EIA REPORT:

Botanical Impact Assessment for the EIAs for the proposed photovoltaic facilities on Du Plessis Dam Farm near De Aar

Client:

Aurecon South Africa (Pty) Ltd

PO Box 494,
Cape Town,
8000

on behalf of

Mulilo Renewable Energy (Pty) Ltd

Date:

26 July 2013

REPORT VERSION:

2nd draft

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David Hoare Consulting cc
Biodiversity Assessments, Vegetation Description & Mapping, Species Surveys

APPOINTMENT OF SPECIALIST

David Hoare of David Hoare Consulting cc was commissioned by Aurecon South Africa (Pty) Ltd to provide specialist consulting services for the Environmental Impact Assessment for the proposed Botanical Impact Assessment services for the EIAs for the proposed photovoltaic facilities on Badenhorst Dam Farm near De Aar. The consulting services comprise an assessment of potential impacts on the flora and vegetation in the study area by the proposed project.

Details of specialist

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Summary of expertise

Dr David Hoare:

- Has majors in Botany and Zoology with distinction from Rhodes University, Grahamstown, an Honours Degree (with distinction) in Botany from Rhodes University, an MSc (cum laude) from the Department of Plant Science, University of Pretoria, and a PhD in Botany from the Nelson Mandela Metropolitan University, Port Elizabeth with a focus on species diversity.
- Registered professional member of The South African Council for Natural Scientific Professions (Ecological Science, Botanical Science), registration number 400221/05.
- Founded David Hoare Consulting cc, an independent consultancy, in 2001.
- Ecological consultant since 1995, with working experience in Gauteng, Mpumalanga, Limpopo, North West, Eastern Cape, Western Cape, Northern Cape and Free State Provinces, Tanzania, Kenya, Mozambique and Swaziland.
- Conducted, or co-conducted, over 330 specialist ecological surveys as an ecological consultant. Areas of specialization include general ecology, biodiversity assessments, vegetation description and mapping, plant species surveys and remote sensing of vegetation. Has undertaken work in grassland, thicket, forest, savannah, fynbos, coastal vegetation, wetlands and nama-karoo vegetation, but has a specific specialization in grasslands and wetland vegetation.
- Published six technical scientific reports, 15 scientific conference presentations, seven book chapters and eight refereed scientific papers.
- Attended 15 national and international congresses & 5 expert workshops, lectured vegetation science / ecology at 2 universities and referee for 2 international journals.

Independence

David Hoare Consulting cc and its Directors have no connection with Mulilo Renewable Energy (Pty) Ltd. David Hoare Consulting cc is not a subsidiary, legally or financially, of the proponent. Remuneration for services by the proponent in relation to this project is not linked to approval by decision-making authorities responsible for authorising this proposed project

and the consultancy has no interest in secondary or downstream developments as a result of the authorisation of this project. David Hoare is an independent consultant to Aurecon South Africa (Pty) Ltd and has no business, financial, personal or other interest in the activity, application or appeal in respect of which he was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of this specialist performing such work.

Conditions relating to this report

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. David Hoare Consulting cc and its staff reserve the right to modify aspects of the report including the recommendations if and when new information may become available from on-going research or further work in this field, or pertaining to this investigation.

This report must not be altered or added to without the prior written consent of the author. This also refers to electronic copies of this report which are supplied for the purposes of inclusion as part of other reports, including main reports. Similarly, any recommendations, statements or conclusions drawn from or based on this report must make reference to this report. If these form part of a main report relating to this investigation or report, this report must be included in its entirety as an appendix or separate section to the main report.

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INTRODUCTION

Terms of reference and approach

On 14 March 2013 David Hoare Consulting cc was appointed by Aurecon South Africa (Pty) Ltd to undertake a botanical assessment of the study area. The intention is to compile one EIA report per farm. The EIA report was to include the assessment of the projects individually and cumulatively per farm. The specific terms of reference for the EIA study are as follows:

DESKTOP STUDY:

A description and characterisation of the broad study area is to be undertaken. A description of the receiving environment must be provided and any major sensitivities within the study area in the form of a desktop study, as follows:

1. Description of the broad vegetation types and/or habitats for the area, including any areas of potential conservation value. This is to be based on published sources, including the vegetation map of South Africa (Mucina et al. 2006), the National Spatial Biodiversity Assessment and any Biodiversity Conservation Plans that exist for the Province.
2. The national conservation status of major vegetation types in which the study sites are located is to be provided, as listed in the National List of Ecosystems that are Threatened and need of protection (GN1002 of 2011), published under the National Environmental Management: Biodiversity Act (Act No. 10, 2004).
3. Investigation into the Red Data (threatened and endangered) flora species within the Province and more specifically the project study area, including information on habitats in which they are most likely to be encountered.
4. The potential presence/absence of Red Data species is to be assessed by means of assessments of the presence, status and linkage of available habitat in the study area. These attributes are to be rated for each Red Data species that has a geographical distribution including the sites using the available literature and personal field experience. Three parameters are to be used to assess the probability of occurrence for each species:
    a. *Habitat requirements*: most Red Data species have very specific habitat requirements and the presence of these habitat characteristics within the study area will be assessed;
    b. *Habitat status*: in the event that available habitat is considered suitable for these species, the status or ecological condition is assessed. Often, a high level of degradation of a specific habitat type will negate the potential presence of Red Data species (especially wetland-related habitats where water-quality plays a major role); and
    c. *Habitat linkage*: for animals, movement between areas used for breeding and feeding purposes forms an essential part of ecological existence of many species. The connectivity of the study area to these surrounding habitats and adequacy of these linkages are assessed for the ecological functioning Red Data species within the study area.
5. Investigation into the potential presence of trees protected according to the National Forests Act (Act 84, 1998) and fauna and flora protected under the National Environmental Management: Biodiversity Act (Act No. 10, 2004).
6. An assessment of the general status of vegetation on site in order to provide a description of which areas contain natural habitat versus those that are transformed and/or degraded.
7. Potential impacts on biodiversity, sensitive habitats and ecosystem function are to be listed and described. These are to be compiled from a generic list of possible impacts derived from previous projects of this nature and from a literature review of the potential impacts of such development on the ecological environment.

These descriptive components are to be incorporated into a single Sensitivity Analysis for the site. An indication of major sensitivities is to be provided, including a description of sensitive features that could potentially occur as well as a map of the potential location of these features.

FIELD DATA COLLECTION

The study area is to be visited and assessed to confirm patterns identified from the desktop assessment. Specific features of potential concern are to be investigated in the field, including the following:

- General vegetation status;
- Presence of habitats of conservation concern;
- Presence of protected trees;
- Potential presence of species of concern.

ASSESSMENT OF IMPACTS:

Impacts identified are to be assessed according to standard criteria (nature, extent, duration, magnitude, probability, significance, status as well as the degree to which impacts can be reversed, the degree to which impacts will cause irreplaceable loss of resources and the degree to which impacts can be mitigated).

This report provides details of the results of the EIA specialist study. The findings of the study are based on a combination of a desktop assessment of the study area, interpretation of aerial photography and fieldwork undertaken on site.

METHODOLOGY

The assessment is to be undertaken in a single phase, an Environmental Impact Assessment phase. This report contains descriptive information on flora and fauna for the study area as well as an assessment of potential impacts.

Assessment philosophy

Many parts of South Africa contain high levels of biodiversity at species and ecosystem level. At any single site there may be large numbers of species or high ecological complexity. Sites also vary in their natural character and uniqueness and the level to which they have been previously disturbed. Assessing the potential impacts of a proposed development often requires evaluating the conservation value of a site relative to other natural areas and relative to the national importance of the site in terms of biodiversity conservation. A simple approach to evaluating the relative importance of a site includes assessing the following:

- Is the site unique in terms of natural or biodiversity features?
- Is the protection of biodiversity features on the site of national/provincial importance?
- Would development of the site lead to contravention of any international, national or provincial legislation, policy, convention or regulation?

Thus, the general approach adopted for this type of study is to identify any critical biodiversity issues that may lead to the decision that the proposed project cannot take place, i.e. to specifically focus on red flags and/or potential fatal flaws. Biodiversity issues are assessed by documenting whether any important biodiversity features occur on site, including species, ecosystems or processes that maintain ecosystems and/or species. These can be organised in a hierarchical fashion, as follows:

Species

1. threatened plant species

2. protected trees

Ecosystems
1. threatened ecosystems
2. protected ecosystems
3. critical biodiversity areas
4. areas of high biodiversity
5. centres of endemism

Processes
1. corridors
2. mega-conservancy networks
3. rivers and wetlands
4. important topographical features

It is not the intention to provide comprehensive lists of all species that occur on site, since most of the species on these lists are usually common or widespread species. Rare, threatened, protected and conservation-worthy species and habitats are considered to be the highest priority, the presence of which are most likely to result in significant negative impacts on the ecological environment. The focus on national and provincial priorities and critical biodiversity issues is in line with National legislation protecting environmental and biodiversity resources, including, but not limited to the following which ensure protection of ecological processes, natural systems and natural beauty as well as the preservation of biotic diversity in the natural environment:
1. Environment Conservation Act (Act 73 of 1989)
2. National Environmental Management Act, 1998 (NEMA) (Act 107 of 1998)
3. National Environmental Management Biodiversity Act, 2004 (Act 10 0f 2004).

Plant species of conservation concern

There are two types of species of concern for the site under investigation, (i) those listed by conservation authorities as being on a Red List and are therefore considered to be at risk of extinction, and (ii) those listed as protected according to National and/or Provincial legislation.

Red List plant species
Determining the conservation status of a species is required in order to identify those species that are at greatest risk of extinction and, therefore, in most need of conservation action. South Africa has adopted the IUCN Red List Categories and Criteria to provide an objective, rigorous, scientifically founded system to identify Red List species. A published list of the Red List species of South African plants (Raimondo *et al.* 2009) contains a list of all species that are considered to be at risk of extinction. This list is updated regularly to take new information into account, but these are not published in book/paper format. Updated assessments are provided on the SANBI website (http://redlist.sanbi.org/). According to the website of the Red List of Southern African Plants (http://redlist.sanbi.org/), *the conservation status of plants indicated on the Red List of South African Plants Online represents the status of the species within South Africa's borders. This means that when a species is not endemic to South Africa, only the portion of the species population occurring within South Africa has been assessed. The global conservation status, which is a result of the assessment of the entire global range of a species, can be found on the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species: http://www.iucnredlist.org*. The South African assessment is used in this study.

The purpose of listing Red List plant species is to provide information on the potential occurrence of species at risk of extinction in the study area that may be affected by the proposed infrastructure. Species appearing on these lists can then be assessed in terms of their habitat requirements in order to determine whether any of them have a likelihood of occurring in habitats that may be affected by the proposed infrastructure.

Lists were compiled specifically for any species at risk of extinction (Red List species) previously recorded in the area. Historical occurrences of threatened plant species were obtained from the South African National Biodiversity Institute (http://posa.sanbi.org) for the quarter degree square/s within which the study area is situated. Habitat information for each species was obtained from various published sources. The probability of finding any of these species was then assessed by comparing the habitat requirements with those habitats that were found, during the field survey of the site, to occur there.

Protected trees

Regulations published for the National Forests Act (Act 84 of 1998) as amended, provide a list of protected tree species for South Africa. The species on this list were assessed in order to determine which protected tree species have a geographical distribution that coincides with the study area and habitat requirements that may be met by available habitat in the study area. The distribution of species on this list was obtained from published sources (e.g. van Wyk & van Wyk 1997) and from the SANBI Biodiversity Information System website (http://sibis.sanbi.org/) for quarter degree grids in which species have been previously recorded. Species that have been recorded anywhere in proximity to the site (within 100 km), or where it is considered possible that they could occur there, were listed and were considered as being at risk of occurring there. The site was searched for these species during the field survey and any individuals or concentrations noted.

Other protected plant species

National legislation was evaluated in order to provide lists of any plant or animal species that have protected status. The most important legislation is the following:

- *National Environmental Management: Biodiversity Act (Act No 10 of 2004)*

This legislation contains lists of species that are protected. These lists were scanned in order to identify any species that have a geographical range that includes the study area and habitat requirements that are met by those found on site. These species were searched for within suitable habitats on site or, where relevant, it was stated that it was considered possible that they could occur on site.

There is additional legislation that provides lists of protected species, but the legislation to which these are attached deal primarily with harvesting or trade in listed species and do not seem to specifically address transformational threates to habitat or individuals. This includes the following legislation:

- *Northern Cape Nature Conservation Act (Act No 9 of 2009)*
- *CITES: Convention on the Trade in Endangered Species of Wild Fauna and Flora*.

Species probability of occurrence

Some species of plants may be cryptic, difficult to find, rare, ephemeral or generally not easy to spot while undertaking a survey of a large area. An assessment of the possibility of these species occurring on the site was therefore provided. For all threatened or protected flora that occur in the general geographical area of the site, a rating of the likelihood of it occurring on site is given as follows:

- LOW: no suitable habitats occur on site / habitats on site do not match habitat description for species;

- MEDIUM: habitats on site match general habitat description for species (e.g. karoo shrubland), but detailed microhabitat requirements (e.g. mountain shrubland on shallow soils overlying sandstone) are absent on the site or are unknown from the descriptions given in the literature or from the authorities;
- HIGH: habitats found on site match very strongly the general and microhabitat description for the species (e.g. mountain shrubland on shallow soils overlying sandstone);
- DEFINITE: species found in habitats on site.

Habitat sensitivity

The purpose of producing a habitat sensitivity map is to provide information on the location of potentially sensitive features in the study area. This was compiled by taking the following into consideration:

1. The general status of the vegetation of the study area was derived by compiling a landcover data layer for the study area (*sensu* Fairbanks et al. 2000) using available satellite imagery and aerial photography. From this it can be seen which areas are transformed versus those that are still in a natural status.
2. Various provincial, regional or national level conservation planning studies have been undertaken in the area, e.g. the National Spatial Biodiversity Assessment (NSBA). The mapped results from these were taken into consideration in compiling the habitat sensitivity map.
3. Habitats in which various species of plants or animals occur that may be protected or are considered to have high conservation status are considered to be sensitive.

An explanation of the different sensitivity classes is given in Table 1. Areas containing untransformed natural vegetation of conservation concern, high diversity or habitat complexity, Red List organisms or systems vital to sustaining ecological functions are considered potentially sensitive. In contrast, any transformed area that has no importance for the functioning of ecosystems is considered to potentially have low sensitivity.

Table 1: Explanation of sensitivity ratings.

Sensitivity	Factors contributing to sensitivity	Example of qualifying features
VERY HIGH	Indigenous natural areas that are highly positive for any of the following: • presence of threatened species (Critically Endangered, Endangered, Vulnerable) and/or habitat critical for the survival of populations of threatened species. • High conservation status (low proportion remaining intact, highly fragmented, habitat for species that are at risk). • Protected habitats (areas protected according to national / provincial legislation, e.g. National Forests Act, Draft Ecosystem List of NEM:BA, Integrated Coastal Zone Management Act, Mountain Catchment Areas Act, Lake Areas Development Act) And may also be positive for the following: • High intrinsic biodiversity value (high species richness and/or turnover, unique ecosystems)	• CBA 1 areas. • Remaining areas of vegetation type listed in Draft Ecosystem List of NEM:BA as Critically Endangered, Endangered or Vulnerable. • Protected forest patches. • Confirmed presence of populations of threatened species.

Sensitivity	Factors contributing to sensitivity	Example of qualifying features
	• High value ecological goods & services (e.g. water supply, erosion control, soil formation, carbon storage, pollination, refugia, food production, raw materials, genetic resources, cultural value) • Low ability to respond to disturbance (low resilience, dominant species very old).	
HIGH	Indigenous natural areas that are positive for any of the following: • High intrinsic biodiversity value (moderate/high species richness and/or turnover). • presence of habitat highly suitable for threatened species (Critically Endangered, Endangered, Vulnerable species). • Moderate ability to respond to disturbance (moderate resilience, dominant species of intermediate age). • Moderate conservation status (moderate proportion remaining intact, moderately fragmented, habitat for species that are at risk). • Moderate to high value ecological goods & services (e.g. water supply, erosion control, soil formation, carbon storage, pollination, refugia, food production, raw materials, genetic resources, cultural value). And may also be positive for the following: • Protected habitats (areas protected according to national / provincial legislation, e.g. National Forests Act, Draft Ecosystem List of NEM:BA, Integrated Coastal Zone Management Act, Mountain Catchment Areas Act, Lake Areas Development Act)	• CBA 2 "critical biodiversity areas". • Habitat where a threatened species could potentially occur (habitat is suitable, but no confirmed records). • Confirmed habitat for species of lower threat status (near threatened, rare). • Habitat containing individuals of extreme age. • Habitat with low ability to recover from disturbance. • Habitat with exceptionally high diversity (richness or turnover). • Habitat with unique species composition and narrow distribution. • Ecosystem providing high value ecosystem goods and services.
MEDIUM-HIGH	Indigenous natural areas that are positive for one or two of the factors listed above, but not a combination of factors.	• CBA 2 "corridor areas". • Habitat with high diversity (richness or turnover). • Habitat where a species of lower threat status (e.g. (near threatened, rare) could potentially occur (habitat is suitable, but no confirmed records).
MEDIUM	Other indigenous natural areas in which factors listed above are of no particular concern. May also include natural buffers around ecologically	

Sensitivity	Factors contributing to sensitivity	Example of qualifying features
	sensitive areas and natural links or corridors in which natural habitat is still ecologically functional.	
MEDIUM-LOW	Degraded or disturbed indigenous natural vegetation.	
LOW	No natural habitat remaining.	

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

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

Assessment of impacts

For each impact, the EXTENT (spatial scale), MAGNITUDE and DURATION (time scale) were described (see Table 2 for a description of these criteria and ratings). These criteria were used to ascertain the SIGNIFICANCE of the impact, firstly in the case of no mitigation and then with the most effective mitigation measure(s) in place.

The tables on the following pages show the scale used to assess these variables, and defines each of the rating categories.

Table 2: Assessment criteria for the evaluation of impacts

Criteria	Category	Description
Extent or spatial influence of impact	Regional	Beyond a 10 km radius of the site
	Local	Within a 10 km radius of the site.
	Site-specific	On site or within 100 m of the site.
Magnitude of impact (at the indicated spatial scale)	High	Natural functions and/or processes are *severely* altered
	Medium	Natural functions and/or processes are *notably* altered
	Low	Natural functions and/or processes are *slightly* altered
	Very low	Natural functions and/or processes are *negligibly* altered
	Zero	Natural functions and/or processes remain *unaltered*

Duration of impact	Construction period	Up to four years if PV facilities are constructed consecutively
	Short term	Up to 5 years after construction
	Medium term	5-15 years after construction
	Long term	More than 15 years after construction

The SIGNIFICANCE of an impact is derived by taking into account the temporal and spatial scales and magnitude. The means of arriving at the different significance ratings is explained in Table 3.

Table 3: Definition of significance ratings.

Significance rating	Level
HIGH	High magnitude with a regional extent and long term duration
	High magnitude with either a regional extent and medium term duration or a local extent and long term duration
	Medium magnitude with a regional extent and long term duration
	High magnitude with a local extent and medium term duration
MEDIUM	High magnitude with a regional extent and construction period or a site specific extent and long term duration
	High magnitude with either a local extent and construction period duration or a site specific extent and medium term duration
	Medium magnitude with any combination of extent and duration except site specific and construction period or regional and long term
	Low magnitude with a regional extent and long term duration
LOW	High magnitude with a site specific extent and construction period duration
	Medium magnitude with a site specific extent and construction period duration
	Low magnitude with any combination of extent and duration except site specific and construction period or regional and long term
	Very low magnitude with a regional extent and long term duration
VERY LOW	Low magnitude with a site specific extent and construction period duration
	Very low magnitude with any combination of extent and duration except regional and long term
NEUTRAL	Zero magnitude with any combination of extent and duration

Once the significance of an impact had been determined, the PROBABILITY of this impact occurring as well as the CONFIDENCE in the assessment of the impact were determined using the rating systems outlined in Table 4 and Table 5 respectively. Lastly, the REVERSIBILITY of the impact is estimated using the rating system outlined in Table 6.

Table 4: Definition of probability ratings.

Probability rating	**Criteria**
Definite	Estimated greater than 95 % chance of the impact occurring
Probable	Estimated 5 to 95 % chance of the impact occurring
Unlikely	Estimated less than 5 % chance of the impact occurring

Table 5: Definition of confidence ratings.

Confidence rating	**Criteria**
Certain	Wealth of information on and sound understanding of the environmental

	factors potentially influencing the impact
Sure	Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact.
Unsure	Limited useful information on and understanding of the environmental factors potentially influencing this impact

Table 6: Definition of reversibility ratings

Reversibility	Criteria
Irreversible	The activity will lead to an impact that is in all practical terms permanent.
Reversible	The impact is reversible within 2 years after the cause or stress is removed.

Limitations

- Red List species are, by their nature, usually very rare and difficult to locate. Compiling the list of species that could potentially occur in an area is limited by the paucity of collection records that make it difficult to predict whether a species may occur in an area or not. The methodology used in this assessment is designed to reduce the risks of omitting any species, but it is always possible that a species that does not occur on a list may be unexpectedly located in an area.

PROJECT DESCRIPTION AND ALTERNATIVES

During the Scoping Phase, various alternatives were screened to derive a list of feasible alternatives that need to be assessed in further detail in the EIA Phase. Subsequently, the following types of alternatives are the most pertinent to the proposed project:

- Layout alternative dependent on the scale and magnitude alternative;
- Technology alternative;
- Transmission line routing alternative; and
- Scale and magnitude alternative.

The alternative types pertinent to this project are described in the subsequent sections.

Location alternative

It is proposed that three PV facilities be constructed at Du Plessis Dam farm. A previous EIA, similar to this study, was undertaken at the same location (Aurecon, 2012). After completion of the EIA (DEA Reference Number: 12/12/20/2498), the Department of Environmental Affairs (DEA) authorised a PV facility with 20MW capacity (Environmental Authorisation (EA) dated 28 September 2012). The approved PV facility will herein after be referred to as Du Plessis PV1. Therefore, information is readily available (Hoare 2012) and environmental sensitive areas have been identified. These sensitive areas were taken into consideration in the preliminary designs. It therefore makes sense to further develop a site which is already well studied, suitable for the proposed development, located close to existing and proposed Eskom infrastructure, and where no fatal flaws have been identified.

It is also more economically feasible to group developments to promote infrastructure sharing. As mentioned in Section 1.2, Mulilo already received an EA for one PV facility on this farm (referred to as PV1) which is further motivation for this location alternative as it could result in the following benefits:

- Sharing of supply infrastructure including water, sewage and electricity;
- Reducing the impact on the environment due to combining infrastructure and footprints;
- Utilizing a single laydown area and construction camp minimizing traffic and associated impacts with multiple camps;
- Allowing phased approach to construction activities thereby extending the construction period for employment and creating more long term employment jobs;
- Reducing the need for multiple electricity grid connection points and transmission lines;
- Motivation for the creation of an industrial zone within De Aar whereby specialised services and manufacturing processes are able to develop in response to consistent demand; and
- Improved accuracy in terms of assessing cumulative impacts during the EIA phase.

The selection of this preferred and only location alternative was furthermore based on the following characteristics of the site:

- Solar resource potential based on historic satellite data;
- Grid connectivity and close proximity to strong grid access;
- Flat, level, and open land;
- Little environmentally and socially sensitive areas; and
- Non-arable or low arable potential of the land.

Based on the above motivation, it was proposed to only assess one location alternative namely Du Plessis Dam Farm, De Aar. The location of the proposed PV facilities on Du Plessis Dam Farm is shown in Figure 1.

Layout alternatives (dependent on the scale and magnitude alternatives)

Layout alternative 1

The Department of Energy (DoE) introduced a capacity limit of 75MW for solar facilities. The capacity (MW) of the facilities therefore determines the layout of the facilities. This layout consists of the three proposed 75MW PV facilities and associated infrastructure as indicated in Figure 1 referred to as PV2, PV3 and PV4. These layouts take cognisance of the 75MW DoE cap and the environmentally sensitive areas as identified by Aurecon (2012). Table includes details of the proposed layouts.

Layout alternative 2

This alternative consists of one 400MW PV facility, covering 1000 ha. The layout for this alternative was developed by extending and combining the proposed 75MW facilities. This alternative is thus not limited to the DOE's 75MW cap per project. By increasing the capacity it has the benefit of utilising industries at scale thereby reducing associated development and construction costs which reduces lending rates and essentially lower the tariff of electricity sold (Aurecon, 2013).

Table 7: Footprints, capacities and coordinates of the three alternative layouts

Facility	Footprint	Capacity	Coordinates of middle point
PV2	169ha	75MW	30°38'11.38"S; 24° 4'22.75"E

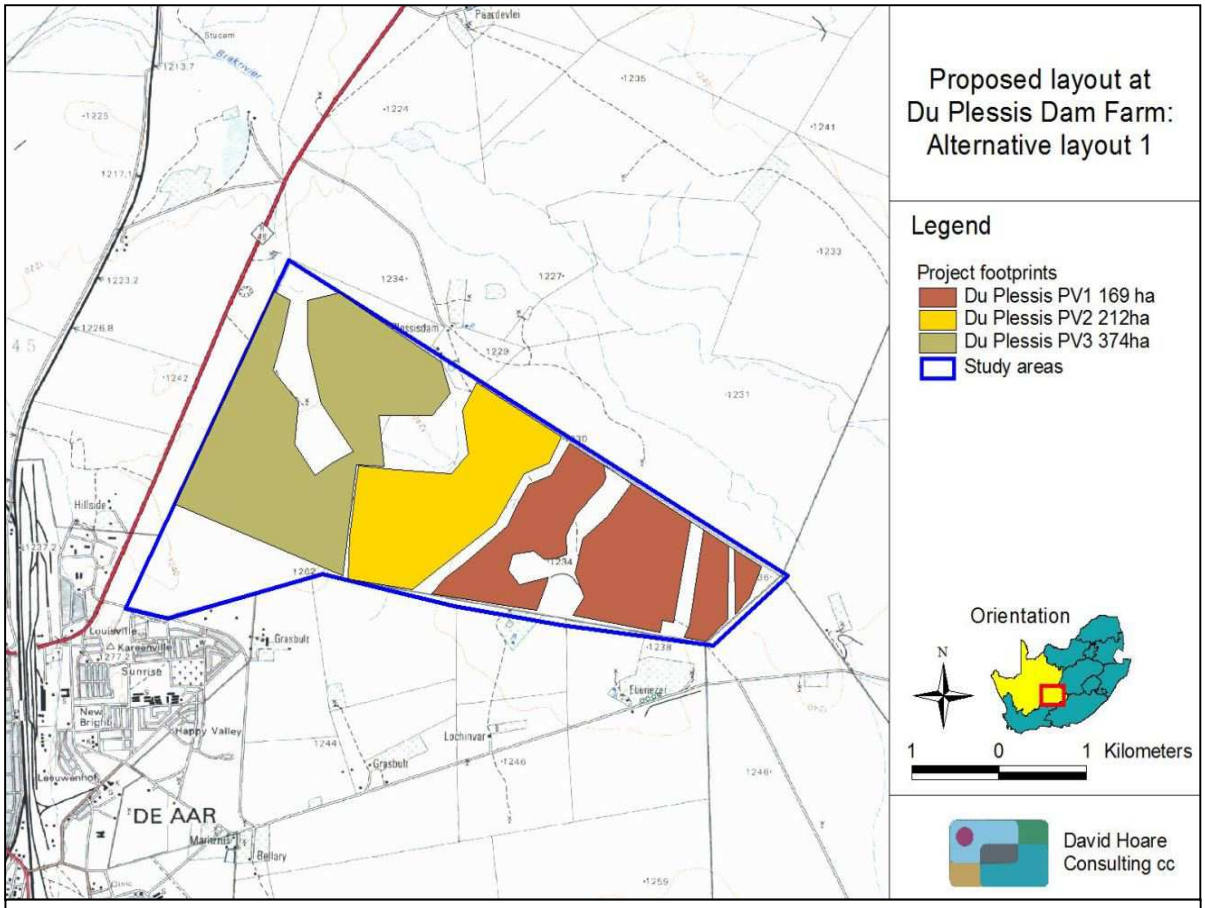

Figure 1: Location of the proposed pv Solar facilities.

PV3	212ha	75MW	30°37'53.03"S; 24° 3'28.26"E
PV4	374ha	75MW	30°37'27.44"S; 24° 2'31.14"E

Layout of additional infrastructure

It is proposed that one layout for the proposed roads and water pipeline be assessed. The layouts provided took the environmentally sensitive areas into consideration and follows the shortest viable route as shown in Figure 2.

Technology alternative

A number of sites are proposed for wind energy facilities in the surrounding area which indicates that the proposed site could also be suitable for wind power. However, the selection of the Badenhorst Dam farm was based on the requirements for solar energy. Therefore, all of the technology alternatives considered revolves around the Solar PV technologies.

Solar panel alternatives

Three solar panel types were considered for the proposed plants: concentrated photovoltaic (CPV), concentrated solar power (CSP) and conventional PV solar cells. Information gathered through previous EIAs (Aurecon, 2012), as well as the recent technology advances informed this investigation.

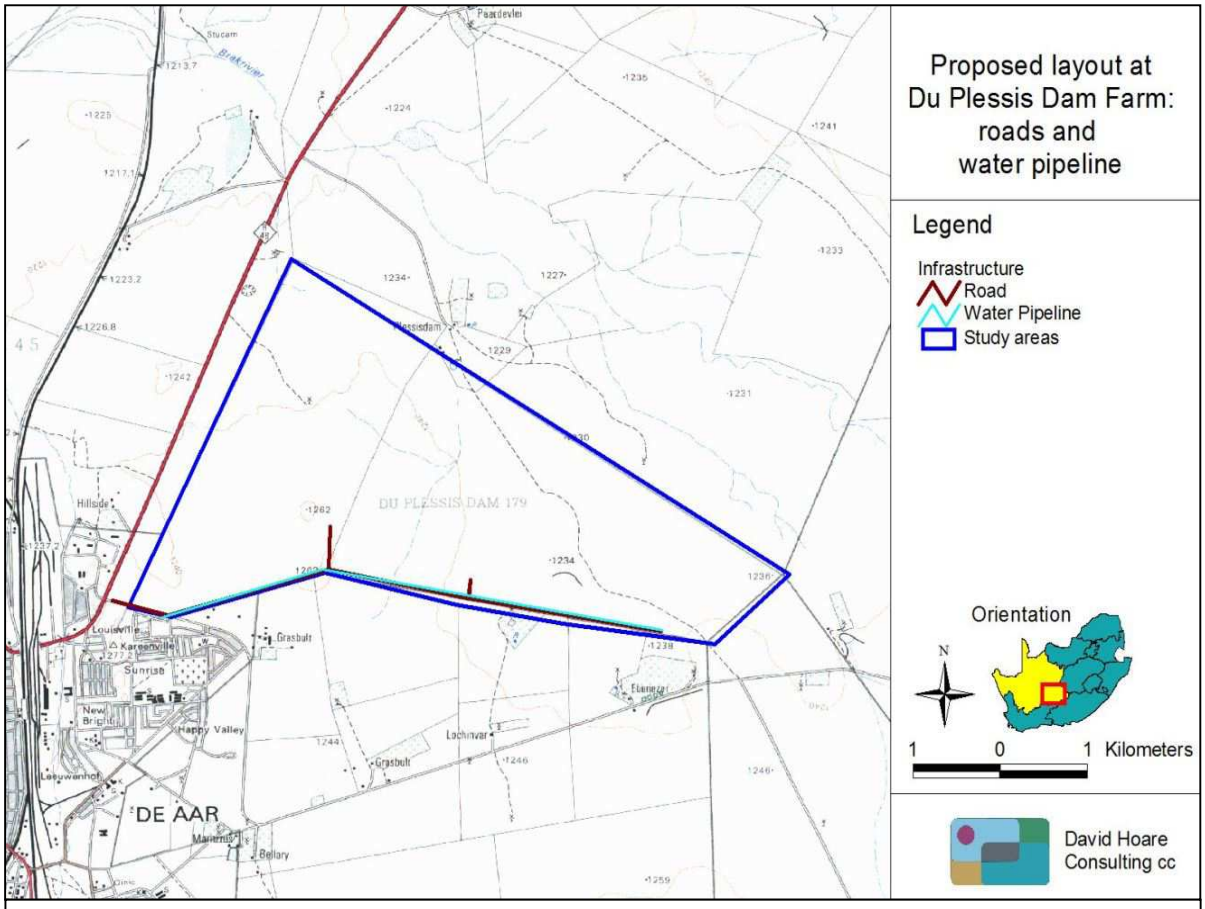

Figure 2: Location of proposed road and water pipeline.

The conventional PV and CPV technologies require less water (19L/MWh of water per day) than the CSP system which needs approximately 3,420L/MWh of water per day during the operational period. Therefore, due to the scarcity of water in this area, and the large volume of water required for the CSP system, only conventional PV and CPV technologies will be considered for the proposed solar facilities.

Mounting Alternatives

In terms of the mounting alternatives, single axis tracking systems will be considered along with fixed axis tracking systems. This decision will be made by the proponent closer to detail design phase after taking into consideration the economic viability, water requirements, land requirements, efficiency and potential environmental impacts of the proposed solar panel types.

In a fixed axis tracking system the PV panels are installed at a set tilt and cannot move, whereas in a single axis tracking system the panels follow the sun to ensure maximum exposure to sunlight.

The photovoltaic single axis tracking technology has the following benefits:

- The panels are the highest efficiency panels with the highest efficiency inverter, maximizing the system output. The installation costs are less as fewer panels are required.
- The panel's anti-reflective glass and exceptional low-light performance characteristics enhances energy delivery; and

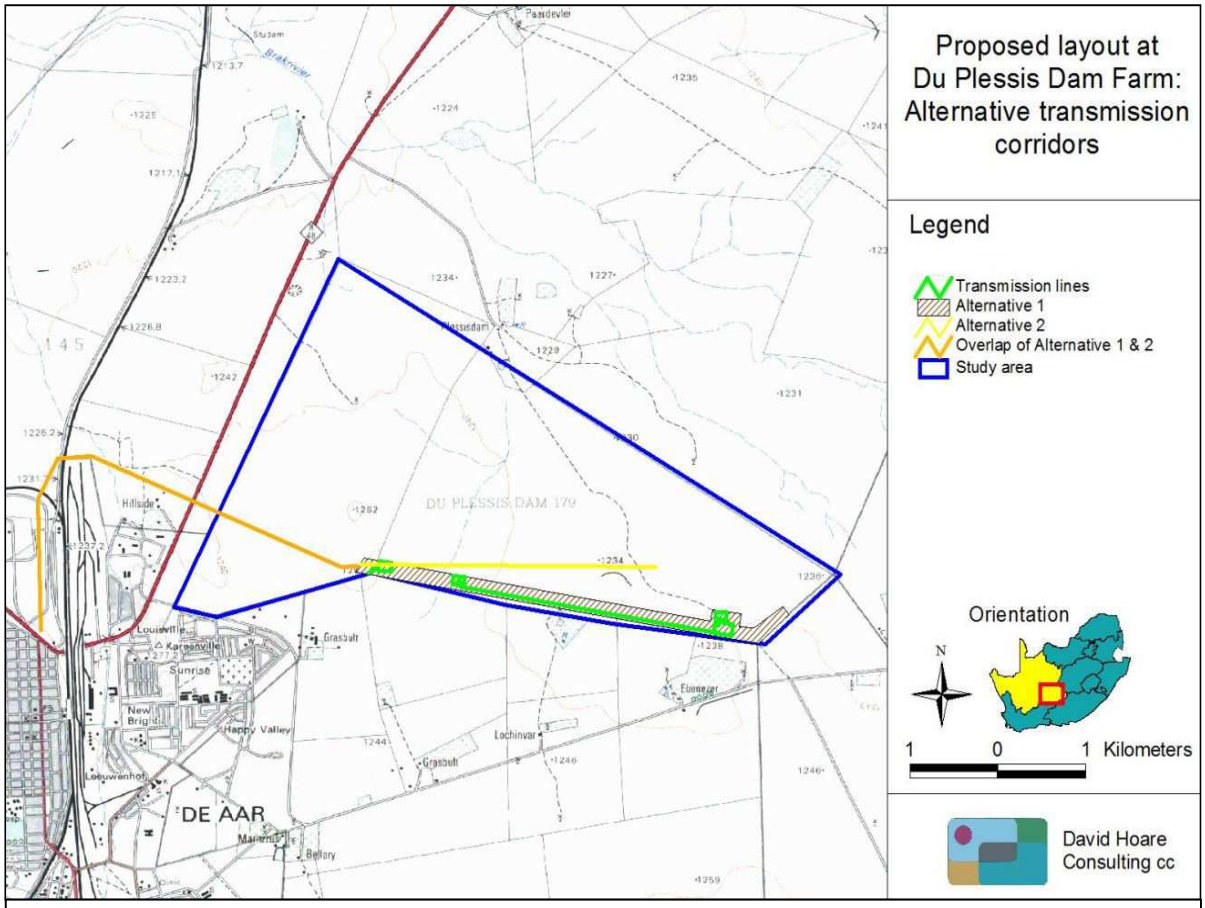

Figure 3: Location of proposed transmission lines and substations.

- By minimising shading and grouping trackers closer together, this highly efficient technology produces the most energy per hectare of any tracking system. It requires up to 20% less land than conventional crystalline fixed tilt systems and up to 60% less than thin film technology.

These highly efficient panels not only require less land, but also less concrete, steel and cabling per MW.

Transmission line routing and substations alternative

It is envisaged that each PV facility would require an onsite substation specific to each PV facility i.e. three onsite substations. These substations would feed into one central onsite substation by means of onsite overhead 132kV transmission lines (shown in green in Figure 3).

Based on the uncertainties regarding the capacity of Eskom's substations and transmission lines, it is proposed to assess a transmission line corridor instead of assessing the preliminary layouts which could be subject to changes. The width of the proposed transmission corridor ranges from 150m to 350m. The proposed transmission corridor is shown in Figure 3. As an alternative, a transmission line slightly north of this corridor is also a possibility.

No-Go alternative

The "no-go" option is taken to be the existing rights on the property, including the approved PV facility, and this includes all the duty of care and other legal responsibilities that apply to the owner of the property.

DESCRIPTION OF STUDY AREA

Topography

The study sites are located on plains and the topography of the sites is therefore relatively gentle. There is a low, narrow ridge that cuts diagonally through the centre of the site. There is also a range of low hills on the eastern side of the site. The remainder of the site is gently sloping. The elevation on site varies from 1233 to 1261 m above sea level.

Land types and soils

Detailed soil information is not available for broad areas of the country. As a surrogate, landtype data was used to provide a general description of soils in the study area (landtypes are areas with largely uniform soils, topography and climate). There is one land type in the study area, namely the Ae land type (Land Type Survey Staff, 1987). The Ae land type covers the entire site.

The A-group of land types refer to yellow and red soils without water tables belonging to one or more of the following soil forms: Inanda, Kranskop, Magwa, Hutton, Griffin, Clovelly. The Ae landtype consists of red, high base status, > 300 mm deep soils and no dunes (MacVicar et al. 1974).

Climate

The climate is arid to semi-arid. Rainfall occurs from November to March, but peaks in mid- to late summer (February / March). Mean annual rainfall is approximately 200 mm per year. All

areas with less than 400 mm rainfall are considered to be arid. The study area can therefore be considered to be arid.

Broad vegetation types of the region

The study area falls within the Nama-Karoo Biome (Rutherford & Westfall 1986, Mucina & Rutherford 2006). The most recent and detailed description of the vegetation of this region is part of a national map (Mucina, Rutherford & Powrie, 2005; Mucina *et al*. 2006). This map shows one vegetation type occurring within or close to the study sites, namely Northern Upper Karoo. No other vegetation type occurs anywhere near to the site. The Northern Upper Karoo vegetation type is described in more detail below.

Northern Upper Karoo
This vegetation type occurs in the northern parts of the Upper Karoo Plateau, with its southern extent ending near De Aar. It is a shrubland dominated by dwarf karoo shrubs, grasses and some low trees, including *Acacia mellifera* subsp. *detinens* (Mucina et al. 2006). There are five known endemics in this vegetation (Mucina *et al*. 2006), namely the succulent shrubs, *Lithops hookeri* and *Stomatium pluridens*, the low shrubs, *Atriplex spongiosa* and *Galenia exigua* and the herb, *Manulea deserticola*. At a national scale this vegetation type has been transformed only a small amount (approximately 4%) and none is conserved; it is considered to be a Least Threatened vegetation type (Mucina *et al*. 2006).

Conservation status of broad vegetation types

On the basis of a recently established approach used at national level by SANBI (Driver *et al*. 2005), vegetation types can be categorised according to their conservation status which is, in turn, assessed according to the degree of transformation relative to the expected extent of each vegetation type. The status of a habitat or vegetation type is based on how much of its original area still remains intact relative to various thresholds. The original extent of a vegetation type is as presented in the most recent national vegetation map (Mucina, Rutherford & Powrie 2005) and is the extent of the vegetation type in the absence of any historical human impact. On a national scale the thresholds are as depicted in Table 8, as determined by best available scientific approaches (Driver *et al*. 2005).

The level at which an ecosystem becomes Critically Endangered differs from one ecosystem to another and varies from 16% to 36% of the ecosystem still remaining in a natural state (Driver et al. 2005). The vegetation types occurring in the study area (Table 8) are classified as Least Threatened (Driver *et al*. 2005; Mucina *et al*., 2006).

Table 8: Determining ecosystem status (from Driver et al. 2005). *BT = biodiversity target (the minimum conservation requirement).

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

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

transformation. The thresholds for listing in this legislation are higher than in the scientific literature, which means there are fewer ecosystems listed in the National Ecosystem List versus in the scientific literature. The vegetation types occurring on site are not listed in the National List of Ecosystems that are Threatened and need of protection (GN1002 of 2011).

Table 9: Conservation status the vegetation types occurring in the study area, according to Driver *et al*. 2005 and Mucina *et al*. 2005.

Vegetation Type	Target (%)	Conserved (%)	Transformed (%)	Conservation status	
				Driver *et al*. 2005; Mucina *et al*., 2006	Draft Ecosystem List (NEMBA)
Northern Upper Karoo	21	0	4	Least Threatened	Not listed

Critical Biodiversity Areas have been identified for all municipal areas of the Northern Cape Province and are published on the SANBI website (bgis.sanbi.org). These maps identify no areas of concern in the current study area. This is consistent with patterns identified from other sources within the current scoping document.

Landuse and landcover of the study area

A landcover map of the study area (Fairbanks *et al*. 2000) indicates that the site consists primarily of natural vegetation, classified as "shrubland and low fynbos". This is confirmed from 1:50 000 topo-cadastral maps (see Figure 1), Google imagery of the sites and the site visits.

The farm is used as grazing for domestic and wild livestock. It is probable that it has been used for cattle, sheep and/or goats at some stage in the past.

The vegetation on site is dominated by grasses, with a significant number of karoo shrubs of low stature amongst the grasses. A general view of the site from the western side is shown in Figure 4.

The vegetation on site is in moderate condition. There were no trees on site.

Red List plant species of the study area

Lists of plant species of conservation concern previously recorded in the quarter degree grids in which the study area is situated were obtained from the South African National Biodiversity Institute (SANBI). These are listed in Appendix 1. Additional species that could occur in similar habitats, as determined from database searches and literature sources, but have not been recorded in these grids are also listed.

There is one species incorrectly listed on this list, *Protea subvestita*, which is listed as Vulnerable. This species occurs along the southern and eastern Great Escarpment of the country in montane habitats, particularly highland grassland and fynbos. The record from the adjacent grid is an incorrect database record and this species does not occur anywhere near to the site. There are, therefore, no threatened, near threatened, declining or rare plant species that could occur on site.

Protected plants (National Environmental Management: Biodiversity Act)

Plant species protected under NEM:BA are listed in Appendix 4. One plant species that appears on this list that could potentially occur in the region, although it has not previously been recorded in the grid, is *Hoodia gordonii*. This species is currently listed in Appendix II to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which includes species not currently considered endangered but are at risk if trade is not

Figure 4: View of the vegetation of the site.

controlled. *Hoodia gordonii* has a wide tolerance of growing habitats and is found in deep Kalahari sands, on dry stony slopes or flats and under the protection of xerophytic bushes. Suitable conditions do occur on site and it is considered possible that this species could occur on site. However, it was not found during the field survey.

Another protected species that could potentially occur in the region, although it has not previously been recorded in the grid, is *Harpagophytum procumbens* (devil's claw). This species is associated mainly with dry sandveld on deep Kalahari sand. It usually occupies plains, dune bases and interdunes. Soils are usually sandy but can be rocky. They are generally nutrient poor, often with lime. The soil conditions expected on site do not co-incide with the habitat requirements for this species and it is not considered likely that it occurs on site. It was not found during the field survey.

Protected trees

Tree species protected under the National Forest Act are listed in Appendix 2. The only one that has a geographical distribution that includes the study area is *Boscia albitrunca* (Shepherd's Tree / Witgatboom / !Xhi). *Boscia albitrunca* occurs in semi-desert areas and bushveld, often on termitaria, but is common on sandy to loamy soils and calcrete soils. This species is usually quite common where it is found, but was not recorded on site.

The tree, *Acacia haematoxylon*, has been previously recorded within 100 km of the site to the north (near Hopetown). The potential presence of this species is, therefore, also assessed for this site. *Acacia haematoxylon* occurs on deep Kalahari sand between dunes or along dry watercourses. Collection records for this species obtained from the SANBI website (http://sibis.sanbi.org/) indicate that this species does not occur anywhere near to the site. No individuals were observed on site or in the surrounding areas during this and other field assessments.

Sensitivity assessment

The sensitivity assessment identifies those parts of the study area that have high conservation value or that may be sensitive to disturbance. Areas of sensitivity are shown in Figure 5. There are features that need to be taken into account in order to evaluate sensitivity in the study area. These include the following:

1. Non-perennial streams and drainage lines: this represents a number of ecological processes including groundwater dynamics, hydrological processes, nutrient cycling and wildlife dispersal. Wetlands are protected according to the National Water Act and the NEMA.

These factors have been taken into account in evaluating sensitivity within the study area (Figure 5). The sensitivity classification is as follows:

1. MEDIUM-HIGH: All of the drainage lines on site are classified as having medium-high sensitivity (see Figure 5). They are protected according to the National Water Act (Act 36 of 1998). Ecologically, they are areas that provide moderate value ecosystem goods and services.
2. MEDIUM: The majority of the study area is classified as having medium sensitivity (see Figure 5). These are areas of natural vegetation which harbour no particular features of conservation concern.

LEGISLATIVE AND PERMIT REQUIREMENTS

Relevant legislation is provided in this section to provide a description of the key legal considerations of biodiversity importance to the proposed project. The applicable legislation is listed below.

Legislation

National Environmental Management Act, Act No. 107 of 1998 (NEMA)

NEMA requires, inter alia, that:

- "development must be socially, environmentally, and economically sustainable",
- "disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied." ,
- "a risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions",

NEMA states that "the environment is held in public trust for the people, the beneficial use of environmental resources must serve the public interest and the environment must be protected as the people's common heritage."

Environment Conservation Act No 73 of 1989 Amendment Notice No R1183 of 1997

The ECA states that:

Development must be environmentally, socially and economically sustainable. Sustainable development requires the consideration of inter alia the following factors:

- that pollution and degradation of the environment is avoided, or, where they cannot be altogether avoided, are minimised and remedied;

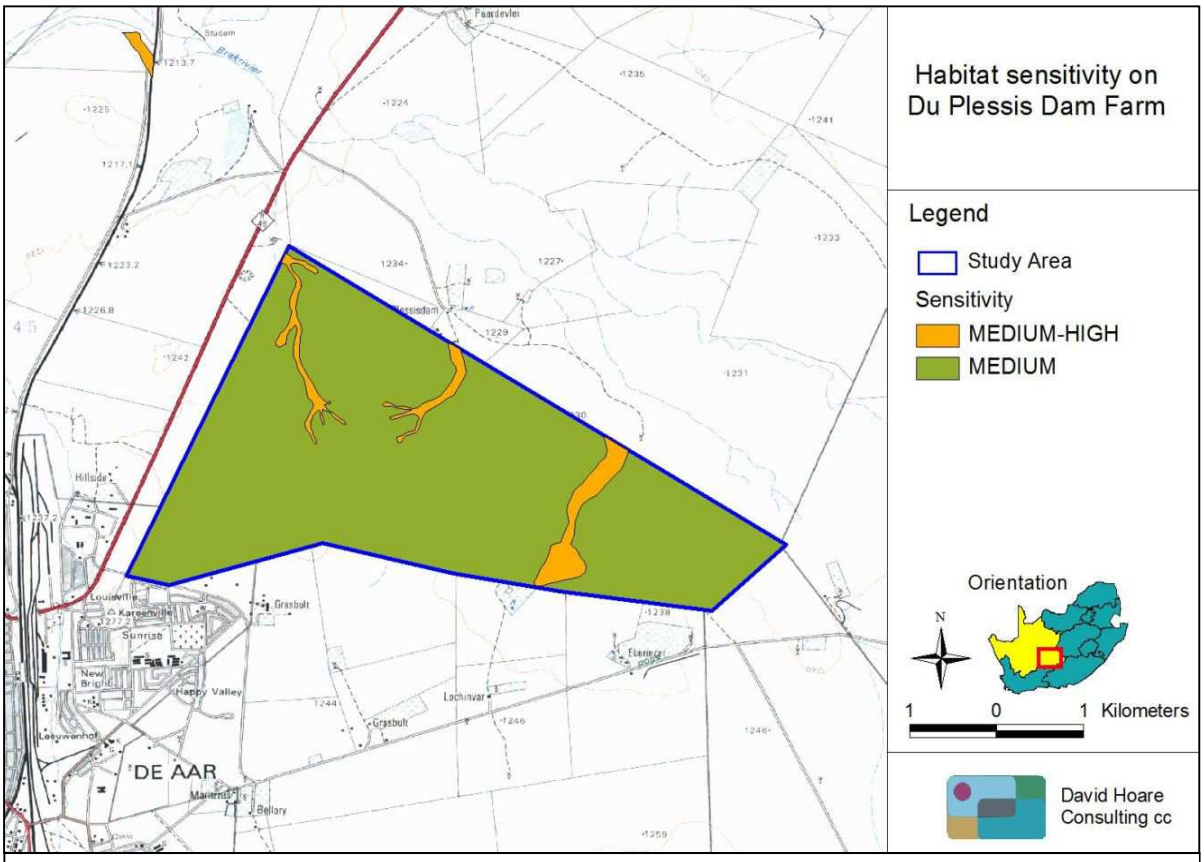

Figure 5: Watercourses and drainage areas of the study area.

- that the use and exploitation of non-renewable natural resources is responsible and equitable, and takes into account the consequences of the depletion of the resource;
- that the development, use and exploitation of renewable resources and the ecosystems of which they are part do not exceed the level beyond which their integrity is jeopardised; and
- that negative impacts on the environment and on peoples' environmental rights be anticipated and prevented, and where they cannot be altogether prevented are minimised and remedied.

The developer is required to undertake Environmental Impact Assessments (EIA) for all projects listed as a Schedule 1 activity in the EIA regulations in order to control activities which might have a detrimental effect on the environment. Such activities will only be permitted with written authorisation from a competent authority.

National Forests Act (Act no 84 of 1998)

Protected trees

According to this act, the Minister may declare a tree, group of trees, woodland or a species of trees as protected. The prohibitions provide that 'no person may cut, damage, disturb, destroy or remove any *protected tree*, or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a licence granted by the Minister'.

Forests

Prohibits the destruction of indigenous trees in any natural forest without a licence.

National Environmental Management: Biodiversity Act (Act No 10 of 2004)

In terms of the Biodiversity Act, the developer has a responsibility for:

- The conservation of endangered ecosystems and restriction of activities according to the categorisation of the area (not just by listed activity as specified in the EIA regulations).
- Promote the application of appropriate environmental management tools in order to ensure integrated environmental management of activities thereby ensuring that all development within the area are in line with ecological sustainable development and protection of biodiversity.
- Limit further loss of biodiversity and conserve endangered ecosystems.

Chapter 4 of the Act relates to threatened or protected ecosystems or species. According to Section 57 of the Act, "Restricted activities involving listed threatened or protected species":

- (1) A person may not carry out a restricted activity involving a specimen of a listed threatened or protected species without a permit issued in terms of Chapter 7.

Such activities include any that are "of a nature that may negatively impact on the survival of a listed threatened or protected species".

Chapter 5 of the Act relates to species and organisms posing a potential threat to biodiversity. According to Section 75 of the Act, "Control and eradication of listed invasive species":

- (1) Control and eradication of a listed invasive species must be carried out by means of methods that are appropriate for the species concerned and the environment in which it occurs.
- (2) Any action taken to control and eradicate a listed invasive species must be executed with caution and in a manner that may cause the least possible harm to biodiversity and damage to the environment.

- (3) The methods employed to control and eradicate a listed invasive species must also be directed at the offspring, propagating material and re-growth of such invasive species in order to prevent such species from producing offspring, forming seed, regenerating or re-establishing itself in any manner.

Government Notice No. 1002 of 2011: National List of Ecosystems that are Threatened and in need of protection

Published under Section 52(1)(a) of the National Environmental Management: Biodiversity Act (Act No. 10 of 2004). This Act provides for the listing of threatened or protected ecosystems based on national criteria. The list of threatened terrestrial ecosystems supersedes the information regarding terrestrial ecosystem status in the National Spatial Biodiversity Assessment (2004).

The Environmental Impact Assessment (EIA) Regulations include three lists of activities that require environmental authorisation:

• Listing Notice 1: activities that require a basic assessment (R544 of 2010),

• Listing Notice 2: activities that require seeping and environmental impact report (EIR) (R545 of 201 0),

• Listing Notice 3: activities that require a basic assessment in specific identified geographical areas only (R546 of 2010).

Activity 12 in Listing Notice 3 relates to the clearance of 300m2 of more of vegetation, which will trigger a basic assessment within any critically endangered or endangered ecosystem listed in terms of S52 of the Biodiversity Act. This means any development that Involves loss of natural habitat In a listed critically endangered or endangered ecosystem Is likely to require at least a basic assessment in terms of the EIA regulations.

It is important to note that while the original extent of each listed ecosystem has been mapped, a basic assessment report in terms of the EIA regulations is triggered only in remaining natural habitat within each ecosystem and not in portions of the ecosystem where natural habitat has already been irreversibly lost.

GNR 151: Critically Endangered, Endangered, Vulnerable and Protected Species List

Published under Section 56(1) of the National Environmental Management: Biodiversity Act (Act No. 10 of 2004).

GNR 1187: Amendment of Critically Endangered, Endangered, Vulnerable and Protected Species List

Published under Section 56(1) of the National Environmental Management: Biodiversity Act (Act No. 10 of 2004).

Conservation of Agricultural Resources (Act No. 43 of 1983) as amended in 2001

Declared Weeds and Invaders in South Africa are categorised according to one of the following categories:

- Category 1 plants: are prohibited and must be controlled.
- Category 2 plants: (commercially used plants) may be grown in demarcated areas providing that there is a permit and that steps are taken to prevent their spread.
- Category 3 plants: (ornamentally used plants) may no longer be planted; existing plants may remain, as long as all reasonable steps are taken to prevent the spreading thereof, except within the floodline of watercourses and wetlands.

National Water Act

Wetlands, riparian zones and watercourses are defined in the Water Act as a water resource and any activities that are contemplated that could affect the wetlands requires authorisation (Section 21 of the National Water Act of 1998). A "watercourse" in terms of the National Water Act (act 36 of 1998) means:

- River or spring;
- A natural channel in which water flows regularly or intermittently;
- A wetland, lake or dam into which, or from which, water flows; and

Any collection of water which the Minister may, by notice in the gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

National Veld and Forest Fire Act (Act No. 101 of 1998)

Provides requirements for veldfire prevention through firebreaks and required measures for fire-fighting. Chapter 4 of the Act places a duty on landowners to prepare and maintain firebreaks. Chapter 5 of the Act places a duty on all landowners to acquire equipment and have available personnel to fight fires.

Northern Cape Nature Conservation Act, No. 9 of 2009

This Act provides for the sustainable utilisation of wild animals, aquatic biota and plants; provides for the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora; provides for offences and penalties for contravention of the Act; provides for the appointment of nature conservators to implement the provisions of the Act; and provides for the issuing of permits and other authorisations. Amongst other regulations, the following may apply to the current project:

- Boundary fences may not be altered in such a way as to prevent wild animals from freely moving onto or off of a property;
- Aquatic habitats may not be destroyed or damaged;
- The owner of land upon which an invasive species is found (plant or animal) must take the necessary steps to eradicate or destroy such species.

The Act provides lists of protected species for the Province.

Other Acts

Other Acts that may apply to biodiversity issues, but which are considered to not apply to the current site are as follows:

- National Environmental Management Protected Areas Act (Act No. 57 of 2003)
- Marine Living Resources Act (Act No. 18 of 1998)
- Sea Birds and Seals Protection Act (Act No. 46 of 1973)
- Lake Areas Development Act (Act No. 39 of 1975)
- Mountain Catchment Areas Act (Act No. 63 of 1970)
- Integrated Coastal Zone Management Act (Act No. 24 of 2008)

IDENTIFICATION OF RISKS AND POTENTIAL IMPACTS

Potential issues relevant to potential impacts on the ecology of the study area include the following:

- Impacts on biodiversity: this includes any impacts on populations of individual species of concern (flora), including protected species, and on overall species richness. This includes impacts on genetic variability, population dynamics, overall species existence or health and on habitats important for species of concern.
- Impacts on sensitive habitats: this includes impacts on any sensitive or protected habitats, including indigenous forest, fynbos and wetland vegetation that leads to direct or indirect loss of such habitat.
- Impacts on ecosystem function: this includes impacts on any processes or factors that maintain ecosystem health and character, including the following:

    - Disruption to nutrient-flow dynamics;
    - Impedance of movement of material or water;
    - Habitat fragmentation;
    - Changes to abiotic environmental conditions;
    - Changes to disturbance regimes, e.g. Increased or decreased incidence of fire;
    - Changes to successional processes;
    - Effects on pollinators;
    - Increased invasion by alien plants.

    Changes to factors such as these may lead to a reduction in the resilience of plant communities and ecosystems or loss or change in ecosystem function.
- Secondary and cumulative impacts on ecology: this includes an assessment of the impacts of the proposed project taken in combination with the impacts of other known projects for the area or secondary impacts that may arise from changes in the social, economic or ecological environment.
- Impacts on the economic use of vegetation: this includes any impacts that affect the productivity or function of ecosystems in such a way as to reduce the economic value to users, e.g. reduction in grazing capacity, loss of harvestable products. It is a general consideration of the impact of a project on the supply of so-called ecosystem goods and services.

A number of direct risks to ecosystems that would result from **construction** of the proposed solar energy facility are as follows:

- Clearing of land for construction.
- Construction of access roads.
- Placement of power lines, cables and water pipelines.
- Establishment of borrow and spoil areas.
- Chemical contamination of the soil by construction vehicles and machinery.
- Operation of construction camps.
- Storage of materials required for construction.

Description of potential impacts

Major potential impacts are described briefly below. These are compiled from a generic list of possible impacts derived from previous projects of this nature and from a literature review of the potential impacts of solar energy facilities on the ecological environment. The major expected negative impact will be due to loss of habitat which may have direct or indirect impacts on individual organisms or on ecosystems as a whole.

Impact 1: Loss or fragmentation of indigenous natural vegetation (terrestrial)
Nature: Construction of infrastructure may lead to direct loss of vegetation. This may lead to localised or more extensive reduction in the overall extent of vegetation. There are factors that may aggravate this potential impact. For example, where this vegetation has already been stressed due to degradation and transformation at a regional level, the loss may lead to increased vulnerability (susceptibility to future damage) of the habitat and a change in the conservation status (current conservation situation). Consequences of the potential impact of loss of indigenous natural vegetation occurring may include:

1. Negative change in conservation status of habitat (Driver et al. 2005);
2. Increased vulnerability of remaining portions to future disturbance;
3. General loss of habitat for sensitive species;
4. Loss in variation within sensitive habitats due to loss of portions of it;
5. General reduction in biodiversity;
6. Increased fragmentation (depending on location of impact);
7. Disturbance to processes maintaining biodiversity and ecosystem goods and services; and
8. Loss of ecosystem goods and services.

The vegetation type site is Northern Upper Karoo, classified nationally as Least Threatened. The Northern Upper Karoo vegetation type occurs across an extensive area (covers an area of almost 42 000 km^2). The regional impact on the vegetation type as a whole therefore appears to be insignificant. Nevertheless, the local impact (at the farm scale) is potentially significant.

Impact 2: Loss of individuals of threatened plants
Nature: Plant species are especially vulnerable to infrastructure development due to the fact that they cannot move out of the path of the construction activities, but are also affected by overall loss of habitat.

Threatened species 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 plant species, 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 may include:

1. Fragmentation of populations of affected species;
2. Reduction in area of occupancy of affected species; and
3. 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 chance of survival of the species.

There are no threatened, near threatened or rare plant species that occur on site. This potential impact is therefore not applicable to the current proposal and is not evaluated further.

Impact 3: Loss of individuals of protected tree species
There are a number of tree species that are protected according to Government Notice no. 1012 under section 12(I)(d) of the National Forests Act, 1998 (Act No. 84 of 1998). In terms of section1 5(1) of the National Forests Act, 1998 "no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell donate or in any other manner acquire or dispose of any protected tree or any forest product derived from a protected tree, except under a license granted by the Minister to an (applicant and subject to such period and conditions as may be stipulated".

One species has a geographic distribution that includes the study area, *Boscia albitrunca*. This species does not occur in any part of the study area. This potential impact is therefore not applicable to the current proposal and is not evaluated further.

Impact 4: Loss of individuals of protected plant species
There are two plant species that are protected according to National Environmental Management: Biodiversity Act (Act No. 10 of 2004) and are known to occur in the general geographical area that includes the site. According to this Act, "*a person may not carry out a restricted activity involving a specimen of a listed threatened or protected species without a permit issued in terms of Chapter 7*". Such activities include any that are "*of a nature that may negatively impact on the survival of a listed threatened or protected species*". This implies that any negative impacts on habitats in which populations of protected species occur or are dependent upon would be restricted according to this Act.

The species that have a geographic distribution that includes the study area are *Hoodia gordonii* and *Harpagophytum procumbens*. No individuals were found during the field survey and it is considered unlikely that they occur on site. This potential impact is therefore not applicable to the current proposal and is not evaluated further.

Impact 5: Establishment and spread of declared weeds and alien invader plants
Major factors contributing to invasion by alien invader plants includes *inter alia* high disturbance (such as clearing for construction activities) and negative grazing practices (Zachariades *et al*. 2005). Exotic species are often more prominent near infrastructural disturbances than further away (Gelbard & Belnap 2003, Watkins *et al*. 2003). Consequences of this may include:

1. Loss of indigenous vegetation;
2. Change in vegetation structure leading to change in various habitat characteristics;
3. Change in plant species composition;
4. Change in soil chemical properties;
5. Loss of sensitive habitats;
6. Loss or disturbance to individuals of rare, endangered, endemic and/or protected species;
7. Fragmentation of sensitive habitats;
8. Change in flammability of vegetation, depending on alien species;
9. Hydrological impacts due to increased transpiration and runoff; and
10. Impairment of wetland function.

Potential weeds with a distribution centred on arid regions of the country include *Salsola kali*, *Atriplex lindleyi*, *Opuntia ficus-indica, Opuntia imbricata, Prosopis glandulosa, Prosopis velutina, Atriplex numularia,* and *Nicotiana glauca*. Species observed during the field survey on the three sites include *Agave americana*, *Prosopis glandulosa*, *Opuntia ficus-indica*, *Datura*

ferox, *Argemone ochroleuca* and *Echinopsis spechiana*. The shrub, *Prosopis glandulosa*, is potentially the most problematic in the study area and is widely distributed in the Northern Upper Karoo vegetation type. It was found at a relatively high frequency on site and in immediately adjacent areas. This species invades riverbeds, riverbanks and drainage lines in semi-arid and arid regions. There is therefore the potential for alien plants to spread or invade following disturbance on site.

Impacts to be assessed for the current project

The impacts to be assessed for the current project are as follows:

- Loss or fragmentation of indigenous natural vegetation (terrestrial)
- Establishment and spread of declared weeds and alien invader plants

ASSESSMENT OF IMPACTS

Impacts are assessed for each component of infrastructure for the proposed solar energy facilities. There is therefore a separate assessment for the solar arrays (including alternative layouts), roads and water pipeline together, overhead power lines and substations together and the no-go alternative.

Solar arrays (layout option 1 & 2)

There are arrays proposed in different parts of the sites (see Figure 1). These are in areas of natural vegetation, and may also indirectly affect some drainage areas, identified as being sensitive. The impacts of potential concern are therefore on natural vegetation, drainage areas and due to the potential establishment and spread of alien plants. Both layout options affect an almost identical area and the impact will be the same for both options.

Differences due to different technology alternatives and mounting alternatives are considered to be irrelevant due to the fact that construction activities (for example, clearing and trampling of vegetation) will extend beyond indivudal components of infrastructure. It is expected that the entire area under the solar panels will be completely cleared of vegetation. For the purposes of undertaking this assessment, it is assumed that the entire footprint of the solar array area will be disturbed and/or lost.

Impact 1: Loss or fragmentation of indigenous natural vegetation
The vegetation type on site that will be affected by construction of infrastructure is Northern Upper Karoo.

Extent: The impact will occur at the site of the proposed solar arrays. The construction of the arrays potentially affects a high proportion of natural vegetation on site and is scored as ***site specific***.

Magnitude: At a site specific scale, the vegetation will probably be almost entirely lost. Natural functions and/or processes will therefore be severely altered. The magnitude of the impact is therefore scored as ***high***.

Duration: The impact will occur during construction, but cause effects that will last longer than 15 years (probably longer than 100 years). It is therefore scored as ***long term***.

Significance: On the basis of the impact being of high magnitude at a site specific scale and of long term duration, the impact is scored as having a significance of ***medium***. Mitigation measures will not reduce the extent, magnitude or duration of the impact. The significance will, therefore, remain ***medium*** after mitigation measures have been implemented.

Probability: According to the provided layout, it is ***definite*** that the impact will occur.

Confidence: There is a reasonable to high amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact. The confidence in the assessment is therefore rated as ***sure***.

Reversibility: The activity will lead to an impact that is in all practical terms permanent. The impact is therefore considered to be ***irreversible***.

Mitigation measures:

1. Unnecessary impacts on surrounding natural vegetation must be avoided. The construction impacts must be contained to the footprint of the solar array and other associated infrastructure.
2. Areas outsie the construction footprint should be fenced and access to these areas should be limited as much as possible.

Impact 5: Establishment and spread of declared weeds and alien invader plants
There are existing infestations of weeds on site and in immediately adjacent areas. There is therefore the potential that activities on site could promote the spread of these onto the site and/or into other natural areas.

Extent: The impact will occur at the site of the proposed solar arrays and in surrounding areas, but could potentially spread into the surrounding landscape, depending on the habitat and the alien species that could potentially invade the site. The impact is therefore scored as ***local***.

Magnitude: At a local scale, natural functions and/or processes will possibly be notably altered. The magnitude of the impact is therefore scored as ***medium***.

Duration: The impact will occur during construction, but cause effects that will last longer than 15 years, if not controlled. It is therefore scored as ***long term***.

Significance: On the basis of the impact being of medium magnitude at a local scale and of long term duration, the impact is scored as having a significance of ***medium***. Mitigation measures will reduce the extent to site specific, the magnitude to very low and the duration of the impact to short term. The significance will, therefore, be reduced to ***very low*** after mitigation measures have been implemented.

Probability: On the basis of known patterns of alien invasions, it is ***probable*** that the impact will occur.

Confidence: There is a reasonable to high amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact. The confidence in the assessment is therefore rated as ***sure***.

Reversibility: The activity will lead to an impact that could be reversed, if identified and managed. Impacts are possibly reversible within 2 years after the cause or stress is removed. The impact is therefore considered to be ***reversible***.

Mitigation measures:
1. Disturbance of indigenous vegetation outside of the footprint of construction must be kept to a minimum.
2. Where disturbance is unavoidable, disturbed areas should be rehabilitated as quickly as possible.
3. Any alien plants within the control zone of the company must be immediately controlled to avoid establishment of a soil seed bank. Control measures must follow established norms and legal limitations in terms of the method to be used and the chemical substances used.
4. An on-going monitoring programme should be implemented to detect and quantify any aliens that may become established and provide information for the management of aliens.

Roads and water pipelines

The proposed access road and water pipeline are shown in Figure 2. These are relatively limited in extent.

Impact 1: Loss or fragmentation of indigenous natural vegetation
The vegetation type on site that will be affected by construction of infrastructure is Northern Upper Karoo. The access road and water pipeline will affect very small, localised areas of vegetation.

Extent: The impact will occur at the site of the proposed access road and water pipeline. The construction potentially affects a small proportion of natural vegetation on site and is scored as ***site specific***.

Magnitude: At a site specific scale, the vegetation will be affected in localised areas. Natural functions and/or processes will therefore be slightly altered. The magnitude of the impact is therefore scored as ***low***.

Duration: The impact will be initiated during construction, but may only result in effects that are evident during operation. It will probably cause effects that will last longer than 15 years. It is therefore scored as ***long term***.

Significance: On the basis of the impact being of low magnitude at a site specific scale and of long term duration, the impact is scored as having a significance of ***low***. Mitigation measures will not reduce the extent, magnitude or duration of the impact. The significance will, therefore, remain ***low*** after mitigation measures have been implemented.

Probability: According to the provided layout, it is ***definite*** that the impact will occur.

Confidence: There is a reasonable to high amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact. The confidence in the assessment is therefore rated as ***sure***.

Reversibility: The activity will lead to an impact that is in all practical terms permanent. The impact is therefore considered to be ***irreversible***.

Mitigation measures:

1. Unnecessary impacts on surrounding natural vegetation must be avoided. The construction impacts must be contained to the footprint of the tower structures and/or the servitude of the power line.

Impact 5: Establishment and spread of declared weeds and alien invader plants
There are existing infestations of weeds on site and in immediately adjacent areas. There is therefore the potential that activities on site could promote the spread of these onto the site and/or into other natural areas.

Extent: The impact will occur at the site of the proposed road and water pieline and in surrounding areas, but could potentially spread into the surrounding landscape, depending on the habitat and the alien species that could potentially invade the site. The impact is therefore scored as ***local***.

Magnitude: At a local scale, natural functions and/or processes will possibly be notably altered. The magnitude of the impact is therefore scored as ***medium***.

Duration: The impact will occur during construction, but cause effects that will last longer than 15 years, if not controlled. It is therefore scored as ***long term***.

Significance: On the basis of the impact being of medium magnitude at a local scale and of long term duration, the impact is scored as having a significance of ***medium***. Mitigation measures will reduce the extent to site specific, the magnitude to very low and the duration of the impact to short term. The significance will, therefore, be reduced to ***very low*** after mitigation measures have been implemented.

Probability: On the basis of known patterns of alien invasions, it is ***probable*** that the impact will occur.

Confidence: There is a reasonable to high amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact. The confidence in the assessment is therefore rated as ***sure***.

Reversibility: The activity will lead to an impact that could be reversed, if identified and managed. Impacts are possibly reversible within 2 years after the cause or stress is removed. The impact is therefore considered to be ***reversible***.

Mitigation measures:

1. Disturbance of indigenous vegetation outside of the footprint of construction must be kept to a minimum.
2. Where disturbance is unavoidable, disturbed areas should be rehabilitated as quickly as possible.
3. Any alien plants within the control zone of the company must be immediately controlled to avoid establishment of a soil seed bank. Control measures must follow established norms and legal limitations in terms of the method to be used and the chemical substances used.
4. An on-going monitoring programme should be implemented to detect and quantify any aliens that may become established and provide information for the management of aliens.

Overhead power lines and substations

The proposed overhead power lines will, in most cases, be adjacent to existing Eskom overhead power lines. Substations will affect only very small local areas of habitat. Both overhead powerline options will have the same relative effect on the ecological environment.

Impact 1: Loss or fragmentation of indigenous natural vegetation
The vegetation type on site that will be affected by construction of infrastructure is Northern Upper Karoo. Power line tower structures will affect very small, localised areas of vegetation. Access roads may affect larger areas.

Extent: The impact will occur at the site of the proposed power line tower structures and access roads. The construction of the power line infrastructure potentially affects a small proportion of natural vegetation on site and is scored as ***site specific***.

Magnitude: At a site specific scale, the vegetation will be affected in localised areas. Natural functions and/or processes will therefore be slightly altered. The magnitude of the impact is therefore scored as ***low***.

Duration: The impact will occur during construction. Indications from existing power lines on site are that the base of tower structures becomes re-vegetated. The impact will therefore be ***medium-term***.

Significance: On the basis of the impact being of low magnitude at a site specific scale and of medium term duration, the impact is scored as having a significance of ***low***. Mitigation measures will reduce the magnitude to very low and the duration of the impact to short term. The significance will, therefore, be reduced to ***very low*** after mitigation measures have been implemented.

Probability: According to the provided layout, it is ***probable*** that the impact will occur.

Confidence: There is a reasonable to high amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact. The confidence in the assessment is therefore rated as ***sure***.

Reversibility: The activity will lead to an impact that is in all practical terms permanent. The impact is therefore considered to be ***irreversible***.

Mitigation measures:

1. Unnecessary impacts on surrounding natural vegetation must be avoided. The construction impacts must be contained to the footprint of the tower structures and/or the servitude of the power line.
2. Existing access roads must be used, where possible.
3. Service roads in the servitude must be properly maintained to avoid erosion impacts.

Impact 5: Establishment and spread of declared weeds and alien invader plants

There are existing infestations of weeds on site and in immediately adjacent areas. There is therefore the potential that activities on site could promote the spread of these onto the site and/or into other natural areas.

Extent: The impact will occur at the site of the proposed solar arrays and in surrounding areas, but could potentially spread into the surrounding landscape, depending on the habitat and the alien species that could potentially invade the site. The impact is therefore scored as ***local***.

Magnitude: At a local scale, natural functions and/or processes will possibly be notably altered. The magnitude of the impact is therefore scored as ***medium***.

Duration: The impact will occur during construction, but cause effects that will last longer than 15 years, if not controlled. It is therefore scored as ***long term***.

Significance: On the basis of the impact being of medium magnitude at a local scale and of long term duration, the impact is scored as having a significance of ***medium***. Mitigation measures will reduce the extent to site specific, the magnitude to very low and the duration of the impact to short term. The significance will, therefore, be reduced to ***very low*** after mitigation measures have been implemented.

Probability: On the basis of known patterns of alien invasions, it is ***probable*** that the impact will occur.

Confidence: There is a reasonable to high amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact. The confidence in the assessment is therefore rated as ***sure***.

Reversibility: The activity will lead to an impact that could be reversed, if identified and managed. Impacts are possibly reversible within 2 years after the cause or stress is removed. The impact is therefore considered to be ***reversible***.

Mitigation measures:

1. Disturbance of indigenous vegetation outside of the footprint of construction must be kept to a minimum.
2. Where disturbance is unavoidable, disturbed areas should be rehabilitated as quickly as possible.
3. Any alien plants within the control zone of the company must be immediately controlled to avoid establishment of a soil seed bank. Control measures must follow established norms and legal limitations in terms of the method to be used and the chemical substances used.
4. An on-going monitoring programme should be implemented to detect and quantify any aliens that may become established and provide information for the management of aliens.

The 'no-go' option

Assessment of the 'no-go' option is as if current activities continue on site. This includes mostly animal husbandry.

Impact 1: Loss or fragmentation of indigenous natural vegetation
The vegetation type on site is Northern Upper Karoo. This will remain intact, although local degradation due to over-utilization could potentially occur.

Extent: The impact will occur at the site of the farm and is scored as ***site specific***.

Magnitude: At a site specific scale, the vegetation will be affected in localised areas. Natural functions and/or processes will therefore be negligibly altered. The magnitude of the impact is therefore scored as ***very low***.

Duration: The existing land-use has been ongoing for many decades. Any impacts will be due to judgement errors by land-users, most of whom have a good understanding on how to manage the land. However, any impact is likely to be ***long-term***.

Significance: On the basis of the impact being of very low magnitude at a site specific scale and of long term duration, the impact is scored as having a significance of ***very low***.

Probability: According to the current land-use, it is ***probable*** that the impact will occur.

Confidence: There is a reasonable to high amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact. The confidence in the assessment is therefore rated as ***sure***.

Reversibility: The activity will lead to an impact that is in all practical terms ***reversible***.

Impact 5: Establishment and spread of declared weeds and alien invader plants
There are existing infestations of weeds on site and in immediately adjacent areas. There is therefore the potential that activities on site could promote the spread of these onto the site and/or into other natural areas, although the lack of major earth disturbance due to existing activities means that any spreading of invasive species is likely to be slow.

Extent: The impact will occur on the farm, but could potentially spread into the surrounding landscape, depending on the habitat and the alien species that could potentially invade the site. The impact is therefore scored as ***local***.

Magnitude: At a local scale, natural functions and/or processes will possibly be slightly altered. The magnitude of the impact is therefore scored as ***low***.

Duration: The impact will cause effects that will last longer than 15 years, if not controlled. It is therefore scored as ***long term***.

Significance: On the basis of the impact being of low magnitude at a local scale and of long term duration, the impact is scored as having a significance of ***low***. Management measures could reduce the extent to site specific, the magnitude to very low and the duration of the impact to short term. The significance will, therefore, be reduced to ***very low*** after mitigation measures have been implemented.

Probability: On the basis of known patterns of alien invasions, it is ***probable*** that the impact will occur.

Confidence: There is a reasonable to high amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact. The confidence in the assessment is therefore rated as ***sure***.

Reversibility: The activity will lead to an impact that could be reversed, if identified and managed. Impacts are possibly reversible within 2 years after the cause or stress is removed. The impact is therefore considered to be ***reversible***.

DISCUSSION AND CONCLUSIONS

There is one major vegetation types that occurs in the study area, namely Northern Upper Karoo. This vegetation type is classified as Least Threatened and also has a wide distribution and extent. The natural vegetation in the study area is therefore not considered, from this perspective, to have high conservation status.

Local factors that may lead to parts of the study area having elevated ecological sensitivity are the presence of watercourses / drainage areas. The assessment of impacts on these areas has been undertaken in a separate aquatic specialist study.

There is one protected tree species that occurs in the area, *Boscia albitrunca* (Shepherd's Tree). It has been evaluated as having a moderate probability of occurring in the general area, but was not found on site.

There are no threatened, near threatened, declining or rare plant species that occur in the area.

There are two protected plant species that have a geographical distribution that includes the area, but neither species was found on site and, based on a field evaluation of the site, neither species is likely to occur there.

The study area is in a mostly natural condition. All of the drainage lines / watercourses on the sites are classified as having medium-high sensitivity. The majority of the study area is classified as having medium sensitivity.

A risk assessment was undertaken which identified two main potential negative impacts on the receiving environment. The identified potential impacts are the following:

1. Impacts on indigenous natural vegetation
2. Establishment and spread of declared weeds and alien invader plants

Impacts were assessed after collection of relevant data in the field. A summary of the significance of impacts is given in Table 10 below. This shows that the potential impact on natural vegetation by the solar arrays (same for both option 1 and 2) is the only impacts with a significance of "medium". This significance score is due to the fact that the impact will be long-term and will definitely occur. The assessment methodology masks the fact that the vegetation type is very extensive and, although the impact will occur at a site specific scale, the regional effect is very low. No mitigation measures will reduce the significance of this impact, but given the large extent of the vegetation type, this is not considered to be a serious impact. Other potential impacts are either "low" or can be reduced to "very low" with mitigation.

In terms of the option between the two solar array layout options, either option is acceptable, although Option 1 affects a slightly lesser amount of natural vegetation. In terms of the option between the two overhead powerline options, either option is acceptable

Conclusion

The overall impacts of this proposed project are of low or moderate significance. With mitigation measures implemented, it should be possible to reduce all negative impacts to low significance, except for the significance of impacts on natural vegetation, which remains medium. Relative to other parts of the country where similar assessments have been

conducted, this site has low sensitivity and few conservation issues. Taking this assessment into consideration and the relatively low sensitivity and conservation value of the site, this project is supported from an ecological point of view.

Table 10: Summary of significance of impacts

Impact	Solar arrays (option 1)		Solar arrays (option 2)		Roads and water pipeline		Overhead power lines (option 1)		Overhead power lines (option 2)		No-go option
	Without mitigation	With mitigation	Without mitigation	With mitigation	Without mitigation	With mitigation	Without mitigation	With mitigation	Without mitigation	With mitigation	Without mitigation
1. Loss or fragmentation of vegetation	Medium	Medium	Medium	Medium	Medium	Medium	Low	Very low	Low	Very low	Very low
2. Spread of alien plants	Medium	Very low	Medium	Very low	Medium	Very low	Medium	Very low	Medium	Very low	Low

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APPENDICES:

Appendix 1: Plant species of conservation importance (Threatened, Near Threatened and Declining) that have historically been recorded in the study area.

Sources: South African National Biodiversity Institute in Pretoria.

Family	Taxon	Status	Habitat	Likelihood of occurrence on site
PROTEACEAE	Protea subvestita	VU	Found primarily in the eastern and southern Great Escarpment region of South Africa. Montane areas, mostly highland grassland and fynbos. Collection in grid 3024CC was from 1886 - no locality information is provided for this specimen and it is possibly incorrectly linked to this grid (no other records are in similar geographical location or habitat and typical habitat does not match anything found in grid).	LOW

* Conservation Status Category assessment according to IUCN Ver. 3.1 (IUCN, 2001), as evaluated by the Threatened Species Programme of the South African National Biodiversity Institute in Pretoria. *IUCN (3.1) Categories: VU = Vulnerable, EN = Endangered, CR = Critically Endangered, NT = Near Threatened.

Appendix 2: List of protected tree species (National Forests Act).

Acacia erioloba	*Acacia haematoxylon*
Adansonia digitata	*Afzelia quanzensis*
Balanites subsp. *maughamii*	*Barringtonia racemosa*
Boscia albitrunca	*Brachystegia spiciformis*
Breonadia salicina	*Bruguiera gymnhorrhiza*
Cassipourea swaziensis	*Catha edulis*
Ceriops tagal	*Cleistanthus schlectheri* var. *schlechteri*
Colubrina nicholsonii	*Combretum imberbe*
Curtisia dentata	*Elaedendron (Cassine) transvaalensis*
Erythrophysa transvaalensis	*Euclea pseudebenus*
Ficus trichopoda	*Leucadendron argenteum*
Lumnitzera racemosa var. *racemosa*	*Lydenburgia abottii*
Lydenburgia cassinoides	*Mimusops caffra*
Newtonia hildebrandtii var. *hildebrandtii*	*Ocotea bullata*
Ozoroa namaensis	*Philenoptera violacea* (*Lonchocarpus capassa*)
Pittosporum viridiflorum	*Podocarpus elongatus*
Podocarpus falcatus	*Podocarpus henkelii*
Podocarpus latifolius	*Protea comptonii*
Protea curvata	*Prunus africana*
Pterocarpus angolensis	*Rhizophora mucronata*
Sclerocarya birrea subsp. *caffra*	*Securidaca longependunculata*
Sideroxylon inerme subsp. *inerme*	*Tephrosia pondoensis*
Warburgia salutaris	*Widdringtonia cedarbergensis*
Widdringtonia schwarzii	

Boscia albitrunca has a geographical distribution that coincides with the study area.

Appendix 3: Checklist of plant species recorded during previous botanical surveys in the study area and surrounds.

This checklist has been compiled from data obtained from the SANBI website (http://posa.sanbi.org/searchspp.php) and includes species from quarter degree grid in which the site is located as well as surrounding grids in which similar vegetation types are found. The checklist provides an indication of the species that occur in the general area and is not a checklist for the site itself.

*
Eragrostis tef
*Pennisetum villosum
*Puccinellia distans
*Sorghum halepense
Allophyllus decipiens
Aptosimum procumbens (Lehm.) Steud.
Aptosimum spinescens (Thunb.) F.E.Weber
Arachnioides webbiana subsp. foliosa
Arctotis leiocarpa Harv.
Aristida adscensionis
Aristida congesta subsp. barbicollis
Aristida congesta subsp. congesta
Aristida vestita Thunb.
Asparagus striatus (L.f.) Thunb.
Asparagus suaveolens Burch.
Athanasia minuta (L.f.) Källersjö subsp. minuta
Atriplex vestita (Thunb.) Aellen var. appendiculata Aellen
Barleria rigida
Bassia salsoloides (Fenzl) A.J.Scott
Berkheya eriobasis (DC.) Roessler
Brunsvigia radulosa Herb.
Bulbostylis humilis (Kunth) C.B.Clarke
Calobota spinescens (Harv.) Boatwr. & B.-E.van Wyk
Campylopus robillardei Besch.
Cenchrus ciliaris L.
Chaenostoma halimifolium Benth.
Cheilanthes eckloniana (Kunze) Mett.
Chloris virgata Sw.
Chrysocoma ciliata L.
Clutia impedita
Colchicum asteroides (J.C.Manning & Goldblatt) J.C.Manning & Vinn.
Commelina africana L. var. africana
Crassula corallina Thunb. subsp. corallina
Cucumis africanus L.f.
Cucumis heptadactylus Naudin
Cucumis myriocarpus Naudin subsp. leptodermis (Schweick.) C.Jeffrey & P.Halliday
Cullen tomentosum (Thunb.) J.W.Grimes
Cyanella lutea L.f.
Cynodon incompletus Nees
Daubenya comata (Burch. ex Baker) J.C.Manning & A.van der Merwe
Dianthus micropetalus Ser.
Dicoma capensis Less.
Digitaria erianthe
Dimorphotheca cuneata (Thunb.) Less.
Dimorphotheca zeyheri Sond.
Dipcadi viride (L.) Moench
Disa pulchra
Empodium elongatum
Enneapogon desvauxii P.Beauv.
Enneapogon scaber Lehm.
Enneapogon scoparius Stapf
Eragrostis bergiana (Kunth) Trin.
Eragrostis bicolor Nees
Eragrostis chloromelas Steud.
Eragrostis curvula (Schrad.) Nees
Eragrostis homomalla Nees
Eragrostis lehmanniana Nees var. lehmanniana
Eragrostis nindensis
Eragrostis obtusa Munro ex Ficalho & Hiern
Eragrostis procumbens Nees
Eragrostis truncata Hack.
Erucastrum strigosum (Thunb.) O.E.Schulz
Eulophia foliosa
Euphorbia aequoris N.E.Br.
Euphorbia arida N.E.Br.
Euphorbia pugniformis
Felicia burkei (Harv.) L.Bolus
Felicia filifolia (Vent.) Burtt Davy subsp. filifolia
Felicia muricata (Thunb.) Nees subsp. muricata
Fingerhuthia africana Lehm.
Gazania jurineifolia DC. subsp. jurineifolia
Gazania krebsiana Less. subsp. arctotoides (Less.) Roessler
Geigeria filifolia Mattf.
Geigeria ornativa O.Hoffm. subsp. ornativa
Gisekia pharnacioides L. var. pharnacioides
Gladiolus dalenii subsp. dalenii
Gladiolus ecklonii

Gladiolus permeabilis D.Delaroche subsp. edulis (Burch. ex Ker Gawl.) Oberm.
Gnidia polycephala (C.A.Mey.) Gilg
Grewia flava
Haworthia venosa (Lam.) Haw. subsp. tessellata (Haw.) M.B.Bayer
Helichrysum asperum (Thunb.) Hilliard & B.L.Burtt var. asperum
Helichrysum dregeanum Sond. & Harv.
Helichrysum micropoides
Helichrysum zeyheri Less.
Heliophila minima (Stephens) Marais
Heliotropium ciliatum Kaplan
Heliotropium lineare (A.DC.) Gürke
Hermannia burkei Burtt Davy
Hermannia cuneifolia Jacq. var. cuneifolia
Hermannia erodioides (Burch. ex DC.) Kuntze
Hermannia pulchella L.f.
Hertia kraussii (Sch.Bip.) Fourc.
Hertia pallens (DC.) Kuntze
Heteropogon contortus (L.) Roem. & Schult.
Huernia humilis (Masson) Haw.
Hymenophyllum tunbridgense
Hypericum lalandii
Hypertelis salsoloides var. salsoloides
Indigastrum argyraeum (Eckl. & Zeyh.) Schrire
Jamesbrittenia filicaulis
Kniphofia ensifolia subsp. ensifolia
Ledebouria apertiflora
Lepidostephium denticulatum
Lessertia annularis Burch.
Leysera tenella DC.
Limeum sulcatum (Klotzsch) Hutch. var. sulcatum
Limosella africana var. africana
Lobelia flaccida subsp. flaccida
Lotononis platycarpa (Viv.) Pic.Serm.
Lycium horridum Thunb.
Lycium pumilum Dammer
Manulea fragrans Schltr.
Melianthus dregeanus
Melica decumbens Thunb.
Melolobium candicans (E.Mey.) Eckl. & Zeyh.
Microloma armatum (Thunb.) Schltr. var. armatum
Monopsis scabra
Moraea falcifolia
Nemesia fruticans (Thunb.) Benth.
Oligomeris dipetala (Aiton) Turcz. var. dipetala
Ornithogalum nannodes F.M.Leight.
Ornithoglossum vulgare B.Nord.
Oropetium capense Stapf
Oscularia deltoides (L.) Schwantes
Osteospermum leptolobum (Harv.) Norl.
Osteospermum spinescens Thunb.
Osyris lanceolata Hochst. & Steud.
Othonna pavonia E.Mey.
Oxalis depressa Eckl. & Zeyh.
Pachypodium succulentum (Jacq.) Sweet
Panicum coloratum L. var. coloratum
Panicum impeditum Launert
Pelargonium aestivale
Pelargonium pseudofumarioides
Pelargonium tragacanthoides Burch.
Peliostomum leucorrhizum E.Mey. ex Benth.
Peliostomum origanoides E.Mey. ex Benth.
Pentaschistis airoides (Nees) Stapf subsp. airoides
Pentaschistis setifolia
Pentzia calcarea Kies
Pentzia elegans DC.
Pentzia globosa
Pentzia incana (Thunb.) Kuntze
Pentzia lanata
Pentzia quinquefida (Thunb.) Less.
Pentzia spinescens Less.
Phymaspermum aciculare
Phymaspermum parvifolium (DC.) Benth. & Hook. ex B.D.Jacks.
Polygala ephedroides Burch.
Pseudocrossidium crinitum
Psilocaulon coriarium (Burch. ex N.E.Br.) N.E.Br.
Pteronia glauca Thunb.
Pteronia glaucescens DC.
Pteronia sordida N.E.Br.
Puccinellia acroxantha C.A.Sm. & C.E.Hubb.
Puccinellia distans (L.) Parl.
Radyera urens (L.f.) Bullock
Riccia albornata
Riccia nigrella DC.
Rosenia humilis (Less.) K.Bremer
Rosenia oppositifolia
Rumex lanceolatus Thunb.
Salsola calluna Fenzl ex C.H.Wright
Salsola dealata
Salsola glabrescens Burtt Davy
Salsola humifusa
Salvia verbenaca L.
Satyrium longicaude var. longicaude
Sebaea pentandra E.Mey. var. pentandra
Selago albida Choisy

Selago albida Choisy
Selago paniculata Thunb.
Selago saxatilis E.Mey.
Senecio isatideus
Sesamum capense Burm.f.
Solanum retroflexum
Sporobolus discosporus
Sporobolus fimbriatus (Trin.) Nees
Sporobolus ioclados (Trin.) Nees
Stachys cuneata Banks ex Benth.
Stachys linearis
Stapelia grandiflora Masson var. grandiflora
Stipagrostis ciliata (Desf.) De Winter var. capensis (Trin. & Rupr.) De Winter
Stipagrostis namaquensis (Nees) De Winter
Stipagrostis obtusa (Delile) Nees
Syringodea concolor (Baker) M.P.de Vos
Tetragonia fruticosa L.
Themeda triandra
Thesium congestum
Tortula atrovirens
Tragus berteronianus Schult.
Tragus koelerioides
Tragus racemosus (L.) All.
Trichostomum brachydontium
Tripteris aghillana DC. var. aghillana
Urochloa panicoides P.Beauv.
Wahlenbergia nodosa (H.Buek) Lammers
Zaluzianskya karrooica Hilliard
Zygophyllum microcarpum Licht. ex Cham. & Schltdl.

Appendix 4: Species protected under the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004)
(as updated in R. 1187, 14 December 2007)

CRITICALLY ENDANGERED SPECIES
Flora
Adenium swazicum
Aloe pillansii
Diaphananthe millarii
Dioscorea ebutsniorum
Encephalartos aemulans
Encephalartos brevifoliolatus
Encephalartos cerinus
Encephalartos dolomiticus
Encephalartos heenanii
Encephalartos hirsutus
Encephalartos inopinus
Encephalartos latifrons
Encephalartos middelburgensis
Encephalartos nubimontanus
Encephalartos woodii

ENDANGERED SPECIES
Flora
Angraecum africae
Encephalartos arenarius
Encephalartos cupidus
Encephalartos horridus
Encephalartos laevifolius
Encephalartos lebomboensis
Encephalartos msinganus
Jubaeopsis caffra
Siphonochilus aethiopicus
Warburgia salutaris
Newtonia hilderbrandi

VULNERABLE SPECIES
Flora
Aloe albida
Encephalartos cycadifolius
Encephalartos Eugene-maraisii
Encephalartos ngovanus
Merwilla plumbea
Zantedeschia jucunda

PROTECTED SPECIES
Flora
Adenia wilmsii
Aloe simii
Clivia mirabilis
Disa macrostachya
Disa nubigena
Disa physodes
Disa procera
Disa sabulosa
Encephelartos altensteinii
Encephelartos caffer
Encephelartos dyerianus
Encephelartos frederici-guilielmi
Encephelartos ghellinckii
Encephelartos humilis
Encephelartos lanatus
Encephelartos lehmannii
Encephelartos longifolius
Encephelartos natalensis
Encephelartos paucidentatus
Encephelartos princeps
Encephelartos senticosus
Encephelartos transvenosus
Encephelartos trispinosus
Encephelartos umbeluziensis
Encephelartos villosus
Euphorbia clivicola
Euphorbia meloformis
Euphorbia obesa
Harpagophytum procumbens
Harpagophytum zeyherii
Hoodia gordonii
Hoodia currorii
Protea odorata
Stangeria eriopus