ECOLOGICAL SCOPING REPORT

PROPOSED BLACKWOOD SOLAR ENERGY FACILITY NEAR KIMBERLEY

FREE STATE

August 2013

Prepared for:
Blackwood Solar Energy Facility (Pty) Ltd

Prepared by:

Savannah Environmental Pty Ltd

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Executive Summary

Blackwood Solar Energy Facility (Pty) Ltd has appointed Savannah Environmental (Pty) Ltd to manage the application for a 75 MW photovoltaic Solar Energy Facility on portion 1 of the farm Pandamsfontein 1593. It is located in the Tokologo Local Municipality, approximately 25 km south-east of Kimberley, between the N8 road and the railway line going in the direction of Modderrivier and Petrusburg. The final placement of the proposed energy facility, which will occupy approximately 200 ha, will depend on the sensitivities identified during the scoping and EIA phase.

This report discusses the approach and findings of a desktop survey carried out for the study area. The main objective of this scoping investigation is to assess the likelihood of ecological sensitivities occurring on the study area in an effort to identify any issues regarding fauna and flora that should receive further attention during the EIA assessment phase.

The study area is situated in the Savanna biome, Eastern Kalahari Bushveld. The vegetation unit covering the study area is Kimberley Thornveld. Other vegetation units that may be affected if the alternative option for the grid connection must be followed include Vaalbos Rocky shrubland and Highveld Salt Pans. Vegetation overall is considered as of least conservation concern, but within the vegetation types more sensitive communities, habitats and species of conservation concern, including protected trees, are expected to be present.

The landscapes within the study area are generally flat to slightly undulating plains, covered by an open to sparse low thorn savanna. The tree and shrub layer is well developed, albeit occurring in a very patchy mosaic. Tree species dominating within this vegetation unit are *Boscia albitrunca, Acacia erioloba,* (both species protected nationally), *A. tortilis,* and *A. karroo*. Dominant shrubs include *Tarchonanthus camphoratus* and *A. mellifera* subsp. *detinens*. Both these shrub species may increase significantly once the herbaceous layer is weakened, with the possibility of forming impenetrable thickets. The grass layer can be patchy and open with large areas of bare soil during the dry season, which is prone to capping, sheet erosion, and degradation.

Within the plains are occasional dolerite intrusions and possibly areas of surface calcrete, forming slight raises to extensive ridges or outcrops that are more isolated. These are mostly covered by a shrubveld with a mixture of differently sized shrubs, and a very variable herb layer (both seasonally and spatially variable). It is expected that several protected species, many of them succulent, will be present on these elevated areas. Depressions of various sizes have developed into pans, mostly salt-pans due to the continued deposition of lime-rich

sediments from surrounding runoff. Many of the larger pans are frequented by flocks of Flamingo and other water-based avifauna during the rainy season.

It is expected that a high number of geophytes (plants that have underground storage tubers and die back after the growing season) will be present in the study area. Many of these are protected and may have red data status. It will thus be important that the field investigation will only be conducted after sufficient rain, preferably between February and April.

Areas with deeper sandy soils are expected to have a higher density of protected tree species – so far only the presence of trees can be confirmed from Google-Earth imagery; the identity of such species can only be verified by ground studies.

Further potentially sensitive areas include those that are expected to be prone to bare patch formation (indicated by distinct banded patterning of vegetation) and more rocky areas with assumed higher species diversity. Depending on their location within the general landscape, these could have a rating of medium sensitivity or higher.

The above types of habitat are more sensitive primarily because of their ecosystem function and associated vegetation. Fauna and flora depend on this ecosystem functionality, which provides specialised niches for fauna and flora, creates corridors in the landscape, filters water, traps sediments and slows water runoff from catchments to retain water, seed and nutrient resources within the ecosystem.

The only No-Go areas so far identified are larger salt pans; areas of potential high(er) sensitivity have been mapped on a preliminary basis. A more detailed investigation will be undertaken as part of the EIA phase.

The initial mapping has been done conservatively and could be significantly revised after a detailed field investigation, which will also determine if the proposed development needs to be excluded from these areas or if mitigation measures can be sufficient to minimise impacts.

Overall, no significant ecological flaws that could pose a problem to the proposed PV facility development could be identified during a desktop study. This will have to be confirmed during a detailed field investigation of the ecology of the area. *As mentioned above, several plant species of conservation concern will only be visible and/or identifiable during the growing season as they may be dormant otherwise. The EIA field investigation that will most accurately record biodiversity and inform decision makers, should be conducted between February and April.*

The most significant potential impacts expected are:

- A loss of large trees (regardless of protection status), leading to wider impacts than just the loss of trees themselves. In the prevailing semi-arid environment of the study area, large trees are usually keystone species. This implies that with the removal of such trees, a host of other fauna and flora species will be affected due to the drastic change or complete obliteration of microhabitats associated with these trees. The loss of mature, large trees can lead to a permanent loss of these trees and their ecosystem function from the environment, as trees grow very slowly and recruitment events in the study area are very limited, all due to the highly variable and generally low rainfall. This effect may become worse with prevailing changes in rainfall patterns due to climate change. The destruction of large trees must be totally avoided or limited to the absolute minimum.
- Reduction of a stable vegetation cover and associated below-ground biomass that currently stabilises sandy plains and areas prone to bare patch formation. Without this vegetation, accelerated erosion and loss of ecosystem resources will lead to potentially irreversible degradation on and beyond the development.
- Destruction of diverse niches provided by rocky outcrops, their footslopes and possibly also rocky plains. Once these habitats are destroyed by grading, the species that are dependent on those niches will also not be able to re-establish. Although higher outcrops can be considered unsuitable for the proposed development in any case, the extent of rocky plains and footslopes that should be excluded from the development needs to be verified during a detailed field visit.
- Possible impacts can occur on pans that may be present on the study area, as well as ephemeral washes and larger drainage lines due to altered surface hydrology of the surrounding plains. This may influence species depending on these parts of the ecosystem, as well as downstream wetland ecosystems. The proposed developments must thus retain as large a buffer as possible from pans, washes and drainage lines (a minimum of 100 m is recommended, preferably more) to avoid all possible impacts on them.

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1. General Information

1.1. Applicant

Blackwood Solar Energy Facility (Pty) Ltd have appointed Savannah Environmental (Pty) Ltd to manage the EIA process for a photovoltaic Solar Energy Facility in the Free State, 25 km south-east of Kimberley.

Project
Blackwood Solar Energy Facility

Proposed Activity

» A PV array with a generating capacity of 75 MW
  - The mechanism still has to be decided upon, both tracking and fixed-panel options are being considered

» Appropriate mounting structures
» Cabling between the project components, to be lain underground where practical
» An on-site substation and overhead power line to facilitate the connection between the solar energy facility and the Eskom grid via one of the following options:
  - A loop in/loop out of the 132kV power line which traverses the site (preferred option);
  - Construction of an overhead distribution power line to the Boundary Substation (alternative option), either following the shortest route or as far as possible along existing Eskom lines.

» Internal access roads and fencing around the site
» Workshop area for maintenance, storage, and offices
» Upgrading of existing access roads and possibly creating new access roads to the proposed development site
» Construction of associated infrastructure such as workshops, office, guard houses
» As part of the construction process, most of the vegetation on the development site will need to be cleared at least temporarily

1.2. Declaration of Independence

A signed declaration of independence for the investigating specialist is attached in Appendix A.

1.3. Specialist Investigator

This report has been prepared by:
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In collaboration with Blair Zoghby (BSc Hons Zoology)
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A *Curriculum Vitae* and summary of expertise of the compiler is attached as Appendix B of this document

Specialist affiliation
South African Council for Natural Scientific Professions (SACNASP) (PrSciNat; Registration no. 400079/10, Botanical Science, Ecological Science)
South African Association of Botanists (www.sabotany.com)
Desert Net International (www.european-desertnet.eu)

1.4. Conditions of this report

Findings, recommendations and conclusions provided in this report are based on the authors' best scientific and professional knowledge and information available at the time of compilation. The author, however, accepts no liability for any actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, and by the use of the information contained in this document. No form of this report may be amended or extended without the prior written consent of the author. Any recommendations, statements or conclusions drawn from or based on this report must clearly cite or make reference to this report. Whenever such recommendations, statements or conclusions form part of a main report relating to the current investigation, this report must be included in its entirety.

Scope and Purpose of Report
To conduct an ecological desktop study for a scoping assessment of the selected study area where the establishment of a Solar Energy Facility and grid connection options is proposed and provide a professional opinion on ecological issues listed pertaining to the target area to aid in future decisions regarding the proposed project.

1.5. Legislation

This study has been conducted in accordance with the following legislation:

1.5.1. Provincial

- The Nature Conservation Ordinance (NCO) 8 of 1969 and subsequent amendments
    - Note: The Free State Conservation Bill as published in the Provincial Gazette 23 of 2010 has yet to be promulgated

1.5.2. National

- National Environmental Management Act / NEMA (Act No 107 of 1998), and all amendments and supplementary listings and/or regulations
- Environment Conservation Act (ECA) (No 73 of 1989) and amendments
- National Environmental Management Act: Biodiversity Act (NEMA:BA) (Act No. 10 of 2004) and amendments
- National list of ecosystems that are threatened and in need of protection (Government Notice 1002 of 2011)
- Threatened or Protected Species Regulations (Government Notice 388 of 2013) under NEMA:BA
- National Veld and Forest Fire Act (Act No. 101 of 1998)
- Conservation of Agricultural Resources Act (CARA) (Act No. 43 of 1983) and amendments

1.5.3. International

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

2. Introduction

South Africa is committed to the Convention of Biological Diversity, and has introduced several legislative mechanisms to ensure that the preservation and sustainable use of all biological diversity, including ecosystem, species, and genetic diversity, is guaranteed for the benefit of current and future generations in South Africa and beyond. The impact of past and present conversion of natural habitat types by cultivation, grazing, urban developments, forestation, mining, dams, industries, and alien plant invasions continues to have a substantial impact on South African biodiversity, with significant portions of South Africa's flora and fauna being threatened (Wynberg 2002). Arid, semi-arid and dry sub-humid areas, covering an estimated 91% of South African land area (Hoffman and Ashwell 2001), including the study area, are particularly prone to degradation arising from human activities, leading to the acceleration of soil erosion, deterioration of the biotic, abiotic and economic properties of soil, and the long-term loss of natural vegetation (UNCCD 1995) and associated habitats for fauna. Rapid recovery of degradation is inhibited by the loss of topsoil and natural seed banks, low rainfall regimes and the unpredictability of rainfall events.

This report lists the findings of a scoping evaluation of the focal area selected by Blackwood Solar Energy Facility (Pty) Ltd for the development of the proposed Blackwood photovoltaic energy facility to help evaluate the possible impacts of such a development on the biodiversity and ecology of the area and its surroundings.

3. Study Area

3.1. Locality

The proposed photovoltaic (PV) solar energy facility is located on portion 1 of the farm Pandamsfontein 1593. It is located in the Tokologo Local Municipality, approximately 25 km south-east of Kimberley, between the N8 road and the railway line going in the direction of Modderrivier and Petrusburg. The final placement of the proposed energy facility, which will occupy approximately 300 ha, will depend on the sensitivities identified during the scoping and EIA phase. At this stage, the entire farm portion and the shortest route between the farm portion and the Boundary Substation, and a route along existing Eskom lines and then to the Boundary substation (grid connection alternative option) is regarded as the study area (more details under section 3.2).

3.2. Surrounding environment

3.2.1. Climate and rainfall

The climate for Blackwood has been derived from climatic data summarised for Kimberley (worldweatheronline, meteoblue), located about 25 km north-west of

Blackwood. The area receives about 400 - 450 mm of rain on average per year. From May to September, rainfall is minimal (Figure 1), with most rainfall occurring from November to April, peaking between January and March. Temperatures in summer peak during December and January at a daily average of 33˚C to 37˚C, with an average of 17C˚to 20˚C for June. During July, night temperatures are on average -4˚C to 2˚C, with frosts during winter common (Mucina and Rutherford 2006, Figure 2).

Plant species resprouting from storage tubers (geophytes) will take advantage of the first rains, stored reserves and low grass cover after the dry season to grow and flower during summer (December to March) and then die back.

Herbs, forbs, and grasses first need adequate rainfall before being able to fully grow and flower between February and April. Geophytes, forbs, succulents, and grasses can only be fully identified if they are actively growing AND have either flowers or fruit. By late April, most species will have produced seed and most of the herbaceous flora will die back to below-ground storage or seed reserves to survive the cold winters in a dormant state. The first frost occurrence usually induces the dormant season for vegetation.

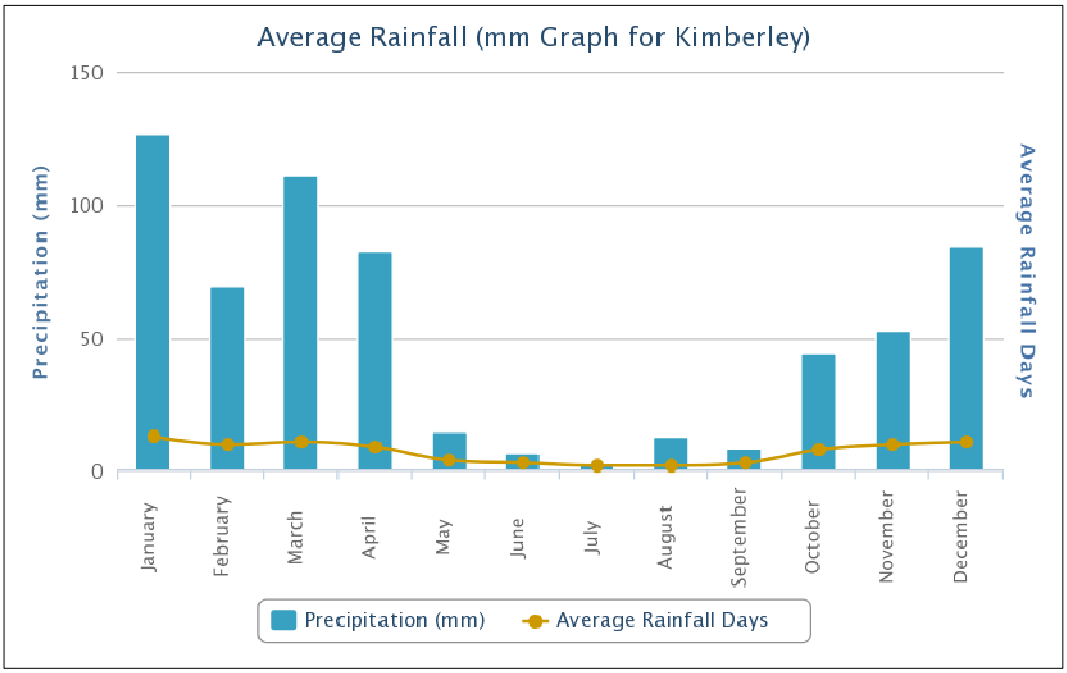

Figure 1: Distribution of average monthly rainfall as summarised by worldweatheronline.com

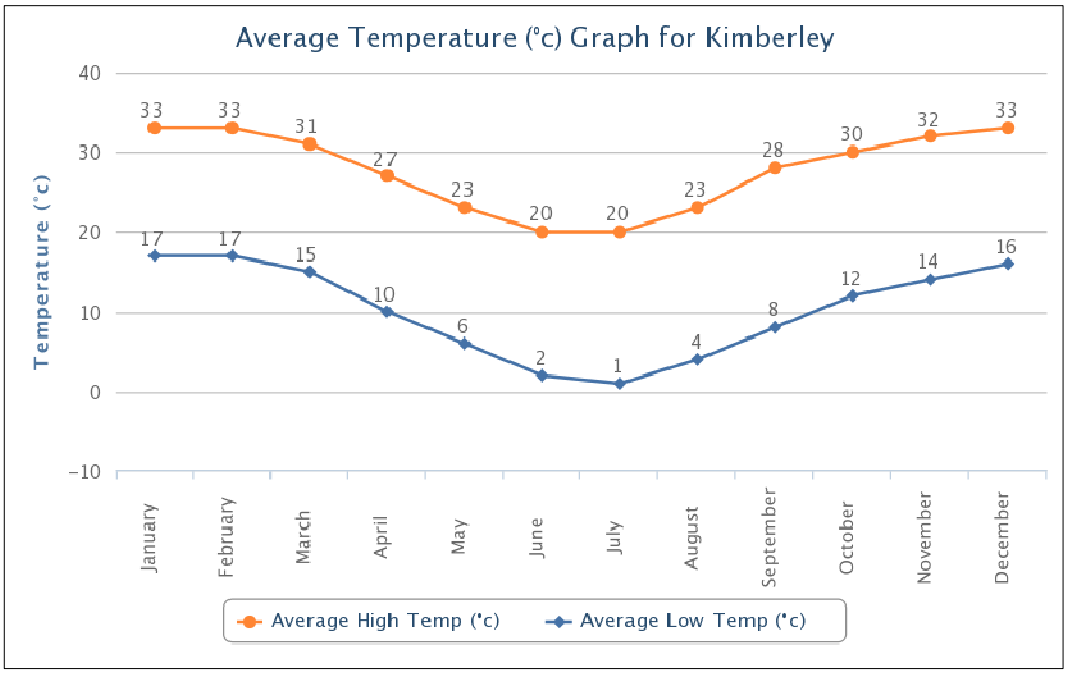

Figure 2: Average monthly temperature ranges as summarised by worldweatheronline.com

3.2.2. Drainage and Wetlands

Smaller ephemeral drainage lines are visible from available Google-earth imagery within the farm portion. Most of these drain into larger salt pans just south of the farm, indicating that the drainage lines carry only small amounts of very localised, short-lived surface floods during the rainfall season. Higher volumes of water may move into the pans from below-ground seepage off surrounding plains, especially where soils may be shallow.

Along the approximate shortest distance between the farm portion and the Boundary substation that may be affected for the alternative grid connection, several salt pans, drainage lines and smaller seepage pans can be found (BGIS, see Figure 3 under section 3.2.5). The largest salt pans are formed by localised drainage between smaller rocky ridges and outcrops, which can also be expected to have higher species diversity.

3.2.3. Existing Land Use and Infrastructure

The farm portion is most likely been used for either livestock or game farming, with no significant portion that appears to have been transformed or altered to a semi-natural state.

An existing Eskom powerline crosses the north-western corner of the farm portion, enabling a relatively short distance for the preferred grid connection, depending on the eventual location of the proposed development area.

3.2.4. Access

The southerly border of the farm portion runs parallel to the national N8 road from Kimberley to Bloemfontein, whilst a railway line (with the Bosvark Siding in close proximity) runs parallel to the northerly border of the property. Within the farm portion are several larger tracks that could be expanded without causing too much additional impact on the environment to gain access to the proposed development, depending on its final placement.

3.2.5. Vegetation overview

The study area is situated in the Savanna biome, Eastern Kalahari Bushveld. The vegetation unit covering the study area is Kimberley Thornveld (SVk 4).

Other vegetation units that may be affected if the alternative option for the grid connection must be followed include Vaalbos Rocky shrubland (SVk 5) and Highveld Salt Pans (AZi 10) (Figure 3, Mucina & Rutherford 2006).

The majority of Kimberley Thornveld (SVk 4) landscapes consist of flat to slightly undulating plains with some smaller outcrops and occasional surface intrusions of dolerites and andesitic lavas. The geology consists of a mixture of Kalahari and Ecca layers. Loose sands or loamy soils can be found over bedrock of shale or calcrete (AGIS, Mucina and Rutherford 2006).

The tree and shrub layer is well developed, albeit occurring in a very patchy mosaic. Tree species dominating within this vegetation unit are *Boscia albitrunca, Acacia erioloba,* (both species protected by the NFA), *A. tortilis*, and *A. karroo*. Dominant shrubs include *Tarchonanthus camphoratus* and *A. mellifera* subsp. *detinens*. Both these shrub species may increase significantly once the herbaceous layer is weakened, with the possibility of forming impenetrable thickets. The grass layer can be patchy and open with large areas of uncovered soil during the dry season. *Eragrostis lehmanniana* is considered the most dominant grass species of this vegetation type, with *Digitaria eriantha* and *Themeda triandra* the most valuable grasses for grazing (Mucina & Rutherford 2006).

The Kimberly Thornveld vegetation is considered least threatened. A target of 16% has been earmarked for conservation, of which 2% are already protected in the Vaalbos National Park, Sandveld, Bloemhof Dam, and S.A. Lombard Nature Reserves. Eighteen percent of the vegetation unit is already transformed, mostly to cultivated lands and urban areas (Mucina & Rutherford 2006).

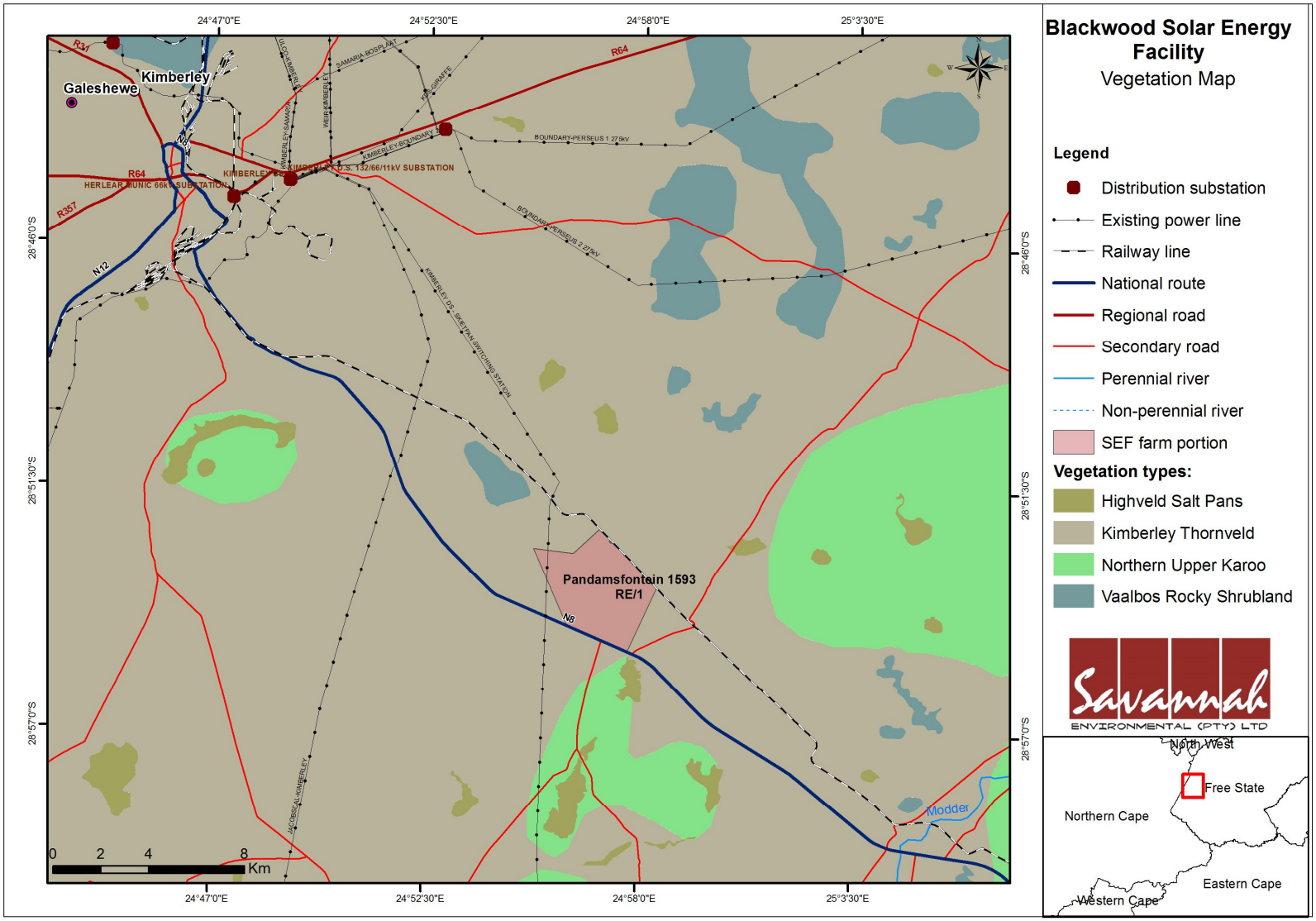

Figure 3: Overview of vegetation types of the study area after Mucina and Rutherford (2006).

Vaalbos Rocky Shrubland (SVk 5) occurs in highly fragmented elevated areas such as slopes, hills, and ridges within plains of the Kimberley Thornveld. Many sections of this vegetation type maybe too small to be mapped at the scale used by Mucina and Rutherford (2006), so its presence can be expected on the farm portion as well. The underlying geology consists of Ecca and Dwyka sediments and Karoo dolerites, of which the latter may form extensive sills, plateaus and ridges. Soils are relatively loamy, stony on elevated areas, and calcrete-rich in the lowlands (Mucina and Rutherford 2006).

Shrub communities are dominated by *Tarchonanthus camphoratus*, *Olea europaea, Euclea crispa, Diospyros* and *Searsia* species. Occasional small trees include *Boscia albitrunca* and *Cussonia paniculata*. The lower shrub and forb communities can be expected to vary significantly between localities. The same can be expected of the relatively diverse grass layer, which is dominated by *Aristida* species, *Digitaria eriantha, Elionurus muticus, Enneapogon, Eragrostis* and *Stipagrostis* species (Mucina and Rutherford 2006). Several protected (and other) succulent species are expected to occur in localities covered by this vegetation type.

The vegetation type is currently considered least threatened, despite only 2% occurring in formally protected areas. The remainder has been subject to only a small amount of transformation up to date (Mucina and Rutherford 2006). The higher niche diversity and range of microclimatic conditions of the landscaped within this vegetation type, however, will most likely give rise to more sensitive habitats expected to harbour a significantly higher amount of species of conservation concern and species restricted to these habitats.

Highveld Salt Pans (AZi 10, considered least threatened) are scattered throughout South Africa where rainfall ranges between 300 and 400 mm per annum. They occur in depressions of various sizes in plateau landscapes, forming temporary water bodies. Drainage from the pans is limited to absent; hence, salinity rises as water evaporates during the season. Vegetation that can persist in these more saline and seasonally inundated conditions on the pan edges consists of a sparse grassy dwarf shrubland (Mucina and Rutherford 2006). Within the wider Kimberley area, these pans are frequented every year by thousands of Flamingo during the rainy season. According to Mucina and Rutherford (2006), some of these salt pans are within a 3 km radius of the proposed development site, and along the alternative option of the grid connection, which implies that extensive rerouting of the alternative option may be necessary.

4. Methods

4.1. Plant Scoping Survey

A species list from POSA (http://posa.sanbi.org, August 2013, Grid reference: 2824) containing the species that might occur in the area was obtained. POSA generated species lists also contain updated Red Data species status according to the Red List of South African Plants 2009 published by SANBI in *Strelitzia* 25 (Raimondo *et al.* 2009, updated 2013).

A list of species of conservation concern that may occur on the site have been extracted from the POSA list, with the status of plant species indicated by using the following symbols:

Protected species, indicated according to relevant legislation (see section 1.6):

NCO Schedule 6
NFA
NEMA:BA
I: CITES Appendix 1
II: CITES Appendix 2

Red data listed species are indicated by their status (red text)
Species endemic to South Africa are indicated by 'end'

4.2. Explanations of Red Data classes

(After Raimondo *et al.* 2009):

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

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

Vulnerable (VU): A species is Vulnerable when the best available evidence indicates that it meets at least one of the five IUCN criteria for Vulnerable, indicating that the species is facing a high risk of extinction.

Near Threatened (NT): A species is Near Threatened when available evidence indicates that it nearly meets any of the IUCN criteria for Vulnerable, and is therefore likely to become at risk of extinction in the near future.

Critically Rare: A species is Critically Rare when it is known to occur at a single site, but is not exposed to any direct or plausible potential threat and does not otherwise qualify for a category of threat according to one of the five IUCN criteria.

Rare: A species is Rare when it meets at least one of four South African criteria for rarity, but is not exposed to any direct or plausible potential threat and does not qualify for a category of threat according to one of the five IUCN criteria.

Declining: A species is Declining when it does not meet or nearly meet any of the five IUCN criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened, but there are threatening processes causing a continuing decline of the species.

Least Concern: A species is Least Concern when it has been evaluated against the IUCN criteria and does not qualify for any of the above categories. Species classified as Least Concern are considered at low risk of extinction. Widespread and abundant species are typically classified in this category.

Data Deficient - Insufficient Information (DDD): A species is DDD when there is inadequate information to make an assessment of its risk of extinction, but the species is well defined. Listing of species in this category indicates that more information is required and that future research could show that a threatened classification is appropriate.

Data Deficient - Taxonomically Problematic (DDT): A species is DDT when taxonomic problems hinder the distribution range and habitat from being well defined, so that an assessment of risk of extinction is not possible.

Plant species nomenclature follows Germishuizen and Meyer (2003).

4.3. Plant Survey Methods to be followed during the EIA phase

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

- A phytosociological classification of the vegetation found on the study area according to vegetation survey data and its TWINSPAN analysis
- A corresponding description of all defined plant communities and their typical habitats, including a full species list for each plant community and a representative photographic record taken on site of each community
- A map of all plant communities within the boundaries of the study area
- A description of the sensitivity of each plant community, based on sensitivity criteria outlined in section 4.5
- A full assessment of impacts according to section 4.6

4.4. Vertebrate Scoping Survey

The SANBI SIBIS and ADU databases were queried regarding vertebrates historically recorded in the study area and surroundings. The likelihood of such species still occurring in the area was verified according available literature and species of conservation concern or that are protected and most likely to occur in the study area listed.

For all protected or threatened species that may occur on site, a short description on the habit and habitat of the species is given.

4.5. Sensitivity Analysis and Criteria

Determining ecosystem services and sensitivity of ecosystem components, both biotic and abiotic, is rather complex, and no single overarching criteria will apply to all habitats studied. The main aspects of an ecosystem that need to be incorporated in a sensitivity analysis, however, include the following:

- Describing the nature and amount of species present, taking into consideration their conservation value as well as the probability of such species to survive or re-establish itself following disturbances of various magnitudes
- Identifying the species or habitat features that are 'key ecosystem providers' and characterising their functional relationships (Kremen 2005)
- Determining the aspects of community structure that influence function, especially aspects influencing stability or rapid decline of communities (Kremen 2005)
- Assessing key environmental factors that influence the provision of services (Kremen 2005)
- Gaining knowledge about the spatio-temporal scales over which these aspects operate (Kremen 2005)

4.5.1. Sensitivity criteria relating to Conservation Value

Species diversity

The number and abundance of species strongly influences key ecosystem processes such as pollination, air quality, primary production, nutrient and water cycling and soil formation and retention. All these processes provide ecosystem services such as shelter, potable water, and nutrients to higher trophic levels. The species composition, including dominant, minor and keystone species, is critical in maintaining ecosystem services (Chapin *et al.* 2000).

A higher number of species insures a stable supply of ecosystem goods and services as spatial and temporal variability increases, which typically occurs over longer time periods. Within a community several species may have similar functions, but react differently to environmental variables, thus can buffer ecosystem function to some degree during short-term environmental fluctuations (Hooper *et al.* 2005, Chapin *et al.* 2000). Further, coexisting plants with very different but complementary resource use strategies will use available resources more effectively, and a larger species pool is more likely to contain more groups of complementary species. Overall, productivity, nutrient retention, and resistance to invasion tend to increase with increasing species number, especially in environments where overall species cover is relatively low.

Expected species diversity

Species diversity ranges enormously between habitats, thus what may seem low species diversity in one habitat, may in fact be maximal species diversity in another, hence a standardisation of number of species across large areas to rank conservation value of an area will be misleading. Added to this, most standard methods for collecting plant species data miss many species, especially species that are less common, patchily distributed or dormant – either in the form of seeds or underground storage organs – at the time of survey. To compensate for this, species-area curves are drawn from the data to estimate total species richness (Chong and Stohlgren 2007, Garrard *et al.* 2008). This is considered a useful tool in conservation biology, because information from the curves allows a comparison of different communities without the absolute knowledge of all species present in unsampled areas (Chong and Stohlgren 2007). Should the area surveyed differ considerably from surrounding areas, such surrounding areas should also be surveyed to obtain a more realistic measure of expected species diversity.

Species that are less common or endemic

It is often difficult to identify what exactly limits the distribution of a species. Factors that have been identified as playing a major role, either on their own or together, are habitat limitation and dispersal limitation (Münzbergová 2006), as well as minimum number of individuals required to enable a viable population. Rare taxa often have specialised habitat requirements and are thus restricted to rare environmental conditions, of which rock outcrops and narrow water channels are typical (Keith 1998). A restricted availability of a habitat may also reduce the dispersal capability of a species. Species of conservation concern be it due to their restricted numbers, decreasing habitat availability and/or exploitation are protected from provincial to international level, and hence their Red Data and protection status can be used as a surrogate to assess the sensitivity of an area to man-made disturbances.

Within a community, the species composition is often as or more important than the species number in affecting ecosystem processes. Changes in species compositions can occur indirectly by an altered resource supply due to anthropogenic influence e.g. change of moisture flows. Although a reduction in the number of species may initially have small effects, even minor losses may indicate that the capacity of the ecosystem to adjust to a changing environment is being lost (Chapin *et al.* 2000, Hooper *et al.* 2005). Species are allocated an official conservation status to prevent their further decline due to identified threats (Keith 1998). Protected or red-data species, as well as endemic species, apart from their conservation status, are a first indicator of the health of an ecosystem. They will most probably be the first to show a sudden decline should their environment be changed beyond a specific threshold, e.g. by excessive erosion.

4.5.2. Sensitivity criteria relating to ecosystem function

Soil water availability

The most limiting factor in arid and semi-arid systems is moisture. Soil water availability is limited not only by timing and amount of rainfall events, but also by low infiltration rates of water into the soil. Vegetation itself, however, promotes the rate of infiltration due to increasing soil surface roughness as well as soil surface porosity, providing a further positive feedback between increased infiltration and increased plant growth. Thus with increasing plant density, the rate of infiltration into the soil will increase significantly, instead of most water being lost as runoff during infrequent rain showers (Dekker *et al.* 2007). Soil surface roughness can also be provided by various degrees of surface rockiness, living soil crusts and micro topography - including the fertile-island effect created by shrubs (Esler *et al.* 2006), which aid as resource traps for runoff and nutrients. Compacted, denuded soils are often prone to surface capping – even more so if the soils have a fine texture due to higher clay or loam contents. Such capped soils are prone to ever increasing erosion, creating a leaky ecosystem that rapidly loses soil, nutrients and seeds from the ecosystem (Tongway and Hindley 2004).

Niches

Relief, topography, and micro-topography are important features of the habitat, because evapotranspiration and photosynthesis correlate with the resultant solar radiation and temperatures, and the variability of in soil attributes and water flows highly depend on these features (Dirnböck *et al.* 2002). Topography has a major influence on the redistribution of rainfall, affecting moisture limitations for plant present, and the effect of this on vegetation increases significantly with aridity, but is also coupled to the geology of the terrain (Dirnböck *et al.* 2002).

Habitat

Several studies have shown that the vegetation units contributing the most to regional species diversity cover the smallest areas because these species are concentrated on and some also limited to particular habitats (Chong and Stohlgren 2007, Keith 1998). However, these communities or habitats may contain species that are of high importance to the entire ecosystem, and an extinction of such a local plant population, or their reduction to a point where they become functionally extinct, can have dramatic consequences on the regulation and support of ecosystem services. The diversity and size of a landscape unit also influences ecosystem services – species on the edges of a habitat are more vulnerable to environmental stresses, and the more a habitat is fragmented, the higher this stressful edge effect becomes, in addition to habitat loss. Habitat loss and/or fragmentation can thus have disproportionately large effects on ecosystem services.

Overall, the properties of species, together with the species composition is often more critical in retaining the function of an ecosystem than species numbers or

total cover (Chapin *et al.* 2000). Many of these species will, however, only establish if the habitat is suitable (Carrick and Krüger 2007). Added to that, rehabilitation in arid and semi-arid zones has been difficult either due to difficulties in establishment because of low, erratic and unpredictable rainfall or due to the lack of available seed material (Le Houérou 2000).

4.5.3. Sensitivity definitions used

According to the above, sensitivity classes have been defined as follows:

High Sensitivity: Areas that are relatively undisturbed or pristine and…

» either very species-rich relative to immediate surroundings
» or have a very unique and restricted indigenous species composition
» or constitute specific habitats or a high niche diversity for fauna and/or flora species of conservation concern, and where the total extent of such habitats and associated species of conservation concern remaining in southern Africa is limited
» Excessive disturbance of such habitats may lead to ecosystem destabilisation and/or species loss
» This would also include areas where the abiotic environment is of such nature that the habitat and its niche-diversity are the main reason for a higher species diversity and cannot be reconstructed or rehabilitated once physically altered in any way

Medium Sensitivity: Areas where disturbances are at most limited and…

» Areas with a species diversity representative of its natural state, but not exceptionally high or unique compared to its surroundings
» Areas that whose biotic configuration does not constitute a very specific or restricted habitat or very high niche diversity
» Areas that provide ecosystem services needed for the continued functioning of the ecosystem and the continued use thereof (e.g. grazing)
» Although species of conservation concern may occur on the area, these are not restricted to these habitats only
» Areas that need to remain intact to ensure the functioning of adjacent ecosystems, or wildlife corridors or portions of land that prevent the excessive fragmentation of natural fauna and flora populations, or areas that will be difficult or impossible to rehabilitate to a functional state after physical alteration

    - **Medium high sensitivity** would include areas:
    - where the landscape can be rehabilitated to allow the re-establishment of some of the original species composition after physical alteration, but some of the species of conservation concern or ecosystem functionality may be lost
    - with a high species diversity and potentially higher number of species of conservation concern,

- **Medium low sensitivity** would include areas:
- with a high species diversity with few species of conservation concern,
- this could also include areas with previous disturbance or transformation, where the impact of the development will lead to irreversible, unjustified degradation of the landscapes that will be difficult to prevent and mitigate
- where the landscape can be rehabilitated to allow the re-establishment of most or all of the original species composition after physical alteration

Low Sensitivity: Areas that have been previously transformed, disturbed or…

» Areas that provide limited ecosystem services, or have a low ecological value
» Species diversity may be low or all species present have a much wider distribution beyond this habitat or locality
» Species of conservation concern may be present on such areas, but these are not restricted to these habitats and can be relocated with ease
» Further arguments may include landscapes where the abiotic nature is such that it can be rehabilitated relatively easy to allow the re-establishment of the original species composition, and where the development will not lead to any unjustified degradation of landscapes or ecosystem services if adequately mitigated

4.6. Assessment of Impacts for the EIA

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

The **nature** of the impact refers to the causes of the effect, what will be affected and how it will be affected.

Extent (E) of impact

Local (site or surroundings)
Regional (provincial)

Rating = 1 (low) to 5 (high).

Duration (D) rating is awarded as follows:

Whether the life-time of the impact will be:

- Very short term – up to 1 year: Rating = 1
- Short term – >1 – 5 years: Rating = 2
- Moderate term - >5 – 15 years: Rating = 3

- Long term – >15 years: Rating = 4
  The impact will occur during the operational life of the activity, and recovery may occur with mitigation (restoration and rehabilitation).
- Permanent – Rating = 5
  The impact will destroy the ecosystem functioning and mitigation (restoration and rehabilitation) will not contribute in such a way or in such a time span that the impact can be considered transient.

Magnitude (M) (severity):
A rating is awarded to each impact as follows:

- Small impact – the ecosystem pattern, process and functioning are not affected.
  Rating = 0
- Minor impact - a minor impact on the environment and processes will occur.
  Rating = 2
- Low impact - slight impact on ecosystem pattern, process and functioning.
  Rating = 4
- Moderate intensity – valued, important, sensitive or vulnerable systems or communities are negatively affected, but ecosystem pattern, process and functions can continue albeit in a slightly modified way.
  Rating = 6
- High intensity – environment affected to the extent that the ecosystem pattern, process and functions are altered and may even temporarily cease. Valued, important, sensitive or vulnerable systems or communities are substantially affected.
  Rating = 8
- Very high intensity – environment affected to the extent that the ecosystem pattern, process and functions are completely destroyed and may permanently cease.
  Rating = 10

Probability (P) (certainty) describes the probability or likelihood of the impact actually occurring, and is rated as follows:

- Very improbable – where the impact will not occur, either because of design or because of historic experience.
  Rating = 1
- Improbable – where the impact is unlikely to occur (some possibility), either because of design or historic experience.
  Rating = 2
- Probable - there is a distinct probability that the impact will occur (<50% chance of occurring).
  Rating = 3
- Highly probable - most likely that the impact will occur (50 – 90% chance of occurring).
  Rating = 4

- Definite – the impact will occur regardless of any prevention or mitigating measures (>90% chance of occurring).
  Rating = 5

Significance (S) - Rating of low, medium or high. Significance is determined through a synthesis of the characteristics described above where:
S = (E+D+M)*P

The **significance weighting** should influence the development project as follows:

- Low significance (significance weighting: <30 points)

If the negative impacts have little real effects, it should not have an influence on the decision to proceed with the project. In such circumstances, there is a significant capacity of the environmental resources in the area to respond to change and withstand stress and they will be able to return to their pre-impacted state within the short-term.

- Medium significance (significance weighting: 30 – 60 points)

If the impact is negative, it implies that the impact is real and sufficiently important to require mitigation and management measures before the proposed project can be approved. In such circumstances, there is a reduction in the capacity of the environmental resources in the area to withstand stress and to return to their pre-impacted state within the medium to long-term.

- High significance (significance weighting: >60 points)

The environmental resources will be destroyed in the area leading to the collapse of the ecosystem pattern, process and functioning. The impact strongly influences the decision whether or not to proceed with the project. If mitigation cannot be effectively implemented, the proposed activity should be terminated.

5. Results

5.1. Plant Survey

Up to date, approximately 970 plant species have been recorded in the Kimberley/Blackwood Area according to the SANBI database. It can be expected that collection intensity in the area has been high due to the activities of the McGregor Museum Herbarium in Kimberley, even though the study area itself may not have been sampled in the past. It is unlikely that all of the recorded species will occur within the study area.

Of the previously recorded species, several are endemic to South Africa, have red-data status or are nationally and/or provincially protected. The presence of these species on site will have to be verified during a detailed field study, but it can be assumed that protected species, including trees, will be part of the study area's vegetation.

Plant species recorded that are of conservation concern and that may occur within the development area are listed below (Table 1).

Table 1: Species of conservation concern that could occur in the study area:

Species	Status
Succulents	
Adenium oleifolium	NCO 6
Aloe claviflora	NCO 6
Aloe grandidentata	NCO 6
Aloe hereroensis var. *hereroensis*	NCO 6
Aloe maculata	NCO 6
Aloe variegata	NCO 6
Aloinopsis rubrolineata	Rare, end
Aptenia cordifolia	end
Bulbine favosa	end
Cotyledon orbiculata var. *dactylopsis*	end
Crassula lanceolata subsp. *lanceolata*	end
Euphorbia avasmontana var. *avasmontana*	NCO 6
Euphorbia bergii	NCO 6
Euphorbia duseimata	NCO 6
Euphorbia gregaria	NCO 6
Euphorbia gummifera	NCO 6

Species	Status
Euphorbia pseudoduseimata	NCO 6
Euphorbia pseudotuberosa	NCO 6
Euphorbia spinea	NCO 6
Huernia longituba subsp. *longituba*	NCO 6
Lithops aucampiae subsp. *aucampiae*	NCO 6, end
Lithops lesliei subsp. *lesliei*	NCO 6, NT
Mesembryanthemum stenandrum	end
Mestoklema copiosum	end
Mestoklema tuberosum	end
Nananthus vittatus	DDT
Orbea lugardii	NCO 6
Orbea lutea subsp. *lutea*	NCO 6
Orbea lutea subsp. *vaga*	NCO 6
Orbea verrucosa	NCO 6, end
Othonna auriculifolia	end
Phyllobolus splendens subsp. *pentagonus*	end

Species	Status
Piaranthus decipiens	NCO 6
Stapelia gettliffei	NCO 6
Stapelia gigantea	NCO 6
Stapelia grandiflora var. *grandiflora*	NCO 6
Stapelia olivacea	NCO 6, end
Tetragonia virgata	end
Titanopsis calcarea	NCO 6
Tridentea gemmiflora	NCO 6
Tridentea marientalensis subsp. *marientalensis*	NCO 6
Zygophyllum incrustatum	end
Zygophyllum lichtensteinianum	end
Low shrubs	
Aptosimum indivisum	end
Atriplex erosa	end
Barleria irritans	end
Blepharis marginata	end
Dichilus gracilis	end
Eriocephalus karooicus	end
Erythrina zeyheri	NCO 6
Felicia fascicularis	end
Galenia collina	end
Galenia exigua	end
Galenia filiformis	end
Galenia portulacacea	end
Galenia procumbens	end
Galenia prostrata	end
Gnidia microphylla	end
Helichrysum dregeanum	NCO 6
Helichrysum lucilioides	NCO 6
Helichrysum zeyheri	NCO 6
Hermannia bryoniifolia	end
Hermannia linearifolia	end
Hertia kraussii	end

Species	Status
Indigofera mauritanica	end
Jamesbrittenia tysonii	end
Justicia orchioides subsp. *glabrata*	end
Limeum aethiopicum var. *intermedium*	end
Microloma armatum var. *armatum*	NCO 6
Microloma armatum var. *burchellii*	NCO 6
Osteospermum leptolobum	end
Peliostomum origanoides	end
Pentzia quinquefida	end
Pentzia viridis	end
Phylica cephalantha	end
Polygala asbestina	end
Rhynchosia ciliata	end
Salsola aellenii	end
Salsola calluna	end
Salsola exalata	end
Salsola geminiflora	end
Salsola henriciae	end
Salsola kalaharica	end
Salsola microtricha	end
Selago albida	end
Selago geniculata	end
Senecio burchellii	end
Senecio intricatus	end
Solanum capense	end
Thesium hystricoides	end
Wahlenbergia nodosa	end
High Shrubs and Trees	
Acacia erioloba	NFA, Declining
Acacia haematoxylon	NFA

Species	Status
Asparagus mucronatus	end
Boscia albitrunca	NFA
Ehretia rigida subsp. *rigida*	end
Euclea crispa subsp. *ovata*	end
Heteromorpha arborescens var. *arborescens*	end
Lycium oxycarpum	end
Nuxia gracilis	end
Olea europaea subsp. *africana*	NCO 6
Putterlickia pyracantha	end
Searsia tridactyla	end
Tarchonanthus obovatus	end
Forbs	
Alchemilla elongata var. *elongata*	end
Amaranthus dinteri subsp. *brevipetiolatus*	end
Amellus strigosus subsp. *strigosus*	end
Amellus tridactylus subsp. *tridactylus*	end
Asclepias meyeriana	NCO 6
Barleria bechuanensis	end
Berkheya pinnatifida subsp. *pinnatifida*	end
Choritaenia capensis	end
Convolvulus boedeckerianus	end
Convolvulus dregeanus	end
Convolvulus multifidus	end
Cotula burchellii	end
Cucumis heptadactylus	end
Cuscuta appendiculata	end
Cynanchum orangeanum	NCO 6
Cynanchum virens	NCO 6
Cyperus capensis	end
Dianthus micropetalus	end

Species	Status
Dicliptera leistneri	end
Galenia acutifolia	end
Gazania jurineifolia subsp. *jurineifolia*	end
Helichrysum arenicola	NCO 6
Helichrysum argyrosphaerum	NCO 6
Helichrysum caespititium	NCO 6
Helichrysum cerastioides var. *cerastioides*	NCO 6
Helichrysum lineare	NCO 6
Helichrysum nudifolium var. *nudifolium*	NCO 6
Helichrysum paronychioides	NCO 6
Heliophila remotiflora	end
Hermannia pulverata	end
Hibiscus marlothianus	end
Kniphofia ensifolia subsp. *ensifolia*	NCO 6
Lactuca dregeana	end
Lasiospermum pedunculare	end
Limeum viscosum subsp. *transvaalense*	end
Nemesia pubescens var. *pubescens*	end
Pharnaceum thunbergii	end
Rennera stellata	VU, end
Selago mixta	end
Selago paniculata	end
Senecio arenarius	end
Senecio repandus	end
Sesbania notialis	end
Stenostelma capense	NCO 6
Vahlia capensis subsp. *capensis*	end
Wahlenbergia denticulata var. *transvaalensis*	end
Wahlenbergia meyeri	end
Zaluzianskya venusta	end

Species	Status
Geophytes	
Albuca tortuosa	end
Ammocharis coranica	NCO 6
Babiana bainesii	end
Brachystelma burchellii var. *burchellii*	NCO 6
Brachystelma dimorphum subsp. *dimorphum*	NCO 6, end
Brachystelma foetidum	NCO 6
Brunsvigia radulosa	NCO 6
Crinum bulbispermum	NCO 6, Declining
Crinum lugardiae	NCO 6
Daubenya comata	end
Drimia physodes	end
Drimia sanguinea	NT
Duthieastrum linifolium	end
Eulophia hereroensis	NCO 6
Fockea angustifolia	NCO 6
Freesia andersoniae	NCO 6, end
Gethyllis transkarooica	NCO 6

Species	Status
Gladiolus orchidiflorus	NCO 6
Gladiolus permeabilis subsp. *edulis*	NCO 6
Haemanthus humilis subsp. *humilis*	NCO 6
Harpagophytum procumbens subsp. *procumbens*	NEMA:BA
Lachenalia karooica	end
Moraea speciosa	end
Nerine frithii	NCO 6, end
Nerine hesseoides	NCO 6, end
Nerine laticoma	NCO 6
Orthanthera jasminiflora	NCO 6
Oxalis setosa	DDT, end
Raphionacme hirsuta	NCO 6
Raphionacme velutina	NCO 6
Scadoxus puniceus	NCO 6
Schizocarphus nervosus	NCO 6
Grasses	
Cynodon incompletus	end
Eragrostis remotiflora	end

Conservation status indicated in Table 1 (see section 1.5 for details on legislation, section 4.2 for details on red data classes):

NCO 6: Provincially protected
NFA: Nationally Protected
NEMA:BA: Nationally Protected
end: endemic to South Africa
Red data listed species by their threat status

5.2. Vertebrates

5.2.1. Amphibians

The ADU lists 14 amphibian species for the greater project area. Of these, 1 is a red data species, listed as *Near Threatened*, the Giant Bull Frog (*Pyxicephalus adspersus*) (Minter *et al.,* 2004). The remaining species are considered as *Least Concern.*

Giant Bull Frog (Pyxicephalus adspersus) – Near Threatened
This species occurs widely in South Africa, where it is considered locally common, favouring drier savannah (Channing, 2001; Channing *et al.,* 2004). It is a fossorial species, spending most of the year buried underground in subterranean cocoons. They emerge after the first rains, to breed in shallow, temporary waters in pools, pans, and depressions. The main threats to the species include harvesting for local consumption and the loss of suitable breeding habitat due to urbanisation (Channing, 2001; Channing *et al*., 2004). This species is likely to occur on the greater project area due to the availability of suitable breeding and foraging habitats.

5.2.2. Reptiles

The ADU lists 50 reptile species for the greater project area. Of these, 4 are endemic, Distant's Ground Agama (*Agama aculeata distanti*), Aurora House Snake (*Lamprophis aurora*), Marico Gecko (*Pachydactylus mariquensis*) and Greater Padloper (*Homopus femoralis*). Although none of the 50 reptile species are of particular conservation concern, all are protected provincially under Schedule 1 of the Nature Conservation Ordinance 8 of 1969. It should however be noted that most species have not had their population status evaluated at this stage.

5.2.3. Birds

The SABAP 2 database lists 174 bird species for the pentad (2840_2445) incorporating the greater project area. Of these, 11 are red data species, 7 of which are listed as *Vulnerable,* Cape Vulture (*Gyps coprotheres*), White-backed Vulture (*Gyps africanus*), Kori Bustard (*Ardeotis kori*), Ludwig's Bustard (*Neotis ludwigii*), Martial Eagle (*Polemaetus bellicosus*), Tawny Eagle *(Aquila rapax)* and Lesser Kestrel (*Falco naumanni*) and 4 listed as *Near Threatened,* Greater Flamingo (*Phoenicopterus ruber*), Lesser Flamingo (*Phoenicopterus minor*), Chestnut-banded Plover (*Charadrius pallidus*) and Secretarybird (*Sagittarius serpentarius*). Not all red list species have been recorded in the pentad (2840_2445), however, have been included due to the high likelihood of occurrence within the greater project area. Red list species will be discussed further below.

Cape Vulture (Gyps coprotheres) – Vulnerable
This species is considered locally common, foraging over open grassland and woodland habitats up to 3 000 m (Hockey *et al.,* 2005). This species roosts and breeds colonially on cliffs with suitable ledges in mountainous areas, but will also roost on trees and pylons (Barnes, 2000). Populations have declined by as much as 20%, with major threats to the species including electrocutions and collisions with overhead power lines, poisoning, and disturbance at breeding and roosting sites. This species is likely to occur within or pass through the greater project

area due to the availability of suitable roosting and breeding sites nearby and the species wide ranging foraging patterns.

White-backed Vulture (Gyps africanus) –Vulnerable
This species is the most widespread vulture in Africa, where it is considered locally common in parts of its range, favouring lightly wooded arid savannah (Hockey *et al.,* 2005; BirdLife International, 2012). Populations of this species have undergone major declines throughout its range due to habitat transformation, reduced availability of carrion due to the loss of wild ungulates, hunting for trade, persecution and poisoning (BirdLife International, 2012). This species is likely to occur within or pass through the greater project area due to its wide ranging foraging patterns.

Kori Bustard (Ardeotis kori) – Vulnerable
This species is considered uncommon to locally common, favouring open savannah woodland, dwarf shrubland and occasionally grassland (Hockey *et al.,* 2005). Although a sedentary resident, this species is locally nomadic in response to rainfall and the subsequent flush of small invertebrates. The species has declined in South Africa due to habitat loss through transformation, collision with overhead power lines and poisoning (Barnes, 2000). This species is likely to occur within or pass through the greater project area due to the availability of suitable foraging habitat and the species nomadic movements.

Ludwig's Bustard (Neotis ludwigii) – Vulnerable
This species is a sparse to locally common near endemic nomad, favouring semi-arid dwarf shrubland, arid woodland and the arid western edge of the grassland biome (Hockey *et al.,* 2005). This species is highly susceptible to collisions with overhead power lines and telephone wires, with this single human-induced mortality factor considered the most important threat to this species (Barnes, 2000). A study of 150 km of power line transects revealed approximately 600 carcasses comprising mainly of this species (± 45% of carcasses). This species is likely to occur within or pass through the greater project area due to the availability of suitable foraging habitat and the species highly nomadic movements.

Martial Eagle (Polemaetus bellicosus) - Vulnerable
This species is widespread, although generally uncommon in South Africa, tolerating a wide range of habitat types, including open grassland, scrub and woodland (Barnes, 2000; Hockey *et al.,* 2005). This species requires exceptionally large home ranges (in excess of 130 km^2), making use of large trees and electricity pylons to provide nest sites (Barnes, 2000). Population declines are largely the result of direct persecution due to the perceived threat posed to livestock, poisoning and the reduction of its prey base as a result of habitat transformation. This species is likely to occur within or pass through the greater project area due to the availability of suitable foraging habitats.

Tawny Eagle (Aquila rapax) – Vulnerable
This species is fairly common within protected areas, but outside of which, the population has experienced worrying declines in the last three generations (Barnes, 2000). This species favours open savannah woodland, where it is largely sedentary, with occasional wanderings. This species hunts from a perch or in flight, where it soars low over its territory searching for invertebrate prey (Hockey *et al.,* 2005). Threats to the species include persecution, poisoning, reduced prey base due to habitat transformation and collisions with overhead power lines and telephone wires whilst foraging. This species is likely to occur within or pass through the greater project area due to the availability of suitable foraging habitats.

Lesser Kestrel (Falco naumanni) – Vulnerable
This species is a locally common, non-breeding Palaearctic migrant, favouring open savannah, shrubland, grassland, and agricultural fields (Hockey *et al.,* 2005). Numbers of this species reaching South Africa, their most important non-breeding area, have declined rapidly (up to 50%) over the last few decades (Barnes, 2000). Highly gregarious, aggregations are nomadic in response to local rainfall and subsequent insect irruptions. Threats to the species include human disturbance, poisoning, and habitat loss due to transformation. This species is likely to occur within or pass through the greater project area due to the availability of suitable foraging habitats.

Greater Flamingo (Phoenicopterus ruber) - Near Threatened
This species is a locally common resident, favouring large eutrophic water bodies such as saltpans, large dams and coastal mudflats (Barnes, 2000; Hockey *et al.*, 2005). Flocks are highly nomadic (almost always at night) in response to inland rains. Although there is no evidence for a decrease in the species, their nocturnal movements put them at high risk of colliding with manmade hazards such as wire fences, overhead power lines and telephone wires (Barnes, 2000). This is species is likely to occur within or pass through the greater project area due to the proximity of nearby saltpans.

Lesser Flamingo (Phoenicopterus minor) - Near Threatened
This species is locally common, with resident and intra-African migrant populations (Hockey *et al.,* 2005). Like the Greater Flamingo, this species favours large eutrophic water bodies, is highly nomadic (almost always at night) and is at high risk of colliding with manmade hazards such as wire fences, overhead power lines and telephone wires (Barnes, 2000; Hockey *et al.,* 2005). This species is likely to occur within or pass through the greater project area due to the proximity of nearby saltpans.

Chestnut-banded Plover (Charadrius pallidus) – Near Threatened

This species is an uncommon to rare resident, favouring natural and man-made saltpans, migrating between sources in response to changes in water levels (Hockey *et al.,* 2005). Although there is no evidence for a decrease in numbers, the species is thought to be impacted by disturbance around saltpans, where it breeds terrestrially in shallow scrapes along the shore (Barnes, 2000; Hockey *et al.,* 2005). This species is likely to occur within or pass through the greater project area due to the proximity of nearby saltpans.

Secretarybird (Sagittarius serpentarius) – Near Threatened
This species is uncommon to locally fairly common, favouring open grasslands with scattered trees and shrubs (Hockey *et al.,* 2005). Although considered resident, it is not sedentary, with highly nomadic movements across their large home range (up to 230km^2) (Hockey *et al.,* 2005). Local populations are thought to have decreased in South Africa, with the species being highly susceptible to being injured or killed by collisions with overhead power lines and telephone wires (Hockey *et al.,* 2005). This species is likely to occur within or pass through the greater project area due to its nomadic movements and wide ranging foraging patterns.

Special consideration should be taken with regards to the positioning of the proposed development as well as the associated overhead power lines and telephone wires. Of the red data species, many are terrestrial breeders that could potentially be affected by the physical development and/or species that are known to be at risk of colliding with overhead power lines and telephone wires. Saltpans and inselbergs have been identified as potentially sensitive areas due to their importance to red list species - flight paths between saltpans and around inselbergs need to be assessed in relation to the proposed development layout, in order to better understand the likely impact of the project on the aforementioned red data species.

5.2.4. Mammals

The ADU lists 13 mammal species for the greater project area. This figure is however thought to be largely underrepresented and has been supplemented by species whose distribution range and habitat requirements are sympatric with the study area. Of these, 3 are red data species, listed as *Near Threatened,* Brown Hyena (*Hyaena brunnea*), Honey Badger (*Mellivora capensis*) and South African Hedgehog (*Atelerix frontalis*) and 15 are protected provincially under Schedule 1 of the Nature Conservation Ordinance 8 of 1969, Cape Fox (*Vulpes chama*), Bat-eared Fox (*Otocyon megalotis*), Striped Polecat (*Ictonyx striatus*), Slender Mongoose (*Galerella sanguinea*), Yellow Mongoose (*Cynictis penicillata*), Suricate (*Suricata suricatta*), Small-spotted Genet (*Genetta genetta*), Aardwolf (*Proteles cristatus*), African Wild Cat (*Felis silvestris lybica*), Black-footed Cat (*Felis nigripes*), Aardvark (*Orycterus afer*) and the 3 aforementioned red list species. Red list species will be discussed further below.

Brown Hyena (Hyaena brunnea) – Near Threatened
This species occupies a wide range of habitats, although due to its shy and secretive behaviour, its presence in an area is not always recognised (Apps, 2012). The species forages far and wide, making use of their large territories (up to 400km^2), to search for carrion, prey items, insects and fruit (Skinner & Chimimba, 2006). This species could occur within or pass through the greater project area due to the availability of suitable habitat, their wide ranging foraging patterns and the fact that their massive territories often overlap with human-modified habitat types.

Honey Badger (Mellivora capensis) – Near Threatened

This species is one of the most wide spread species of small carnivores, occurring across a diverse range of habitats, albeit uncommon throughout most of its range (Skinner & Chimimba, 2006). They are predominantly nocturnal, solitary and unobtrusive (Apps, 2012). This species could occur within or pass through the greater project area due to their tolerance for human-modified habitat types and wide ranging foraging patterns.

South African Hedgehog (Atelerix frontalis) – Near Threatened

This species occurs in a wide range of habitats, favouring semi-arid and sub-temperate areas with an annual rainfall ranging between 300-800 mm (Skinner & Chimimba, 2006; Apps, 2012). They are predominantly nocturnal, becoming active after sundown, foraging for invertebrate prey. This species could occur within the greater project area due to the availability of suitable habitat requirements, most notably dry cover, which they require for resting places and in which to have their young.

5.3. Invasive Plants

The SANBI database lists several alien invasive species in the wider Kimberley area. Even if none of the recorded species can currently be found on the study area, there is a high potential of species establishing on site once the vegetation has been subjected to extensive disturbance.

The species that could possibly be on the study area already or that would pose the biggest threat of invasion include *Opuntia* and *Prosopis* species. Seeds of both species are readily distributed by sheet erosion, mammals, and birds.

Additional alien invasive species do occur in the surrounding area along major transport routes, which could be accidentally introduced to the project site during construction. Regular monitoring and early eradication should enable a cost-effective control of invasives.

5.4. Sensitivity analysis

At the time of compilation of this report, no site visit had been undertaken by the specialists.

Potentially sensitive areas were delineated for the scoping study from visual inspection of Google Earth imagery and (personal) observations during previous studies in the Kimberley Area. The areas thus identified as assumed to have higher sensitivity (Figure 4) are depressions and wetlands such as larger drainage lines, dams and pans. The delineation of these and potentially more wetlands will have to be confirmed during the EIA phase. All large salt pans must be regarded as No-Go areas.

Areas with deeper sandy soils are expected to have a higher density of protected tree species – so far only the presence of trees can be confirmed from Google-Earth imagery; the identity of such species can only be verified by ground studies. Areas with potentially high numbers of protected species have only been mapped within the farm portion, but there may be similar habitats along the grid connection alternative route.

Further potentially sensitive areas, include those that are expected to be prone to bare patch formation (indicated by distinct banded patterning of vegetation) and more rocky areas with assumed higher species diversity. Depending on their location within the general landscape, these could have a rating of medium-low sensitivity or higher. The initial mapping has been done conservatively and could be significantly revised after a detailed field investigation, which will also determine if the proposed development needs to be excluded from these areas or if mitigation measures can be sufficient to minimise impacts.

The above types of habitat are more sensitive primarily because of their ecosystem function and associated vegetation. Fauna and flora depend on this ecosystem functionality, which provides specialised niches for fauna and flora, creates corridors in the landscape, filters water, traps sediments and slows water runoff from catchments to retain water, seed and nutrient resources within the ecosystem (Tongway and Hindley 2004).

The sensitivity analysis provided may only be considered as a *preliminary* assessment that will be updated after a detailed field investigation. A specific wetland delineation may be required, especially if the alternative grid connection option will be followed.

Overall, it should be possible to position the PV arrays in such a way around more sensitive areas to prevent any unjustified negative impact.

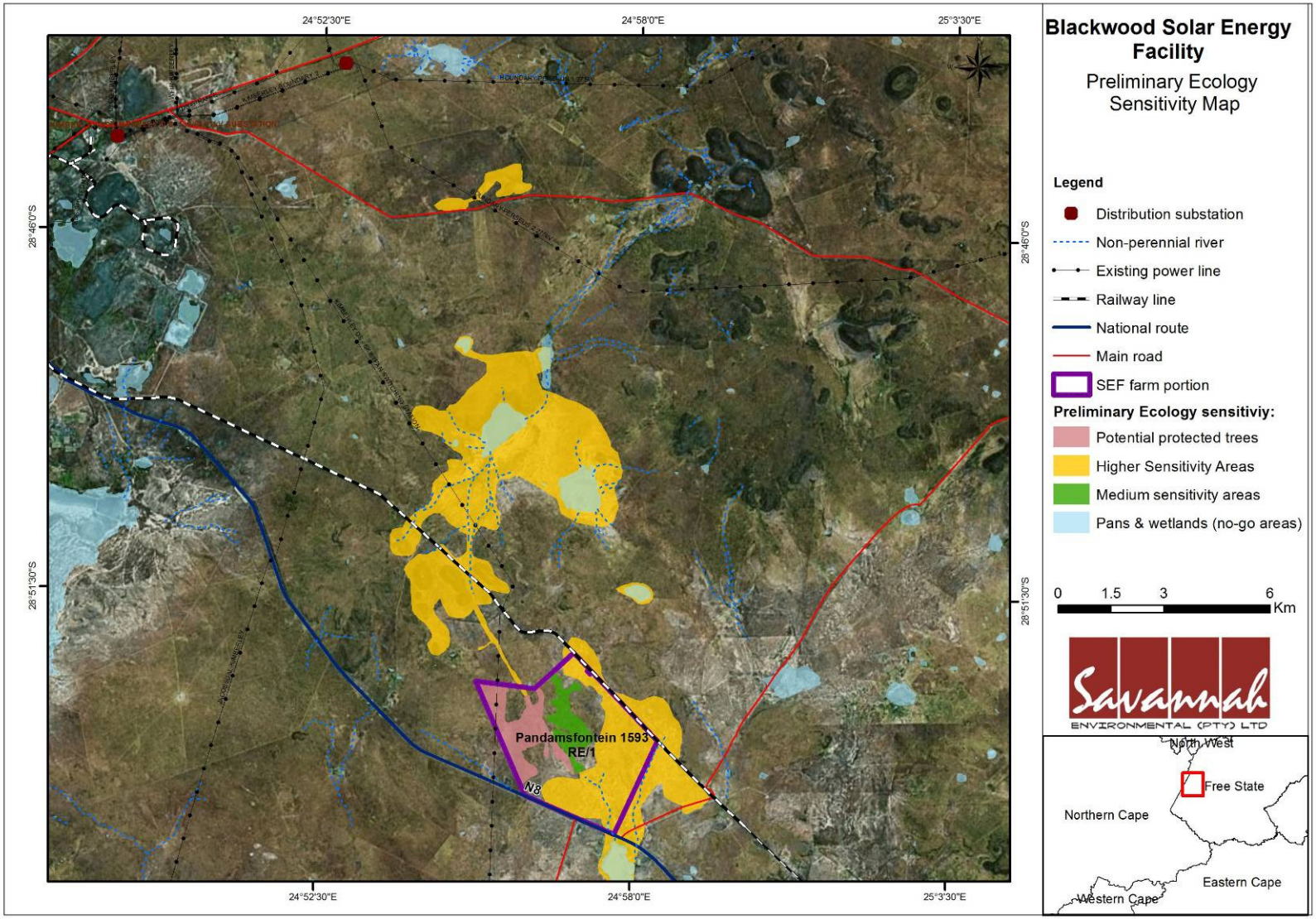

Figure 4: Preliminary sensitivity map of the study area.

"Higher sensitivity" indicates areas that may potentially be sensitive, but at this stage, it is difficult to gauge exactly how sensitive. "Medium sensitivity" areas could be medium-low or higher, depending on findings from the field study. These ratings are precautionary, and development may still be possible on *portions* of these areas if appropriate mitigation measures are implemented. *The destruction of protected trees should be avoided as far as possible*.

5.5. Assessment of potential impacts

Impacts of the proposed development will be mostly on the vegetation and supporting substrate. Potential expected impacts are listed below, but it must be stressed that this evaluation is preliminary and will only be finalised after a detailed field study of the area. Impacts on animals are regarded as low to minimal unless it affects their specific (limited) habitat or migration routes.

Overview of habitat

The landscapes within the study area are generally flat to slightly undulating plains, covered by an open to sparse low thorn savanna. The tree and shrub layer is well developed, albeit occurring in a very patchy mosaic. Tree species dominating within this vegetation unit are *Boscia albitrunca, Acacia erioloba,* (both species protected by the NFA), *A. tortilis,* and *A. karroo*. Dominant shrubs include *Tarchonanthus camphoratus* and *A. mellifera* subsp. *detinens*. Both these shrub species may increase significantly once the herbaceous layer is weakened, with the possibility of forming impenetrable thickets. The grass layer can be patchy and open with large areas of bare soil during the dry season, which is prone to capping, sheet erosion, and degradation.

Within the plains are occasional dolerite intrusions and possibly areas of surface calcrete, forming slight raises to extensive ridges or outcrops that are more isolated. These are mostly covered by a shrubveld with a mixture of differently sized shrubs, and a very variable herb layer (both seasonally and spatially variable). It is expected that several protected species, many of them succulent, will be present on these elevated areas. Depressions of various sizes have developed into pans, mostly salt-pans due to the continued deposition of lime-rich sediments from surrounding runoff. Many of the larger pans are frequented by flocks of Flamingo and other water-based avifauna during the rainy season.

It is expected that a high number of geophytes (plants that have underground storage tubers and die back after the growing season) will be present in the study area. Many of these are protected and may have red data status. It will thus be important that the field investigation will only be conducted after sufficient rain, preferably between February and April.

The initial sensitivity mapping has been done conservatively and it could be significantly revised after a detailed field investigation, which will also determine if the proposed development needs to be excluded from all of these areas or if mitigation measures can be sufficient to minimise impacts. *The final placement of the proposed development will have to be aligned with ecological sensitivities after these have been determined during a detailed investigation.*

Overview of the most significant effects of the proposed development

» For the construction of the PV arrays, even if some form of vegetation is permissible during the operational phase, the area affected is usually cleared of all vegetation prior to construction. This reduces construction effort and limits residual pollution that may be caused by possible breakages or spills. All permissible vegetation will thus have to be re-established after construction.
  - The above implies that, depending on the final location of the proposed development, several slow-growing *Acacia erioloba* and/or *Boscia albitrunca* trees may be destroyed, with low expected success of re-establishment.

» The PV arrays introduce a high level of shading to vegetation, which has evolved to grow and persist in environments with high levels of irradiation. Depending on the final mechanism of the PV array chosen, the intensity and duration of the shade on any particular area within the array may vary. Despite that, the highly altered levels of shading will lead to a change in plant species composition that is able to persist underneath the panels, which may cause secondary effects, including altered forage and breeding grounds for birds and small mammals and altered runoff and erosion patterns.

» The PV arrays and associated infrastructure is expected to influence the surface hydrology of the development area, especially on and around the PV array, which may affect moisture dynamics on and beyond the proposed development site. The magnitude of this effect will depend to some degree on the type of PV panels used.

» Depending on the type of PV panel used, these may contain heavy metals and/or other toxic substances, even if only in small amounts. Accidental breakage of panels can happen, and toxins could be leached into lower lying riverine and adjacent ecosystems if immediate mitigation is not followed.

» Routes between larger salt pans or over ridges should be regarded as possible migration routes to low-flying birds such as Flamingo or raptors, which could suffer higher mortality rates due to collisions with overhead power lines.

» Ground-dwelling small mammals or birds (or other vertebrates) may be affected by a reduction or significant alteration of suitable habitats.

Issue	Nature of Impact during Construction	Extent of Impact	No-Go Areas
Disturbance or loss of indigenous natural vegetation	Construction of infrastructure may lead to direct loss of natural vegetation, causing a reduction in the overall extent of specific species, vegetation cover and associated ecosystem processes. Consequences of the potential impact of loss of indigenous vegetation occurring may include: » Increased vulnerability of remaining vegetation portions to future disturbance, including erosion;	Local	The only No-Go areas so far identified are larger pans; areas of potential high(er) sensitivity have been mapped on a preliminary basis. A more detailed

	» General loss of habitat for sensitive species; » General reduction in biodiversity; » Disturbance to processes maintaining biodiversity and ecosystem goods and services; or » Direct loss of ecosystem goods and services.		investigation will be undertaken as part of the EIA phase.
Disturbance or loss of threatened / protected plants	Several protected or threatened plant species are expected to occur on and adjacent to the proposed development site. Flora is affected by loss or change of habitat due to infrastructure development, as plants are immobile. In the case of threatened plant species, a loss of a population or individuals could lead to a direct change in the conservation status of the species, possibly extinction. This may arise if the proposed infrastructure is located where it will impact on such individuals or populations. Consequences of this may include: » Fragmentation of populations of affected species » Reduction in area of occupancy of affected species » Loss of genetic variation within affected species	Local	The only No-Go areas so far identified are larger pans; areas of potential high(er) sensitivity have been mapped on a preliminary basis. A more detailed investigation will be undertaken as part of the EIA phase.
Loss of protected trees	According to the National Forests Act, no person may cut, disturb, damage or destroy any listed protected tree species. Protected tree species are expected to occur in parts of the study area, depending on local conditions. A permit is required from the Department of Agriculture, Forestry and Fisheries (DAFF) before any protected trees may be impacted. The loss of protected trees may have wider consequences than losing individuals of species of conservation concern: » In the prevailing environment of the study area, large trees are usually keystone species. This implies that with the removal of such trees, a host of other fauna and flora species will be affected due to the drastic change or complete obliteration of microhabitats associated with these trees. » The loss of mature, large trees can lead to a permanent loss of these trees and	Local and surroundings	Some protected trees are expected to occur on the study area, most likely in restricted habitats. Their presence and density needs to be confirmed during the EIA field investigation.

	their ecosystem function from the environment, as trees grow very slowly and recruitment events in the study area are limited, all due to the highly variable and generally low rainfall. This effect may become worse with prevailing changes in rainfall patterns due to climate change.		
Loss of habitat for threatened and /or protected vertebrates	Threatened fauna species are affected due to loss or alteration of habitat. Animals are generally mobile and, in most cases, can move away from a potential threat, but may suffer from the loss or fragmentation of habitat and associated resources. Threatened species include those classified as critically endangered, endangered, or vulnerable. For any other species, a loss of individuals or localised populations is unlikely to lead to a change in the conservation status of the species. However, in the case of threatened animal species, loss of a population or individuals could lead to a direct change in the conservation status of the species. This may arise if the proposed infrastructure is located where it will impact on such individuals or populations or the habitat that they depend on. Consequences may include: » Reduction in area of occupancy of affected species; » Reduction of reproductive potential and success of species, and » Loss of genetic variation within affected species. These may all lead to a negative change in conservation status of the affected species, which implies a reduction in the chances of the species overall survival chances.	Local	The only No-Go areas so far identified are larger pans; areas of potential high(er) sensitivity have been mapped on a preliminary basis. A more detailed investigation will be undertaken as part of the EIA phase.
Impacts on Avifauna	» Of the red data species, many are terrestrial breeders that could potentially be affected by the physical development and/or species that are known to be at risk of colliding with overhead power lines and telephone wires.	Local to regional	Saltpans and Inselbergs will be highly sensitive for avifauna, and flight paths between saltpans and

	» Saltpans and inselbergs have been identified as potentially sensitive areas due to their importance to red list species - flight paths between saltpans and around inselbergs need to be assessed in relation to the proposed development layout, in order to better understand the likely impact of the project on the aforementioned red data species. » Special consideration should be taken with regards to the positioning of the proposed development as well as the associated overhead power lines and telephone wires.		around inselbergs need to be assessed. Potential terrestrial breeding areas may exist and need to be studied.
Impacts on wetlands	Available Google imagery shows that small seasonal drainage lines, pans, and dams may be present within the study area. Just beyond the study area, and potentially along the grid connection alternative, are larger salt pans. The closest large perennial river is the Modder River, flowing approximately 10 km south of the farm portion, and not likely to be impacted by the proposed development. » Construction, if it occurred within any significant drainage lines, wetlands or immediately surrounding areas, would lead to direct or indirect loss of or damage to some of these areas or changes to the catchment of these areas; » The nature of the site preparation and construction activities for the proposed development will change surface characteristics, rainfall interception patterns and hence runoff characteristics of the area; » This may affect the geohydrology, susceptibility to erosion and potential erosion rates of the landscape, which may lead to an alteration to or loss of habitat for fauna and flora species, especially those that depend on wetland habitats; A decline in ecosystem functionality of smaller wetlands and drainage lines will impact lower-lying larger wetlands, such as the salt pans, whilst also reducing the ability of the environment to buffer effects of extreme climatic events.	Local and regional	The only No-Go areas so far identified are larger pans; areas of potential high(er) sensitivity have been mapped on a preliminary basis. A more detailed investigation will be undertaken as part of the EIA phase.

Establishment and spread of weeds and alien invader plants.	Major factors contributing to the invasion by alien invader plants and weeds includes high disturbance (such as clearing for construction activities or fires) and unsustainable grazing practices. Exotic species are often more prominent near infrastructural disturbances than within less disturbed natural vegetation. Consequences of the presence of invasive plants, especially if in high density, may include: » Loss of indigenous vegetation; » Change in vegetation structure leading to a change in various habitat characteristics and associated ecosystem function; » Change in plant species composition; » Change in soil chemical properties; » Loss of sensitive habitats; » Loss or disturbance to individuals of rare, endangered, endemic and/or protected species; » Fragmentation of sensitive habitats; » Change in flammability of vegetation, depending on alien species; » Hydrological impacts due to increased transpiration and runoff; and » Impairment of wetland function.	Local	Several alien species are expected to grow along major transport lines in the area, and could be present within the study area already. A full list of species present and with a potential of establishing on site will be provided in the EIA phase.
Gaps in knowledge & recommendations for further study » The initial desk-top investigation of the study area indicates that placement of components of the solar energy facility will have to be aligned according to ecological sensitivities that are currently assumed but need to be confirmed with a detailed field study. Several protected and red-data species as well as highly sensitive habitats potentially occur on the site. However, the likelihood that the development, once the final layout has been designed in accordance to findings of a field investigation, will compromise the survival of any species of conservation concern may be limited. » **Plant species of conservation concern will only be identifiable during the growing season, thus any field survey of vegetation should be conducted between February and April.** » A detailed ecological survey and sensitivity assessment will be undertaken during the EIA phase according to the methods outlined in section 4.			

Issue	Nature of Impact during the Operational Phase	Extent of Impact	No-Go Areas
Disturbance or loss of natural vegetation	PV panels create large areas of altered surface characteristics, rainfall interception patterns, and intensive shade that will not be tolerated by most of the species present on site, as these have evolved with a high daily irradiance. Consequently, it can be expected that within the Solar Energy Facility footprint, species composition and topsoil characteristics will change. No equivalent experiments have been undertaken in similar environments up to date, thus the nature and density of vegetation may persist cannot be predicted at this stage. A sparser or less stable vegetation beneath the PV panels, together with the altered surface and runoff characteristics may lead to: » Increased vulnerability of remaining vegetation to future disturbance, including erosion; » Accelerated erosion may negatively affect the functionality of nearby salt pans; » General loss or significant alteration of habitats for sensitive species; » Loss in variation within sensitive habitats due to loss of portions of it; » General reduction in biodiversity; » Increased fragmentation (depending on location of impact); » Future extinction debt of a particular species; » Disturbance to processes maintaining biodiversity and ecosystem goods and services; and » Loss of ecosystem goods and services.	Local	The only No-Go areas so far identified are larger pans; areas of potential high(er) sensitivity have been mapped on a preliminary basis. A more detailed investigation will be undertaken as part of the EIA phase
Altered runoff patterns due to rainfall interception by PV	The PV panels create large surfaces of rainfall interception, where rainfall is collected and concentrated at the edges from where it then moves onto the ground in larger, concentrated quantities opposed to small drops being directly intercepted and	Local and surroundings	The only No-Go areas so far identified are larger pans; areas of potential high(er)

panels and compacted areas	raindrop impact dispersed by vegetation, then absorbed by the ground. This may lead to a localised increase in runoff during rainfall events, which could result in localised accelerated erosion. Likewise, access roads and areas where soils have been compacted during construction will have a low rainfall infiltration rate, hence creating more localised runoff from those surfaces. This runoff will thus have to be monitored and channelled where necessary to prevent erosion over larger areas.		sensitivity have been mapped on a preliminary basis. A more detailed investigation will be undertaken as part of the EIA phase
Disturbance to migration routes and associated impacts to species populations	Components of the proposed development may interfere with current migration routes of fauna species. This may lead to: » Reduced ability of species to move between breeding an foraging grounds, reducing breeding success rates; » Increased mortality rates due to fatal collisions with infrastructure; » Reduced genetic variation due to reduced ability of especially smaller organisms' to have individual interacting; » Future extinction debt of a particular species.	Local and surroundings	The only No-Go areas so far identified are larger pans ad inselbergs; areas of potential high(er) sensitivity have been mapped on a preliminary basis. A more detailed investigation will be undertaken as part of the EIA phase
Increase in mortalities of low-flying and perching birds	The construction of overhead power lines and exposed electrical infrastructure could increase mortality rates of avifauna by: » Collision of low-flying birds into overhead power lines » Electrocution of birds perching on exposed electrical components It should be possible to prevent such mortalities by ensuring adequate protection of all electrical components, ensuring that electrical components do not provide perching or nesting sites as well as increasing the visibility of overhead power lines by suitable anti-collision devices.	Local and surroundings	Saltpans and Inselbergs will be highly sensitive for avifauna, and flight paths between saltpans and around inselbergs need to be assessed. Potential terrestrial breeding areas may exist and need to be studied.

Impacts on wetlands (ephemeral drainage lines, seepage areas, seasonal pans, salt pans)	Available Google imagery shows that small seasonal drainage lines, pans, and dams may be present within the study area. Just beyond the study area, and potentially along the grid connection alternative, are larger salt pans. According to the National Water Act, these are classified as wetlands or water resources. Although a minimum buffer of 32 m, preferably at least 100 m, must be maintained around all drainage lines and wetlands, disturbance on adjacent areas may also influence drainage lines and wetlands: » Accidental breakage of PV panels and accidental spills, if not contained and mitigated immediately, may results in harmful/toxic substances ending up in wetlands; » The nature of the proposed development, especially the PV arrays and new hard surfaces, will change surface characteristics, rainfall interception patterns and hence runoff characteristics of the project area; » This may affect the geohydrology, susceptibility to erosion and potential erosion rates of the landscape, which may lead to a significant alteration to or loss of habitat for fauna and flora species that depend on riparian and wetland habitats; » Altered runoff patterns may influence infrequent filling of possible small pans on site, which may eliminate localised populations of water-dwelling organisms such as the tadpole shrimp (*Triops* sp) that depend on occasional small areas of standing water to breed out and regenerate; » A decline in ecosystem functionality of smaller wetlands and riparian areas of smaller drainage lines will impact lower-lying larger wetlands	Local to regional	Significant ephemeral drainage lines and small seasonal wetlands that may be present must be adequately studied, delineated and regarded as NO-GO areas
Establishment and spread of declared weeds and alien invader plants.	The envisaged altered vegetation cover after construction and during the operation phase of the proposed development will create a window of opportunity for the establishment of alien invasive species. In addition, regenerative material of alien invasive species may be introduced to the site by birds, or machinery and persons traversing through areas with such plants or materials that may contain regenerative	Local to regional	None identified at this stage. A high risk of potential introduction from material transport to the site does exist.

	materials of such species. Consequences of the establishment and spread of invasive plants include: » Loss of indigenous vegetation or change in vegetation structure leading to an even more significant change in or loss of various habitat characteristics; » Loss of plant resources available to fauna; » Change in soil chemical properties; » Loss or fragmentation of sensitive or restricted habitats; » Loss or disturbance to individuals of rare, endangered, endemic and/or protected species; » Change in flammability of vegetation, depending on alien species; » Hydrological impacts due to increased transpiration and runoff; » Increased production and associated dispersal potential of alien invasive plants, especially to lower-lying wetland areas, and » Impairment of wetland function. The extent to which the site contains alien plants will be determined in the EIA phase.		

Gaps in knowledge & recommendations for further study

» The largest opportunity for mitigating any negative impacts exists during the design phase, if layouts adhere to the findings and recommendations of detailed field studies carried out during the EIA phase
» It can be expected that during the initial detailed field investigation several plant species may be dormant, either as seed reserves or underground storage tubers, and such species may suddenly emerge after construction or after sufficient rainfall events
» Limited knowledge does, however exist on the potential and ease with which vegetation can be re-established after construction given the erratic and low rainfall regime of the region, which species are able to persist in the altered environment on and around the proposed development, and what effect will this altered species composition and –density have on ecosystem intactness and –functionality
» Regular monitoring of a minimum set of environmental parameters throughout the operational phase, coupled with an adaptive environmental management program, will thus be essential to prevent any environmental degradation and any cumulative effects of the development beyond its

periphery

5.6. Limitations of study

There is a key difference between the approach of the ecological consultant and that of the ecological researcher. In consultancy, judgements have to be made and advice provided that is based on the best available evidence, combined with collective experience and professional opinion. The available evidence may not be especially good, potentially leading to over-simplification of ecological systems and responses, and do contain a considerable deal of uncertainty. This is opposed to ecological research, where evidence needs to be compelling before conclusions are reached and research is published (Hill & Arnold 2012). The best option available to the consulting industry is to push for more research to be conducted to address its questions. However, such research is often of a baseline nature and thus attracts little interest by larger institutions that need to do innovative research to be able to publish and attract the necessary funding. Clients in need of ecological assessments are used to funding such assessments, but are seldom willing to fund further research to monitor the effects of developments. Furthermore, a review to test the accuracy of the predictions of an ecologist following completion of the development is very rarely undertaken, which means the capacity to predict the future is not tested and therefore remains unknown (Hill & Arnold 2012).

Predictions on future changes on ecosystems and populations once a development has happened are seldom straightforward, except in cases of such as the total loss of a habitat to development. However, most development impacts are indirect, subtle, and cumulative or unfold over several years following construction or commencement of the operation of the development. Whilst a possible mechanism for an impact to occur can usually be identified, the actual likelihood of occurrence and its severity are much harder to describe (Hill & Arnold 2012).

A closely related issue is that of the effectiveness of ecological mitigation which stems from ecological assessments, as well as in response to legal and planning policy requirements for development. Many recommendations may be incorporated into planning conditions or become conditions of protected species licences, but these recommendations are implemented to varying degrees, with most compliance being for the latter category, protected species, because there is a regulatory framework for implementation. What is often missing is the follow-up monitoring and assessment of the mitigation with sufficient scientific rigour or duration to determine whether the mitigation, compensation or enhancement measure has actually worked in the way intended (Hill & Arnold 2012).

6. Discussion and Conclusion

The study area is situated in the Savanna biome, Eastern Kalahari Bushveld. The vegetation unit covering the study area is Kimberley Thornveld. Other vegetation units that may be affected if the alternative option for the grid connection must be followed include Vaalbos Rocky shrubland and Highveld Salt Pans. Vegetation overall is considered as of least conservation concern, but within the vegetation types more sensitive communities, habitats and species of conservation concern, including protected trees, are expected to be present.

Areas with deeper sandy soils are expected to have a higher density of protected tree species – so far only the presence of trees can be confirmed from Google-Earth imagery; the identity of such species can only be verified by ground studies.

Further potentially sensitive areas include those that are expected to be prone to bare patch formation (indicated by distinct banded patterning of vegetation) and more rocky areas with an assumed higher species diversity. Depending on their location within the general landscape, these could have a rating of medium sensitivity or higher.

The above types of habitat are more sensitive primarily because of their ecosystem function and associated vegetation. Fauna and flora depend on this ecosystem functionality, which provides specialised niches for fauna and flora, creates corridors in the landscape, filters water, traps sediments and slows water runoff from catchments to retain water, seed and nutrient resources within the ecosystem.

The only No-Go areas so far identified are larger salt pans; areas of potential high(er) sensitivity have been mapped on a preliminary basis. A more detailed investigation will be undertaken as part of the EIA phase.

The initial mapping has been done conservatively and could be significantly revised after a detailed field investigation, which will also determine if the proposed development needs to be excluded from these areas or if mitigation measures can be sufficient to minimise impacts.

Overall, no significant ecological flaws that could pose a problem to the proposed PV facility development could be identified during a desktop study. This will have to be confirmed during a detailed field investigation of the ecology of the area. **It is important to note that several plant species of conservation concern will only be identifiable during the growing season as they may be dormant and not visible otherwise. The EIA field investigation that will most accurately record biodiversity and inform decision makers, should be conducted between February and April.**

The most significant potential impacts expected are:

- A loss of large trees (regardless of protection status), leading to wider impacts than just the loss of trees themselves. In the prevailing semi-arid environment of the study area, large trees are usually keystone species. This implies that with the removal of such trees, a host of other fauna and flora species will be affected due to the drastic change or complete obliteration of microhabitats associated with these trees. The loss of mature, large trees can lead to a permanent loss of these trees and their ecosystem function from the environment, as trees grow very slowly and recruitment events in the study area are very limited, all due to the highly variable and generally low rainfall. This effect may become worse with prevailing changes in rainfall patterns due to climate change. The destruction of large trees must be totally avoided or limited to the absolute minimum.
- Reduction of a stable vegetation cover and associated below-ground biomass that currently stabilises sandy plains and areas prone to bare patch formation. Without this vegetation, accelerated erosion and loss of ecosystem resources will lead to potentially irreversible degradation on and beyond the development.
- Destruction of diverse niches provided by rocky outcrops, their footslopes and possibly also rocky plains. Once these habitats are destroyed by grading, the species that are dependent on those niches will also not be able to re-establish. Although higher outcrops can be considered unsuitable for the proposed development in any case, the extent of rocky plains and footslopes that should be excluded from the development needs to be verified during a detailed field visit.
- Possible impacts can occur on pans that may be present on the study area, as well as ephemeral washes and larger drainage lines due to altered surface hydrology of the surrounding plains. This may influence species depending on these parts of the ecosystem, as well as downstream wetland ecosystems. The proposed developments must thus retain as large a buffer as possible from pans, washes and drainage lines (a minimum of 100 m is recommended, preferably more) to avoid all possible impacts on them.

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The Natural Scientific Professions Act (Act 27 of 2003)

Nature and Environmental Conservation Ordinance 19 of 1974 and amendments

The Free State Conservation Bill (Provincial Act 23 of 2010)

Websites:

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

SANBI databases:

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

http://SIBIS.sanbi.org

ADU databases: http://vmus.adu.org.za

Climate :

http://en.climate-data.org/location/636/

http://www.meteoblue.com/en_ZA/weather/charts/yearclimate/kimberley_za_43860

http://www.worldweatheronline.com/Kimberley-weather-averages/Northern-Cape/ZA.aspx

8. Appendix A: Declaration of Independence

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	14/12/16/3/3/2/281
NEAS Reference Number:	DEAT/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010

PROJECT TITLE

Blackwood Solar Energy Facility

Specialist:	Marianne Strohbach		
Contact person:	Marianne Strohbach		
Postal address:	PO Box 148, Sunninghill		
Postal code:	2157	Cell:	
Telephone:	*(011) 656 3237*	Fax:	*086 684 0547*
E-mail:	marianne@savannahsa.com		
Professional affiliation(s) (if any)	SACNASP (Reg No 400079/10) Desert Net International South African Association of Botanists		

Project Consultant:	Savannah Environmental (Pty) Ltd		
Contact person:	Karen Jodas		
Postal address:	PO Box 148, Sunninghill		
Postal code:	2157	Cell:	
Telephone:	*(011) 656 3237*	Fax:	*086 684 0547*
E-mail:	karen@savannahsa.com		

4.2 The specialist appointed in terms of the Regulations_

I, Marianne Strohbach , declare that --

General declaration:

- I act as the independent specialists in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- **all the particulars furnished by me in this form are true and correct; and**
- **I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.**

Signature of the specialist:

Savannah Environmental (Pty) Ltd

Name of company (if applicable):

28 August 2013

Date:

9. Appendix B: Curriculum Vitae of Specialist

CURRICULUM VITAE

MARIANNE STROHBACH
SAVANNAH ENVIRONMENTAL (PTY) LTD

Profession : Specialist Scientist
Specialisation: Plant Ecology and Botany, with special reference to vegetation mapping, vegetation state assessment, dynamics of arid and semi-arid vegetation and population dynamics of harvested plants, conservation planning
Work experience: Twenty (20) years active in Plant Ecology

SKILLS BASE AND CORE COMPETENCIES

- Four years Plant Conservation (Namibia)
- 16 years active research in vegetation mapping, vegetation state assessment, vegetation and plant population dynamics, long-term vegetation monitoring
- Advisory to International Standards for plant species that are harvested for commercial purposes
- Research Project Management
- Ecological assessments for developmental purposes (BAR, EIA)
- Working knowledge of environmental planning policies, regulatory frameworks and legislation
- Identification and assessment of potential environmental impacts and benefits
- Development of practical and achievable mitigation measures and management plans and evaluation of risk to project execution
- Experienced in environmental monitoring and research
- Working knowledge of GIS applications and analysis of satellite imagery data
- Completed projects in several Provinces of South Africa, as well as Zimbabwe and Namibia
- Several publications in peer-reviewed journals, book chapters, scientific conference presentations and popular articles

EDUCATION AND PROFESSIONAL STATUS

Degrees:
2003: M.Sc. in Botany, University of Pretoria, Pretoria, RSA
1991: B.Sc. Hons in Botany, Nelson Mandela Metropolitan University, Port Elizabeth, RSA
1990: B.Sc. in Biological Sciences, Nelson Mandela Metropolitan University, Port Elizabeth

Short Courses:
2008: Landscape Functional Analysis for vegetation condition and restoration monitoring
2002: Satellite Image Analysis for Vegetation Mapping, German Aerospace Centre (DLR) in Cologne/Würzburg, Germany
1994: Methods and Techniques of Environmental Management, Deutsche Stiftung für Internationale Entwicklung, Berlin, Germany
1993: Conservation Law Enforcement, Ministry of Environment and Tourism, Namibia

Professional Society Affiliations:

- South African Association for Botanists
- Association of Desert Net International
- The South African Council for Natural Scientific Professions: Pr. Sci. Nat. Reg. No. 400079/10 (Botany and Ecology)

Publications:

- 7 Articles in peer-reviewed scientific journals
- 5 Book-chapters in scientific publications
- 10 Popular articles
- 9 presentations at scientific conferences
- 2 contributions to TV documentaries on nature

Ongoing outputs:

- Project-specific specialist reports for Ecological Screening Studies, Basic Assessments, Environmental Scoping and Impact Assessments and Ecological Footprint Investigations
- Compilation of Environmental Management Plans: Invasive Plant management, Plant Search and Rescue, Revegetation, Erosion Control

EMPLOYMENT

- **Current**: Ecologist, Savannah Environmental (Pty) Ltd
- 2011: Lecturer, Plant Ecology, University of Pretoria
- 1997 onwards: working as vegetation ecologist on a freelance basis, involved in part-time positions and contractual research as outlined below
- 1995 to 1996: Agricultural Researcher at the National Botanical Research Institute, Windhoek, Namibia
- 1992 to 1995: Vegetation ecologist at the Ministry of Environment and Tourism, Namibia, Directorate of Scientific Services

Past Affiliations and Research

2001 – 2010: contractual work with BIOTA (BIOdiversity Transect analysis in Africa) as affiliate to the National Botanical Research Institute, Namibia.

Deliverables:

Project management, including research proposal, financial management and project implementation.

Modelling of Savanna Dynamics:

Collating and summarising available phytosociological data for ecological modellers to use in creating a generic savanna model for the Namibian savannas

Defining plant functional types to simplify vegetation data and to use as indicators in monitoring techniques by livestock farmers

Vegetation Patterns and Processes in Namibian Savannas:
Small scale monitoring of vegetation dynamics over a range of soil conditions and seasons
Determine ecological barriers to and best practice for rangeland restoration

Vegetation classification and mapping in Central Namibia:
Collection and analysis of phytosociological baseline data for the central Thornbush Savanna in Namibia, delineation of vegetation types with the aid of satellite imagery

2006: German Scientific Authority to CITES, Plants, Federal Agency for Nature Conservation
International Standard for the Sustainable Wild Collection of Medicinal & Aromatic Plants
Assisting in the compilation of a reference guide for minimum research standards necessary to ensure sustainable use of economically utilised plants (updated in FairWild Standard Version 2, 2010)

2004: contractual work for Desert Research Foundation of Namibia
Vegetation description and mapping of the Namibian Eastern Communal Areas and assess possible development options using indigenous plant resources

1997 to 2010: contractual work with CRIAA-SADC as ecologist.
Deliverables:

The Sustainably Harvested Devil's Claw Project:
Annual surveys of *Harpagophytum* populations to determine harvesting quotas for rural communities
Determine and monitor impact of harvesting frequency and techniques on survival of *Harpagophytum procumbens*
Educate harvester communities on issues of resource management
In collaboration with the German Federal Agency for Nature Conservation
This work was extended in 2006 to the Hwange Area, NW Zimbabwe, together with Africa Now

Pilot Devil's Claw cultivation trials:
Increase available resources of *Harpagophytum procumbens*
Give communities ownership and better access of their resources to improve their income

Namibian National Devil's Claw Situation Analysis:
Design and implement a country-wide survey of *Harpagophytum* species to assess resource availability compared to annual export figure

1999 to 2001: Assistant curator at the Swakopmund Museum (part-time position)
Help maintain existing collections and exhibits , design and create new exhibits for the museum in collaboration with the Museum Hannover, Germany

Specialist Scientist Vegetation Surveys and related Impact Assessments were done for following clients:

- Langer Heinrich Uranium Pty (Ltd): Central Namib Desert, Namibia
- University of Namibia, Hentiesbay Research Centre: West Coast, Namibia
- Sasol – Limpopo Province
- EcoAgent – Northern Cape, Eastern Cape, Limpopo and Mpumalanga
- Namwater – Karst aquifers, north-central Namibia
- ENVASS (for AfriDevo) – Northern Cape
- Savannah Environmental – Northern Cape, Eastern Cape, Free State, North-West Province, Western Cape, Limpopo

Nature of developments covered by the above EIA studies:

- New mines and associated infrastructure, including material processing, housing and transport
- Mine rehabilitation evaluation
- Coastal infrastructure development
- Renewable energy facilities
- Large-scale water abstraction
- Housing developments
- Electrical infrastructure (long-distance power lines, substations, power generating plants)