBI).

#### 1.2 REGULATIONS GOVERNING THIS REPORT

##### 1.2.1 National Environmental Management Act, 1998 (Act No. 107 of 1998) - Regulation No. R982

This report was prepared in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) Gazette No. 38282 Government Notice R. 982. Appendix 6 – Specialist reports includes a list of requirements to be included in a specialist report:

1. A specialist report or a 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 curriculum vitae;

## East 2 & 3 Solar Park Ecological Study

- b. A declaration that the specialist is independent in a form as may be specified by the competent authority;
- c. An indication of the scope of, and purpose for which, the report was prepared;
- d. The date and season of the site investigation and the relevance of the season to the outcome of the assessment;
- e. A description of the methodology adopted in preparing the report or carrying out the specialized process;
- f. The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure;
- g. An identification of any areas to be avoided, including buffers;
- 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;
- i. A description of any assumptions made and any uncertainties or gaps in knowledge;
- j. A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment;
- k. Any mitigation measures for inclusion in the EMPr;
- l. Any conditions for inclusion in the environmental authorisation;
- m. Any monitoring requirements for inclusion in the EMPr or environmental authorisation
- n. A reasoned opinion –
  - i. As to whether the proposed activity or portions thereof should be authorised and
  - ii. If the opinion is that the proposed activity 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;
- o. A description of any consultation process that was undertaken during the course of preparing the specialist report;
- p. A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and
- q. Any other information requested by the competent authority.



## East 2 & 3 Solar Park Ecological Study

### 1.2.2 The National Environmental Management Act (NEMA) (Act No. 107 of 1998)

This Act embraces all three fields of environmental concern namely: resource conservation and exploitation; pollution control and waste management; and land-use planning and development. The environmental management principles include the duty of care for wetlands and special attention is given to management and planning procedures.

### 1.2.3 Conservation of Agricultural Resources Act (Act No. 43 of 1983)

This Act regulates the utilization and protection of wetlands, soil conservation and all matters relating thereto; control and prevention of veld fires, control of weeds and invader plants, the prevention of water pollution resulting from farming practices and losses in biodiversity.

### 1.2.4 National Environmental Management Biodiversity Act (NEMBA: Act 10 Of 2004)

The following aspects of the NEMBA (2004) are important to consider in an ecological report. It:

- Lists ecosystems that are threatened or in need of national protection;
- Links to Integrated Environmental Management processes;
- Must be taken into account in EMP and IDPs;
- The Minister may make regulations to reduce the threats to listed ecosystems.

### 1.2.5 The National Forest Act (Act 84 of 1998)

The National Forest Act:

- Promotes the sustainable management and development of forests for the benefit of all;
- Creates the conditions necessary to restructure forestry in State Forests;
- Provide special measures for the protection of certain forests and protected trees;
- Promotes the sustainable use of forests for environmental, economic, educational, recreational, cultural, health and spiritual purposes.
- Promotes community forestry.

### 1.2.6 Northern Cape Nature Conservation Act, No. 9 of 2009

This Act deals with the following:

- To provide for the sustainable utilisation and protection of biodiversity within the Northern Cape Province;
- To provide for professional hunting;
- To provide for the preservation of caves and cave formations;
- To provide for the establishment of zoos and similar institutions;
- To provide for the appointment of nature conservators;
- To provide for the issuing of permits and other authorisations;
- To provide for offences and penalties for contravention of the Act;

To implement the provisions of the Act; and to provide for matters connected therewith.

## East 2 & 3 Solar Park Ecological Study

### 1.3 TERMS OF REFERENCE

#### 1.3.1 Rationale of solar plant development

South Africa currently relies principally on fossil fuels (coal and oil) for the generation of electricity. At the present date, Eskom generates approximately 95% of the electricity used in South Africa. On the other hand, South Africa has a largely unexploited potential in renewable energy resources such as solar, wind, biomass and hydro-electricity to produce electricity as opposed to other energy types (fuel or coal).

South Africa's electricity supply still heavily relies upon coal power plants, whereas the current number of renewable energy power plants is very limited. In the last few years, the demand for electricity in South Africa has been growing at a rate of approximately 3% per annum. These factors, if coupled with the rapid advancement in community development, have determined the growing consciousness of the significance of environmental impacts, climate change and the need for sustainable development. The use of renewable energy technologies is a sustainable way in which to meet future energy requirements.

The development of clean, green and renewable energy has been qualified as a priority by the Government of South Africa with a target goal for 2013 of 10,000 GWh, as planned in the Integrated Resource Plan 1 (IRP1) and with the Kyoto Protocol. Subsequently the Department of Energy of South Africa (DoE) decided to undertake a detailed process to determine South Africa's 20-year electricity plan, called Integrated Resources Plan 2010-2030 (IRP 2010).

The IRP1 (2009) and the IRP 2010 (2011) outline the Government's vision, policy and strategy in matter of the use of energy resources and the current status of energy policies in South Africa.

The IRP 2010 highlights the necessity of commissioning 1200 MW with solar PV technology by the end of 2015. In order to achieve this goal, in 2011 the DoE announced a Renewable Energy IPP (Independent Power Producers) Procurement Programme. The IPP Procurement Programme, issued on 3rd August 2011, plans the commissioning of 3725 MW of renewable projects (1450 MW with solar photovoltaic technology) capable of beginning commercial operation before end of 2017. Therefore, the development of PV power plants will represent a key feature in the fulfilment of the proposed target goal and the reduction of CO<sub>2</sub> emissions.

The purpose of the East 2 & 3 Solar Parks is to add new capacity for the generation of renewable electrical energy to the national electricity supply in compliance with the IPP Procurement Programme and in order to meet the "sustainable growth" of the Northern Cape Province.

The use of solar radiation for power generation is considered as a non-consumptive use and a renewable natural resource which does not produce greenhouse gas emissions. With specific reference to PV energy and the proposed project, it is important to consider that South Africa has one of the highest levels of solar radiation in the world.

## East 2 & 3 Solar Park Ecological Study

### 1.3.2 Objectives

1. The primary aim of this project is to investigate options for enhancing and/or maintaining biodiversity to mitigate impact of the proposed development and related infrastructure with the overall objective of preventing further loss of biodiversity. The end product would be a tool for promoting and lobbying for the recognition of the importance of species habitat and habitat conservation. Options available to maintain the current level of floral diversity include:
  - a. Protection of native vegetation restored elsewhere in return for unavoidable clearing;
  - b. Minimisation of habitat fragmentation;
  - c. Minimisation of any threats to the native flora and fauna and their habitats during the construction and operational phases of the developments and;
  - d. Rehabilitation to establish plant communities / landscaping that will provide future habitat values.
2. To produce a clear and agreed species and habitat priorities for conservation actions. This includes the following:
  - i. Determine the potential ecological impacts and actions the developments will have on the biodiversity on a species and habitat level;
  - ii. Conduct a risk analyses of the impacts identified to determine the significance of the impacts on the fauna and flora of the study area;
  - iii. Protection and enhancement of vegetation / habitats of high conservation value;
  - iv. The retention of a substantial amount of native vegetation / habitat of adequate size and configuration to promote the conservation of the existing flora communities;
  - v. Retention and/or creation of vegetation links, wildlife corridors and vegetation buffers where possible, subject to appropriate bush fire risk management; and
  - vi. The protection of water quality in the locality so as not to threaten native aquatic flora that rely on the watercourse for survival.
3. Provide recommendations on the ecological mitigation measures to be implemented by the developer and the way forward.

### 1.3.3 Scope

1. Detailed flora survey – in each vegetation type/plant community on site:
  - a. After studying the aerial photograph identify specific areas to be surveyed and confirm location by making use of a Geographical Positioning System (GPS).
  - b. Conduct a site visit and list the plant species (trees, shrubs, grasses, succulents and other herbaceous species of special interest) present for plant community and ecosystem delimitation.

## East 2 & 3 Solar Park Ecological Study

- c. Identify potential red data plant species, possible encroacher species, medicinal plants of value and exotic plant species.
  - d. Indicate suitable plant species that can be used for the landscaping around the proposed developments.
2. Plant community delimitation and description
  - a. Process data (vegetation and habitat classification) to determine vegetation types on an ecological basis.
  - b. Describe the habitat and vegetation.
3. Fauna scoping
  - a. List the potential fauna (mammal species, red data birds, reptiles, amphibians, invertebrates) present linked to the specific potential habitats that occur as identified in the vegetation survey.
  - b. Analyse the data and identify potential red data fauna species, as well as other endemic or protected species of importance.
  - c. Indicate species mitigation measures and management measures to be implemented to prevent any negative impacts on the fauna of the area.
4. General
  - a. Identify and describe ecologically sensitive areas. Create a sensitivity map to indicate specific sensitive areas based on various environmental parameters such as natural vegetation in a good condition, rockiness, slopes, flood lines etc.
  - b. Identify problem areas in need of special treatment or management, e.g. bush encroachment, erosion, degraded areas, reclamation areas.
  - c. Make recommendations, impact ratings and risk assessments for each impact.

### 1.3.4 Limitations and assumptions

- In order to obtain a comprehensive understanding of the dynamics of the flora of the study area, surveys should ideally be replicated over several seasons and over a number of years. However, due to project time constraints such long-term studies are not feasible and this floral study was conducted over two seasons;
- The large study area did not allow for the finer level of assessment that can be obtained in smaller study areas. Therefore, data collection in this study relied heavily on data from representative, homogenous sections of vegetation units, as well as general observations, aerial photograph analysis, generic data and a desktop analysis;
- The surveys were focused on the proposed footprint areas as well as areas in close proximity to the access point in the south. The northern vegetation units were broadly identified through a drive through survey.

### East 2 & 3 Solar Park Ecological Study

- Visibility proved to be a constraint in encroached areas where plant species might have been missed beneath the densely overgrown and obstructed by surface vegetation;

Thus, even though it might be assumed that survey findings are representative of the ecosystem of the project area, it should be stated that the possibility exists that individual plants species might have been missed due to the nature of the terrain (dense vegetation). Therefore, maintaining due cognisance of the integrity and accuracy of the ecological survey, it should be stated that the ecological resources identified during the study do not necessarily represent all the ecological resources present on the property.

## East 2 & 3 Solar Park Ecological Study

### 2 INTRODUCTION

South Africa has one of the world's greatest diversity of plant and animal species contained within one country, and is home to many species found nowhere else in the world. Terrestrial resources are rapidly disappearing however, due to conversion of natural habitat to farmland, forestry, human settlement, and industrial development. Some species are under threat from over-collection for medicinal, ornamental, and horticultural purposes.

Today it is widely recognised that it is of utmost importance to conserve natural resources in order to maintain ecological processes and life support systems for plants, animals and humans. Recent policies, international conventions, and community-based initiatives being carried out are aimed at improved conservation and more sustainable use of natural resources in future. To ensure that sustainable development takes place, it is therefore important that the environment is considered before local authorities approve any development.

All components of any of the ecosystems (physical environment, vegetation, animals) of a site are interrelated and interdependent. A holistic approach is therefore imperative to effectively include any proposed development, utilisation and where necessary conservation of the given natural resources in an integrated development plan, which will address all the needs of the modern human population (Bredenkamp & Brown 2001). Ideally the area should be developed so that the quality of the resources does not decrease, as this would inevitably lead to ecosystem degradation and lower productivity. It is therefore necessary to make a thorough inventory of the plant communities at the site of the proposed development, their biota and their associated habitats (=ecosystems), in order to evaluate its potential for development, or conservation. This inventory should then serve as a scientific and ecological basis for the planning exercises.

## East 2 & 3 Solar Park Ecological Study

### 3 STUDY AREA

#### 3.1 LOCATION AND DESCRIPTION OF ACTIVITY

East 2 Solar Park and East 3 Solar Park will be established on Remainder (964.27 ha) and Portion 2 (856.53 ha) of the Farm East 270, Kuruman RD, 4 km North of Hotazel, located in the Joe Morolong Local Municipality, John Taolo Gaetsewe District Municipality, Northern Cape Province. (Figure 1). The proposed project is situated directly north of the town of Hotazel and 62 kilometers North of Kathu, with the footprint planned to the west (East 2) and east (East 3) of Eskom's "Hotazel - Heuningvlei" 132 kV power line.

The solar projects are called EAST 2 SOLAR PARK and EAST 3 SOLAR PARK, and it envisages the establishment of two Photovoltaic (PV) Power Plants having a maximum generating capacity up to 120MW each. The PV power plants will each have a footprint (fenced area) up to 250 ha, within the total study area 1830 ha in extent.

Access to the East Solar Park will be from a new access road, 4km long, running along the southern boundary of Portion 2 of the Farm East 270. This new access road will start from a local upgraded farm road diverted of the regional road R31, which runs parallel to the eastern boundary of Portion 2 of the Farm East 270.

The chosen site is suitable for the installation of a photovoltaic (PV) power plant. It is appropriate morphologically (flat terrain) and regarding the favourable radiation conditions. The available radiation allows a high rate of electric energy production, as a combination of latitude-longitude and climatic conditions.

The aerial image of the site is indicated in figure 2, while the layout plan of the proposed development is indicated in figure 3.

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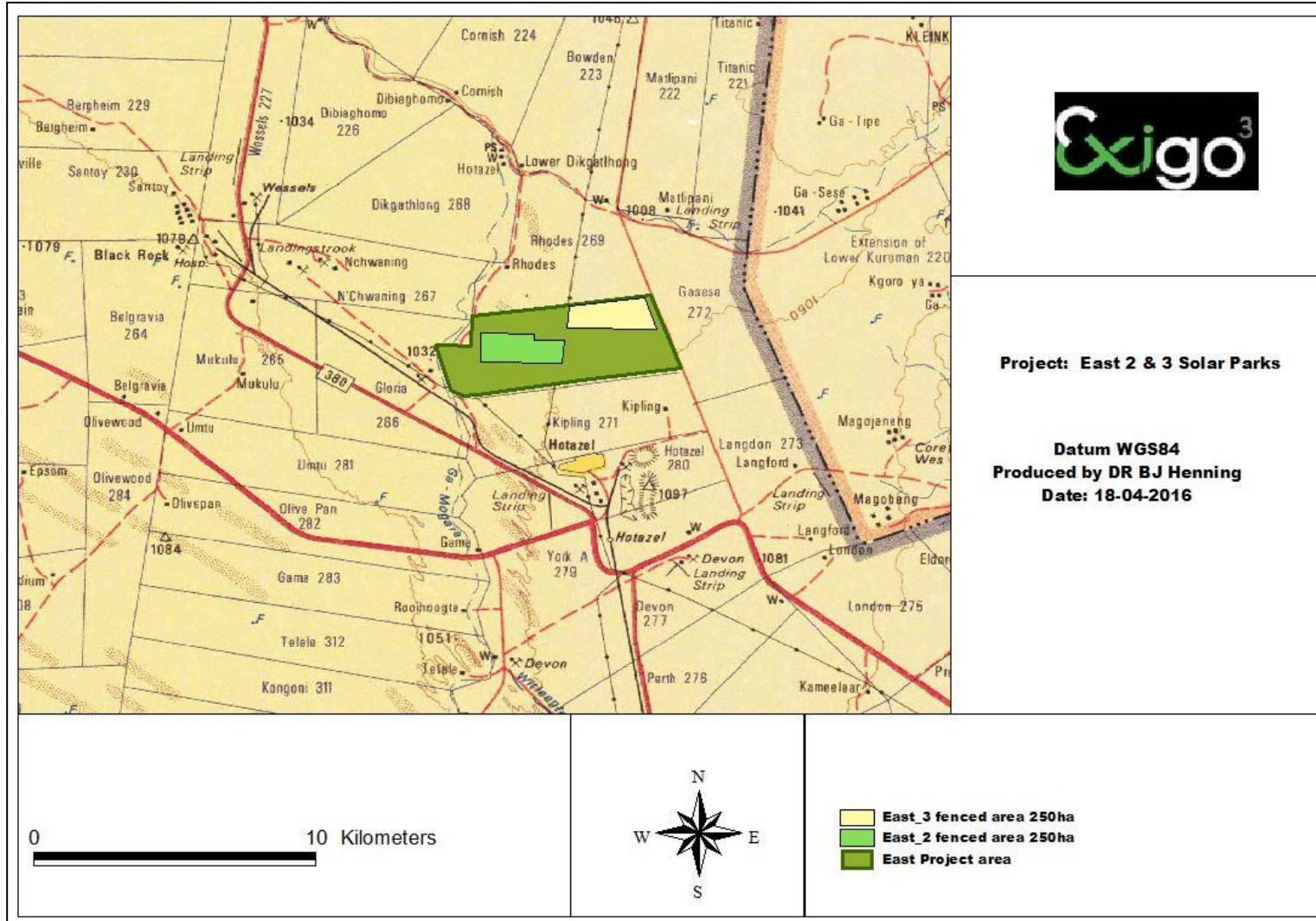


Figure 1. Regional Location Map



## East 2 & 3 Solar Park Ecological Study

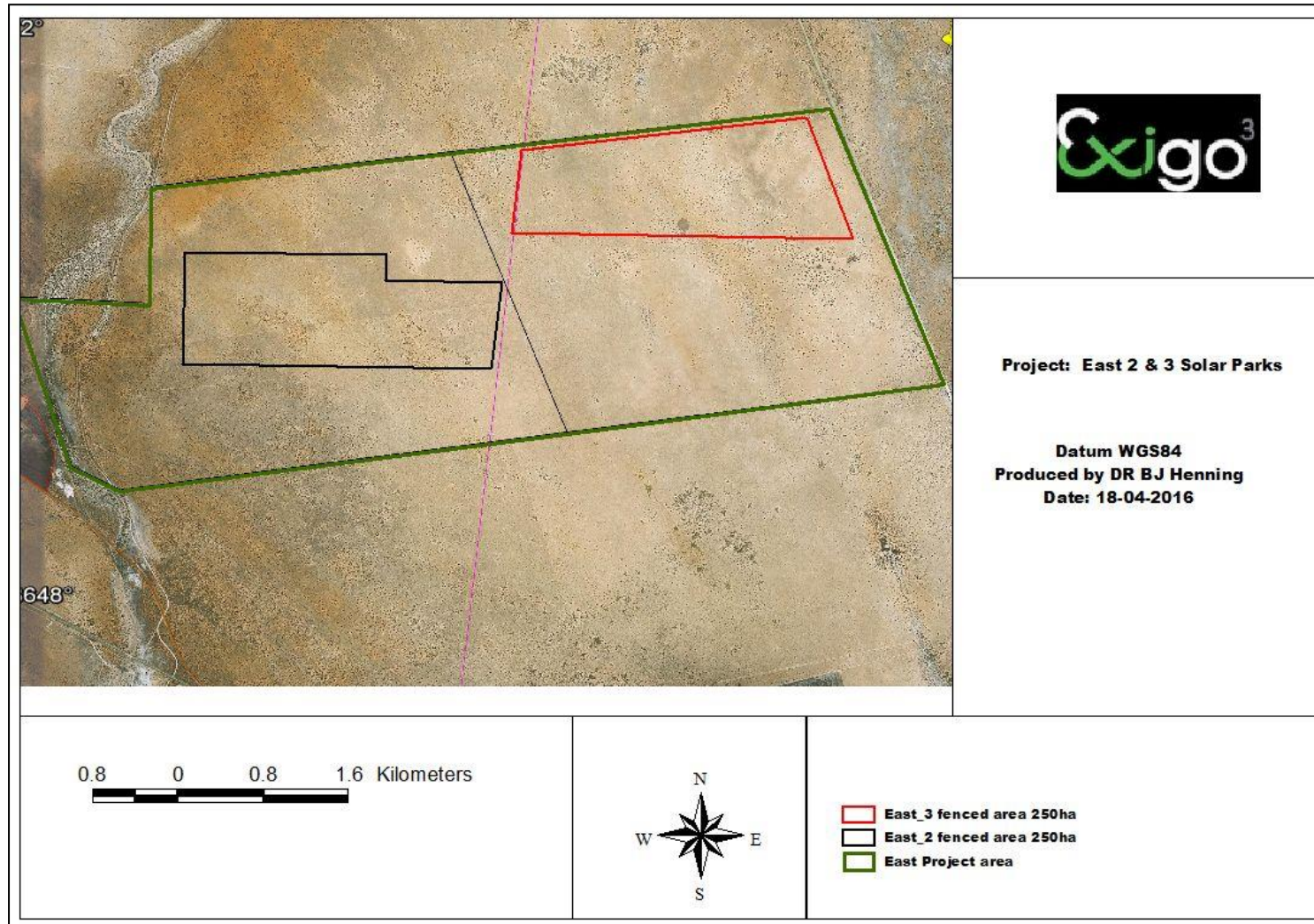


Figure 2. Satellite image showing the project area (Google Pro, 2010)



## East 2 & 3 Solar Park Ecological Study

### 3.2 CLIMATE

Climate in the broad sense is a major determinant of the geographical distribution of species and vegetation types. However, on a smaller scale, the microclimate, which is greatly influenced by local topography, is also important. Within areas, the local conditions of temperature, light, humidity and moisture vary greatly and it is these factors which play an important role in the production and survival of plants (Tainton, 1981). The climate for the region can be described as warm-temperate. In terrestrial environments, limitations related to water availability are always important to plants and plant communities.

The spatial and temporal distribution of rainfall is very complex and has great effects on the productivity, distribution and life forms of the major terrestrial biomes (Barbour et al. 1987). The study area is situated within the summer and autumn rainfall region with very dry winters and frequent frost that occurs during the colder winter months. The spatial and temporal distribution of rainfall is very complex and has great effects on the productivity, distribution and life forms of the major terrestrial biomes (Barbour et al. 1987). The mean annual precipitation varies between 120 and 260mm. The mean monthly maximum and minimum temperatures for the area are 41.5°C and -4°C, for December and July, respectively.

### 3.3 VEGETATION TYPES

#### 3.3.1 REGIONAL CONTEXT: THE GRIQUALAND WEST CENTRE OF ENDEMISM

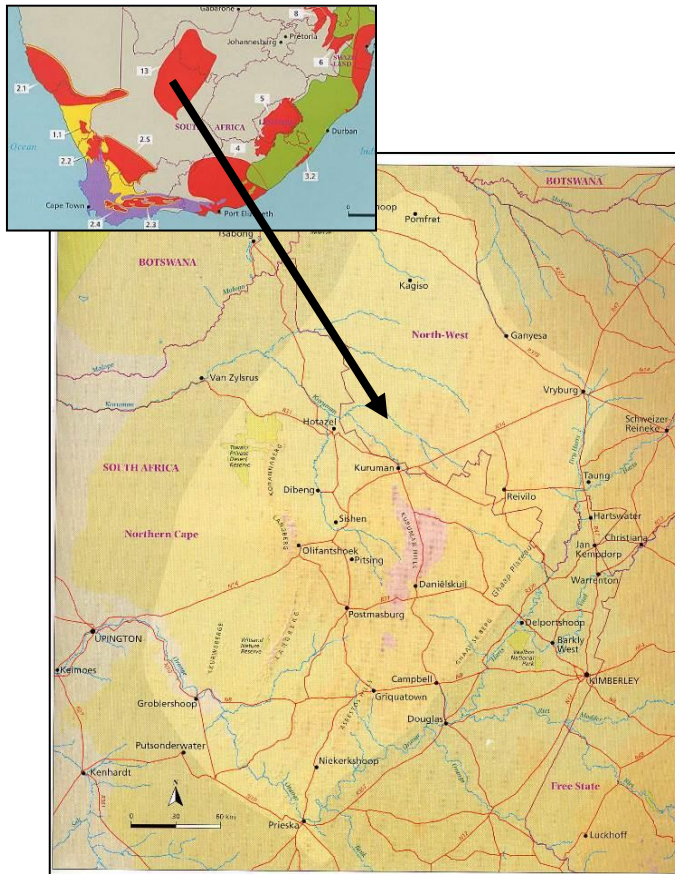
The vegetation of the proposed development site falls within the south-eastern range of the Griqualand West Centre of Endemism (Van Wyk & Smith 2001). A centre of plant endemism is an area with high concentrations of plant species with very restricted distributions. Centres of endemism are important because it is these areas, which if conserved, would safeguard the greatest number of plant species. They are extremely vulnerable; relatively small disturbances in a centre of endemism may easily pose a serious threat to its many range-restricted species (Van Wyk & Smith 2001). The Griqualand West Centre (GWC) is one of the 84 African centres of endemism and one of 14 centres in southern Africa, and these centres are of global conservation significance.

The endemic and near-endemic species make up 2.2% of the total flora, and are mostly from the Asclepiadaceae, Euphorbiaceae and Mesembryanthemaceae families. Some of the endemics are edaphic specialists, adapted to lime-rich substrates.

Endemics and near-endemics include *Searsia tridactyla*, *Aloinopsis orpenii*, *Euphorbia planiceps*, *Euphorbia bergii*, *Lebeckia macrantha*, *Lithops aucampiae* subsp. *aucampiae* and *Tarchonanthus obovatus*.

The GWC of endemism is extremely poorly conserved, and is a national conservation priority. Figure 4 shows the extent of the GWC.

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**Figure 4. Map showing the extent of the Griqualand West Centre of Endemism (light centre). It is centred on the surface outcrops of the Ghaap Group (limestone and dolomite) and those of the Olifantshoek Supergroup (quartzite). From Van Wyk & Smith (2001)**

### 3.3.2 LOCAL CONTEXT

The development site lies within the Savanna biome which is the largest biome in Southern Africa. It is characterized by a grassy ground layer and a distinct upper layer of woody plants (trees and shrubs). Environmental factors delimiting the biome are complex and include altitude, rainfall, geology and soil types, with rainfall being a major delimiting factor. Fire and grazing keep the grassy layer dominant. The most recent classification of the area by Mucina & Rutherford (2006) shows the sites form part of the Kathu Bushveld and Gordonia Dunveld vegetation types.

The vegetation and landscape characteristics of Kathu Bushveld include a medium-tall tree layer with dense stands of *Acacia erioloba* in places, but mostly an open woodland with *Boscia albitrunca* as the prominent tree species, while the shrub layer is dominated by *Acacia mellifera*, *Lycium hirsutum* and *Diospyros lycioides*. This vegetation type in its pristine state is characterized by plains with layer of scattered, low to medium high deciduous microphyllous trees and shrubs with a few broadleaved tree species, and an almost continuous herbaceous layer dominated by grass species. This vegetation type has a Least Threatened conservation status, with 1% transformed and none statutorily conserved.

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The landscape features of the Gordonia Duneveld vegetation type are mostly parallel dunes (3-8m in height) with an open shrubland woody structure and ridges of grassland dominated by *Stipagrostis amabilis* on the dune crests and *Acacia haematoxylon* on the dunes slopes. The conservation status of the Gordonia Duneveld is Least Threatened with very little transformation and 14% statutorily conserved in the Kgalagadi Transfrontier Park (Mucina & Rutherford, 2006).

### 3.4 GEOLOGY AND SOIL TYPES

Geology is directly related to soil types and plant communities that may occur in a specific area (Van Rooyen & Theron, 1996). A Land type unit is a unique combination of soil pattern, terrain and macroclimate, the classification of which is used to determine the potential agricultural value of soils in an area. The land type unit represented within the footprint area include the Ah9 and Af28 land types (Land Type Survey Staff, 1987) (ENPAT, 2000). The land types, geology and associated soil types is presented in Table 1 below as classified by the Environmental Potential Atlas, South Africa (ENPAT, 2000), while the location of the land types are indicated in Figure 6.

**Table 1. Land types, geology and dominant soil types of the proposed development site**

Land type	Soils	Geology
Ah9	Red-yellow apedal, freely drained soils; red and yellow, high base status, usually < 15% clay	Aeolian sand of Recent age with a few outcrops of Tertiary Kalahari beds (surface limestone, silcrete and sandstone) in the riverbeds.
Af28	Red-yellow apedal, freely drained soils; red, high base status, > 300 mm deep (with dunes)	Red to flesh-coloured wind-blown sand (sand dunes) of Tertiary to Recent age with some outcrops of coarse-grained brown quartzite and subgreywacke and conglomerate (Matsap Formation).

Soils associated with the site are mostly deep, Aeolian sands overlying calcrete

### 3.5 TOPOGRAPHY & DRAINAGE

Two land facets are present on site. Dunes occur as high-gradient hills in the west and north of the site, while remainder of the site represent slightly undulating plains. The topography across the site is slightly undulating with the average elevation of 1030 mamsl. The site is located within two quaternary catchments namely D41K (Eastern section of site) and D41L (western section of site) and is situated in the Lower Vaal Water Management Area. Drainage occurs as sheet-wash towards major rivers namely the Gamagara River west and the Kuruman River north of the site.

### 3.6 LAND USE AND EXISTING INFRASTRUCTURE

The current land-use of the proposed development site is grazing by livestock and game. Neighbouring farms are being used for livestock grazing and game farming, with mining further away from the site. The major land use of the study area as classified by the Environmental Potential Atlas of South Africa (2000) is vacant / unspecified land.

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### 4 METHODS

#### 4.1 VEGETATION SURVEY

Two basic methods were used during the vegetation survey:

- Line transects were walked on the site surveyed to record the plant species present. Rare and threatened plant species and any botanically sensitive sites or habitats were searched for in the various vegetation units.
- The Braun-Blanquet survey technique to describe plant communities as ecological units was also used for this study. It allows for the mapping of vegetation and the comparison of the data with similar studies in the area.

The vegetation survey was conducted on site during March 2014 and July 2015. The vegetation was in a moderate to good condition and most species could be identified, although some species might have been missed as a result of the large site. No further surveys were necessary considering that the area received sufficient precipitation during the wet season to allow for the identification of most plants in the study area.

##### 4.1.1 Data recorded:

Plant names used in this report are in accordance with Arnold & De Wet (1993), with the exception of a few newly revised species. A list of all plant species present, including trees, shrubs, grasses, forbs, geophytes and succulents were compiled. All identifiable plant species were listed. Notes were additionally made of any other features that might have an ecological influence as well as potential fauna habitat that might occur.

##### 4.1.2 Red data species

A species list of the red data species previously recorded in the vicinity of the proposed development was obtained from the South African Biodiversity Institute (SANBI), South Africa as classified by the IUCN red data list categories.

##### 4.1.3 Protected trees

A species list of the protected tree species was obtained from the Department of Forestry. These trees are listed by the NFA (Act 84 of 1998) as protected.

##### 4.1.4 Protected plants

A list of protected and specially protected plants was obtained from the LEMA (2004).

##### 4.1.5 Data processing

A classification of vegetation data was done to identify, describe and map vegetation types. The descriptions of the vegetation units include the tree, shrub and herbaceous layers.

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Conservation priority of each vegetation unit was assessed by evaluating the plant species composition in terms of the present knowledge of the vegetation of the Northern Cape Province, as well as the Bushmanland Arid Grassland vegetation type and Nama Karoo Biome of South Africa.

The following four conservation priority categories were used for each vegetation unit:

- High: Ecologically sensitive and valuable land with high species richness that should be conserved and no development allowed.
- Medium: Land that should be conserved but on which low impact development could be considered with the provision of mitigation measures.
- Medium-low: Land that has some conservation value but on which development could be considered with limited impact on the vegetation / ecosystem. It is recommended that certain sections of the vegetation be maintained.
- Low: Land that has little conservation value and that could be considered for developed with little to no impact on the vegetation / ecosystem.

### 4.2 FAUNA SURVEY

The fauna survey was conducted as follows:

- A site survey was done to identify potential habitats after identifying the vegetation units. Fauna observed on site or any specific indication of species was noted as confirmed in the species lists.
- A scoping survey was then conducted by comparing the habitat types identified with the preferred habitats of species occurring in the area.

#### 4.2.1 Data recorded:

A list of all species of fauna and their status as observed on site or that could potentially occur on site. Notes were made of specific sensitive or specialized habitats that occur on the site.

#### 4.2.2 Red data species lists

A species list of the red data species of the different faunal classes was obtained from the following references:

- Red Data Book of the Mammals of South Africa (Friedman & Daly, 2004)
- The Atlas of the Southern African Birds - digital data on quarter degree grid data (Avian Demography Unit, University of Cape Town)
- Atlas and red data book of the frogs of South Africa, Lesotho and Swaziland (Minter et al. 2004)
- South African Red Data Book – Reptiles and Amphibians. National Scientific Programmes Report no. 151;

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### 4.2.3 Data processing

A comparison of the habitats (vegetation units) occurring on the property was made to the preferred habitats of the faunal species. In addition to species observed on the site, lists of the potential mammal, bird, reptile, amphibian and insect species were compiled and mitigating measures recommended if needed.

### 4.3 SENSITIVITY ASSESSMENT

The ecological sensitivity of any piece of land is based on its inherent ecosystem service and overall preservation of biodiversity.

#### 4.3.1 Ecological function

The ecological function relates to the degree of ecological connectivity between systems within a landscape matrix. Therefore, systems with a high degree of landscape connectivity amongst one another are perceived to be more sensitive and will be those contributing to ecosystem service (e.g. wetlands) or overall preservation of biodiversity.

#### 4.3.2 Conservation importance

Conservation importance relates to species diversity, endemism (unique species or unique processes) and the high occurrence of threatened and protected species or ecosystems protected by legislation.

#### 4.3.3 Sensitivity scale

- High – sensitive ecosystem with either low inherent resistance or low resilience towards disturbance factors or highly dynamic systems considered being important for the maintenance of ecosystem integrity. Most of these systems represent ecosystems with high connectivity with other important ecological systems or with high species diversity and usually provide suitable habitat for a number of threatened or rare species. These areas should be protected;
- Medium – These are slightly modified systems which occur along gradients of disturbances of low-medium intensity with some degree of connectivity with other ecological systems or ecosystems with intermediate levels of species diversity but may include potential ephemeral habitat for threatened species;
- Low – Degraded and highly disturbed / transformed systems with little ecological function and which are generally very poor in species diversity.



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### 4.4 IMPACT RATING ASSESSMENT MATRIX

An impact can be defined as any change in the physical-chemical, biological, cultural and/or socio-economic environmental system that can be attributed to human activities related to alternatives under study for meeting a project need. The significance of the impacts will be determined through a synthesis of the criteria below (Plomp, 2004):

**Probability.** This describes the likelihood of the impact actually occurring:

- **Improbable:** The possibility of the impact occurring is very low, due to the circumstances, design or experience.
- **Probable:** There is a probability that the impact will occur to the extent that provision must be made therefore.
- **Highly Probable:** Most likely that impact will occur at some stage of development.
- **Definite:** The impact will take place regardless of any prevention plans, and there can only be relied on mitigation actions or contingency plans to contain the effect.

**Duration.** The lifetime of the impact

- **Short term:** The impact will either disappear with mitigation or will be mitigated through natural processes in a time span shorter than any of the phases.
- **Medium term:** Impact will last up to end of the phases, where after it will be negated.
- **Long term:** The impact will last for the entire operational phase of the project but will be mitigated by direct human action or by natural processes thereafter.
- **Permanent:** Impact will be non-transitory. Mitigation by man or natural processes will not occur in such a way or such a time span that the impact can be considered transient.

**Scale.** The physical and spatial size of the impact

- **Local:** The impacted area extends only as far as the activity, e.g. footprint.
- **Site:** Impact could affect the whole, or measurable portion of development sites.
- **Regional:** The impact could affect the area including the neighbouring areas.

**Magnitude/ Severity.** Does the impact destroy the environment, or alter its function?

- **Low:** Impact alters affected environment in such a way that natural processes are not affected.
- **Medium:** The affected environment is altered, but functions and processes continue in a modified way.
- **High:** Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.

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**Significance.** This is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required.

- **Negligible:** The impact is non-existent or unsubstantial and is of no or little importance to any stakeholder and can be ignored.
- **Low:** The impact is limited in extent, has low to medium intensity; whatever its probability of occurrence is, the impact will not have a material effect on the decision and is likely to require management intervention with increased costs.
- **Moderate:** The impact is of importance to one or more stakeholders, and its intensity will be medium or high; therefore, the impact may materially affect the decision, and management intervention will be required.
- **High:** The impact could render development options controversial or the project unacceptable if it cannot be reduced to acceptable levels; and/or the cost of management intervention will be a significant factor in mitigation.

The following weights will be assigned to each attribute:

Aspect	Description	Weight
<b>Probability</b>	Improbable	1
	Probable	2
	Highly Probable	4
	Definite	5
<b>Duration</b>	Short term	1
	Medium term	3
	Long term	4
	Permanent	5
<b>Scale</b>	Local	1
	Site	2
	Regional	3
<b>Magnitude/Severity</b>	Low	2
	Medium	6
	High	8
<b>Significance</b>	<b>Sum (Duration, Scale, Magnitude) x Probability</b>	
	Negligible	<20
	Low	<40
	Moderate	<60
	High	>60

The significance of each activity will be rated without mitigation measures and with mitigation measures for the development.

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### 5 RESULTS

#### 5.1 VEGETATION UNITS

The proposed development is planned on a landscape that varies from slightly undulating plains to moderately undulating terrain associated with dunes. The importance to survey the area as a whole to have a better understanding of the ecosystem and the potential impact of the development on the natural environment was identified as a key factor, and subsequently the property was completely surveyed. The farm is currently managed as a livestock farm. The vegetation units on the site vary according to soil characteristics, topography and land-use. Most of the site is characterized by microphyllous woodland that varies in density and species composition. Pans (depressions) represent the only drainage feature on site, although the Kuruman and Gamagara Rivers occur to the north and west of the site, respectively. Vegetation units were identified and can be divided into 5 distinct vegetation units according to soil types and topography.

The vegetation communities identified on the proposed development site are classified as physiographic physiognomic units, where physiognomic refers to the outer appearance of the vegetation, and physiographic refers to the position of the plant communities in the landscape. The physiographic-physiognomic units will be referred to as vegetation units in the following sections. These vegetation units are divided in terms of the land-use, plant species composition, topographical and soil differences that had the most definitive influence on the vegetation units. Each unit is described in terms of its characteristics and detailed descriptions of vegetation units are included in the following section. A species list for the site is included in Appendix A, while a plant species list for the quarter degree grid square (QDS) is included in Appendix B. Photographs of each unit is included in the next section to illustrate the grass layer, woody structure and substrate (soil, geology etc.). The following vegetation units were identified during the survey.

1. Open *Acacia haematoxylon* woodland on deep Aeolian sand;
2. *Acacia mellifera* thickets;
3. *Acacia mellifera* – *Acacia hebeclada* woodland;
4. Mixed *Acacia haematoxylon* – *Grewia flava* – *Acacia mellifera* woodland;
  - o Plains;
  - o Low dunes
5. Depression (pan) wetland type.

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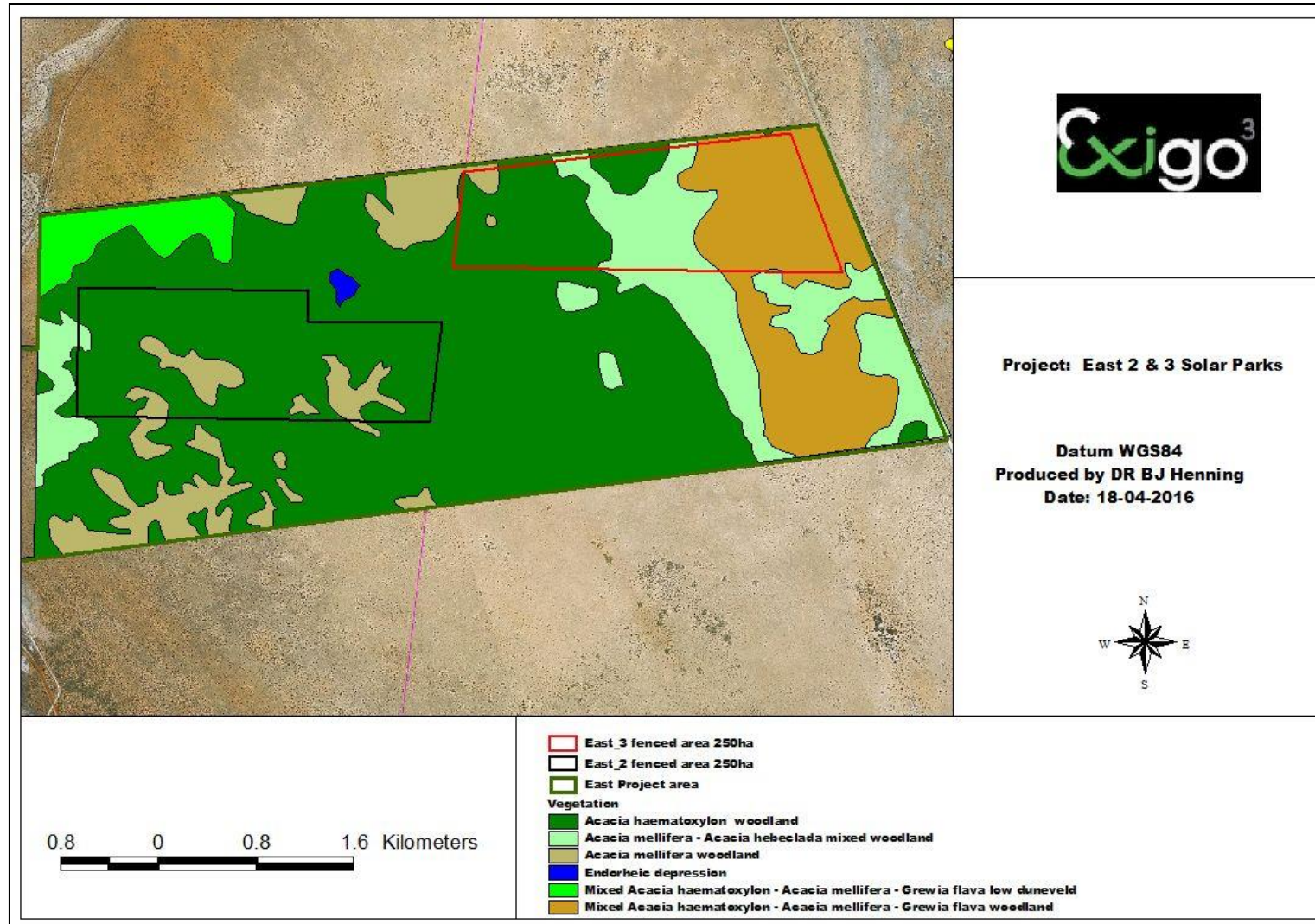


Figure 5. Vegetation Map

### 5.1.1 OPEN ACACIA HAEMATOTOXYLON WOODLAND ON DEEP AEOLIAN SAND

This vegetation unit occurs throughout large sections of the farm East and specifically on the proposed footprint areas of the solar park and access road. The woody structure is open woodland dominated by the protected tree species *Acacia haematoxylon* (grey camel thorn), while the herbaceous layer is dominated by grass species such as *Stipagrostis uniplumis*, *Eragrostis pallens* and *Schmidtia kalaharensis*. The characteristics of this vegetation unit are summarized in Table 2, while the state of the vegetation indicated in photograph 1.

**Table 2. Botanical analysis and characteristics of Open *Acacia haematoxylon* woodland**

<b>State of the vegetation:</b>	Natural woodland in a pristine state
<b>Need for rehabilitation</b>	Low
<b>Conservation priority</b>	Medium
<b>Characteristics</b>	Open woodland component. The woodlands are completely dominated by <i>Acacia haematoxylon</i> and the grass layer is well developed.
<b>Soils &amp; Geology</b>	Deep, red Aeolian (wind-blown) sands
<b>Dominant spp.</b>	<i>Acacia haematoxylon</i> , <i>Stipagrostis uniplumis</i> , <i>Schmidtia kalaharensis</i> , <i>Crotalaria orientalis</i>
<b>Density of woody layer</b>	Trees: 5-10% (avg. height: 3-6m) Shrubs: 2-5% (avg. height: 1-2m)
<b>Density of herbaceous layer</b>	Grasses: 60-70% (avg. height: 0.8-1.2m) Forbs: 1-2% (avg. height: 0.8m)
<b>Sensitivity</b>	Medium
<b>Red data species</b>	None observed
<b>Protected species</b>	<i>Acacia haematoxylon</i> <i>Acacia erioloba</i>

The following specific recommendations for the area should be adhered to

- The vegetation unit is classified as having a medium sensitivity due to the dense stands of protected trees observed in the indigenous woodland;
- The development can be supported provided that a licence is obtained from DAFF for the eradication of the protected trees. The remainder of the site outside of the proposed footprint should be preserved as an offset area.



Photograph 1. *Acacia haematoxylon* woodland on deep, red Aeolian sands in the project area

### 5.1.2 ACACIA MELLIFERA THICKETS / BUSHCLUMPS

This vegetation unit occurs in isolated pockets where the calcrete bedrock is closer to the surface, although still overlaid by kalahari sands. The bushclumps are almost completely dominated by *Acacia mellifera* (black thorn). A poor grass layer occurs in and around the bushclumps as a result of overgrazing. The habitat type can be considered slightly degraded. No red data species occurs; probably as a result of the habitat being different compared to the potential red data species that could occur. The state of the vegetation is indicated in photograph 2, while the characteristics of the variations of this vegetation unit are summarized in Table 3.

Table 3. Botanical analysis and characteristics of *Acacia mellifera* thickets / bushclumps

<b>State of the vegetation:</b>	Slightly to moderately degraded
<b>Need for rehabilitation</b>	Medium
<b>Conservation priority</b>	Low
<b>Characteristics</b>	Microphyllous thickets dominated by <i>Acacia mellifera</i> . The herbaceous layer is poorly developed as a result of the higher nutrient content that causes overgrazing of the grass layer.
<b>Soils &amp; Geology</b>	Shallow to medium depth Aeolian sand overlying calcrete.
<b>Dominant spp.</b>	<i>Acacia mellifera</i> , <i>Grewia flava</i>

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<b>State of the vegetation:</b>	Slightly to moderately degraded
<b>Need for rehabilitation</b>	Medium
<b>Density of woody layer</b>	Trees: 10-15% (avg. height: 3-6m) Shrubs: 15-20% (avg. height: 1-2m)
<b>Density of herbaceous layer</b>	Grasses: 10-15% (avg. height: 0.8-1.2m) Forbs: <1% (avg. height: 0.8m)
<b>Sensitivity</b>	Medium-low
<b>Red data species</b>	None observed
<b>Protected species</b>	None observed



**Photograph 2. *Acacia mellifera* thickets in the project area**

The following specific recommendations for the area should be adhered to

- The vegetation unit is classified as having a medium-low sensitivity due to the encroachment and overgrazing observed in the area;
- The development can be supported in this vegetation unit considering the widespread status of this vegetation entity in the Savanna Biome.

**5.1.3 ACACIA MELLIFERA – ACACIA HEBECLADA WOODLAND**

This vegetation unit become more prominent in the central and western sections of portion 2 of the farm East. The vegetation structure is a low shrubveld and dominated by the microphyllous species *Acacia hebeclada* and *Acacia mellifera*. The substrate is red Kalahari sands overlying limestone, and the presence of *Acacia hebeclada* is often associated with calcrete. It is considered to be a good indicator of calcium-rich soils. The habitat type can be considered slightly degraded due to overgazing on the calcium rich soils. No red data species occurs; probably as a result of the habitat being different compared to the potential red data species that could occur. The state of the vegetation is indicated in photograph 3, while the characteristics of the variations of this vegetation unit are summarized in Table 4.

**Table 4. Botanical analysis and characteristics of *Acacia mellifera* – *Acacia hebeclada* woodland**

<b>State of the vegetation:</b>	Slightly degraded
<b>Need for rehabilitation</b>	Low
<b>Conservation priority</b>	Medium-low
<b>Characteristics</b>	Microphyllous shrubveld dominated by <i>Acacia mellifera</i> and <i>Acacia hebeclada</i> . The herbaceous layer is poorly developed as a result of the higher nutrient content that causes overgrazing of the grass layer.
<b>Soils &amp; Geology</b>	Shallow to medium depth Aeolian sand overlying calcrete.
<b>Dominant spp.</b>	<i>Acacia mellifera</i> , <i>Acacia hebeclada</i> , <i>Rhigozum trichotomum</i> , <i>Stipagrostis obtusa</i>
<b>Density of woody layer</b>	Trees: 10-15% (avg. height: 3-6m) Shrubs: 15-20% (avg. height: 1-2m)
<b>Density of herbaceous layer</b>	Grasses: 10-15% (avg. height: 0.8-1.2m) Forbs: <1% (avg. height: 0.8m)
<b>Sensitivity</b>	Medium-low
<b>Red data species</b>	None observed
<b>Protected species</b>	None observed

The following specific recommendations for the area should be adhered to

- The vegetation unit is classified as having a medium-low sensitivity due to the encroachment and overgrazing observed in the area;
- The development can be supported in this vegetation unit considering the widespread status of this vegetation entity in the Savanna Biome.





Photograph 3. *Acacia mellifera* – *Acacia hebeclada* woodland

#### 5.1.4 MIXED *ACACIA HAEMATOXYLON* – *GREWIA FLAVA* – *ACACIA MELLIFERA* WOODLAND

Two specific variations of this vegetation unit were identified during the surveys according to the landscape and topography. The north-western areas of the remainder of the farm East is characterised by low duneveld, while the western sections of portion 2 of the farm East forms slightly undulating plains.

The vegetation are characterised by dense stands of *Acacia haematoxylon* on the deeper sandy areas, while *Acacia mellifera* dominate where the calcrete bedrock are closer to the surface. The shrub species *Grewia flava* occur on low-lying areas where higher clay content occurs in the soil. Where deeper sand occur on top of dunes or on the deeper, leached soils, isolated individuals of *Terminalia sericea* occurs. Typical grass species associated with this vegetation unit include *Stipagrostis amabilis* (duneveld species), *Enneapogon scabra* and *Schmidtia kalahariense*.

The characteristics of this vegetation unit are summarized in Table 5, while the state of the vegetation indicated in photograph 4 and 5.

**Table 5. Botanical analysis and characteristics of the Mixed *Acacia haematoxylon* – *Grewia flava* – *Acacia mellifera* woodland**

Vegetation unit characteristics	Duneveld	Plains
<b>State of the vegetation:</b>	Natural woodland in a pristine state	
<b>Need for rehabilitation</b>	Low	
<b>Conservation priority</b>	Medium-high	Medium
<b>Characteristics</b>	The dunes are dominated by <i>Acacia haematoxylon</i> , while the lower-lying interdune areas are dominated by <i>Acacia mellifera</i> and <i>Grewia flava</i> .	Even distribution of dominant species <i>Acacia haematoxylon</i> , <i>Acacia mellifera</i> and <i>Grewia flava</i> on medium depth, red Aeolian sands
<b>Soils &amp; Geology</b>	Medium depth red Aeolian (wind-blown) sands on calcrete bedrock. Dunes are calcrete outcrops overlaid by Kalahari sand.	
<b>Dominant spp.</b>	<i>Acacia haematoxylon</i> , <i>Acacia mellifera</i> , <i>Grewia flava</i> , <i>Schmidtia kalaharensis</i> , <i>Crotalaria orientalis</i>	
<b>Density of woody layer</b>	Trees: 10-15% (avg. height: 3-6m) Shrubs: 5-10% (avg. height: 1-2m)	
<b>Density of herbaceous layer</b>	Grasses: 60-70% (avg. height: 0.8-1.2m) Forbs: 1-2% (avg. height: 0.8m)	
<b>Sensitivity</b>	Medium-high	Medium
<b>Red data species</b>	None observed	
<b>Protected species</b>	<i>Acacia haematoxylon</i> <i>Acacia erioloba</i>	

The following specific recommendations for the mixed duneveld on site should be adhered to:

- The duneveld variation of this vegetation unit is classified as having a Medium-High sensitivity due to the sloping terrain and dense stands of protected trees observed in the area, although the plains section has a Medium Sensitivity. The development of a solar park within this vegetation unit should be restricted to flatter areas, while sloping terrain associated with dunes should be avoided;
- The development can be supported provided that a licence is obtained from DAFF for the eradication of the protected trees. The remainder of the site outside of the proposed footprint should be preserved as an offset area.

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Photograph 4. Low mixed duneveld associated with the western section of the project area



Photograph 5. Mixed *Acacia haematoxylon* – *Grewia flava* – *Acacia mellifera* woodland in the western section of portion 2 of the farm East

**5.1.5 ENDORHEIC DEPRESSION**

The depression on site occurs in the central section of the project area on the Remainder of the farm East and forms part of the Kalahari Salt Pans vegetation type (Mucina & Rutherford, 2006). A depression is classified as a landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates. Dominant water sources are precipitation, ground water discharge, interflow and (diffuse or concentrated) overland flow. Dominant hydrodynamics are (primarily seasonal) vertical fluctuations. Pans such as in the study area are flat-bottomed lack in and outlets. For this 'endorheic depression', water exits by means of evaporation and infiltration. Southern Africa is well endowed with endorheic pans or depressions (Allan, Seaman and Kaletja 1995), depending on drainage and aridity. They occur on plains of low relief, as a result of which drainage is poor. Their bases are impervious to downward (vertical) drainage. The base is often calcrete as observed in the study area. Some drainage occurs laterally, both into and out of the pan. Geomorphological processes, including wind-driven deflation, lead to the formation of depressions, which hold water for varying periods (Walsmley, 2003). The pan is not as sensitive as would be expected since it is a closed-off ecosystem with little connectivity with the groundwater. This vegetation entity still has an important functional role as habitats for fauna though and therefore can be classified as having a high sensitivity.

The characteristics of the pan on site are summarized in Table 6, while the state of the vegetation indicated in photograph 6.

**Table 6. Botanical analysis and characteristics of the depression in the project area**

Vegetation unit	Pan (depression)
<b>State of the vegetation:</b>	Slightly degraded depression
<b>Conservation priority</b>	High
<b>Characteristics</b>	Classified as an endorheic pan (depression) according to South African Wetland Classification System (refer to the description above). Represent short grassland and forbs on a pan bottom.
<b>Density of woody layer</b>	Trees: <1% (avg. height: 3-6m) Shrubs: <1% (avg. height: 1-2m)
<b>Density of herbaceous layer</b>	Grasses: 10-15% (avg. height: 0.8-1.2m) Forbs: 30-40% (avg. height: 0.8m)
<b>Sensitivity</b>	High
<b>Red data species</b>	None observed

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**Photograph 6. Pan (depression) in the central section of the project area**

The following specific recommendations for the area should be adhered to for the drainage features on site:

- The vegetation associated with the wetlands has a high sensitivity with a high conservation priority. No major alteration of these important drainage areas is recommended, especially considering it to form part of an important catchment. The potential to impact on the wetland habitat is high and therefore a sufficient buffer zone of 30 meters is applicable for the solar plant, while strict mitigation should be implemented for the access road to allow natural flow underneath the road surface;
- All construction and maintenance activities should be conducted in such a way that minimal damage is caused to the drainage features on site.
- A detailed wetland delineation study should be conducted by a wetland specialist.

## **5.2 FLORA: SPECIES LEVEL ASSESSMENT**

South Africa has been recognized as having remarkable plant diversity with high levels of endemism. The major threats to plants in the study area are urban expansion, non-sustainable harvesting, collecting, overgrazing/browsing, mining and agriculture. The objective of this section was to compile a list of plant species for which there is conservation concern. This included threatened, rare, declining, protected and endemic species.

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### 5.2.1 RED DATA FLORA SPECIES

A list of red data plant species previously recorded in the study area in which the proposed development is planned was obtained from the Plants of Southern Africa (POSA) database of SANBI. There are various categories for Red Data Book species, such as 'Endangered', 'Vulnerable', 'Rare' and 'Near threatened' as listed in the Red Data List of Southern African Plants (Hilton-Taylor 1996). No red data species exist according to the SANBI data base for the grid square 2722BB and no other potential red data species was observed during the surveys.

### 5.2.2 ENDEMIC OR NEAR-ENDEMIC SPECIES

These species are classified as such according to the species' restricted distribution. For the purposes of this assessment this refers to species which are largely restricted to the GWC and should also be protected. Table 7 indicate the two species classified as endemic or near-endemic in the study area.

**Table 7. Plant species endemic or near-endemic to the Griqualand West Centre of endemism, present in the study area**

Species	Status
<i>Searsia tridactyla</i>	Endemic
<i>Tarchonanthus obovatus</i>	Near Endemic

However, as the site falls within the Griqualand West Centre of Endemism the following endemics can also occur within the area:

Tall shrubs: *Lebeckia macrantha*, *Nuxia gracilis*

Low shrubs: *Blepharis marginata*, *Putterlickia saxatalis*, *Tarchonanthus obovatus*

Succulent shrubs: *Euphorbia wilmaniae*, *Prepodesma orpenii*

Graminoids: *Digitaria polyphylla*, *Panicum kalaharensense*

Herbs: *Corchorus pinnatipartitus*, *Helichrysum arenicola*

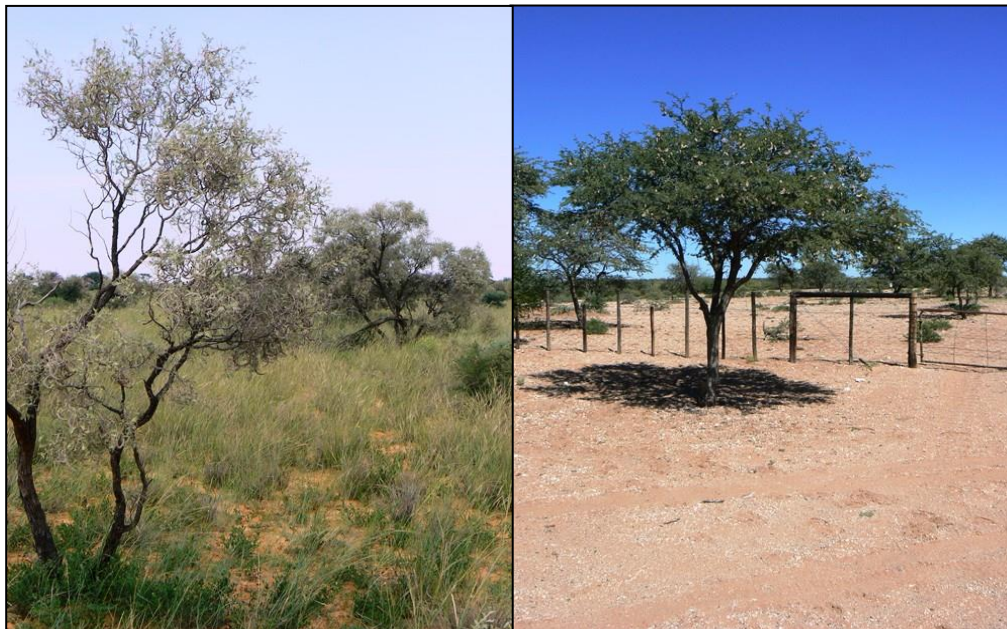
Succulent herb: *Orbea knobelii*

These species' habitat is mainly found on rocky areas and around drainage channels at the edge of dense scrub. No individuals of these plants were observed during the surveys.

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### 5.2.3 PROTECTED TREE SPECIES (NFA)

The National Forest Act (no.84 of 1998: National Forest Act, 1998) provides a list of tree species that are considered important in a South African perspective as a result of scarcity, high utilization, common value, etc. In terms of the National Forest Act of 1998, these tree species may not be cut, disturbed, damaged, destroyed and their products may not be possessed, collected, removed, transported, exported, donated, purchased or sold – except under license granted by DWAF (or a delegated authority). Obtaining relevant permits are therefore required prior to any impact on these individuals. Taking cognizance of the data obtained from the field surveys, the following tree species occur in the area namely *Acacia haematoxylon* (Grey camel thorn, Photograph 7) and *Acacia erioloba* (Camel thorn, Photograph 7). A licence application should therefore be submitted to DAFF before any of these trees can be removed during construction.



Photograph 7. *Acacia haematoxylon* (left) and *Acacia erioloba* (right) protected tree species on site

### 5.2.4 PROTECTED PLANTS (NCNCA)

Plant species are also protected according to the Northern Cape Nature Conservation Act (NCNCA), No. 9 of 2009. According to this Act, no person may pick, import, export, transport, possess, cultivate or trade in a specimen of a specially protected or protected plant species. The Appendices to the Act provide an extensive list of species that are protected, comprising a significant component of the flora expected to occur on site. Communication with Provincial authorities indicates that a permit is required for all these species, if they are expected to be affected by the proposed project. After a detailed survey was conducted during March 2014 and July 2015, no protected plant was found on site.

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### 5.2.5 INVASIVE ALIEN SPECIES

Invasive alien plants pose a direct threat not only to South Africa's biological diversity, but also to water security, the ecological functioning of natural systems and the productive use of land. They intensify the impact of fires and floods and increase soil erosion. Of the estimated 9000 plants introduced to this country, 198 are currently classified as being invasive. It is estimated that these plants cover about 10% of the country and the problem is growing at an exponential rate.

The Alien and Invasive Species Regulations (GNR 599 of 2014) are stipulated as part of the National Environmental Management: Biodiversity Act (10/2004). The regulation listed a total of 559 alien species as invasive and further 560 species are listed as prohibited and may not be introduced into South Africa. Below is a brief explanation of the four categories of Invasive Alien Plants as per the regulation.

- Category 1a: Invasive species requiring compulsory control. Remove and destroy. Any specimens of Category 1a listed species need, by law, to be eradicated from the environment. No permits will be issued.
- Category 1b: Invasive species requiring compulsory control as part of an invasive species control programme. Remove and destroy. These plants are deemed to have such a high invasive potential that infestations can qualify to be placed under a government sponsored invasive species management programme. No permits will be issued.
- Category 2: Invasive species regulated by area. A demarcation permit is required to import, possess, grow, breed, move, sell, buy or accept as a gift any plants listed as Category 2 plants. No permits will be issued for Category 2 plants to exist in riparian zones.
- Category 3: Invasive species regulated by activity. An individual plant permit is required to undertake any of the following restricted activities (import, possess, grow, breed, move, sell, buy or accept as a gift) involving a Category 3 species. No permits will be issued for Category 3 plants to exist in riparian zones

The fight against invasive alien plants is spearheaded by the Working for Water (WfW) programme, launched in 1995 and administered through the DWA. This programme works in partnership with local communities, to whom it provides jobs, and also with Government departments including the Departments of Environmental Affairs and Tourism, Agriculture, and Trade and Industry, provincial departments of agriculture, conservation and environment, research foundations and private companies.

WfW currently runs over 300 projects in all nine of South Africa's provinces. Scientists and field workers use a range of methods to control invasive alien plants.



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These include:

- Mechanical methods - felling, removing or burning invading alien plants.
- Chemical methods - using environmentally safe herbicides.
- Biological control - using species-specific insects and diseases from the alien plant's country of origin. To date 76 bio-control agents have been released in South Africa against 40 weed species.
- Integrated control - combinations of the above three approaches. Often an integrated approach is required in order to prevent enormous impacts.

Vehicles often transport many seeds and some may be of invader species, which may become established along the roads through the area, especially where the area is disturbed. The construction phase of the development will almost certainly carry the greatest risk of alien invasive species being imported to the site, and the high levels of habitat disturbance also provide the greatest opportunities for such species to establish themselves, since most indigenous species are less tolerant of disturbance. The biggest risk is that invasive alien species such as the seeds of noxious plants may be carried onto the site along with materials that have been stockpiled elsewhere at already invaded sites.

Continued movement of personnel and vehicles on and off the site, as well as occasional delivery of materials required for maintenance, will result in a risk of importation of alien species throughout the life of the project. The following alien invasive and exotic plant species were recorded on the site during the surveys (Table 7) although no eradication is needed since these species do not occur on the proposed development footprint:

**Table 8. List of exotic plant species of the study area**

Species	Category
<i>Datura stramonium</i>	1b
<i>Opuntia ficus-indica</i>	1b
<i>Prosopis glandulosa</i>	3

### 5.2.6 GENERAL

An important aspect relating to the proposed development is to protect and manage biodiversity (structure and species composition) of the Kathu Bushveld and Gordonia Duneveld vegetation represented in the project area. Vegetation removal should be kept to a minimum during construction and only vegetation on footprint areas should be removed. Unnecessary impacts on surrounding vegetation types and riverine ecosystems should be avoided as far as possible. Considering the footprint area to form part of a widespread vegetation entity and slightly degraded state of the proposed development sites, the impact on the vegetation of the larger area would be medium. Mitigation measures and monitoring should therefore be implemented should the development be approved.

### 5.3 FAUNAL ASSESSMENT

#### 5.3.1 OVERVIEW

A healthy environment is inhabited by animals that vary from micro-organisms to the birds and mammals. The species composition and diversity are often parameters taken into consideration when determining the state of the environment. A comprehensive survey of all animals is a time consuming task that will take a long time and several specialists to conduct. The alternative approach to such a study is to do a desktop study from existing databases and conduct a site visit to verify the habitat requirements and condition of the habitat. If any rare or endangered species are discovered in the desktop study that will be negatively influenced by the proposed development, specialist surveys will be conducted.

#### 5.3.2 RESULTS OF DESKTOP SURVEY AND SITE VISITS DURING MARCH 2014 AND JULY 2015

A survey was conducted during March 2014 and July 2015 to identify specific fauna habitats, and to compare these habitats with habitat preferences of the different fauna groups (birds, mammals, reptiles, amphibians) occurring in the QDS. The area represents microphyllous woodland with some broadleaf elements in isolated areas. Detailed fauna species list for the area is included in Appendix C (birds), D (mammals) and E (herpetofauna). During the site visits mammals, birds, reptiles, and amphibians were identified by visual sightings through random transect walks. Mammals were recognized as present by means of spoor, droppings, burrows or roosting sites. The 500 meters of adjoining properties were scanned for important fauna habitats.

##### a. Mammal Habitat Assessment

Large mammals such as black rhino that occurred historically at the site, are absent from the area, owing to anthropogenic impacts in recent centuries. Black rhinoceros is today confined to game reserves and national parks in South Africa and therefore will not occur naturally in the study area. This loss of large species means that the mammal diversity at the site is far from its original natural state not only in terms of species richness but also with regards to functional roles in the ecosystem. One large predator of which the existence in the larger area could not be ruled out, is brown hyena (*Hyaena brunnea*). Brown hyena tracks were not found during the surveys.

##### b. Avifaunal Habitat Assessment

Three major bird habitat systems were identified in the study area, including microphyllous woodland, duneveld and wetland habitat (pan). The Kalahari is a dry subset of the woodland biome. It comprises extensive central depression of Southern Africa, characterized by deep Kalahari sands and low rainfall. In the north, where rainfall averages 400 500 mm, the vegetation mostly comprises dense shrubland or woodland dominated by semi deciduous to deciduous acacia, *Terminalia* and *Combretum* trees, and *Acacia*, *Grewia* and *Catophractes alexandri* shrubs.

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The avifauna of the Kalahari is characteristic and essentially comprises a subset of the birds of drier woodlands generally. Many species widespread in moister woodlands avoid the Kalahari, e.g. Greenspotted Dove and Blue Waxbill, with perhaps the absence of surface water in most of the Kalahari providing the major constraint. This is not matched by the presence of any species truly endemic to the Kalahari, as all Kalahari woodland birds also extend into many of the other woodland types, where patches of acacia dominated woodland occur. Nevertheless, the Fawn-coloured Lark and Kalahari Robin are two examples of species with their ranges and abundances obviously centred on the Kalahari vegetation type. Within the Kalahari, many species also show clear differences between the southern and northern Kalahari. For example, the Namaqua Sandgrouse and Sociable Weaver are widespread and common in the south but are uncommon in the north, and the reverse applies to the Lilac-breasted Roller, Fork-tailed Drongo and Marico Flycatcher. Another interesting feature is the large difference in abundance of several species in the central Kalahari across the South Africa Botswana border, e.g. Laughing Dove, White-backed Mousebird, Fiscal Flycatcher and Cape Sparrow. It seems likely that an increase in surface water points, presence of farm homesteads and irrigated farming is responsible for the abundance of these species in South Africa.

**Woodland habitat**, in its undisturbed state, is suitable for a wide range of birds – in fact the woodland species are the most species rich community. Relevant to this study is the fact that many power line sensitive raptor species utilize woodland extensively. Both broadleaf and microphyllous woodland components occur in the study area. Conservation status of many bird species that are dependent on wetlands reflects the critical status of wetland nationally, with many having already been destroyed. In the study area, only small salt pans were observed. These pans are important sources of water for most bird species and will be regularly utilised not only as a source of drinking water and food, but also for bathing. The pans in this study area could also be used as flight paths for certain species. Species such as greater flamingos will utilize the salt pans in the area for foraging during the wet season.

### c. **Reptiles and Amphibians Assessment**

Typical species associated with arid and semi-arid habitat types occur in the study area. Venomous species such as the puff adder, boomslang and cape cobra is expected to occur in the study area, although the presence of these snakes is dependent on the presence of prey species (rodents, frogs etc.). General habitat type for reptiles consists of shrubveld with limited available habitat for diurnally active and sit-and-wait predators, such as terrestrial skinks and other reptiles. Amphibians appear to be poorly represented on site and seasonal pools in the drainage channel represent the most suitable habitat for the few amphibian species that could occur in the area. No threatened herpetofauna occur in the area

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### d. Red data species

According to the existing databases and field survey the following number of fauna species included in the IUCN red data lists can potentially be found in the study area (Table 8):

**Table 9. Red data list of potential fauna for the study area**

English Name	Conservation status
Bateleur	Vulnerable
Black Harrier	Near threatened
Black Stork	Near threatened
Blackwinged Pratincole	Near threatened
Blue Crane	Vulnerable
Cape Vulture	Vulnerable
Chestnutbanded Plover	Near threatened
Greater Flamingo	Near threatened
Kori Bustard	Vulnerable
Lanner Falcon	Near threatened
Lappetfaced Vulture	Vulnerable
Lesser Flamingo	Near threatened
Lesser Kestrel	Vulnerable
Ludwig's Bustard	Vulnerable
Marabou Stork	Near threatened
Peregrine Falcon	Near threatened
Secretarybird	Near threatened
Tawny Eagle	Vulnerable
Whitebacked Vulture	Vulnerable
<b>MAMMALS</b>	
Reddish grey musk shrew	Data deficient
Lesser red musk shrew	Data deficient
Black rhino	Critically endangered
Hartman's mountain zebra	Endangered
Roan antelope	Vulnerable
Brown hyaena	Near threatened
Honey badger	Near threatened
Schreiber's long-fingered bat	Near threatened
African weasel	Data deficient
Geoffroy's Horseshoe bat	Near threatened
Darling's horseshoe bat	Near threatened
Dent's horseshoe bat	Near threatened
Bushveld gerbil	Data deficient

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The following general observations with regards to the study area can be made. Recommendations and mitigating measures need to be implemented to ensure the survival of these species other fauna habitats and feeding grounds:

- The impact of the proposed development on the red data and other mammal species will mostly have a medium probability as a result of the following:
  - The habitat of the red data species such as water birds is mostly in and around the drainage features (on and off the site) that will not be impacted on by the development.
  - If one considers the habitat descriptions of the red data species, some of them are limited in range or threatened as a direct result of habitat loss in the southern African sub-region (blue crane), although other species with large home ranges (e.g martial eagle) are not directly threatened by habitat loss. The impact of development on the red data species would therefore be less than predicted.
  - Larger mammal species such as black rhino and roan antelope no longer occur naturally in the area and are confined to nature reserves;
  - The development would not have a significant impact on the above mentioned red data fauna since the herbaceous layer will be preserved below the solar panels while adequate natural habitat/vegetation would be available on the peripheral habitats outside the study area as.
  - The habitats of the fauna will not be significantly fragmented since the area below the panels will still be available for fauna to move through. Development also won't influence the natural feeding and movement patterns of the existing fauna in the area. Peripheral impacts on the larger area should however still be avoided.
- The protection of different habitat types in the area will be important to ensure the survival of the different animals due to each species' individual needs and requirements. Sufficient natural corridor sections should be protected around the proposed development footprints to allow fauna to move freely between the different vegetation units on the property. In this regard the surrounding shrubveld and woodland areas outside the footprint of the solar plant, and herbaceous layer that will be preserved beneath the solar panels, will be more than sufficient as corridors.

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If the following mitigation and management actions are taken, impacts on faunal populations should be low.

- Where trenches pose a risk to animal safety, they should be adequately cordoned off to prevent animals falling in and getting trapped and/or injured. This could be prevented by the constant excavating and backfilling of trenches during construction process;
- No animals may be poached during the construction of the Photovoltaic Power Plant. Many animals are protected by law and poaching or other interference could result in a fine or jail term;
- Do not feed any wild animals on site;
- Waste bins and foodstuffs should be made scavenger proof;
- Roads in the area should be designed without pavements to allow for the movement of small mammals;
- Power line structures on the site that are associated with the Photovoltaic Power Plant can present electrocution hazards to birds when less than adequate separation exist between energized conductors or between energized conductors and grounded conductors. Avian-safe facilities can be provided by one or more of the following mitigation measures:
  - Increasing separation between conductors to achieve adequate separation for the species involved (larger birds, raptors);
  - Covering energized parts and / or covering grounded parts with materials appropriate for providing incidental contact protection to birds;
  - Applying perch managing techniques such as conspicuous objects and support roosting sites along the power line that would allow large raptors and bustards to safely roost;
  - A detailed avifauna study should address the impact of the power line on birds in more detail.
- Monitoring of the environmental aspects should be done over the longer term to ensure that impacts are limited to a minimum during the construction and operational phases. Monitoring of specific species is necessary to ensure that these species would be unaffected over the longer term by the development. Information on red data species should be provided to construction workers to make them more aware of these fauna and their behaviour.

## 6 POTENTIAL IMPACTS OF THE PROPOSED DEVELOPMENT ON THE FAUNA AND FLORA

An environmental impact is defined as a change in the environment, be it the physical/chemical, biological, cultural and or socio-economic environment. Any impact can be related to certain aspects of human activities in this environment and this impact can be either positive or negative. It could also affect the environment directly or indirectly and the effect of it can be cumulative. There are three major categories of impacts on biodiversity namely:

- Impacts on habitat resulting in loss, degradation and / or fragmentation.
- Direct impacts on fauna and flora and species, for example plants and animals that are endemic / threatened / special to a particular habitat will not be able to survive if that habitat is destroyed or altered by the development.
- Impact on natural environmental processes and ecosystem functioning. This can lead to an accumulated effect on both habitat and species.

There are three levels at which biodiversity can be approached - namely the genetic, the species and the ecosystem levels. Genetic diversity refers to the variation of genes within species. Species diversity refers to the variety and abundance of species within a geographic area. Ecosystem diversity can refer to the variety of ecosystems within a certain political or geographical boundary (National Environmental Management Biodiversity Act, 2004). This biodiversity assessment focused on the description of ecosystem- and species-related biodiversity. It can be expected that if ecosystem diversity is managed effectively, species and genetic diversity should also be protected. Emphasis was therefore placed on the ecosystem diversity (landscape/habitat types) within the proposed development area, with reference to biota observed and expected to utilise these landscapes or habitat types.

### 6.1 POTENTIAL IMPACTS

#### 6.1.1 Direct habitat destruction

##### 6.1.1.1 Description of impact:

Construction of the PV plant and associated infrastructure will result in loss of and damage to natural habitats. During construction phase and maintenance of infrastructure, some habitat modification and alteration will take place. However re-growth of grass under the power line and solar panels will take place. Areas below the panels and power line will have to be cleared (slashed) of excess vegetation at regular intervals in order to allow access to the area for maintenance, to prevent vegetation from intruding into the legally prescribed clearance gap between the ground and the power line conductors and to minimize the risk of fire which can result in electrical flashovers.

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These activities will have an impact on birds breeding, foraging and roosting in or in close proximity of the servitude through modification of habitat. Rehabilitation of some of these areas would be possible but there is likely to be long-term damage in large areas. Most habitat destruction will be caused during the construction of the infrastructure.

### 6.1.1.1.1 Destruction or loss of floral diversity or vegetation communities

The following major impacts of the development will potentially impact on the flora of the site:

- Loss of threatened, “near-threatened” and endemic taxa: The anticipated loss of some of the woodland habitats that support endemic species will result in the local displacement of endemic listed flora;
- The construction will lead to the loss of individual plants such as trees and shrubs that will be cleared on the footprint area;
- The construction activities can impact on surrounding vegetation by dust and altered surface run-off patterns;
- The disturbance of the area could lead to an increase in the growth of alien vegetation;

### 6.1.1.1.2 Loss of faunal diversity through migration and decline in animal numbers

The following major impacts of the development will potentially impact on the faunal habitats of the site:

- The construction activities by heavy vehicles and back-actors could cause fauna mortalities and even impact on small populations of rare / threatened fauna species (e.g. amphibian species in small wetlands);
- Habitat loss and construction activities will force animals out of the area and animal numbers will decrease. This impact could also take place because of hunting and snaring of animals in natural areas.
- When the area is rehabilitated and the new habitats begin to establish, animals will start to return to the area.
- Changes in the community structure: It is expected that the faunal species composition will shift, due to an anticipated loss in habitat surface area. In addition, it is predicted that more generalist species (and a loss of functional guilds) will dominate the study area. Attempts to rehabilitate will attract taxa with unspecialized and generalist life-histories. It is predicted that such taxa will persist for many years before conditions become suitable for succession to progress.



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### 6.1.1.2 Mitigation measures:

- The removal of grassland, indigenous trees and shrubs should be kept to a minimum necessary. Trim, rather than fell of woody species along the power line route where possible. Brushwood should be left for the use of the landowner or the local community, as agreed to by the landowner and with due regard to preventing fire hazards. The clearing and damage of plant growth in these areas should be restricted to the servitude and way leave area. Where protected flora will need to be cleared permits should be obtained from the relevant authority;
- Peripheral impacts around the footprint area on the surrounding vegetation of the area should be avoided and a monitoring programme should be implemented to ensure the impacts are kept to a minimum, while the rehabilitation of the site should be prioritised after the construction has been completed.
- During construction, sensitive habitats must be avoided by construction vehicles and equipment, wherever possible, in order to reduce potential impacts. Only necessary damage must be caused and, for example, unnecessary driving around in the veld or bulldozing natural habitat must not take place.
- All development activities should be restricted to specific recommended areas. The Environment Control Officer (ECO) should control these areas. Storage of equipment, fuel and other materials should be limited to demarcated areas. Layouts should be adapted to fit natural patterns rather than imposing rigid geometries. The entire development footprint should be clearly demarcated prior to initial site clearance and prevent construction personnel from leaving the demarcated area. This would only be applicable to the construction phase of the proposed development.
- The ECO should advise the construction team in all relevant matters to ensure minimum destruction and damage to the environment. The ECO should enforce any measures that he/she deem necessary. Regular environmental training should be provided to construction workers to ensure the protection of the habitat, fauna and flora and their sensitivity to conservation.
- Where holes for poles pose a risk to animal safety, they should be adequately cordoned off to prevent animals falling in and getting trapped and/or injured. This could be prevented by the constant excavating and backfilling during planting of the poles along the lines.
- Poisons for the control of problem animals should rather be avoided since the wrong use thereof can have disastrous consequences for the raptors occurring in the area. The use of poisons for the control of rats, mice or other vermin should only be used after approval from an ecologist.

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- Limit pesticide use to non-persistent, immobile pesticides and apply in accordance with label and application permit directions and stipulations for terrestrial and aquatic applications.
- Monitoring should be implemented during the construction phase of the development to ensure that minimal impact is caused to the fauna and flora of the area.

### 6.1.2 Habitat fragmentation

#### 6.1.2.1 Description of impact:

The construction of the solar plant, access road and power line will result in natural movement patterns being disrupted for a limited period of time and, to a varying degree depending on how different species react to these barriers will result in the fragmentation of natural populations, although the impact will be minimal and restricted to the construction phase.

#### 6.1.2.2 Mitigation measures:

- Use existing facilities (e.g., access roads) to the extent possible to minimize the amount of new disturbance.
- Ensure protection of important resources by establishing protective buffers to exclude unintentional disturbance. All possible efforts must be made to ensure as little disturbance as possible to the sensitive features such as riparian zones and wetlands during construction;
- During construction, sensitive habitats must be avoided by construction vehicles and equipment, wherever possible, in order to reduce potential impacts. Only necessary damage must be caused and, for example, unnecessary driving around in the veld or bulldozing natural habitat must not take place.
- Construction activities must remain within defined construction areas and the road servitudes. No construction / disturbance will occur outside these areas.

### 6.1.3 Increased Soil erosion and sedimentation

#### 6.1.3.1 Description of impact:

The construction activities associated with the development may result in widespread soil disturbance and is usually associated with accelerated soil erosion. Soil erosion promotes a variety of terrestrial ecological changes associated with disturbed areas, including the establishment of alien invasive plant species, altered plant community species composition and loss of habitat for indigenous flora.

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### 6.1.3.2 Mitigation measures:

The following mitigation measures should be implemented to prevent erosion along slopes and drainage channels during trench excavation:

- When possible, topsoil stripping and excavation activities should be scheduled for the low rainfall season (winter);
- The project should be divided into as many phases as possible, to ensure that the exposed areas prone to erosion are minimal at any specific time;
- Cover disturbed soils as completely as possible, using vegetation or other materials;
- Control the flow of runoff to move the water safely off the site without destructive gully formation;
- Trap the sediment before releasing the run-off water off site;
- Sediment control devices need to be installed to capture mobilised sediment. The following sediment control devices are suggested:
  - Sediment filters: use materials such as fine mesh or geofabric to filter run-off prior to discharge;
  - Sediment traps: temporary sedimentation basins;
  - Drop inlet filters: e.g. hay bales and silt fences, which prevent sediment entry into the drainage system;
- Minimize the amount of land disturbance and develop and implement stringent erosion and dust control practices. Control dust on construction sites and access roads using water-sprayers;
- Storm-water and run-off systems: install temporary drains and minimize concentrated water flows. Control storm-water velocity where necessary with temporary energy dissipater structures. Divert run-off around trench excavations or disturbed areas. Institute a storm water management plan including strategies such as:
  - Minimising impervious area;
  - Increasing infiltration to soil by use of recharge areas;
  - Use of natural vegetated swales instead of pipes; or
  - Installing detention or retention facilities with graduated outlet control structures. Hard armor such as riprap (large angular rocks), gabions or interlocking concrete blocks can cover the sides and bottom of drainage channels to withstands the cutting force of flowing water. The soil is first covered with a geotextile filter cloth to prevent mixing of the soil into the rock or stone;

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- Do not allow surface water or storm water to concentrate or to flow down cut/fill slopes or along power line route without erosion protection measures in place;
- Line overflow and scour channels at their points of discharge to prevent soil erosion and point of discharge must be where there is dense natural grass cover;
- Ensure channels do not discharge straight down contours. These must be aligned at such an angle to contours that they have the least possible gradient;
- Temporary water diversion measures are to be designed and protected so that no undue scouring of river banks occurs.
- Have both temporary (during construction) and permanent erosion control plans:
  - Temporary control plans should include:
    - Brush-packing of exposed areas to prevent overgrazing and subsequent erosion;
    - Silt fencing;
    - Temporary silt trap basins;
    - Short term seeding or mulching of exposed soil areas (particularly on slopes);
    - Limitations on access for heavy machinery and the storage of materials to avoid soil compaction;
  - Permanent erosion control plans should focus on the establishment of stable native vegetation communities.
- Protect all areas susceptible to erosion and ensure that there is no undue soil erosion resultant from activities within and adjacent to the construction camp and Work Areas;
- Repair all erosion damage as soon as possible and not later than six months before the termination of the Maintenance Period to allow for sufficient rehabilitation growth;
- Gravel roads must be well drained in order to limit soil erosion;

### 6.1.4 Soil and water pollution

#### 6.1.4.1 Description of impact:

Construction work for the proposed development will always carry a risk of soil and water pollution, with large construction vehicles contributing substantially due to oil and fuel spillages. If not promptly dealt with, spillages or accumulation of waste matter can contaminate the soil and surface or ground water, leading to potential medium/long-term impacts on fauna and flora. During the constructional phase heavy machinery and vehicles as well as sewage and domestic waste from workers would be the main contributors to potential pollution problems.

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### 6.1.4.2 Mitigation measures:

- Water falling on areas polluted with oil/diesel or other hazardous substances must be contained. Any excess or waste material or chemicals should be removed from site and discarded in an environmental friendly way. The ECO should enforce this rule rigorously.
- Chemicals to be stored on an impervious surface protected from rainfall and storm water run-off.
- Spill kits should be on-hand to deal with spills immediately;
- Spillages or leakages must be treated according to an applicable procedure as determined by a plan of action for the specific type of disturbance;
- All construction vehicles should be inspected for oil and fuel leaks regularly and frequently. Vehicle maintenance will not be done on site except in emergency situations in which case mobile drip trays will be used to capture any spills. Drip trays should be emptied into a holding tank and returned to the supplier.

### 6.1.5 Air pollution

#### 6.1.5.1 Description of impact:

The environmental impacts of wind-borne dust, gases and particulates from the construction activities associated with the proposed development are primarily related to human health and ecosystem damage. The proposed development will typically comprise the following sources and associated air quality pollutants:

- Stockpiling (particulate matter);
- Materials handling operations (truck loading & unloading, tipping, stockpiling);
- Vehicle entrainment on paved and unpaved roads;
- Windblown dust-fugitive emissions (stockpiles).

One of the primary impacts on the biophysical environment is linked to emission of dusts and fumes from both the transportation system. Dust pollution will impact the most severe during the construction phase. Construction vehicles and equipment are the major contributors to the impact on air quality. Dust is generated during site clearance for the construction of infrastructure. Diesel exhaust gasses and other hydrocarbon emissions all add to the deterioration in air quality during this phase. Vehicles travelling at high speeds on dirt roads significantly aggravate the problem.

Although the potential for severe fugitive dust impacts is greatest within 100 m of dust-generating activities, there is still the potential for dust to affect vegetation up to five kilometres or more downwind from the source. Sensitivities to dust deposition of the various plant species present in the area are not known. It is therefore difficult to predict which species may be susceptible.

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### 6.1.5.2 Mitigation measures:

- Dust suppression must be undertaken and there should be the implementation of standard dust control measures, including periodic spraying of construction areas and access roads.
- A speed limit (preferably 40 km/hour) should be enforced on dirt roads.

### 6.1.6 Spread and establishment of alien invasive species

#### 6.1.6.1 Description of impact:

The construction of the solar plant almost certainly carries by far the greatest risk of alien invasive species being imported to the site, and the high levels of habitat disturbance also provide the greatest opportunities for such species to establish themselves, since most indigenous species are less tolerant of disturbance. The biggest risk is that seeds of noxious plants may be carried onto the site along with materials that have been stockpiled elsewhere at already invaded sites.

Continued movement of personnel and vehicles on and off the site, as well as occasional delivery of materials required for maintenance, will result in a risk of importation of alien species throughout the life of the project.

#### 6.1.6.2 Mitigation measures:

- Institute strict control over materials brought onto site, which should be inspected for potential invasive invertebrate species and steps taken to eradicate these before transport to the site. Routinely fumigate or spray all materials with appropriate low-residual insecticides prior to transport to or in a quarantine area on site. The Argentine ant is nearly impossible to eradicate once it has established itself.
- Rehabilitate disturbed areas as quickly as possible to reduce the area where invasive species would be at a strong advantage and most easily able to establish.
- Institute a monitoring programme to detect alien invasive species early, before they become established and, in the case of weeds, before the release of seeds.
- Institute an eradication/control programme for early intervention if invasive species are detected, so that their spread to surrounding natural ecosystems can be prevented.

### 6.1.7 Negative effect of human activities and road mortalities

#### 6.1.7.1 Description of impact:

An increase in human activity on the site and surrounding areas is anticipated. The risk of snaring, killing and hunting of certain faunal species is increased. If staff compounds are erected for construction workers, the risk of pollution because of litter and inadequate sanitation and the introduction of invasive fauna and flora are increased. The presence of a large number of construction workers or regular workers during the construction phase on site over a protracted period will result in a greatly increased risk of uncontrolled fires arising from cooking fires, improperly disposed cigarettes etc. Large numbers of fauna are killed daily on roads. They are either being crushed under the tyres of vehicles in the case of crawling species, or by colliding with the vehicle itself in the case of avifauna or flying invertebrates. The impact is intensified at night, especially for flying insects, as result of their attraction to the lights of vehicles.

#### 6.1.7.2 Mitigation measures:

- The minimum staff should be accommodated on the site. If practical, construction workers should stay in one of the nearby villages and transported daily to the site.
- The ECO should regularly inspect the site, including storage facilities and compounds and eradicate any invasive or exotic plants and animals.
- Maintain proper firebreaks around entire development footprint.
- Educate construction workers regarding risks and correct disposal of cigarettes.
- More fauna are normally killed the faster vehicles travel. A speed limit should be enforced (preferably 40 km/hour). It can be considered to install speed bumps in sections where the speed limit tends to be disobeyed. (Speed limits will also lessen the probability of road accidents and their negative consequences).
- Travelling at night should be avoided or limited as much as possible.

## 6.2 IMPACT ASSESSMENT MATRIX

Table 11 indicate the impacts described above and specific ratings of significance the impact will potentially have on the ecological components of the study area:

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Table 10. Impact assessment Matrix

Impacts	Probability	Duration	Scale	Magnitude (WOM)	Magnitude (WM)	Scoring (WOM)	Scoring (WM)
1. Direct habitat destruction	5	5	1	6	2	60 (High)	40 (Moderate)
2. Habitat fragmentation	5	5	2	6	2	65 (High)	45 (Moderate)
3. Soil erosion	4	4	3	8	2	60 (High)	36 (low)
4. Soil and water pollution	4	4	3	6	2	52 (moderate)	36 (low)
5. Air pollution (dust)	5	4	3	8	2	75 (High)	45 (Moderate)
6. Spread and establishment of alien invasives	3	4	2	6	2	36 (Low)	24 (Low)
7. Negative effect of human activities	4	3	2	6	2	44 (Moderate)	28 (Low)



## 7 SENSITIVITY

Following the ecological surveys, the classification of the study area into different sensitivity classes and development zones was based on information collected at various levels on different environmental characteristics. Factors which determined sensitivity classes were as follows:

- Presence, density and potential impact of development on rare, endemic and protected plant species;
- Conservation status of vegetation units;
- Soil types, soil depth and soil clay content;
- Previous land-use;
- State of the vegetation in general as indicated by indicator species.

Below included is the sensitivity map for the proposed development site (Figure 5). Only criteria applicable to the specific vegetation units were used to determine the sensitivity of the specific unit.

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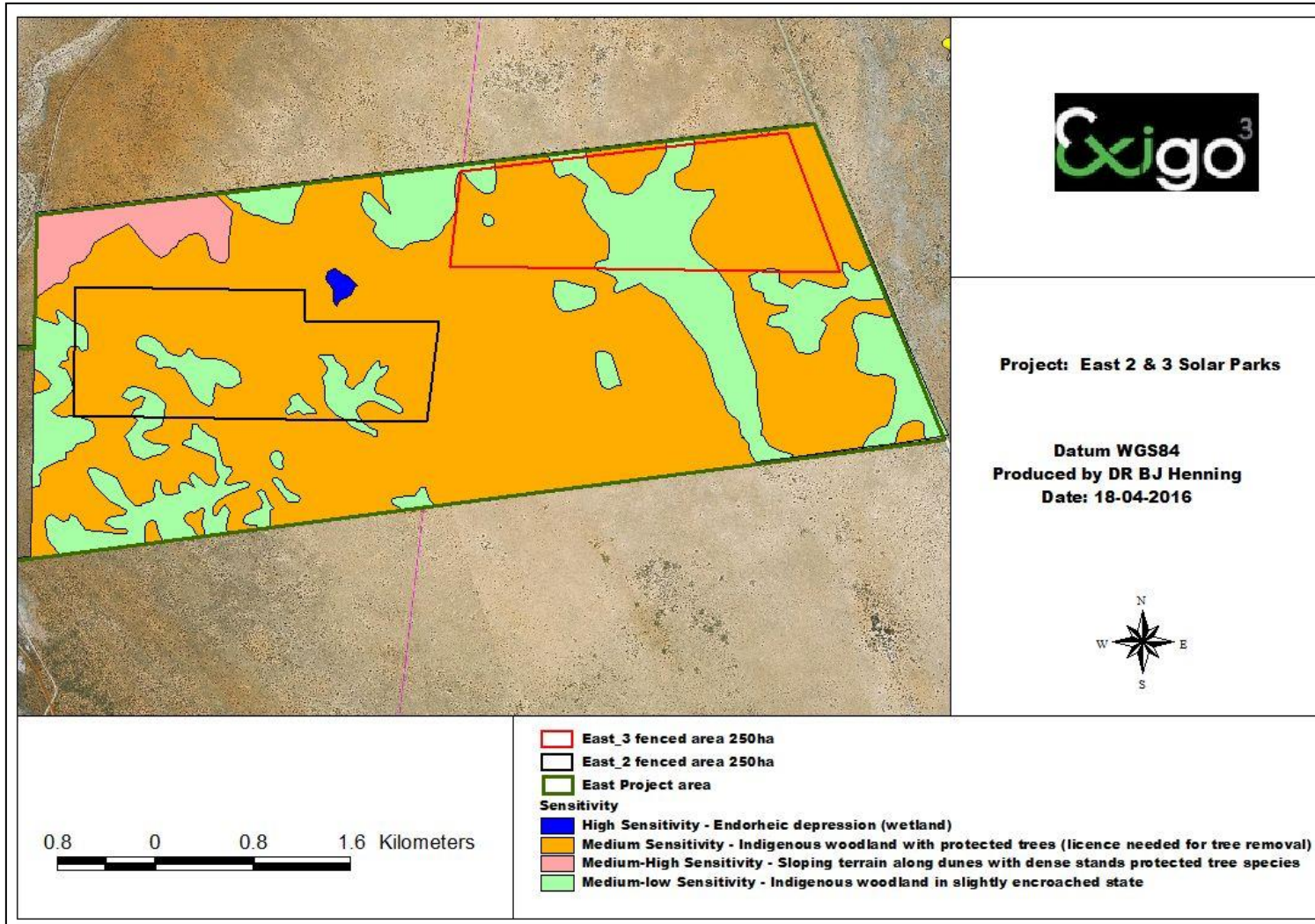


Figure 6. Sensitivity Map of the proposed development site

## 8 DISCUSSION

Most development has an impact on the environment. In this case the area on which the proposed development footprint will be built will be cleared, therefore directly impacting on the environment. Most of the vegetation will be completely modified during the construction. Detailed ecological (fauna habitat & flora) surveys were conducted during March 2014 and July 2015 to verify the ecological sensitivity and ecological components of the site at ground level.

The development will have a medium to high impact on the vegetation and general ecology of the area, due to the sensitive habitats (dunes, pan, woodland with dense stands of protected tree species) that occur in the area, and therefore the least sensitive areas should be considered for the proposed footprint of the East 2 and 3 Solar Parks. Considering the results from the field surveys, mitigation needs to be implemented to prevent any negative impacts on the ecosystem, since most of the site is in a natural state. A sensitivity analyses was conducted to identify the most suitable site for the development. From this investigation and ecological survey, the following main observations was made:

- The duneveld areas have a medium to high sensitivity. These areas play an important role as habitat for fauna and flora. Strict mitigation is needed for the preservation of some sections of this natural vegetation entity. The solar plant development should avoid these areas if possible;
- The most suitable area for the development of the solar farm would be in the woodland areas with a Medium (*Acacia haematoxylon* dominated woodland) or Medium-low Sensitivity (*Acacia mellifera* dominated woodland). Limited mitigation is needed for the preservation of some sections of this natural vegetation entity, and the main mitigation would be to obtain a licence from DAFF for the eradication of the protected tree species. The herbaceous layer should preferably be preserved below the solar panels and managed through slashing during the entire lifetime of the project;
- The pan has a high sensitivity and should be preserved as important fauna and flora habitats. A 30 meter buffer zone should be implemented.

Some potential rare fauna may also occur in the area, and specific mitigation measures need to be implemented to ensure that the impact of the development on the species' habitat will be low. Specific mitigation relating to red data fauna includes the following:

- Disturbances in close vicinity of the development (periphery) should be limited to the smallest possible area in order to protect species habitat;
- Corridors between the development zones are also important to allow fauna to move freely between the areas of disturbance. The preservation of the herbaceous layer below the solar panels will play an important role in this regard and therefore habitat fragmentation for smaller mammals, birds and herpetofauna will be minimal.

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A number of ecological potential impacts were identified and assessed. A few of these were assessed as having potentially medium or high significance, including the following:

- Destruction or disturbance to ecosystems leading to reduction in the overall extent of a particular habitat;
- Impairment of the movement and/or migration of animal species resulting in genetic and/or ecological impacts (habitat fragmentation);
- Increased soil erosion;
- Destruction/permanent loss of rare, endangered, endemic and/or protected species;
- Establishment and spread of declared weeds and alien invader plants;
- Soil and water pollution due to spillages;
- Air pollution as a result of dust;
- Negative effect of human activities and road mortality.

Mitigation measures provided would reduce impacts from a high to low significance. A monitoring plan is recommended for construction phase should the application be approved.

## 9 CONCLUSION

All aspects of the environment, especially living organisms, are vulnerable to disturbance of their habitat. If we can bring about a more integrated approach to living within our ecosystems, we are much more likely to save the fundamental structure of biodiversity. Positive contributions can be made even on a small scale within the proposed East 2 and 3 Solar Parks and associated infrastructure. All stakeholders need to be involved to avoid a loss of biodiversity in the area.

The proposed development site will partially modify the natural vegetation and faunal habitats, although the herbaceous layer will be preserved below the panels. The importance of rehabilitation and implementation of mitigation processes to prevent negative impacts on the environment during and after the development phase should be considered a high priority.

The proposed development should avoid sensitive areas such as duneveld and pan habitats, while sections of the woodland with dense stands of protected trees should be preserved.

Where sensitive areas of natural vegetation cannot be avoided, a number of mitigation measures have been recommended to minimise and/or offset impacts (licence application for eradication of protected species, identification of offset areas). Negative impacts can be minimised by strict enforcement and compliance with an Environmental Management Plan which takes into account the recommendations for managing impacts detailed above.

Provided that the proposed development is consistent with the sensitivity map and take all the mitigation measures into consideration stipulated in this report, the planned development can be supported.

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**APPENDIX A. PLANT SPECIES LIST FOR SITE**

<b>Tree &amp; shrub species</b>	<b>Grass species</b>	<b>Dwarf shrubs, Forbs, succulents &amp; geophytes</b>
<i>Acacia erioloba</i>	<i>Anthehora pubescens</i>	<i>Acanthosicyos naudinianus</i>
<i>Acacia haematoxylon</i>	<i>Aristida congesta</i>	<i>Argemone ochroleuca</i>
<i>Acacia hebeclada</i>	<i>Aristida meridionalis</i>	<i>Bulbostylis hispidula</i>
<i>Acacia mellifera</i>	<i>Digitaria eriantha</i>	<i>Chrysocoma obtusata</i>
<i>Albizia anthelmintica</i>	<i>Enneapogon cenchroides</i>	<i>Citrullis lanatus</i>
<i>Ehretia rigida</i>	<i>Enneapogon desvauxii</i>	<i>Cleome angustifolia</i>
<i>Gewia bicolor</i>	<i>Eragrostis echinocloidea</i>	<i>Convolvulus sagittatus</i>
<i>Grewia flava</i>	<i>Eragrostis pallens</i>	<i>Crotalaria orientalis</i>
<i>Prosopis glandulosa</i>	<i>Eragrostis viscosa</i>	<i>Cucumis zeyheri</i>
<i>Terminalia sericea</i>	<i>Melinis repens</i>	<i>Cyperus obtusiflorus</i>
<i>Ziziphus mucronata</i>	<i>Panicum coloratum</i>	<i>Datura stramonium</i>
	<i>Pogonarthria squarrosa</i>	<i>Dicerocarum eriocarpum</i>
	<i>Schmidtia kalaharensis</i>	<i>Elephanthorhiza elephanthina</i>
	<i>Sporobolus coromadelianus</i>	<i>Giseckia africana</i>
	<i>Stipagrostis amabilis</i>	<i>Heliotropium ciliatum</i>
	<i>Stipagrostis hirtigluma</i>	<i>Hermestaedia fleckii</i>
	<i>Stipagrostis obtusa</i>	<i>Hirpicium echninus</i>
	<i>Tragus racemosus</i>	<i>Indigofera alternans</i>
	<i>Urochloa oligotrocha</i>	<i>Indigofera charlieriana</i>
		<i>Ipomoea magnusiana</i>
		<i>Kedrostis africana</i>
		<i>Kohautia caespitosa</i>
		<i>Limeum argute-carinatum</i>
		<i>Limeum viscosum</i>
		<i>Momordica balsamina</i>
		<i>Monechma genistifolium</i>
		<i>Oxygonum delagoense</i>
		<i>Pavonia burchelli</i>
		<i>Pergularia daemia</i>
		<i>Polygala spp.</i>
		<i>Pupalia lapaceae</i>
		<i>Senecio eenii</i>
		<i>Senna italic</i>
		<i>Sesamum triphyllum</i>
		<i>Sida cordifolia</i>
		<i>Tribulis terrestris</i>
		<i>Turbinia spp.</i>
		<i>Verbesina encelioides</i>
		<i>Walafrida saxatilis</i>



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Tree & shrub species	Grass species	Dwarf shrubs, Forbs, succulents & geophytes
		<i>Xenostegia tridentate</i>

APPENDIX B. PLANT SPECIES LIST FOR QDS 2722BB

Family Name	Species Name
CUCURBITACEAE	<i>Acanthosicyos naudinianus</i>
POACEAE	<i>Anthephora argentea</i>
POACEAE	<i>Aristida adscensionis</i>
POACEAE	<i>Aristida congesta</i>
POACEAE	<i>Aristida congesta subsp. congesta</i>
POACEAE	<i>Aristida stipitata subsp. spicata</i>
POACEAE	<i>Aristida vestita</i>
ASTERACEAE	<i>Berkheya ferox var. tomentosa</i>
POACEAE	<i>Brachiaria marlothii</i>
POACEAE	<i>Chrysopogon serrulatus</i>
CAPPARACEAE	<i>Cleome angustifolia subsp. diandra</i>
POACEAE	<i>Coelachyrum yemenicum</i>
LOPHIOCARPACEAE	<i>Corbichonia rubriviolacea</i>
FABACEAE	<i>Crotalaria virgultalis</i>
FABACEAE	<i>Cullen tomentosum</i>
POACEAE	<i>Cymbopogon pospischilii</i>
POACEAE	<i>Cynodon dactylon</i>
CYPERACEAE	<i>Cyperus margaritaceus var. margaritaceus</i>
ASTERACEAE	<i>Dimorphotheca zeyheri</i>
POACEAE	<i>Enneapogon cenchroides</i>
POACEAE	<i>Enneapogon desvauxii</i>
POACEAE	<i>Eragrostis echinochloidea</i>
POACEAE	<i>Eragrostis lehmanniana var. lehmanniana</i>
POACEAE	<i>Eragrostis pallens</i>
POACEAE	<i>Eragrostis trichophora</i>
POACEAE	<i>Eustachys paspaloides</i>
POACEAE	<i>Fingerhuthia africana</i>
ASTERACEAE	<i>Geigeria ornativa subsp. ornativa</i>
GISEKIACEAE	<i>Gisekia pharnacioides var. pharnacioides</i>
MALVACEAE	<i>Grewia flava</i>
PEDALIACEAE	<i>Harpagophytum procumbens</i>
AMARANTHACEAE	<i>Hermbstaedtia fleckii</i>
FABACEAE	<i>Indigostrum argyraeum</i>
FABACEAE	<i>Indigofera alternans var. alternans</i>
FABACEAE	<i>Indigofera hololeuca</i>
MOLLUGINACEAE	<i>Limeum myosotis var. myosotis</i>
POACEAE	<i>Megaloprotachne albescens</i>

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Family Name	Species Name
FABACEAE	<i>Melolobium candicans</i>
FABACEAE	<i>Melolobium humile</i>
CONVOLVULACEAE	<i>Merremia verecunda</i>
ACANTHACEAE	<i>Monechma genistifolium subsp. australe</i>
IRIDACEAE	<i>Moraea longistyla</i>
IRIDACEAE	<i>Moraea pallida</i>
POLYGONACEAE	<i>Oxygonum delagoense</i>
POACEAE	<i>Panicum coloratum</i>
ASTERACEAE	<i>Pentzia calcarea</i>
POACEAE	<i>Pogonarthria squarrosa</i>
POLYGALACEAE	<i>Polygala leptophylla var. leptophylla</i>
POLYGALACEAE	<i>Polygala seminuda</i>
FABACEAE	<i>Prosopis glandulosa var. glandulosa</i>
FABACEAE	<i>Prosopis velutina</i>
AMARANTHACEAE	<i>Pupalia lappacea var. velutina</i>
RICCIACEAE	<i>Riccia albolimbata</i>
MESEMBRYANTHEMACEAE	<i>Ruschia sp.</i>
CHENOPODIACEAE	<i>Salsola kali</i>
CHENOPODIACEAE	<i>Salsola patentipilosa</i>
POACEAE	<i>Schmidtia kalahariensis</i>
ANACARDIACEAE	<i>Searsia dregeana</i>
ANACARDIACEAE	<i>Searsia erosa</i>
SCROPHULARIACEAE	<i>Selago mixta</i>
AMARANTHACEAE	<i>Sericorema remotiflora</i>
POACEAE	<i>Setaria verticillata</i>
POACEAE	<i>Sporobolus fimbriatus</i>
LAMIACEAE	<i>Stachys spathulata</i>
POACEAE	<i>Stipagrostis ciliata var. capensis</i>
OROBANCHACEAE	<i>Striga gesnerioides</i>
FABACEAE	<i>Tephrosia burchellii</i>
SANTALACEAE	<i>Thesium hystrix</i>
POACEAE	<i>Tragus racemosus</i>
POACEAE	<i>Tricholaena monachne</i>

**APPENDIX C. BIRD SPECIES LIST FOR QDS**

English Name	Map Status	General Status
Abdim's Stork	NBM-U	NBM-C
African Black Duck	R-C	R-U
African Cuckoo	BM-U	BM-U
African Fish Eagle	R-U	R-C
African Hoopoe	R-VC	R(n)-C
African Jacana	R-U	R-VC
African Marsh Harrier	R-U	R-C
African Marsh Warbler	BM-C	BM-C
African Pied Wagtail	R-C	R-C
African Rail	R-C	R/BM-C
African Spoonbill	R-U	R(n)-C
Alpine Swift	BM-U	BM-C
Anteater Chat	E-VC	E-C
Ashy Tit	E-C	Er-U
Baillon's Crake	R-U	R-C
Banded Martin	BM-U	BM-U
Barn Owl	R-C	R-C
Bennett's Woodpecker	R-U	R-U
Black Crake	R-C	R-C
Black Crow	R-U/VC	R-C
Black Eagle	R-C	R-U
Black Egret	R-U	R-LC/R
Black Harrier	NBM-U	E-U
Black Kite	NBM-U	NBM-LC
Black Stork	R-U	R-U/R
Black Swift	BM-U	R-C
Blackbreasted Snake Eagle	R-C	R-U
Blackcheeked Waxbill	R-C	R-LC
Blackchested Prinia	E-VC	Er-C
Blackcrowned Night Heron	R-U	R-C
Blackheaded Heron	R-VC	R-C
Blacknecked Grebe	R-U	R(n)-U
Blackshouldered Kite	R-VC	R(n)-C
Blacksmith Plover	R-A	R-VC
Blacktailed Godwit	Rare	NBM-R
Blackthroated Canary	R-VC	R-C
Blackwinged Pratincole	NBM-U	NBM-LA
Blackwinged Stilt	R-C	R-C
Blue Crane	E-U	E-U
Bluecheeked Bee-eater	NBM-U	NBM-LC

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English Name	Map Status	General Status
Bokmakierie	E-VC	Er-C
Booted Eagle	NBM-U	R/NBM-C
Bradfield's Swift	E-U	Er-C
Brownhooded Kingfisher	R-C	R-C
Brownthroated Martin	R-C	R-C
Brubru	R-U	R-C
Buffy Pipit	R-U	R-U
Burchell's Coucal	R-U	R-C
Burchell's Courser	E-U	Er-U
Burchell's Sandgrouse	E-C	E-C
Cape Bunting	R-U	R-C
Cape Penduline Tit	E-C	Er-C
Cape Reed Warbler	R-C	R-C
Cape Robin	R-VC	R-C
Cape Shoveller	E-VC	Er-C
Cape Sparrow	E-A	Er-VC
Cape Teal	R-C	R-C
Cape Turtle Dove	R-A	R-VC
Cape Vulture	E-U	E-LC
Cape Wagtail	R-VC	R-C
Capped Wheatear	R-C	R/BM-C
Cardinal Woodpecker	R-U	R-C
Caspian Plover	NBM-C	NBM-U
Cattle Egret	R-A	R-C
Chat Flycatcher	E-C	Er-C
Chestnutbanded Plover	R-U	R-U
Common Moorhen	R-C	R-C
Common Quail	R-U	R/BM/NBM-C
Common Sandpiper	NBM-C	NBM-C
Common Waxbill	R-VC	R-C
Crested Barbet	R-U	R-C
Crimsonbreasted Shrike	E-VC	Er-C
Crowned Plover	R-VC	R-C
Curlew	NBM-U	NBM-U
Curlew Sandpiper	NBM-C	NBM-VC
Dabchick	R-VC	R-C
Darter	R-U/C	R-C
Desert Barred Warbler	E-U	Er-C
Desert Cisticola	R-C	R-C
Diederik Cuckoo	BM-C	BM-VC
Doublebanded Courser	R-C	R-LC
Dusky Sunbird	E-VC	Er-C

## East 2 & 3 Solar Park Ecological Study

English Name	Map Status	General Status
Eastern Clapper Lark	E-C	Er-C
Egyptian Goose	R-VC	R-A
Ethiopian Snipe	R-U	R-LC
Eurasian Bee-eater	NBM-VC	NBM/BM-C
Eurasian Golden Oriole	NBM-U	NBM-U
Eurasian Marsh Harrier	NBM-U	NBM-R
Eurasian Nightjar	NBM-U	R-U
Eurasian Roller	NBM-U	NBM-C
Eurasian Swallow	NBM-VC	NBM-A
Eurasian Swift	NBM-U	NBM-C
Fairy Flycatcher	NBM-C	E-C
Familiar Chat	R-VC	R-C
Fantailed Cisticola	R-C	R-VC
Fawncoloured Lark	R-VC	R-C
Feral Pigeon	R-C	R-A
Fiscal Flycatcher	E-VC	E-C
Fiscal Shrike	R-A	R-C
Forktailed Drongo	R-VC	R-C
Fulvous Duck	R-U	R-C
Gabar Goshawk	R-U	R-C
Garden Warbler	NBM-U	NBM-C
Giant Eagle Owl	R-U	R-U
Giant Kingfisher	R-U	R-U
Glossy Ibis	R-C	R-U
Glossy Starling	E-VC	Er-C
Golden Bishop	R-U/C	R(n)-LC
Goldenbreasted Bunting	R-U/VC	R-U
Goldentailed Woodpecker	R-U	R-C
Goliath Heron	R-C	R-U
Grassveld Pipit	R-VC	R-C
Great Crested Grebe	R-U	R(n)-U
Great Reed Warbler	NBM-U	NBM-C
Great Sparrow	R-C	R-U
Great Spotted Cuckoo	BM-U	NBM-U
Great White Egret	R-U/C	R-C
Greater Flamingo	R-C	R(n)-LA
Greater Honeyguide	R-U	R-U
Greater Kestrel	R-C	R-C
Greater Striped Swallow	BM-VC	BM-C
Greenshank	NBM-C	NBM-C
Grey Heron	R-C	R-C
Grey Hornbill	R-C	R-C

## East 2 & 3 Solar Park Ecological Study

English Name	Map Status	General Status
Greybacked Finchlark	E-C	Er-VC
Greyheaded Gull	R-C	R-VC
Groundscraper Thrush	R-VC	R-C
Gymnogene	R-U	R-C
Hadedda Ibis	R-C/VC	R-A
Hamerkop	R-VC	R-C
Helmeted Guineafowl	R-VC	R-VC
Horus Swift	BM-U	BM-LC
Hottentot Teal	R-C	R-C
House Martin	NBM-U	NBM-LC
House Sparrow	R-VC	R-VC
Icterine Warbler	NBM-U	NBM-C
Jackal Buzzard	E-U	E-C
Jacobin Cuckoo	BM-C	BM-C
Kalahari Robin	E-VC	Er-C
Karoo Robin	E-VC	E-C
Karoo Thrush	E-VC	E-C
Kittlitz's Plover	R-C	R-C
Knobilled Duck	R-U	R-LC
Kori Bustard	R-VC	R-R
Kurrichane Buttonquail	R-U	R(n)-U/LC
Lanner Falcon	R-C	R-C
Lappetfaced Vulture	R-U/C	R-U
Larklike Bunting	E-VC	Er-VC
Laughing Dove	R-A	R-VC
Lesser Flamingo	R-C	R(n)-LA
Lesser Grey Shrike	NBM-C	NBM-C
Lesser Honeyguide	R-U	R-LC
Lesser Kestrel	NBM-C	NBM-VC
Levaillant's Cisticola	R-U	R-C
Lilacbreasted Roller	R-VC	R/LM-C
Little Bittern	R-U	R/NBM-U
Little Egret	R-C	R-C
Little Stint	NBM-C	NBM-C
Little Swift	R-VC	R/BM-VC
Longbilled Crombec	R-VC	R-C
Longtailed Widow	R-VC	R(n)-C
Maccoa Duck	R-VC	R-U
Malachite Kingfisher	R-U	R-C
Marabou Stork	R-U	R-R/LC
Marico Flycatcher	E-C	Er-C
Marsh Owl	R-U	R-C

## East 2 & 3 Solar Park Ecological Study

English Name	Map Status	General Status
Marsh Sandpiper	NBM-C	NBM-C
Martial Eagle	R-C	R-U
Masked Weaver	R-VC	R-C
Melba Finch	R-U	R-C
Monotonous Lark	E-U	Er-C
Montagu's Harrier	NBM-U	NBM-R
Mountain Chat	E-VC	Er-C
Namaqua Dove	R-VC	R-VC
Namaqua Sandgrouse	E-VC	Er-C
Neddicky	R-C	R-C
Old World Painted Snipe	R-U	R-U
Orange River Francolin	R-U	R-C
Orange River White-eye	E-VC	E-VC
Orangethroated Longclaw	E-VC	E-C
Ostrich	R-C	R-C
Pale Chanting Goshawk	E-VC	Er-C
Palewinged Starling	E-VC	Er-C
Palm Swift	R-U	R-C
Paradise Whydah	R-U	R-C
Pearlbreasted Swallow	NBM-U	R/BM-C
Pearlspotted Owl	R-C	R-C
Peregrine Falcon	R-U	R/NBM-R
Pied Avocet	R-C	R-LC
Pied Barbet	E-VC	Er-C
Pied Crow	R-A	R-A
Pied Kingfisher	R-C	R-C
Pied Starling	E-C	E-C
Pinkbilled Lark	E-C	Er-C
Pintailed Whydah	R-VC	R(n)-C
Pirit Batis	E-VC	Er-C
Purple Gallinule	R-U	R-C
Purple Heron	R-U	R-U
Purple Roller	R-C	R-U
Pygmy Falcon	R-U	R-C
Quail Finch	R-U/C	R-C
Red Bishop	R-VC	R-C
Redbacked Shrike	NBM-VC	NBM-C
Redbilled Firefinch	R-U	R-C
Redbilled Quelea	R-VC	R(n)-LA
Redbilled Teal	R-C	R-C
Redbilled Woodhoopoe	R-U	R-C
Redbreasted Swallow	BM-C	BM-C

## East 2 & 3 Solar Park Ecological Study

English Name	Map Status	General Status
Redcapped Lark	R-C	R(n)-C
Redchested Cuckoo	BM-U	BM-C
Redcrested Korhaan	E-VC	Es-C
Redeyed Bulbul	E-A	Er-VC
Redeyed Dove	R-VC	R-C
Redfaced Mousebird	R-VC	R-C
Redheaded Finch	E-VC	Er-VC
Redknobbed Coot	R-VC	R-A
Reed Cormorant	R-VC	R-C
Ringed Plover	NBM-U	NBM-C
Rock Bunting	R-U	R(n)-LC
Rock Kestrel	R-U/VC	R-C
Rock Martin	R-VC	R-C
Rock Pigeon	R-VC	R-C
Ruddy Turnstone	NBM-U	NBM-C
Ruff	NBM-U/C	NBM-C
Rufouscheeked Nightjar	BM-C	BM-C
Rufouseared Warbler	E-U	E-C
Rufousnaped Lark	R-U	R-C
Sabota Lark	E-VC	Er-C
Sacred Ibis	R-VC	R-C
Sand Martin	NBM-U	NBM-C
Sanderling	NBM-U	NBM-C
Scalyfeathered Finch	E-VC	Er-C
Scimitar billed Woodhoopoe	R-VC	R-C
Secretarybird	R-C	R-U
Shafttailed Whydah	E-U	Er-C
Shorttoed Rockthrush	E-U/C	Er-U
Sociable Weaver	E-U	E-C
South African Cliff Swallow	BM-C	Ebm-LC
South African Shelduck	E-VC	E-C
Southern Greyheaded Sparrow	E-VC	Er-C
Southern Pochard	R-C	R-C
Southern Yellowbilled Hornbill	E-VC	Er-C
Spikeheeled Lark	E-VC	Er-C
Spotted Dikkop	R-C	R-C
Spotted Eagle Owl	R-C	R-C
Spotted Flycatcher	NBM-C	NBM-C
Spurwinged Goose	R-C	R-VC
Squacco Heron	NBM-U	R/NBM-U
Steelblue Widowfinch	R-U	R(n)-C
Steppe Buzzard	NBM-C	NBM-C



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English Name	Map Status	General Status
Stonechat	R-U	R-VC
Swainson's Francolin	E-VC	Er-C
Swallowtailed Bee-eater	R-U/VC	R-LC
Tawny Eagle	R-U	R-LC
Temminck's Courser	R-U	R-U
Threebanded Plover	R-VC	R-C
Threestreaked Tchagra	R-U	R-C
Tinkling Cisticola	R-U	R-U
Titbabbler	E-VC	Er-C
Violeteared Waxbill	E-U	Er-LC
Wattled Starling	R-VC	R(n)-LA
Whimbrel	NBM-U	NBM-C
Whiskered Tern	BM-C	R(n)-LC
White Stork	NBM-C	NBM-C
Whitebacked Duck	R-U	R-U
Whitebacked Mousebird	E-VC	E-C
Whitebacked Vulture	R-U	R-C
Whitebellied Sunbird	R-U	R-C
Whitebreasted Cormorant	R-VC	R-C
Whitebrowed Sparrowweaver	R-VC	R-VC
Whitefaced Duck	R-VC	R-C
Whitefaced Owl	R-U	R-C
Whitefronted Bee-eater	R-U	R-C
Whiterumped Swift	BM-C	BM-VC
Whitethroat	NBM-U	NBM-U
Whitethroated Canary	E-U	Er-C
Whitethroated Swallow	BM-C	BM-C
Whitewinged Korhaan	E-VC	E-VC
Whitewinged Tern	NBM-C	NBM-A
Willow Warbler	NBM-C	NBM-VC
Wood Sandpiper	NBM-C	NBM-C
Yellow Canary	E-VC	Er-C
Yellowbellied Eremomela	R-C	R-U
Yellowbilled Duck	R-VC	R-A
Yellowbilled Egret	R-C	R-U
Yellowbilled Kite	BM-U	BM-C
Yellowbilled Stork	NBM-U	NBM/R-LC

R=RESIDENT; E=ENDEMIC; BM=BREEDING MIGRANT; NBM=NON-BREEDING MIGRANT; V=VAGRANT; A=ABUNDANT;  
VC=VERY COMMON; C=COMMON; U=UNCOMMON; R=RARE

## East 2 & 3 Solar Park Ecological Study

### APPENDIX D MAMMAL SPECIES LIST

Scientific name	Vernacular name	Status (Friedman & Daly, 2004)
<i>Aethomys namaquensis</i>	Namaqua rock mouse	Least concern
<i>Alcelaphus buselaphus</i>	Red hartebeest	Least concern
<i>Antidorcas marsupialis</i>	Springbok	Least concern
<i>Canis mesomelas</i>	Black backed jackal	Least concern
<i>Caracal caracal</i>	Caracal	Least concern
<i>Ceratotherium simum</i>	White Rhino	Least concern
<i>Connochaetes taurinus taurinus</i>	Blue wildebeest	Least concern
<i>Crocidura cyanea</i>	Reddish grey musk shrew	Data deficient
<i>Cynictus penicillata</i>	Yellow mongoose	Least concern
<i>Crocidura hirta</i>	Lesser red musk shrew	Data deficient
<i>Cryptomys hottentotus</i>	Common mole rat	Least concern
<i>Desmodillus auricularis</i>	Short-tailed gerbil	Least concern
<i>Diceros bicornis bicornis</i>	Black rhino	Critically endangered
<b><i>Equus zebra hartmannae</i></b>	<b>Hartman's mountain zebra</b>	<b>Endangered</b>
<i>Felis nigripes</i>	Black footed cat	Least concern
<i>Felis silvestris</i>	African wild cat	Least concern
<i>Galerella pulverulenta</i>	Small grey mongoose	Least concern
<i>Galerella sanguinea</i>	Slender mongoose	Least concern
<i>Genetta genetta</i>	Small spotted genet	Least concern
<i>Gerbilurus paeba</i>	Hairy footed gerbil	Least concern
<i>Giraffae camelopardalis</i>	Giraffe	Least concern
<b><i>Hippotragus equinus</i></b>	<b>Roan antelope</b>	<b>Vulnerable</b>
<b><i>Hyaena brunnea</i></b>	<b>Brown hyaena</b>	<b>Near threatened</b>
<i>Hystrix africaeaustralis</i>	Porcupine	Least concern
<i>Ictonyx striatus</i>	Striped polecat	Least concern
<i>Lepus capensis</i>	Cape hare	Least concern
<i>Lepus saxatilis</i>	Schrub hare	Least concern
<i>Malacothrix typica</i>	Large-eared mouse	Least concern
<i>Mastomys coucha</i>	Multimammate mouse	Least concern
<b><i>Mellivora capensis</i></b>	<b>Honey badger</b>	<b>Near threatened</b>
<b><i>Miniopterus schreibersii</i></b>	<b>Schreiber's long-fingered bat</b>	<b>Near threatened</b>
<i>Neoromicia capensis</i>	Cape serotine bat	Least concern
<i>Nycteris thebaica</i>	Common slit-faced bat	Least concern
<i>Oreotragus oreotragus</i>	Klipspringer	Least concern
<i>Orycteropus afer</i>	Antbear	Least concern
<i>Oryx gazella</i>	Gemsbok	Least concern
<i>Otocyon megalotis</i>	Bat-eared fox	Least concern

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Scientific name	Vernacular name	Status (Friedman & Daly, 2004)
<i>Panthera pardus</i>	Leopard	Least concern
<i>Pedetes capensis</i>	Springhare	Least concern
<i>Poecilogale albinucha</i>	African weasel	Data deficient
<i>Procavia capensis</i>	Rock dassie	Least concern
<i>Pronolagus capensis</i>	Smith's red rock rabbit	Least concern
<i>Proteles cristatus</i>	Aardwolf	Least concern
<i>Raphicerus campestris</i>	Steenbok	Least concern
<i>Rhabdomys pumilio</i>	Striped mouse	Least concern
<b><i>Rhinolophus clivus</i></b>	<b>Geoffroy's Horseshoe bat</b>	<b>Near threatened</b>
<b><i>Rhinolophus darlingii</i></b>	<b>Darling's horseshoe bat</b>	<b>Near threatened</b>
<b><i>Rhinolophus denti</i></b>	<b>Dent's horseshoe bat</b>	<b>Near threatened</b>
<i>Saccostomus campestris</i>	Pouched mouse	Least concern
<i>Suricata suricatta</i>	Suricate	Least concern
<i>Sylvicapra grimmia</i>	Common duiker	Least concern
<i>Tadarida aegyptiaca</i>	Egyptian free-tailed bat	Least concern
<i>Tatera brantsii</i>	Highveld gerbil	Least concern
<i>Tatera leucogaster</i>	Bushveld gerbil	Data deficient
<i>Tragelaphus sterpsiceros</i>	Kudu	Least concern
<i>Vulpes chama</i>	Cape fox	Least concern
<i>Xerus inaris</i>	Cape ground squirrel	Least concern

**APPENDIX E HERPETOFAUNA LIST**

Common Name	Status
<b>AMPHIBIANS</b>	
Bubbling Kassina	Least Concern
Eastern Olive Toad	Least Concern
Flat-backed toad	Least Concern
Common river frog	Least Concern
<b>REPTILES</b>	
Bibron's thick toed gecko	Least Concern
Boomslang	Least Concern
Bushveld lizard	Least Concern
Brown house snake	Least Concern
Cape Cobra	Least Concern
Cape skink	Least Concern
Cape thick-toed gecko	Least Concern
Cape wolf snake	Least Concern
Cape, Namib and Fork-Marked sand snakes	Least Concern
Common barking gecko	Least Concern
Common egg eater	Least Concern
Common night adder	Least Concern
Common rough scaled lizard	Least Concern
Delalande's beaked blind snake	Least Concern
Dusky spade-snouted worm lizard	Least Concern
Beetz' Tiger snake	Least Concern
Flap-neck chameleon	Least Concern
Giant ground gecko	Least Concern
Ground agama	Least Concern
Herald snake	Least Concern
Horned Adder	Least Concern
Kalahari round headed worm lizard	Least Concern
Kalahari sand snake	Least Concern
Kalahari tent tortoise	Least Concern
Kalahari tree skink	Least Concern
Kalahari whip snake	Least Concern
Karoo girdled lizard	Least Concern
Karoo sand snake	Least Concern
Leopard tortoise	Least Concern
Marsh terrapin	Least Concern
Mole snake	Least Concern
Mountain skink	Least Concern
Namaqua sand lizard	Least Concern

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Common Name	Status
Peter's thread snake	Least Concern
Puffadder	Least Concern
Rock Monitor	Least Concern
Southern stiletto snake	Least Concern
Southern rock agama	Least Concern
Spotted sandveld lizard	Least Concern
Spotted sand lizard	Least Concern
Sundevall's shovel snout	Least Concern
Thin-tailed legless skink	Least Concern
Variegated skink	Least Concern
Western rock skink	Least Concern
Western three striped skink	Least Concern
Yellow-throated plated lizard	Least Concern