Appendix D2: Updated Biodiversity Assessment and Botanical Scan Addendum (2017 revision)

ADDENDUM

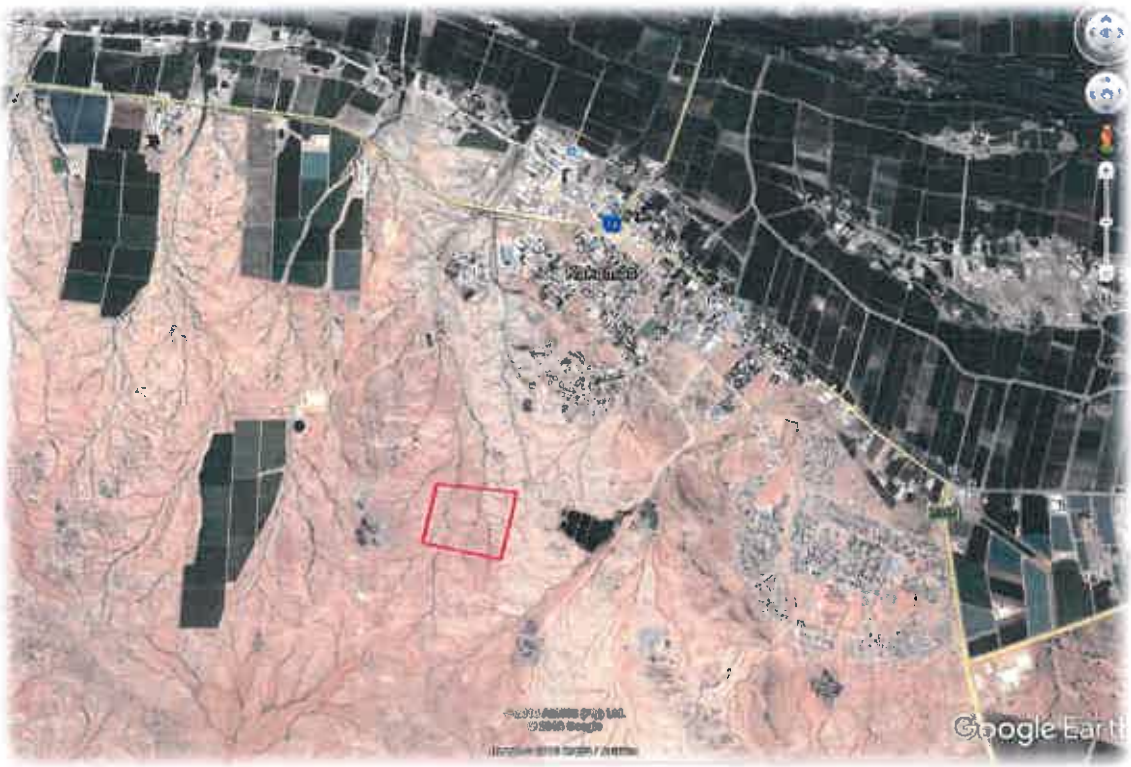
TO THE BIODIVERSITY ASSESSMENT & BOTANICAL SCAN

Revision 1

for the,

KAKAMAS SOLAR PROJECT

A re-assessment of the area that will be impacted by the proposed solar project at Kakamas, Northern Cape Province.



DATE: 29 MARCH 2017

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PREPARED FOR: ENVIROAFRICA CC

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SUMMARY - MAIN CONCLUSIONS

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MAIN VEGETATION TYPE(S)	**Bushmanland Arid Grassland** Described as an open, shrubby thornveld characterized by a dense shrub layer, often lacking a tree layer, with a sparse grass layer **Least Threatened:** But only 4% formally protected (Augrabies Falls National Park).
CRITICAL BIODIVERSITY AREAS	Fine scale maps are not yet defined for this Municipal area. In terms of possible future CBA's and ESA delineation the following was considered: • The site is still covered by natural veld (subject to grazing by livestock (cattle), which shows signs of impact as a result of grazing, some areas (notably along the south boundary) shows signs of disturbance; • The site does not fall in any Centre of Endemism; • Bushmanland Arid Grassland is classified as "*Least Threatened*" with more than 99% still remaining in its natural state, but only 4% of this vegetation type is formally protected; • The most significant biodiversity features associated with the site are two small seasonal watercourses going through the site and a few smallish *Boscia albitrunca* trees associated with these drainage lines. • A number of plant species protected in terms of the NCNCA was observed within the site. • The proposed is located near to the Kakamas sewerage works and waste disposal site (which are inherently degraded). The site still shows excellent connectivity with surrounding vegetation, but the location is also well chosen in that it will be in proximity of already disturbed areas and an access road exists. It is possible that the proposed footprint might be considered for future inclusion into a CBA or ESA on strength of its connectivity value, but there are likely better options available. On the other hand, the small size of the proposed development is unlikely to have any significant impact on connectivity within the larger area.
LAND USE AND COVER	The study area is situated on an Erf within the urban edge of Kakamas, but with little development or agricultural practices (apart from small Municipal works). Natural vegetation forms a sparse cover over the entire area of the study area. The Kakamas waste disposal site as well as sewerage works are located on the same property. Various non-perennial watercourses or drainage lines criss-cross the larger property.
SIGNIFICANT PLANT SPECIES	**No red list plant species were encountered** (Refer to Heading 5.3.1). **No species protected in terms of NEM: BA encountered** (Heading 5.3.2). One species protected in terms of the NFA were encountered (Refer to Table 3), namely Sheppard's trees (*Boscia albitrunca*) associated with the watercourses (which will be excluded from the development). Seven species (Refer to Table 4) protected in terms of the NCNCA were encountered of which two is recommended for search & rescue.
IMPACT ASSESSMENT	**Significance before mitigation:** The impact assessment suggests that the proposed Kakamas development is expected to have a **Low cumulative** impact, with the most significant aspect being the potential impact on the

	protected species encountered within the site and to a lesser degree potential accidental veld fires. The evaluation is based the fact that the small watercourses and its associated vegetation will be protected by default. **Significance after mitigation:** Since the proposed development footprint needs only be approximately 50% of the 20ha, there is great potential for micro-adjustment of the final layout plans. Even though the impact is already considered low it will still be possible to reduce direct impacts on other features of significance through layout adjustments, search & rescue and topsoil management. The potential impact on the regional status of the vegetation type and associated biodiversity features (e.g. corridor function or special habitats) will also be minimised through the above mitigations. Apart from the potential impact on protected species no further irreversible species-loss, habitat-loss, connectivity or associated impact can be foreseen from locating and operating the solar facility on the proposed site. With mitigation the impact on biodiversity features can be reduced but will stay **Low**. Please refer to Table 12 for the full impact assessment.
SUMMARY & RECOMMENDATION	**The NO-GO option:** The "No-Go Alternative" alternative will not result in significant gain in regional conservation targets, the conservation of rare & endangered species or gain in connectivity. At the best the No-Go alternative will only maintain the *"status quo"* on the site. On the other hand the pressure on Eskom facilities, most of which is currently still dependant on fossil fuel electricity generation, will remain. Solar power remains a much cleaner and more sustainable option for electricity production. **WITH THE AVAILABLE INFORMATION AT THE AUTHOR'S DISPOSAL IT IS RECOMMENDED THAT THE PROJECT BE APPROVED, BUT THAT ALL MITIGATION MEASURES DESCRIBED IN THIS DOCUMENT BE IMPLEMENTED.**

INDEPENDENCE & CONDITIONS

PB Consult is an independent consultant and has no interest in the activity other than fair remuneration for services rendered. Remunerations for services are not linked to approval by decision making authorities and PB Consult have no interest in secondary or downstream development as a result of the authorization of this proposed project. There are no circumstances that compromise the objectivity of this report. The findings, results, observations and recommendations given in this report are based on the author's best scientific and professional knowledge and available information. PB Consult reserve the right to modify aspects of this report, including the recommendations if new information become available which may have a significant impact on the findings of this report.

RELEVANT QUALIFICATIONS & EXPERIENCE OF THE AUTHOR

Mr. Peet Botes holds a BSc. (Hons.) degree in Plant Ecology from the University of Stellenbosch (Nature Conservation III & IV as extra subjects). Since qualifying with his degree, he had worked for more than 20 years in the environmental management field, first at the Overberg Test Range (a Division of Denel) managing the environmental department of OTB and being responsible for developing and implementing an ISO14001 environmental management system, ensuring environmental compliance, performing environmental risk assessments with regards to missile tests and planning the management of the 26 000 ha of natural veld, working closely with CapeNature (De Hoop Nature Reserve). In 2005 he joined Enviroscientific, an independent environmental consultancy specializing in wastewater management, botanical and biodiversity assessments, developing environmental management plans and strategies, environmental control work as well as doing environmental compliance audits and was also responsible for helping develop the biodiversity part of the Farming for the Future audit system implemented by Woolworths. During his time with Enviroscientific he performed more than 400 biodiversity and environmental legal compliance audits. During 2010 he joined EnviroAfrica in order to move back to the biodiversity aspects of environmental management. Experience with EnviroAfrica includes EIA applications, biodiversity assessment, botanical assessment, environmental compliance audits and environmental control work.

Mr. Botes is also a registered Professional Botanical, Environmental and Ecological Scientists at SACNASP (South African Council for Natural Scientific Professions) as required in terms of Section 18(1)(a) of the Natural Scientific Professions Act, 2003, since 2005.

Yours sincerely,

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1. INTRODUCTION

Roma Energy Holdings is proposing the establishment of a solar energy facility on Erf 1655 Kakamas (Northern Cape Province, Kai! Garib Local Municipality). Please note, that the infrastructure will be fitted onto an area of approximately 20 ha, on a portion of the property, but the actual footprint will be approximately 50% of the footprint. Seasonal streams will be excluded from the footprint and there will be room for micro-adjustment of the infrastructure to further minimise potential impact on any other significant environmental aspects encountered on the terrain. The purpose of the proposed facility is to supply electricity to Eskom as part of the Renewable Energy Independent Power Producers Procurement Programme.

During 2012, PB Consult was appointed by EnviroAfrica to assessed and reported on the potential biodiversity impacts of this project on the proposed footprint (Refer to the Biodiversity Assessment & Botanical Scan report dated 13 March 2012) as part an environmental impact assessment application to the Department of Environmental Affairs (in terms of the NEMA EIA Regulations). Environmental authorisation (EA) was originally granted by the Department of Environmental Affairs (DEA) for the above application on the 25th January 2013 but the EA expired before physical work on the site could commence. To continue with the development, reapplication for an EA is required. Original DEA Reference Number: 12/12/20/2519 (NEAS Ref: DEA/EIA/0001436/2012).

PB Consult was instructed to re-visit the site and re-evaluate the original biodiversity report in order to determine if the findings of the original report (PB Consult, 2012) is still applicable. **The terms of reference and the physical footprint remains the same.**

1.1 STATUS OF THE ORIGINAL REPORT

In terms of the above a further site visit was performed on the 8th of March 2017, during which the author re-evaluated the site. The additional site visit did not reveal any new biodiversity features that were not evaluated during the original study. The site visit and updated desk studies did not resulted in any significant additional impacts being identified by the author, which was not considered in the original report. The can still be described as a very arid, semi-desert landscape with sparse vegetation consisting mainly of low shrubs and grassy layer. The seasonal watercourses support a larger shrubs and small trees, which can vary from medium-low *Euphorbia* dominated stands to a medium-high shrubs and small trees (e.g. *Senegalia mellifera* and *Parkinsonia africana*).

The author would like to confirm that the original report still stands, but must be read in conjunction with this addendum, which includes the following:

- Updated legal requirements register;
- Potential impacts on centres of Endemism in the Northern Cape;
- Updated plant species lists,

- Updated impact evaluation on endangered or protected plant species;
- Updated impact assessment to include cumulative impacts (based on the latest available information).
- Updated recommendations.

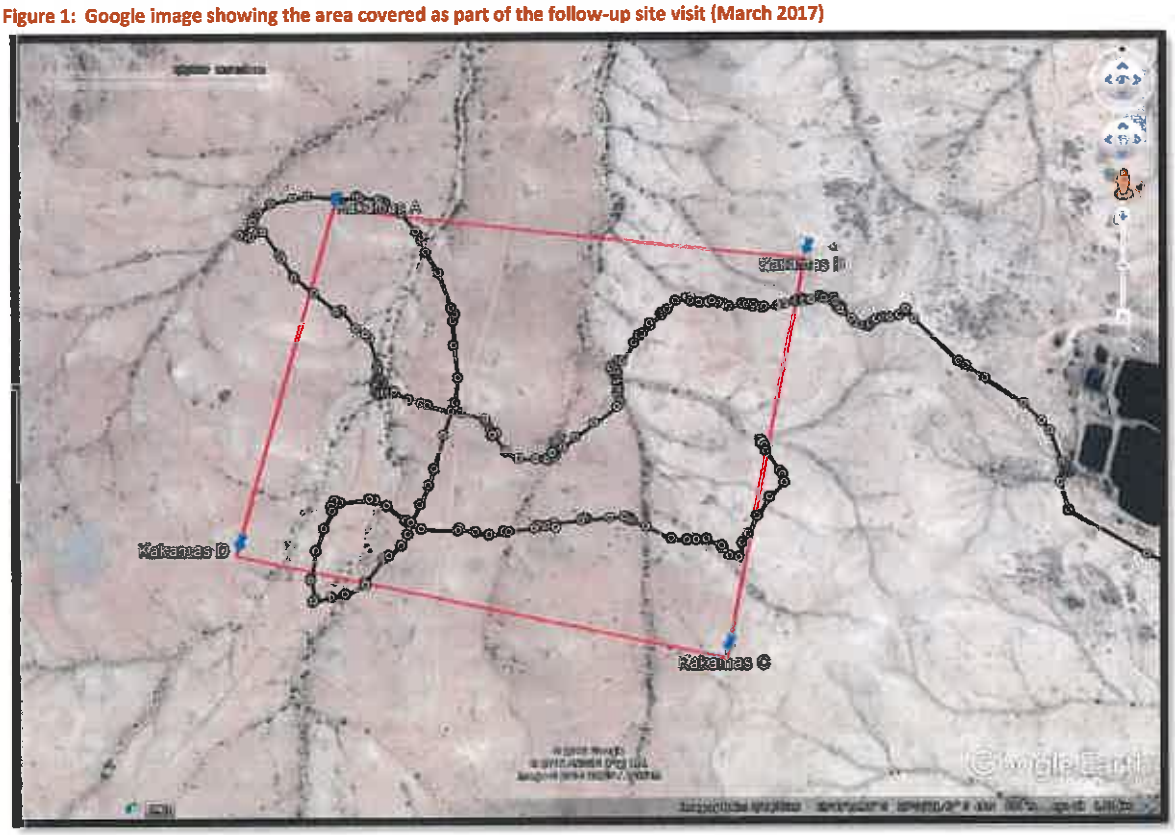
2. METHODS USED

The objective of this study was to re-evaluate the biological diversity associated with the study area in order to identify significant environmental features which should be avoided during development activities and to re-evaluate short and long term impact and possible mitigation actions in context of the proposed development.

2.1 SITE VISIT

The original site visit was done during November 2011. The follow-up site visit was done on the 8th of March 2017. The site visit compromises walking the site, examining and photographing any area of interest. During the site visit and desktop studies, a fairly good understanding of the environment was achieved. The timing of the site visit was very good in that essentially all perennial plants where identifiable and although the possibility remains that a few species may have been missed, the author is confident that a fairly good understanding of the biodiversity status in the area was obtained.

Figure 1: Google image showing the area covered as part of the follow-up site visit (March 2017)



3. APPLICABLE LEGISLATION (UPDATED)

Constitution of the Republic of South Africa (1996): of special relevance in terms of environment is section 24

Conservation of Agricultural Resources Act 43 of 1983 (CARA): supports conservation of natural agricultural resources (soil, water, plant biodiversity) by maintaining the production potential of the land and combating/preventing erosion; for example, by controlling or eradicating declared weeds and invader plants.

Fertilizer, Farm Feeds, Agricultural Remedies and Stock Remedies Act (Act No. 36 of 1947), to control the sell, purchase, use and disposal of agricultural or stock remedies.

Hazardous Substances Act 15 of 1973: to control substances that may cause injury, ill-health, or death through their toxic, corrosive, irritant, strongly sensitizing or flammable nature, or by the generation of pressure

National Environmental Management Act 107 of 1998 (as amended): replaces the Environmental Conservation Act (ECA) and establishes principles for decision-making on matters affecting the environment, and for matters connected therewith.

- **Environmental Impact Assessment Regulations** (R543 of 2010): procedures to be followed for application to conduct a listed activity.

National Environmental Management: Air Quality Act 39 of 2004 (NEMAQA): replaces the Atmospheric Pollution Prevention Act (No. 45 of 1965).

National Environmental Management: Biodiversity Act 10 of 2004 (NEMBA): supports conservation of plant and animal biodiversity, including the soil and water upon which it depends.

- **National list of ecosystems that are threatened and in need of protection** (GN 1002 of 9 December 2011).
- **Alien and invasive species list 2016** (GN R. 864 of 29 July 2016).

National Environmental Management: Protected Areas Act 57 of 2003 (as amended Act 31 of 2004) (NEMPAA): To provide for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes.

National Environmental Management: Waste Act 59 of 2008 (NEMWA): To reform the law regulating waste management in order to protect health and the environment by providing reasonable measures for the prevention of pollution and ecological degradation and for securing ecologically sustainable development.

- **List of Waste Management Activities that have, or are likely to have a detrimental effect on the environment** (GN 718 of 3 July 2009): Identifies activities in respect of which a waste management license is required.

National Forests Act 84 of 1998 (as amended): supports sustainable forest management and the restructuring of the forestry sector.

- **List of protected tree species** (as updated)

National Heritage Resources Act 25 of 1999: supports an integrated and interactive system for the management of national heritage resources, including supports soil, water and animal and plant biodiversity.

National Veld and Forest Fire Act 101 of 1998 (NVFFA): protects soil, water and plant life through the prevention and combating of veld, forest, and mountain fires

National Water Act 36 of 1998 (NWA): promotes the protection, use, development, conservation, management, and control of water resources in a sustainable and equitable manner.

Northern Cape Nature Conservation Act 9 of 2009 (NCNCA): which provides for the sustainable utilization of wild animals, aquatic biota and plants.

4. DEFINITIONS & ABBREVIATIONS

4.1 DEFINITIONS

Contaminated water: means water contaminated by the activities associated with construction, *e.g.* concrete water and runoff from plant/ personnel wash areas.

Environment: means the surroundings within which humans exist and that are made up of:

- the land, water and atmosphere of the earth;
- micro-organisms, plant and animal life;
- any part of the combination of the above two bullets and the interrelationships between them;
- the physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being

Environmental Aspect: any element of any construction activity, product or services that can interact with the environment.

Environmental Control Officer: a suitably qualified environmental agent responsible for overseeing the environmental aspects of the Construction phase of the EMP.

Environmental Impact: any change to the environment, whether adverse or beneficial, wholly or partially resulting from any construction activity, product or services.

No-Go Area(s): an area of such (environmental/aesthetical) importance that no person or activity are allowed within a designated boundary surrounding this area.

Owner: the owner, or dedicated person, responsible for the management of the property on which the proposed activity will be performed.

Solid waste: means all solid waste, including construction debris, chemical waste, excess cement/concrete, wrapping materials, timber, tins and cans, drums, wire, nails, food and domestic waste (e.g. plastic packets and wrappers).

Precautionary principle: means the basic principle, that when in doubt or having insufficient or unreliable information on which to base a decision, to then limit activities in order to minimise any possible environmental impact.

Watercourse: in this report the author uses a very simplified classification system to define the difference between a river, a water course and an ephemeral stream as encountered in the study area.

- River: A river is a natural watercourse with a riverbed wider than 3m, usually freshwater, flowing toward an ocean, a lake, a sea or another river. In a few cases, a river simply flows into the ground or dries up completely before reaching another body of water. The flow could be seasonal or permanent.

- Stream: A small river or natural watercourse with a riverbed of less than 3 m, usually freshwater, flowing toward an ocean, a lake, a sea or another river. In a few cases, a river simply flows into the ground or dries up completely before reaching another body of water. The flow could be seasonal or permanent.
- Ephemeral drainage line: A very small and poorly defined watercourse, mostly on relatively flat areas, which only flows for a short period after heavy rains, usually feeding into a stream or river or dries up completely before reaching another body of water.

4.2 ABBREVIATIONS

AIP	Alien and invasive plants
AIS	Alien and invasive species
BGIS	Biodiversity Geographical Information System
CARA	Conservation of Agricultural Resources Act 43 of 1983
CBA	Critical Biodiversity Areas (Municipal)
DEA	Department of Environmental Affairs
EAP	Environmental Assessment Practitioner
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EMF	(Municipal) Environmental Management Framework
EMP	Environmental management plan
GWC	Griqualand West Centre of endemism
IDP	Integrated development plan
IUCN	International Union for Conservation of Nature
NCNCA	Northern Cape Nature Conservation Act, Act 9 of 2009
NEMA	National Environmental Management Act, Act 107 of 1998
NEMAQA	National Environmental Management Air Quality Act 39 of 2004
NEMBA	National Environmental Management Biodiversity Act, Act 10 of 2004
NEMPAA	National Environmental Management Protected Areas Act 57 of 2003
NEMWA	National Environmental Management Waste Act 59 of 2008
NFA	National Forests Act 84 of 1998
NSBA	National Spatial Biodiversity Assessment
NVFFA	National Veld and Forest Fire Act 101 of 1998
NWA	National Water Act 36 of 1998
SABIF	South African Biodiversity Information Facility
SANBI	South African National Biodiversity Institute
SIBIS	SANBI's Integrated Biodiversity Information System
SKEP	Succulent Karoo Ecosystem Project

5. VEGETATION (UPDATED)

The vegetation described in the original report remains the same and still stands, although the author during this site visit concentrated on the physical site and not on its surroundings as was done during the original site visit. In accordance with the Vegetation map of South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2006, as updated in the 2012 beta version) only one broad vegetation type is expected in the proposed area and its immediate vicinity, namely Bushmanland Arid Grassland. More than 99% of this vegetation still remains, but only 4% is formally conserved (Augrabies Falls National Park). According to the *National list of ecosystems that are threatened and in need of protection* (GN 1002, December 2011), **Bushmanland Arid Grassland, remains classified as Least Threatened**.

The vegetation can be described as a very sparse (semi-desert type) dwarf shrubland (Photo 1 & Photo 2) with grasses sometimes present (which will probably be more prominent for short periods after rain).

Photo 1: Typical sparse semi-desert vegetation encountered on site (*Tetraena* species prominent)

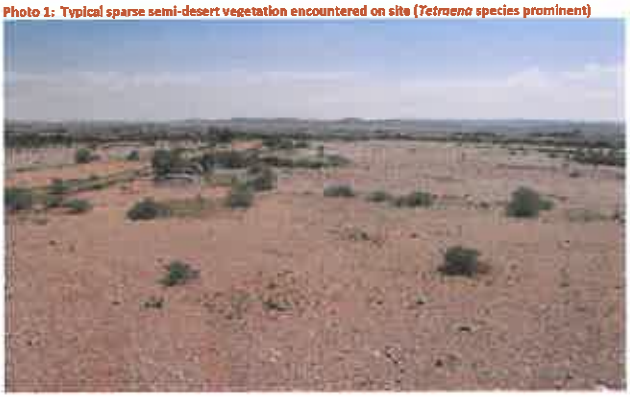


Photo 2: Sparse shrubland with a denser patch of vegetation in background (along a watercourse)

The most significant biodiversity features associated with the site are two small seasonal watercourses going through the site and a few smallish *Boscia albitrunca* trees associated with these drainage lines. Since these streams have been delineated as special features, which will not be part of the physical footprint (not be impacted) the *Boscia* trees will be protected as a result.

The open sparse dwarf shrub layer was dominated by *Tetraena rigida*. It also included the following species: *Acanthopsis disperma, Aloe claviflora* (with its circle arrangement), *Aptosimum lineare, Aptosimum marlothii* (very spiny), *Asparagus cooperi, Avonia papyracea, Blepharis macra, Chascanum garipense, Cynanchum viminale, Euphorbia mauritanica* var. *lignosa* (only observed outside of the site), *Galenia africana, Hermannia stricta, Justicia australis, Justicia* cf. *cuneata Kewa salsoloides, Kleinia longiflora, Lessertia macrostachya, Limeum aethiopicum, Lycium cinereum, Lycium* cf. *hirsutum, Monsonia flavescens, Monsonia umbellate, Moquiniella rubra* (Mistletoe within the *Ziziphus mucronata*), *Rhigozum trichotomum, Salsola* species, *Tephrosia dregeana, Tetraena decumbens, Tetraena rigida* and *Tribulus pterophorus*. Sparsely distributed grasses like *Aristida adscensionis, Aristida congesta, Eragrostis* species and *Stipagrostis uniplumis* were distributed within the shrub layer. The following plants were only encountered within the riparian zone of the small seasonal watercourses namely: *Boscia albitrunca, Boscia foetida* (outside of the site), *Lycium cinereum, Lycium* cf. *hirsutum, Montinia caryophyllacea, Parkinsonia africana, Senegalia mellifera, Ziziphus mucronata*.

Please note that the original document did not list plant species within its own table (which has been added in this document – Table 1). In addition the South African National Biodiversity Institute's biodiversity website added the function of being able to download plant species checklists per vegetation type. This checklist was also added as Appendix 1.

5.1 POTENTIAL IMPACTS ON CENTRES OF ENDEMISM

The proposed development does not impact on any recognised centre of endemism. The Garlep Centre is located to the north (quite a distance away) associated with Augrabies, Pella and Onseepkans along the border of South Africa and Namibia, while the Griqualand West Centre of Endemism starts to the east of Upington Northern Cape Province (Van Wyk & Smith, 2001).

The proposed Kakamas site does not fall within any recognised centre of endemism.

5.2 FLORA ENCOUNTERED (UPDATED)

Please note that this study never intended to be full botanical assessment. However, a scan of significant species was done during the site visit, and even though the author does not claim that all species encountered were identified, all efforts were made to do just that. Table 1 gives an updated list of the species encountered within the study area (for both site visits) as well as their status and further actions needed where applicable.

Table 1: List of flora encountered on the property

No.	Species name	FAMILY	Status Red list, NFA, NCNCA	Alien & invader species (AIS)	Legal requirements
1.	*Acanthopsis disperma*	ACANTHACEAE			
2.	*Aloe claviflora*	ASPHODELACEAE	NCNCA, Schedule 2 Protected (all species in this Family)		Apply for a NCNCA Flora permit (DENC)
3.	*Aptosimum lineare*	SCROPHULARIACEAE			
4.	*Aptosimum marlothii*	SCROPHULARIACEAE			
5.	*Aristida adscensionis*	POACEAE			
6.	*Aristida congesta*	POACEAE			
7.	*Asparagus cooperi*	ASPARAGACEAE			
8.	*Avonia papyracea*	ANACAMPSEROTACEAE			
9.	*Blepharis macra*	ACANTHACEAE			
10.	*Boscia albitrunca*	BRASSICACEAE (CAPPARACEAE)	NCNCA, Schedule 2 Protected (all species in this Genus)		Apply for a NFA Tree permit (DAFF) Apply for a NCNCA Flora permit (DENC)
11.	*Boscia foetida*	BRASSICACEAE (CAPPARACEAE)	NCNCA, Schedule 2 Protected (all species in this Genus)		Apply for a NCNCA Flora permit (DENC)
12.	*Chascanum garipense*	VERBENACEAE			
13.	*Cynanchum viminale (=Sarcostemma viminale)*	APOCYNACEAE	NCNCA, Schedule 2 Protected (all species in this Family)		Apply for a NCNCA Flora permit (DENC)
14.	*Eragrostis* species	POACEAE			
15.	*Euphorbia mauritanica* var. *lignosa*	EUPHORBIACEAE	NCNCA, Schedule 2 Protected (all species in this Genus)		Apply for a NCNCA Flora permit (DENC)
16.	*Euphorbia spinea*	EUPHORBIACEAE	NCNCA, Schedule 2 Protected (all species in this Genus)		Apply for a NCNCA Flora permit (DENC)
17.	*Galenia africana*	AIZOACEAE	NCNCA, Schedule 2 Protected (all species in this Family)		Apply for a NCNCA Flora permit (DENC)
18.	*Hermannia stricta*	STERCULIACEAE			
19.	*Justicia australis (=Monechma genistifolium)*	ACANTHACEAE			
20.	*Justicia cf. cuneata*	ACANTHACEAE			

No	Species name	FAMILY	Status Red list, NFA, NCNCA	Alien & invader species (AIS)	Legal requirements
21.	*Kewa salsaloides (=Hypertelis salsaloides)*	MOLLUGINACEAE			
22.	*Kleinia longiflora*	ASTERACEAE			
23.	*Lessertia macrostachya*	FABACEAE			
24.	*Limeum aethiopicum*	LIMEACEAE			
25.	*Lycium cf. hirsutum*	SOLANACEAE			
26.	*Lycium cinereum*	SOLANACEAE			
27.	*Monsonia flavescens*	GERANIACEAE			
28.	*Monsonia umbellate*	GERANIACEAE			
29.	*Montinia caryophyllacea*	MONTINIACEAE			
30.	*Moquiniella rubra*	LORANTHACEAE			
31.	*Parkinsonia africana*	FABACEAE			
32.	*Rhigozum trichotomum*	BIGONACEAE			
33.	*Salsola* species	AMARANTHACEAE			
34.	*Senegalia mellifera (=Acacia mellifera)*	FABACEAE			
35.	*Stipagrostis uniplumis*	POACEAE			
36.	*Tephrosia dregeana*	FABACEAE			
37.	*Tetraena decumbens (=Zygophyllum decumbens)*	ZYGOPHYLLACEAE			
38.	*Tetraena rigida (=Zygophyllum rigidum)*	ZYGOPHYLLACEAE			
39.	*Tribulus pterophorus*	ZYGOPHYLLACEAE			
40.	*Ziziphus mucronata*	RHAMNACEAE			

5.3 THREATENED AND PROTECTED PLANT SPECIES

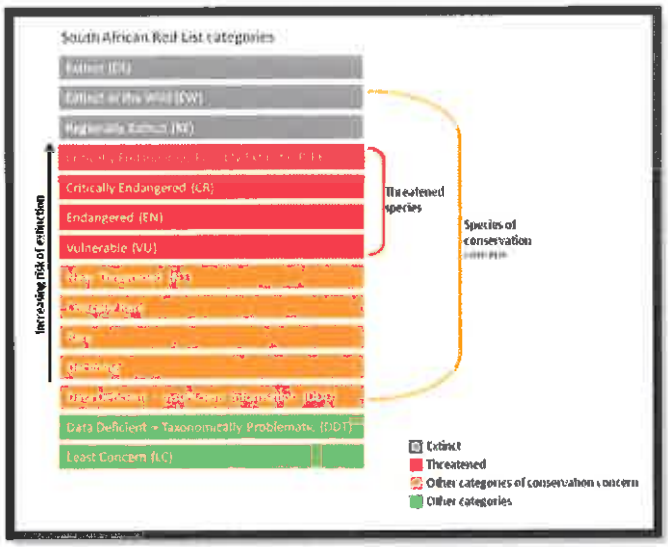
South Africa has become the first country to fully assess the status of its entire flora. Major threats to the South African flora are identified in terms of the number of plant taxa Red-Listed as threatened with extinction as a result of threats like, habitat loss (e.g. infrastructure development, urban expansion, crop cultivation and mines), invasive alien plant infestation (e.g. outcompeting indigenous plant species), habitat degradation (e.g. overgrazing, inappropriate fire management etc.), unsustainable harvesting,

demographic factors, pollution, loss of pollinators or dispersers, climate change and natural disasters (e.g. such as droughts and floods). South Africa uses the internationally endorsed IUCN Red List Categories and Criteria in the Red List of South African plants. However, due to its strong focus on determining risk of extinction, the IUCN system does not highlight species that are at low risk of extinction, but may nonetheless be of high conservation importance. As a result a SANBI uses an amended system of categories in order to highlight species that may be of low risk of extinction but are still of conservation concern (SANBI, 2015).

In the Northern Cape, species of conservation concern are also protected in terms of national and provincial legislation, namely:

- The National Environmental Management: Biodiversity Act, Act 10 of 2004, provides for the protection of species through the *"Lists of critically endangered, endangered, vulnerable and protected species"* (GN. R. 152 of 23 February 2007).
- National Forest Act, Act 84 of 1998, provides for the protection of forests as well as specific tree species through the *"List of protected tree species"* (GN 1602 of 23 December 2016).
- Northern Cape Nature Conservation Act, Act of 2009, provides for the protection of *"specially protected species"* (Schedule 1), *"protected species"* (Schedule 2) and *"common indigenous species"* (Schedule 3).

5.3.1 RED LIST OF SOUTH AFRICAN SPECIES



The Red List of South African Plants online provides up to date information on the national conservation status of South Africa's indigenous plants (SANBI, 2015). The South African red list categories are given in Figure 2.

Figure 2: South African red list categories (SANBI, 2015)

5.3.1.1 *Definitions of the national Red List categories*

Categories marked with [N] are non-IUCN, national Red List categories for species not in danger of extinction, but considered of conservation concern (Refer to Table 2). The IUCN equivalent of these categories is Least Concern (LC) (SANBI, 2015).

Table 2: Definitions of the South African national red list categories (SANBI, 2015)

Extinct (EX): A species is Extinct when there is no reasonable doubt that the last individual has died. Species should be classified as Extinct only once exhaustive surveys throughout the species' known range have failed to record an individual.
Extinct in the Wild (EW): A species is Extinct in the Wild when it is known to survive only in cultivation or as a naturalized population (or populations) well outside the past range.
Regionally Extinct (RE): A species is Regionally Extinct when it is extinct within the region assessed (in this case South Africa), but wild populations can still be found in areas outside the region.
Critically Endangered, Possibly Extinct (CR PE): Possibly Extinct is a special tag associated with the category Critically Endangered, indicating species that are highly likely to be extinct, but the exhaustive surveys required for classifying the species as Extinct has not yet been completed. A small chance remains that such species may still be rediscovered.
Critically Endangered (CR): A species is Critically Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Critically Endangered, indicating that the species is facing an extremely high risk of extinction.
Endangered (EN): A species is Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Endangered, indicating that the species is facing a very high risk of extinction.
Vulnerable (VU): A species is Vulnerable when the best available evidence indicates that it meets at least one of the five IUCN criteria for Vulnerable, indicating that the species is facing a high risk of extinction.
Near Threatened (NT): A species is Near Threatened when available evidence indicates that it nearly meets any of the IUCN criteria for Vulnerable, and is therefore likely to become at risk of extinction in the near future.
[N]"Critically" Rare A species is Critically Rare when it is known to occur at a single site, but is not exposed to any direct or plausible potential threat and does not otherwise qualify for a category of threat according to one of the five IUCN criteria.
[N]Rare: A species is Rare when it meets at least one of four South African criteria for rarity, but is not exposed to any direct or plausible potential threat and does not qualify for a category of threat according to one of the five IUCN criteria. The four criteria are as follows: ➢ Restricted range: Extent of Occurrence (EOO) <500 km2, OR ➢ Habitat specialist: Species is restricted to a specialized microhabitat so that it has a very small Area of Occupancy (AOO), typically smaller than 20 km2, OR ➢ Low densities of individuals: Species always occurs as single individuals or very small subpopulations (typically fewer than 50 mature individuals) scattered over a wide area, OR ➢ Small global population: Less than 10 000 mature individuals.

Declining: A species is Declining when it does not meet or nearly meet any of the five IUCN criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened, but there are threatening processes causing a continuing decline of the species.
Least Concern (LC): A species is Least Concern when it has been evaluated against the IUCN criteria and does not qualify for any of the above categories. Species classified as Least Concern are considered at low risk of extinction. Widespread and abundant species are typically classified in this category.
Data Deficient - Insufficient Information (DDD): A species is DDD when there is inadequate information to make an assessment of its risk of extinction, but the species is well defined. Listing of species in this category indicates that more information is required and that future research could show that a threatened classification is appropriate.
Data Deficient - Taxonomically Problematic (DDT): A species is DDT when taxonomic problems hinder the distribution range and habitat from being well defined, so that an assessment of risk of extinction is not possible.
Not Evaluated (NE): A species is Not Evaluated when it has not been evaluated against the criteria. The national Red List of South African plants is a comprehensive assessment of all South African indigenous plants, and therefore all species are assessed and given a national Red List status. However, some species included in Plants of southern Africa: an online checklist are species that do not qualify for national listing because they are naturalized exotics, hybrids (natural or cultivated), or synonyms. These species are given the status Not Evaluated and the reasons why they have not been assessed are included in the assessment justification.

5.3.1.2 *Red listed plant species encountered*

According to the Red List of South African Plants (version 2017.1., www.redlist.sanbi.org, accessed on 2017/03/30) a number of listed plant species is associated with Bushmanland Arid Grassland namely:

- *Aloidendron dichotomum* (Masson) Klopper & Gideon.F.Sm. **VU**
- *Anacampseros recurvata* Schönland subsp. *minuta* Gerbaulet **DDD**
- *Conophytum blandum* L.Bolus **NT**
- *Conophytum ratum* S.A.Hammer **CR**
- *Conophytum tantillum* N.E.Br. subsp. *eenkokerense* (L.Bolus) S.A.Hammer **Rare**
- *Crotalaria pearsonii* Baker f. **VU**
- *Dinteranthus pole-evansii* (N.E.Br.) Schwantes VU
- *Moraea indecora* Goldblatt **VU**
- *Schwantesia borcherdsii* L.Bolus **VU**

No red list plant species was encountered on the proposed site.

5.3.2 NEM: BA PROTECTED SPECIES

The National Environmental Management: Biodiversity Act, Act 10 of 2004, provides for the protection of species through the "Lists of critically endangered, endangered, vulnerable and protected species" (GN. R. 152 of 23 February 2007).

No species protected in terms of NEM: BA was encountered.

5.3.3 NFA PROTECTED SPECIES

The National Forests Act (NFA) of 1998 (Act 84 of 1998) provides for the protection of forests as well as specific tree species their List of Protected tree species, updated on a yearly basis. The latest list on which this

evaluation is based was published on the 23rd of December 2016 (GN 1602). One species protected in terms of the NFA was observed (refer to Table 3).

Table 3: NFA protected species encountered within the footprint and immediate surroundings

NO.	SPECIES NAME	COMMENTS	RECOMENDATIONS
1.	*Boscia albitrunca*	5 individuals encountered including 1 beautiful large specimen	No mitigation possible (Root system normally to extensive for transplanting).

NB: Please note that this species was only encountered in association with the small seasonal streams and will be protected as part of this stream (no impact expected).

5.3.4 NCNCA PROTECTED SPECIES

The Northern Cape Nature Conservation Act 9 of 2009 (NCNCA) came into effect on the 12th of December 2011, and also provides for the sustainable utilization of wild animals, aquatic biota and plants. Schedule 1 and 2 of the act give extensive lists of specially protected and protected fauna and flora species in accordance with this act. NB. Please note that all indigenous plant species are protected in terms of Schedule 3 of this act (e.g. any work within a road reserve).

The following species (Refer to Table 4) protected in terms of the NCNCA were encountered. Recommendations on impact minimisation also included.

Table 4: Plant species protected in terms of the NCNCA encountered within the study area

NO.	SPECIES NAME	COMMENTS	RECOMENDATIONS
1.	*Aloe claviflora* **Schedule 2 protected**	Occasionally observed within the footprint. Likely to be impacted.	Search & rescue and transplant within the immediate vicinity (but not within the construction footprint).
2.	*Boscia albitrunca* **Schedule 2 protected.**	Only observed in association with the seasonal watercourses and will be protected within the ecological support area. Will not be impacted.	Include within the ecological support area for the seasonal streams and protect as part of this feature. Ensure that laydown areas or construction associated activities does not impact on any of these plants.
3.	*Boscia foetida* **Schedule 2 protected.**	Only observed outside of the proposed site. Unlikely to be impacted.	Ensure that laydown areas or construction associated activities does not impact on any of these plants.
4.	*Cynanchum viminale* **Schedule 2 protected**	Occasionally observed, but common in the larger site. Likely to be impacted.	Search & rescue **not** expected to be successful. Topsoil conservation and re-use may allow for seed preservation.
5.	*Euphorbia mauritanica var. lignosa* **Schedule 2 protected**	Only observed outside of the footprint. Unlikely to be impacted.	Ensure that laydown areas or construction associated activities does not impact on any of these plants.
6.	*Euphorbia spinea* **Schedule 2 protected**	Rarely observed. Likely to be impacted.	Search & rescue and transplant within the immediate vicinity (but not within the construction footprint).
7.	*Galenia africana* **Schedule 2 protected**	A common pioneer species, but, in this case only occasionally observed. Likely to be impacted.	Topsoil conservation and re-use may allow for seed and bulb preservation.

5.4 CRITICAL BIODIVERSITY AREAS

At present there are not fine scale conservation maps for the ZF Mgcawu (previously Siyanda) District Municipality available. However, following the criteria used for typical biodiversity categories (as given below) the author tried to anticipate whether the proposed footprint is likely to be included in potential CBA's or ESA's (Refer to Heading 5.4.2, underneath).

5.4.1 BIODIVERSITY CATEGORIES FOR LAND-USE PLANNING

Critical biodiversity areas (CBA's) are terrestrial and aquatic features in the landscape that are critical for retaining biodiversity and supporting continued ecosystem functioning and services (SANBI 2007). The primary purpose of CBA's is to inform land-use planning in order to promote sustainable development and protection of important natural habitat and landscapes. CBA's can also be used to inform protected area expansion and development plans. The CBA's underneath is based on the definition laid out in the guideline for publishing bioregional plans (Anon, 2008):

- **Critical biodiversity areas (CBA's)** are areas of the landscape that need to be maintained in a natural or near-natural state in order to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. In other words, if these areas are not maintained in a natural or near-natural state then biodiversity conservation targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity-compatible land uses and resource uses.
- **Ecological support areas (ESA's)** are areas that are not essential for meeting biodiversity representation targets/thresholds but which nevertheless play an important role in supporting the ecological functioning of critical biodiversity areas and/or in delivering ecosystem services that support socio-economic development, such as water provision, flood mitigation or carbon sequestration. The degree of restriction on land use and resource use in these areas may be lower than that recommended for critical biodiversity areas.

From a land-use planning perspective it is useful to think of the difference between CBA's and ESA's in terms of where in the landscape the biodiversity impact of any land-use activity action is most significant:

- For CBA's the impact on biodiversity of a change in land-use that results in a change from the desired ecological state is most significant locally at the point of impact through the direct loss of a biodiversity feature (e.g. loss of a populations or habitat).
- For ESA's a change from the desired ecological state is most significant elsewhere in the landscape through the indirect loss of biodiversity due to a breakdown, interruption or loss of an ecological process pathway (e.g. removing a corridor results in a population going extinct elsewhere or a new plantation locally results in a reduction in stream flow at the exit to the catchment which affects downstream biodiversity).

5.4.2 POTENTIAL CRITICAL BIODIVERSITY AREAS ENCOUNTERED

Of importance in terms of consideration for inclusion into a critical biodiversity area (CBA) or ecological support area (ESA) will be the following:

- The site is still covered by natural veld in relative good condition;
- The site does not fall within any Centre of Endemism;
- Bushmanland Arid Grassland is classified as "*Least Threatened*" with more than 99% still remaining in its natural state, but only 4% of this vegetation type is formally protected;
- The most significant biodiversity features associated with the site are two small seasonal watercourses going through the site and a few smallish *Boscia albitrunca* trees associated with these drainage lines.
- A number of plant species protected in terms of the NCNCA was observed within the site.
- The proposed is located near to the Kakamas sewerage works and waste disposal site (which are inherently degraded).

The site still shows excellent connectivity with surrounding vegetation, but the location is also well chosen in that it will be in proximity of already disturbed areas and an access road exists. It is possible that the proposed footprint might be considered for future inclusion into a CBA or ESA on strength of its connectivity value, but there are likely better options available. On the other hand, the small size of the proposed development is unlikely to have any significant impact on connectivity within the larger area.

5.5 INVASIVE ALIEN PLANTS

Alien and invasive plant (AIP) species were introduced into South Africa more than 1 000 years ago *via* trading routes from other countries in southern Africa (Alberts & Moolman, 2013). Since the arrival of settlers from Europe these numbers have increased dramatically. At present, AIPs are encountered on large portions of land in South Africa (10 million hectares) and it is reportedly consuming nearly 330 million cubic meters of water annually, or 7% of the annual run-off. But what is really scary is that this water consumption levels are increasing rapidly and could reach 50% of the mean annual run-off in the not too distant future (Alberts & Moolman, 2013). The aggressive behaviour of the AIPs in their unnatural habitat is a direct threat to the vast wealth of biodiversity in South Africa. South Africa is a relatively small country that comprises only 2% of the total surface of the Earth, but it contains 10% of the plant species, 7% of the vertebrates, and is home to three biodiversity hotspots.

In South Africa, there are currently three pieces of national legislation that relate to the control of Alien and Invasive Species (AIS) namely:

- Fertilizer, Farm Feeds, Agricultural Remedies and Stock Remedies Act (Act No. 36 of 1947), administered by the Department of Agriculture, forestry and Fisheries.

- List of weeds and invader plants declared in terms of Regulations 15 and 16 (as Amended, March 2001) of the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) (CARA) administered by the Department of Agriculture, Forestry and Fisheries (DAFF);
- Alien and invasive species list 2016 (GN R. 864 of 29 July 2016) promulgated in terms of sections 66(1), 67(1), 70(1)(a), 71(3) and 71A of the National Environmental Management, Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA), administered by the Department of Environmental Affairs (DEA).

5.5.1 FERTILIZER, FARM FEEDS, AGRICULTURAL REMEDIES AND STOCK REMEDIES ACT

According to Government Notice No. 13424 dated 26 July 1992, it is an offence to "acquire, dispose, sell or use an agricultural or stock remedy for a purpose or in a manner other than that specified on the label on a container thereof or on such a container".

Contractors using herbicides need to have a valid Pest Control Operators License (limited weeds controller) according to the Fertilizer, Farm Feeds, Agricultural Remedies and Stock Remedies Act (Act No. 36 of 1947).

5.5.2 CONSERVATION OF AGRICULTURAL RESOURCES ACT

The **CARA** sets out the regulations (amended March 2001) regarding the control of weeds and invasive plants and provides a list of declared plants. The amended regulations make provision for four groups of invader plants. The first three groups consist of undesirable alien plants and are covered by Regulation 15, namely:

- **Category 1** declared weeds (Section 15A of the amended act) are prohibited plants that will no longer be tolerated on land or on water surfaces, neither in rural or urban areas. These plants may no longer be planted or propagated, and all trade in their seeds, cuttings or other propagative material is prohibited. Plants included in this category because their harmfulness outweighs any useful properties or purpose they may have.
- **Category 2** declared plant invaders (Section 15B of the amended act) are plants with a proven potential of becoming invasive, but which nevertheless have certain beneficial properties that warrant their continued presence in certain circumstances. May be grown in demarcated areas provided that there is a permit and that steps are taken to prevent their spread.
- **Category 3** declared plant invaders (Section 15C of the amended act) are undesirable because they have the proven potential of becoming invasive, but most of them are nevertheless popular ornamentals or shade trees that will take a long time to replace. May no longer be planted. Existing plants may be retained as long as all reasonable steps are taken to prevent the spreading thereof, provided they are not within 30 metres of the 1:50 year flood line of a river, stream, lake or other type of inland water body. The "executive officer" can impose further conditions on Category 3 plants already in existence, which might include removing them if the situation demands it.

- **Bush encroachers**, which are indigenous plants that require sound management practices to prevent them from becoming problematic, are covered separately by Regulation 16.

Refer to heading 5.5.5 for listed weeds and invader species encountered in terms of CARA.

5.5.3 NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT

NEMBA aims to provide the framework, norms, and standards for the conservation, sustainable use, and equitable benefit-sharing of South Africa's biological resources. The purpose of NEMBA as it relates to Alien and Invasive Species (AIS) is to prevent the unauthorised introduction and spread of such species to ecosystems and habitats where they do not naturally occur; manage and control such species to prevent or minimise harm to the environment and to biodiversity in particular; and to eradicate alien invasive species from ecosystems and habitats where they may harm such ecosystems or habitats. The Regulations on Alien and Invasive Species, referred to as the **"AIS Regulations"** combine invasive species already listed in the CARA, with two new lists relating to invasive species and prohibited species.

The AIS Regulations list 4 different categories of invasive species that must be managed, controlled or eradicated from areas where they may cause harm to the environment, or that are prohibited to be brought into South Africa, namely:

- **Category 1a:** invasive species that may not be owned, imported into South Africa, grown, moved, sold, given as a gift or dumped in a waterway. These species need to be controlled on your property, and officials from the Department of Environmental Affairs must be allowed access to monitor or assist with control.
- **Category 1b**: invasive species that may not be owned, imported into South Africa, grown, moved, sold, given as a gift or dumped in a waterway. Category 1b species are major invaders that may need government assistance to remove. All Category 1b species must be contained, and in many cases they already fall under a government sponsored management programme.
- **Category 2**: These are invasive species that can remain in your garden, but only with a permit, which is granted under very few circumstances.
- **Category 3:** These are invasive species that can remain in your garden. However, you cannot propagate or sell these species and must control them in your garden. In riparian zones or wetlands all Category 3 plants become Category 1b plants.

Refer to heading 5.5.5 for listed alien and invasive species encountered in terms of NEM: BA.

5.5.4 NORTHERN CAPE NATURE CONSERVATION ACT

Although provinces have a mandate to implement and enforce national legislation (such as CARA or NEM:BA), provincial authorities can also add further to legislation in the form of provincial ordinances, whereby each province can further prohibit certain species should the authorities feel that a species poses a potential risk or threat to the province's ecosystems or biodiversity.

In the Northern Cape Schedule 6 of the Northern Cape Nature Conservation Act, Act 9 of 2009 list additional invasive species that must be controlled. Schedule 6 list includes all species listed as weeds in CARA as well as an additional 36 species (none of which has been observed during this study).

Refer to heading 5.5.5 for listed invasive species encountered in terms of NCNCA. *Please note that all species categorized as Category 1 plants in terms of CARA are automatically listed in terms of the NCNCA (Refer to Table 1).*

5.5.5 ALIEN AND INVASIVE PLANTS ENCOUNTERED

Single *Prosopis* trees were observed in the wetter area next to the Kakamas sewerage works, but no alien plant species was observed within the proposed footprint area (Refer to Table 5).

Table 5: List of alien and invasive species encountered within the larger footprint

SPECIES	CARA	NEM: BA	NCNCA	MANAGEMENT RECOMMENDATIONS

There are various means of managing alien and invasive plant species, which can include mechanical-, chemical- and biological control methods or a combination of these. Control methods prescribed by the author are usually based on used by the Working for Water Programme (Bold, 2007) and or the CapeNature alien control guideline (Martens *et. al.,* 2003).

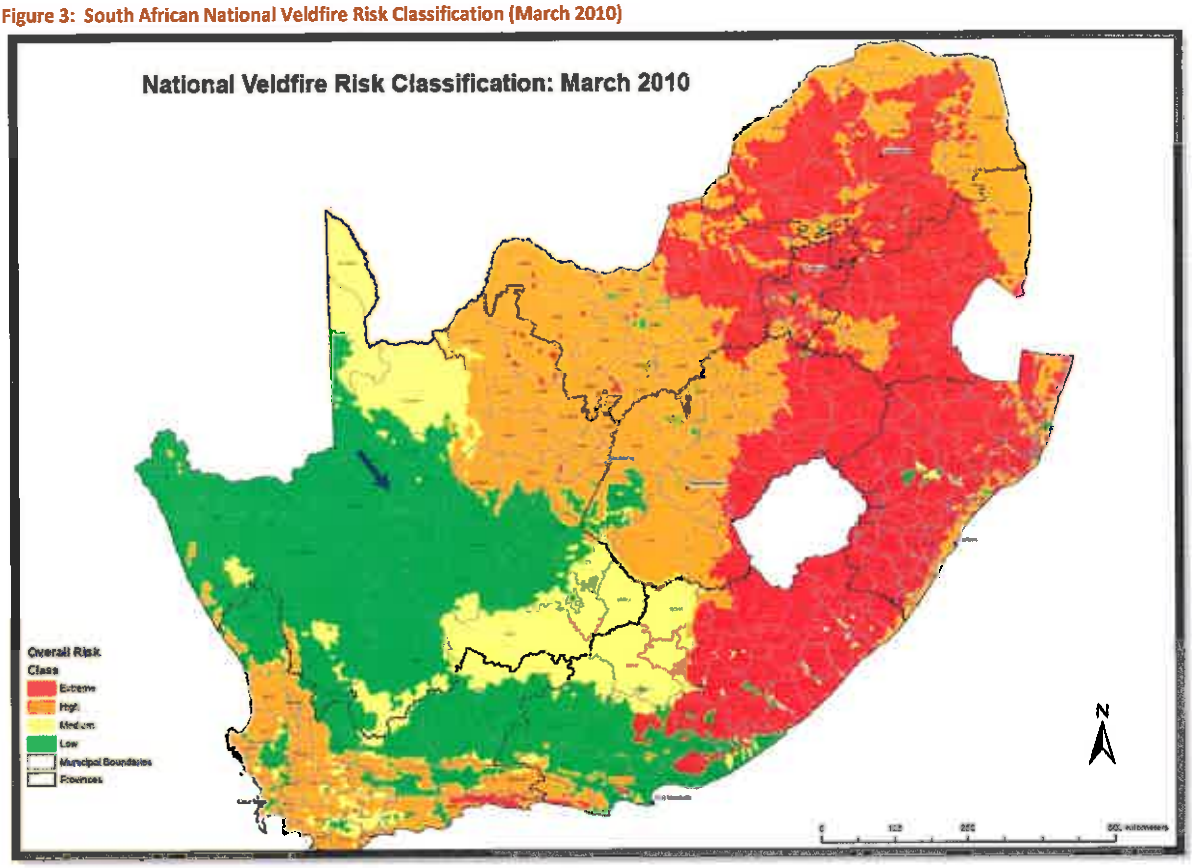
5.6 VELD FIRE RISK

The revised veldfire risk classification (Forsyth, 2010) in terms of the National Veld and Forest Fire Act 101 of 1998 was promulgated in March 2010. The purpose of the revised fire risk classification is to serve as a national framework for implementing the National Veld and Forest Fire Act, and to provide a basis for setting priorities for veldfire management interventions such as the promotion of and support to Fire Protection Associations. In the fire-ecology types and municipalities with High to Extreme fire risk, comprehensive risk management strategies are needed.

The proposed site is located in an area supporting a very sparse semi-desert low shrubland which has been classified with a **Low fire risk classification** (Refer to Figure 3). Still it is important that during construction and

operation the site must adhere to all the requirements of the local Fire Protection Association (FPA), if applicable, or must adhere to responsible fire prevention and control measures.

Figure 3: South African National Veldfire Risk Classification (March 2010)



6. IMPACT ASSESSMENT METHOD

The concept of environmental impact assessment in terms of the National Environmental Management Act, Act 107 of 1998 (NEMA) and the Environmental Impact Assessment (EIA) was developed to identify and evaluate the nature of potential impact in order to determine whether an activity is likely to cause significant environmental impact on the environment. The concept of significance is at the core of impact identification, evaluation and decision making, but despite this the concept of significance and the method used for determining significance remains largely undefined and open to interpretation (DEAT, 2002).

6.1 DETERMINING SIGNIFICANCE

Determining impact significance from predictions of the nature of the impact has been a source of debate and will remain a source of debate. The author used a combination of scaling and weighting methods to determine significance based on a simple formula. The formula used is based on the method proposed by Edwards (2011). However, the criteria used were adjusted to suite its use for botanical assessment. In this document significance rating was evaluated using the following criteria.

Significance = Conservation Value x (Likelihood + Duration + Extent + Severity) (Edwards 2011)

6.1.1 CRITERIA USED

Conservation value: Conservation value refers to the intrinsic value of an attribute (e.g. an ecosystem, a vegetation type, a natural feature or a species) or its relative importance towards the conservation of an ecosystem or species or even natural aesthetics. Conservation status is based on habitat function, its vulnerability to loss and fragmentation or its value in terms of the protection of habitat or species (Refer to Table 6 for categories used).

Table 6: Categories used for evaluating conservation status

CONSERVATION VALUE	
Low (1)	The attribute is transformed, degraded not sensitive (e.g. Least threatened), with unlikely possibility of species loss.
Medium/low (2)	The attribute is in good condition but not sensitive (e.g. Least threatened), with unlikely possibility of species loss.
Medium (3)	The attribute is in good condition, considered vulnerable (threatened), or falls within an ecological support area or a critical biodiversity area, but with unlikely possibility of species loss.
Medium/high (4)	The attribute is considered endangered or, falls within an ecological support area or a critical biodiversity area, or provides core habitat for endemic or rare & endangered species.
High (5)	The attribute is considered critically endangered or is part of a proclaimed provincial or national protected area.

Likelihood refers to the probability of the specific impact occurring as a result of the proposed activity (Refer to Table 7, for categories used).

Table 7: Categories used for evaluating likelihood

LIKELIHOOD	
Highly Unlikely (1)	Under normal circumstances it is almost certain that the impact will not occur.
Unlikely (2)	The possibility of the impact occurring is very low, but there is a small likelihood under normal circumstances.
Possible (3)	The likelihood of the impact occurring, under normal circumstances is 50/50, it may or it may not occur.
Probable (4)	It is very likely that the impact will occur under normal circumstances.
Certain (5)	The proposed activity is of such a nature that it is certain that the impact will occur under normal circumstances.

Duration refers to the length in time during which the activity is expected to impact on the environment (Refer to Table 8).

Table 8: Categories used for evaluating duration

DURATION	
Short (1)	Impact is temporary and easily reversible through natural process or with mitigation. Rehabilitation time is expected to be short (1-2 years).
Medium/short (2)	Impact is temporary and reversible through natural process or with mitigation. Rehabilitation time is expected to be relative short (2-5 years).
Medium (3)	Impact is medium-term and reversible with mitigation, but will last for some time after construction and may require ongoing mitigation. Rehabilitation time is expected to be longer (5-15 years).
Long (4)	Impact is long-term and reversible but only with long term mitigation. It will last for a long time after construction and is likely to require ongoing mitigation. Rehabilitation time is expected to be longer (15-50 years).
Permanent (5)	The impact is expected to be permanent.

Extent refers to the spatial area that is likely to be impacted or over which the impact will have influence, should it occur (Refer to Table 9).

Table 9: Categories used for evaluating extent

EXTENT	
Site (1)	Under normal circumstances the impact will be contained within the construction footprint.
Property (2)	Under normal circumstances the impact might extent outside of the construction site (e.g. within a 2 km radius), but will not affect surrounding properties.
Surrounding properties (3)	Under normal circumstances the impact might extent outside of the property boundaries and will affect surrounding land owners or –users, but still within the local area (e.g. within a 50 km radius).
Regional (4)	Under normal circumstances the impact might extent to the surrounding region (e.g. within a 200 km radius), and will regional land owners or –users.
Provincial (5)	Under normal circumstances the effects of the impact might extent to a large geographical area (>200 km radius).

Severity refers to the direct physical or biophysical impact of the activity on the surrounding environment should it occur (Refer to Table 10).

Table 10: Categories used for evaluating severity

SEVERITY	
Low (1)	It is expected that the impact will have little or no affect (barely perceptible) on the integrity of the surrounding environment. Rehabilitation not needed or easily achieved.
Medium/low (2)	It is expected that the impact will have a perceptible impact on the surrounding environment, but it will maintain its function, even if slightly modified (overall integrity not compromised). Rehabilitation easily achieved.
Medium (3)	It is expected that he impact will have an impact on the surrounding environment, but it will maintain its function, even if moderately modified (overall integrity not compromised). Rehabilitation easily achieved.
Medium/high (4)	It is expected that the impact will have a severe impact on the surrounding environment. Functioning may be severely impaired and may temporarily cease. Rehabilitation will be needed to restore system integrity.
High (5)	It is expected that the impact will have a very severe to permanent impact on the surrounding environment. Functioning irreversibly impaired. Rehabilitation often impossible or unfeasible due to cost.

6.2 SIGNIFICANCE CATEGORIES

The formal NEMA EIA application process was developed to assess the significance of impacts on the surrounding environment (including socio-economic factors), associated with any specific development proposal in order to allow the competent authority to make informed decisions. Specialist studies must advise the environmental assessment practitioner (EAP) on the significance of impacts in his field of specialty. In order to do this, the specialist must identify all potentially significant environmental impacts, predict the nature of the impact and evaluate the significance of that impact should it occur.

Potential significant impacts are evaluated, using the method described above, in order to determine its potential significance. The potential significance is then described in terms of the categories given in Table 11. Mitigation options are evaluated and comparison is then made (using the same method) of potential significance before mitigation and potential significance after mitigation (to advise the EAP).

Table 11: Categories used to describe significance rating (adjusted from DEAT, 2002)

SIGNIFICANCE	DESCRIPTION
Insignificant or Positive (4-22)	There is no impact or the impact is insignificant in scale or magnitude as a result of low sensitivity to change or low intrinsic value of the site, or the impact may be positive.
Low (23-36)	An impact barely noticeable in scale or magnitude as a result of low sensitivity to change or low intrinsic value of the site, or will be of very short-term or is unlikely to occur. Impact is unlikely to have any real effect and no or little mitigation is required.
Medium Low (37-45)	Impact is of a low order and therefore likely to have little real effect. Mitigation is either easily achieved. Social, cultural and economic activities can continue unchanged, or impacts may have medium to short term effects on the social and/or natural environment within site boundaries.
Medium (46-55)	Impact is real, but not substantial. Mitigation is both feasible and fairly easily possible, but may require modification of the project design or layout. Social, cultural and economic activities of communities may be impacted, but can continue (albeit in a different form). These impacts will usually result in medium to long term effect on the social and/or natural environment, within site boundary.
Medium high (56-63)	Impact is real, substantial and undesirable, but mitigation is feasible. Modification of the project design or layout may be required. Social, cultural and economic activities may be impacted, but can continue (albeit in a different form). These impacts will usually result in medium to long-term effect on the social and/or natural environment, beyond site boundary within local area.
High (64-79)	An impact of high order. Mitigation is difficult, expensive, time-consuming or some combination of these. Social, cultural and economic activities of communities are disrupted and may come to a halt. These impacts will usually result in long-term change to the social and/or natural environment, beyond site boundaries, regional or widespread.
Unacceptable (80-100)	An impact of the highest order possible. There is no possible mitigation that could offset the impact. Social, cultural and economic activities of communities are disrupted to such an extent that these come to a halt. The impact will result in permanent change. Very often these impacts are un-mitigatable and usually result in very severe effects, beyond site boundaries, national or international.

7. BIODIVERSITY ASSESSMENT

Bushmanland Arid Grassland is part of the Nama-Karoo Biome. The Nama-Karoo Biome is not particularly rich in species and local endemism is very low. Rainfall seasonality and frequency are too unpredictable and winter temperatures too low to enable leaf succulents to dominate as they do in the more reliable rainfall areas of the Succulent Karoo. It is also too dry in summer for dominance by perennial grasses and the soils are generally too shallow and the rainfall too low for trees.

The site visit showed no other significant geographical features (apart from the watercourses, which will not be impacted) such as wetlands, upland- down land gradients or vegetation boundaries on the site or limited to the site. The site is located near an area already heavily disturbed by urban associated development (Sewerage works and Municipal disposal site).

7.1 BIOPHYSICAL ENVIRONMENT

No special habitats, geology or soils were encountered. It is likely (although not observed) that the larger property is utilized as natural grazing by local towns people, but the grazing potential of this veld is very low and it is considered highly unlikely that the proposed development can have any significant impact on available grazing land.

7.2 THREATENED OR PROTECTED ECOSYSTEMS

The Bushmanland Arid Grassland vegetation type is not considered vulnerable or threatened with more 99% of this vegetation still remaining in its natural state. However, at present little of this vegetation type is formally conserved in South Africa. It is thus important the viable areas are considered for inclusion into Conservation areas or CBA's or ESA's. The site is not located within any Centre of Endemism. It is also considered unlikely that the proposed footprint can have any significant impact local or national conservation targets and the small size of the proposed development makes it unlikely to have any significant impact on connectivity within the larger area.

No Red list species was encountered (Heading 5.3.1), or species protected in terms of NEMBA (Heading 5.3.2), but a few *Boscia albitrunca* (Sheppard's tree) protected in terms of the NFA (Heading 5.3.3) were observed, but not within the development footprint. A number of species protected in terms of the NCNCA (Heading 5.3.4) was encountered. It is important to note that the actual development footprint only need to compromise about 50% of the total site, which means that with micro adjustment of the layout within the site, can be done to exploit further impact minimisation options, if needed. Two species was recommended for search & rescue and topsoil (with its seedbank) protection and re-use will allow seed preservation and thus species distribution/relocation.

Two seasonal watercourses cross the proposed footprint, but they have been identified as significant environmental features and will be excluded from the development footprint and protected through a physical offset (natural corridor). It is also considered unlikely that the proposed development will have any significant impact on any single fauna or avi-fauna species. No invasive alien plant species was observed within the proposed footprint. The potential veld fire risk is low.

7.3 CUMMULATIVE IMPACTS

The Department of Environmental Affairs requires that specialist evaluates the accumulative impacts of all other renewable energy sites within a 30 km radius of the proposed development. According to the information obtained from the Department of Environmental Affairs renewable energy database website for South Africa (https://dea.maps.arcgis.com/apps/webappviewer), there are potentially three renewable energy sites within a 30 km radius of the proposed Kakamas site (Figure 4), not including the Keren Kakamas site, which refers to this application.

The proposed Slypsteen South Hydroelectric power scheme is located on the adjacent property (just north) of Kakamas, while two sites are located towards Hopetown (to the south) and one site is located to the north of the Kakamas site. Of the four sites two sites (Site 1 and 2 Figure 5) can also potentially impact on the same vegetation type as the proposed Kakamas solar site. The Zoetgat and Moletzi sites are not expected to impact on Bushmanland Arid Grassland (this will not compete with national conservation targets within the 30km radius of Kakamas).

Name	Type	MW	Vegetation type
1. Hydropower station on Orange River near Kakamas	Hydroelectric	10	Lower Gariep Alluvial Vegetation Bushmanland Arid Grassland Lower Gariep Broken Veld
2. Solar facility on Farm Baviaanz Kranz No. 474	Solar PV	200	Kalahari Karroid Shrubland Lower Gariep Broken Veld
3. Solar facility on Prt. 2 of Farm Eenduin No. 465	Solar PV	10	Bushmanland Arid Grassland

Figure 4: Indicating potential renewable energy sites within 30km radius of the proposed Kakamas Solar site

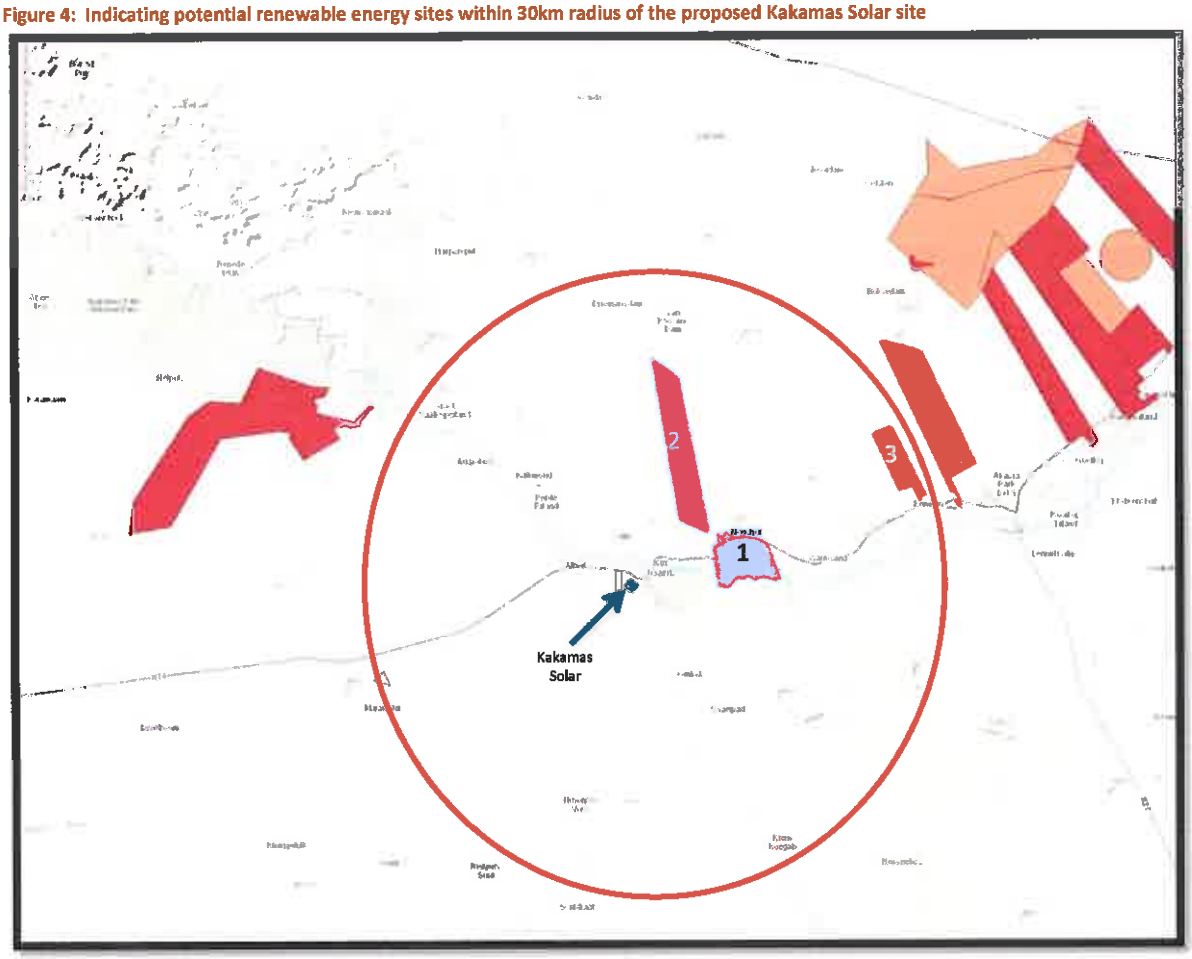
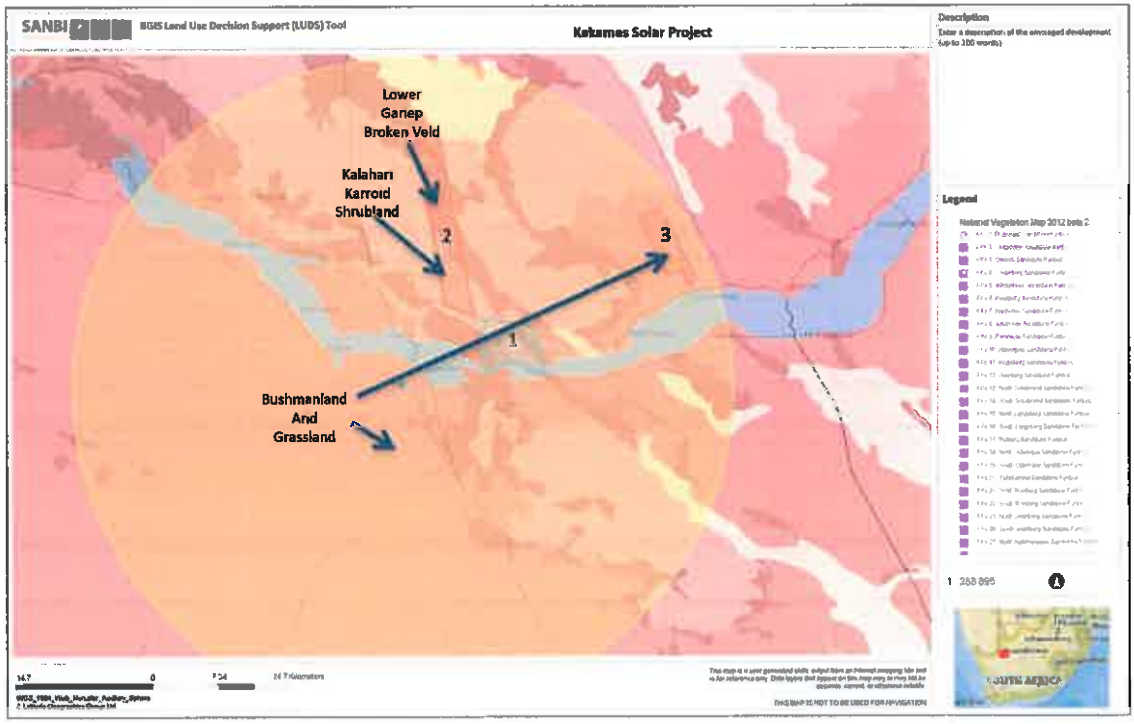


Figure 5: The vegetation map of South Africa (2012, beta version) showing the vegetation associated with the RE sites within 30km



The proposed Kakamas development is small (<20ha) and will impact on Bushmanland Arid Grassland. Bushmanland Arid Grassland vegetation type is not considered vulnerable or threatened with more 99% still remaining in its natural state. Ecological connectivity is still very good for most of the Kakamas area (the veld being mainly natural grazing land). Since there is no fine scale mapping for this area available, it means that ecological corridors and provincial conservation targets had not yet been defined.

Because of the small size of the proposed footprint is unlikely to have any significant impact on connectivity and it is considered unlikely to have any significant impact on any future CBA or ESA. Floristically, the most significant potential impact will be on protected plant species (none of which is listed in the Red List of South African Plant Species). In the case of the Kakamas Solar site, two other renewable energy sites within 30km may impact on the same vegetation type namely Site 1 and 3 in Figure 4 & Figure 5.

Cumulative impacts for this project was calculated taking into account the small size of the proposed development, the impact of similar developments within a 30km radius on the same vegetation type, connectivity, potential critical biodiversity areas or ecological support areas and the impact on protected tree species (which can potentially be negated) as well as land-use, geology and soils, fauna and avi-fauna (Refer to Table 12).

7.4 IMPACT EVALUATION

Table 12 rates the significance of environmental impacts associated with the proposed development. It also evaluates the expected accumulative effect of the proposed development as well as the No-Go option.

Table 12: Significant rating of impacts associated with the proposed development (including the No-Go option)

Aspect	Short description	CV	Lik	Dur	Ext	Sev	Sig before Mit	CV	Lik	Dur	Ext	Sev	Sig after Mit	Short discussion
Geology & soils	Possible impact on special habitats	1	1	3	1	1	6	1	1	3	1	1	6	No special features encountered (e.g. true quartz patches). The impact on geology and soils is expected to be very low. No mitigation required.
Landuse and cover.	Possible impact on socio-economic activities as a result of the physical footprint or associated activities.	1	2	3	1	1	7	1	2	3	1	1	7	The proposed development will impact on a small area used for grazing by the landowner. Loss of grazing will be barely perceptible within the larger property.
Vegetation type	Possible loss of vegetation and associated habitat.	1	2	3	1	2	8	1	1	3	1	1	6	More than 99% of this vegetation remains in its natural state, but little formally conserved. Mitigation - Minimise impact on large indigenous trees and minimise footprint.
Connectivity	Possible loss of ecosystem function as a result of habitat fragmentation.	1	2	3	1	2	8	1	1	3	1	1	6	Permanent impact, but with small footprint, unlikely to impact on overall connectivity. Mitigation - minimise impact on large indigenous trees and minimise footprint.
Corridors and conservation priority areas	Possible loss of identified terrestrial and aquatic critical biodiversity areas, ecological support areas or ecological corridors.	1	2	3	1	2	8	1	2	3	1	1	7	CBA's and ECA's not yet defined, but unlikely to impact on any priority sites. Mitigation - minimise footprint.
Watercourses and wetlands	Possible impact on natural water resources and its associated ecosystem.	0	0	0	0	0	0	0	0	0	0	0	0	No watercourses or wetlands will be impacted.
Flora	Possible loss of threatened or protected species.	3	4	3	1	2	30	3	2	3	1	1	21	Protected species of encountered but no red species. But impact can be minimised through protection indigenous tree species and footprint minimisation.
Fauna	Possible impact on species as well as potential loss of threatened or protected species.	1	1	2	1	1	5	1	1	2	1	1	5	Unlikely to impact significantly on any single species. No mitigation required.
Avi-fauna	Possible impact on species as well as potential loss of threatened or protected species.	1	1	2	1	1	5	1	1	2	1	1	5	Unlikely to impact significantly on any single species. Mitigation - minimise footprint and impact on protected trees.
Invasive alien species	Possible alien infestation as a result of activities.	0	0	0	0	0	0	0	0	0	0	0	0	No AIS observed.
Veld fire	The risk of veld fires as a result of the proposed activities.	1	3	3	1	1	8	1	2	2	1	1	6	Veld fire risk is low and is unlikely to impacts on the surroundings.

Aspect	Short description	CV	Lik	Dur	Ext	Sev	Sig before Mit.	CV	Lik	Dur	Ext	Sev	Sig after Mit.	Short discussion
Accumulative	Accumulative impact associated with the proposed activity.	3	4	3	1	2	30	3	3	3	1	1	24	Cumulative impact can be reduced through mitigation measures.
No-Go alternative	Potential environmental impact associated with the no-go alternative.	1	1	1	1	1	4	1	1	1	1	1	4	The above impacts will not occur, but the site will remain subject to slow degradation as a result of informal grazing and urban footprint creep.

Significance before mitigation:

The impact assessment suggests that the proposed Kakamas development is expected to have a **Low cumulative** impact, with the most significant aspect being the potential impact on the protected species encountered within the site and to a lesser degree potential accidental veld fires. The evaluation is based the fact that the small watercourses and its associated vegetation will be protected by default.

Significance after mitigation:

Since the proposed development footprint needs only be approximately 50% of the 20ha, there is great potential for micro-adjustment of the final layout plans. Even though the impact is already considered low it will still be possible to reduce direct impacts on other features of significance through layout adjustments, search & rescue and topsoil management. The potential impact on the regional status of the vegetation type and associated biodiversity features (e.g. corridor function or special habitats) will also be minimised through the above mitigations. Apart from the potential impact on protected species no further irreversible species-loss, habitat-loss, connectivity or associated impact can be foreseen from locating and operating the solar facility on the proposed site. With mitigation the impact on biodiversity features can be reduced but will stay **Low**.

The NO-GO option: The "No-Go Alternative" alternative will not result in significant gain in regional conservation targets, the conservation of rare & endangered species or gain in connectivity. At the best the No-Go alternative will only support the "status quo" on the site. On the other hand the pressure on Eskom facilities, most of which is currently still dependant on fossil fuel electricity generation, will remain. Solar power remains a much cleaner and more sustainable option for electricity production.

8. RECOMMENDATIONS

Having evaluated and discussed the various biodiversity aspects associated with the project it is clear that the most significant impacts are expected to be associated with the impacts on:

- protected plant species (taken into account that the watercourses and associated vegetation will be protected by default);

There is still potential to minimise potential impacts further, after which it should be unlikely that the proposed project will contribute significantly to any of the following:

- Significant loss of vegetation and associated habitat in terms of local or national conservation targets;
- Loss of ecological processes (e.g. migration patterns, pollinators, river function etc.) due to development and operational activities;
- Significant loss of local biodiversity and threatened plant species;
- Significant loss of ecosystem connectivity (e.g. corridor function).

Lastly it is felt that good environmental planning and control during construction, the appointment of a suitably qualified ECO and the implementation of an approved EMP, could significantly reduce environmental impact.

With the available information to the author's disposal it is recommended that project be approved since it is not associated with irreversible environmental impact, provided that mitigation is adequately addresses.

9. IMPACT MINIMIZATION

There are numerous possibilities for mitigation measures to lessen the direct impact during construction (and operational) phases, of which the overriding goal should be to clearly define the final layout which must aim at minimising the impact on protected tree species and minimising the disturbance footprint.

- All construction must be done in accordance with an approved construction and operational phase Environmental Management Plan (EMP), which must be developed by a suitably experienced Environmental Assessment Practitioner.
- A suitably qualified Environmental Control Officer must be appointed to monitor the construction phase in terms of the EMP and the Biodiversity study recommendations as well as any other conditions pertaining to other specialist studies and requirements of the DENC or DAFF.
- **Permits must be obtained in terms of the NFA, for the removal of any protected trees (if necessary)**. But final layout plans must aim at minimising the direct impact on all protected tree species (especially larger individuals).
- An **application must be made to DENC for a flora permit in terms of the NCNCA** with regards to search and rescue and other impacts on species protected in terms of Schedule 1 and 2 of the act.
- Before any work is done the footprint must be clearly demarcated. The demarcation must aim at minimum footprint and minimisation of disturbance.
- Topsoil (the top 15-20 cm) must be removed and protected and re-used for rehabilitation purposes of suitable areas on site or within the immediate surroundings (Seedbed protection).
- Before construction the footprint must be scanned by a botanist or suitably qualified ECO in order to identify the plants listed for Search & Rescue. The Botanist must advise on the best way for search & rescue and must also take the following into account:
    - These plants must be transplanted outside of the disturbance footprint, but within the same vegetation type (preferably the immediate surroundings of the site).
    - A watering program must be implemented for transplanted plants.
- Before construction the footprint must be approved by a botanist or suitably qualified ECO in order to ensure that impacts on protected plant species (especially protected tree species) are minimised.
- All efforts must be made to protect other large mature indigenous trees where possible.
- Lay-down areas or construction camp sites must be located within areas already disturbed or areas of low ecological value and must be pre-approved by the ECO.
- Indiscriminate clearing of any area outside of these footprints may not be allowed.
- All construction areas must be suitably rehabilitated on completion of the project.
    - This includes the removal of all excavated material, spoil and rocks, all construction related material and all waste material.
    - This must include re-using the protected as well as shaping the area to represent the original shape of the environment.

- An integrated waste management approach must be implemented during construction.
    - Construction related general and hazardous waste may only be disposed of at approved waste disposal sites.
    - Clean spoil from excavation work should be used as fill where possible.
    - All rubble and rubbish should be collected and removed from the site to a Municipal approved waste disposal site.

10. REFERENCES

Acocks, J.P.H. 1953. Veld types of South Africa. *Mem. Bot. Surv. .S. Afr.* No. 28: 1-192.

Alberts, R. & Moolman, J. 2013. Protecting ecosystems by way of biological control: Cursory reflection on the main regulatory instruments for biological control agents, present and future.

Anon, 2008. Guideline regarding the determination of bioregions and the preparation and publication of Bioregional Plans. April 2008. Government Notice No. 291 of 16 March 2009.

Bold, T. 2007. Management treatments summary guide for terrestrial alien and invasive plants. www.dwaf.gov.za/wfw.

De Villiers C.C., Driver, A., Brownlie, S., Clark, B., Day, E.G., Euston-Brown, D.I.W., Helme, N.A., Holmes, P.M., Job, N. & Rebelo, A.B. 2005. Fynbos Forum Ecosystem Guidelines for Environmental Assessment in the Western Cape. Fynbos Forum, c/o Botanical Society of South Africa: Conservation Unit, Kirstenbosch, Cape Town.

DEAT, 2002. Impact significance. Integrated Environmental Management, Information series 5. Department of Environmental Affairs and Tourism (DEAT). Pretoria.

Driver A., Sink, K.J., Nel, J.N., Holness, S., Van Niekerk, L., Daniels, F., Jonas, Z., Majiedt, P.A., Harris, L. & Maze, K. 2012. National Biodiversity Assessment 2011: An assessment of South Africa's biodiversity and ecosystems. Synthesis Report. South African National Biodiversity Institute and Department of Environmental Affairs, Pretoria

Driver, A., Maze, K., Rouget, M., Lombard, A.T., Nel, J.L., Turpie, J.K., Cowling, R.M., Desmet, P., Goodman, P., Harris, J., Jonas, Z., Reyers, B., Sink, K. & Strauss, T. 2005. National spatial biodiversity assessment 2004: priorities for biodiversity conservation in South Africa. Strelitzia, 17. South African National Biodiversity Institute, Pretoria.

Edwards, R. 2011. Environmental impact assessment method. Unpublished report for SiVest (Pty) Ltd. Environmental division. 9 May 2011.

Forsyth, G.G., FJ Kruger, F.J., & Le Maitre, D.C. 2010. National veldfire risk assessment: analysis of exposure of social, economic and environmental assets to veldfire hazards in South Africa. CSIR Report No: CSIR/NRE/ECO/ER/2010/0023/C. March 2010.

Le Roux, A. 2015. Wild flowers of Namaqualand. A botanical society guide. Fourth revised edition. Struik Nature. Cape Town.

Low, A.B. & Rebelo, A.(T.)G. (eds.) 1996. *Vegetation of South Africa, Lesotho and Swaziland*. Department of Environmental Affairs and Tourism, Pretoria.

Manning, J. 2008. Namaqualand Eco Guide. Briza Publications. Pretoria

Mucina, L. & Rutherford, M.C. (eds.) 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria.

Rutherford, M.C., Mucina, L., Lötter, M.C., Bredenkamp, G.J., Smit, J.H.L., Scott-Shaw, R., Hoare, D.B., Goodman, P.S., Bezuidenhout, H., Scott, L., Ellis, F., Powrie, L.W., Siebert, F., Mostert, T.H., Henning, B,J., Venter, C.E., Camp, K.G.T., Siebert, S.J., Matthews, W.S., Burrows, J.E., Dobson, L., Van Rooyen, N., Schmidt, E., Winter, P.J.D., Du Preez, P.J., Ward, R.A., Williamson, S. & Hurter, J.H. 2006. Savanna Biome. In Mucina, L. & Rutherford, M.C. 2006. (eds.) The Vegetation of South Africa. Lesotho & Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria. Pp. 221 – 299

Rouget, M., Reyers, B., Jonas, Z., Desmet, P., Driver, A., Maze, K., Egoh, B. & Cowling, R.M. 2004. South Africa National Spatial Biodiversity Assessment 2004: Technical report. Volume 1: Terrestrial Component. Pretoria: South African National Biodiversity Institute.

SANBI. 2015. Statistics: Red List of South African Plants version 2015.1. Downloaded from Redlist.sanbi.org on 2016/07/27.

Seymour, C. & Milton, S. 2003. A collation and overview of research information on Acacia erioloba (Camelthorn) and identification of relevant research gaps to inform protection of the species. Research report done for the Department of Water affairs and Forestry. 31 August 2003.

Van der Merwe, H., Van Rooyen, M.W. & Van Rooyen, N. 2008a. Vegetation of the Hantam-Tanqua-Roggeveld subregion, South Africa. Part 1: Fynbos Biome related vegetation. Koedoe Vol. 50(1): 61-76

Van der Merwe, H., Van Rooyen, M.W. & Van Rooyen, N. 2008b. Vegetation of the Hantam-Tanqua-Roggeveld subregion, South Africa. Part 2: Succulent Karoo Biome related vegetation. Koedoe Vol. 50(1): 160-183.

White, F. 1983. The vegetation of Africa: A descriptive memoir to accompany the Unesco/AETEAT/UNSO vegetation map of Africa. In Van Wyk, A.E., & Smith, G.F. 2001. Regions of floristic endemism in South Africa. A review with emphasis on succulents. Umdaus press. Hatfield

Van Wyk, A.E., & Smith, G.F. 2001. Regions of floristic endemism in South Africa. A review with emphasis on succulents. Umdaus press. Hatfield.

APPENDIX 1

Plant species checklist for Bushmanland Arid Grassland (SANBI: BGIS)

FAMILY NAME	GROWTH FORM	SPECIES NAME
FABACEAE	Small Trees	*Acacia mellifera subsp. detinens*
ACANTHACEAE	Herbs	*Acanthopsis hoffmannseggiana*
AIZOACEAE	Low Shrubs	*Aizoon asbestinum*
AIZOACEAE	Herbs	*Aizoon canariense*
AIZOACEAE	Low Shrubs	*Aizoon schellenbergii*
AMARANTHACEAE	Herbs	*Amaranthus praetermissus*
SCROPHULARIACEAE	Low Shrubs	*Aptosimum elongatum*
SCROPHULARIACEAE	Low Shrubs	*Aptosimum lineare*
SCROPHULARIACEAE	Low Shrubs	*Aptosimum marlothii*
SCROPHULARIACEAE	Low Shrubs	*Aptosimum spinescens*
POACEAE	Graminoids	*Aristida adscensionis*
POACEAE	Graminoids	*Aristida congesta*
ACANTHACEAE	Herbs	*Barleria lichtensteiniana*
ACANTHACEAE	Low Shrubs	*Barleria rigida*
ASTERACEAE	Low Shrubs	*Berkheya annectens*
ACANTHACEAE	Low Shrubs	*Blepharis mitrata*
CAPPARACEAE	Small Trees	*Boscia foetida subsp. foetida*
CAPPARACEAE	Tall Shrubs	*Cadaba aphylla*
POACEAE	Graminoids	*Cenchrus ciliaris*
EUPHORBIACEAE	Herbs	*Chamaesyce inaequilatera*
ASTERACEAE	Herbs	*Dicoma capensis*
MESEMBRYANTHEMACEAE	Succulent Shrubs	*Dinteranthus pole-evansii*
POACEAE	Graminoids	*Enneapogon desvauxii*
POACEAE	Graminoids	*Enneapogon scaber*
POACEAE	Graminoids	*Eragrostis annulata*
POACEAE	Graminoids	*Eragrostis nindensis*
POACEAE	Graminoids	*Eragrostis porosa*
POACEAE	Graminoids	*Eragrostis procumbens*
ASTERACEAE	Low Shrubs	*Eriocephalus ambiguus*
ASTERACEAE	Low Shrubs	*Eriocephalus spinescens*
GISEKIACEAE	Succulent Herbs	*Gisekia pharnacioides*
MALVACEAE	Low Shrubs	*Hermannia spinosa*
FABACEAE	Herbs	*Indigastrum argyraeum*
ASTERACEAE	Succulent Shrubs	*Kleinia longiflora*
APOCYNACEAE	Succulent Shrubs	*Larryleachia dinteri*
APOCYNACEAE	Succulent Shrubs	*Larryleachia marlothii*
MOLLUGINACEAE	Low Shrubs	*Limeum aethiopicum*
PHYTOLACCACEAE	Low Shrubs	*Lophiocarpus polystachyus*
FABACEAE	Herbs	*Lotononis oligocephala*
FABACEAE	Herbs	*Lotononis platycarpa*
SOLANACEAE	Succulent Shrubs	*Lycium bosciifolium*
SOLANACEAE	Tall Shrubs	*Lycium cinereum*
ACANTHACEAE	Low Shrubs	*Monechma incanum*
ACANTHACEAE	Low Shrubs	*Monechma spartioides*
IRIDACEAE	Geophytic Herb	*Moraea venenata*
SCROPHULARIACEAE	Herbs	*Nemesia maxii*
POACEAE	Graminoids	*Panicum lanipes*
FABACEAE	Tall Shrubs	*Parkinsonia africana*
ASTERACEAE	Low Shrubs	*Pentzia pinnatisecta*
ASTERACEAE	Low Shrubs	*Pentzia spinescens*
NYCTAGINACEAE	Low Shrubs	*Phaeoptilum spinosum*

FAMILY NAME	GROWTH FORM	SPECIES NAME
POLYGALACEAE	Low Shrubs	*Polygala seminuda*
MESEMBRYANTHEMACEAE	Succulent Herbs	*Psilocaulon coriarium*
ASTERACEAE	Low Shrubs	*Pteronia leucoclada*
ASTERACEAE	Low Shrubs	*Pteronia mucronata*
ASTERACEAE	Low Shrubs	*Pteronia sordida*
BIGNONIACEAE	Tall Shrubs	*Rhigozum trichotomum*
ASTERACEAE	Low Shrubs	*Rosenia humilis*
MESEMBRYANTHEMACEAE	Succulent Shrubs	*Ruschia kenhardtensis*
CHENOPODIACEAE	Succulent Shrubs	*Salsola glabrescens*
CHENOPODIACEAE	Succulent Shrubs	*Salsola tuberculata*
POACEAE	Graminoids	*Schmidtia kalahariensis*
ASTERACEAE	Low Shrubs	*Senecio niveus*
AMARANTHACEAE	Low Shrubs	*Sericocoma avolans*
PEDALIACEAE	Herbs	*Sesamum capense*
POACEAE	Graminoids	*Setaria verticillata*
SOLANACEAE	Low Shrubs	*Solanum capense*
POACEAE	Graminoids	*Sporobolus nervosus*
POACEAE	Graminoids	*Stipagrostis brevifolia*
POACEAE	Graminoids	*Stipagrostis ciliata*
POACEAE	Graminoids	*Stipagrostis obtusa*
POACEAE	Graminoids	*Stipagrostis uniplumis*
PORTULACACEAE	Low Shrubs	*Talinum arnotii*
AIZOACEAE	Low Shrubs	*Tetragonia arbuscula*
POACEAE	Graminoids	*Tragus berteronianus*
POACEAE	Graminoids	*Tragus racemosus*
AIZOACEAE	Succulent Herbs	*Trianthema parvifolia*
ZYGOPHYLLACEAE	Herbs	*Tribulus pterophorus*
ZYGOPHYLLACEAE	Herbs	*Tribulus terrestris*
APOCYNACEAE	Succulent Herb	*Tridentea dwequensis*
VAHLIACEAE	Herbs	*Vahlia capensis*
ZYGOPHYLLACEAE	Low Shrubs	*Zygophyllum microphyllum*

PB CONSULT

CURRICULUM VITAE	PEET JJ BOTES
Nationality	South African
Profession	Environmental Scientist
Specialization	Environmental Management Systems
	Botanical Assessments
	Environmental Compliance Auditing
	Environmental Impact Assessments
Position in Firm	Member
Language	Afrikaans (home)
	English (fluent)
Years Experience: With Organisation:	Since March 2011
In field of Speciality:	Since 1997

KEY QUALIFICATIONS

- Botanical Assessments
- Wastewater Management
- Environmental Management Systems (Planning, Development, Implementation and Review)
- Environmental Management plans (EMP)
- Environmental Control (ECO) during construction phase
- Environmental Compliance Auditing
- Environmental Impact Assessment and Review
- Environmental Advisory Services

EDUCATION AND PROFESSIONAL STATUS

- BSc (Botany & Zoology), Dept. of Natural Sciences, Stellenbosch University 1989
  Additional Subjects: Nature Conservation III & IV & Biochemistry II
- Hons. BSc (Plant Ecology), Stellenbosch University, 1989
  Additional Subjects: Soil Science & Statistical Methods

REGISTERED MEMBER: Registered Professional Environmental and Ecological Scientist at SACNASP (South African Council for Natural Scientific Professions) as required in terms of Section 18(1)(a) of the Natural Scientific Professions Act, 2003.

EMPLOYMENT RECORD

July 2010 – February 2011 till present	PB Consult, Western Cape
March 2005 – June 2010	Enviroscientific, Western Cape
November 1997 –February 2005	Denel OTB (Overberg Test Range), Western Cape

BRIEF RESUME OF RELEVANT EXPERIENCE:

- Act as environmental scientist, managing the environmental department of OTB (a division of Denel): developing and implementing an ISO14001 environmental management system, ensuring environmental legal compliance, performing environmental risk assessments with regards to missile tests performed on terrain, developed policy and management plans for natural veld- (26 000ha), alien plant-, game-, fire- and coastal management according to CapeNature principles;
- Evaluate Development proposals from an environmental perspective.
- Act as independent environmental consultant guiding and advising development proposals within legal constraints;
- Assess the potential impacts of proposed activities to allow for effective management and/or mitigation of negative impacts;
- Develop ISO 14001 environmental management systems for proposed developments;
- Ensure the implementation of good management principles by developing environmental management plans (EMP), both for the construction and operational phases of developments and offering environmental control officer (ECO) services;
- Facilitate DWA license application, especially with regards to winery wastewater and sewerage treatment systems;
- Facilitate and coordinate the Environmental Impact Assessment (EIA) process;
- Perform botanical assessments with regards to development proposals;
- Developing the biodiversity and legal insets for and environmental audit system with regards to the Woolworths Farming for the Future project.
- Performed more than 400 environmental audits with regards to biodiversity management and legal compliance within the agricultural sector;
- Ensure compliance to ROD by performing independent environmental compliance audits on completed development projects.

PROJECT EXPERIENCE:

- Environmental Control Officer for numerous projects e.g.: Frandevco Estate in Franschhoek; Crystal Creek in Somerset West; Various Ervin in Gordon's Bay; Mount Royal Estate, Malmesbury; Old Mill Estate, Worcester; Alleé Blue winery in Franschhoek; Arabella winery in Ashton; De Aria winery in Durbanville; Worcester WWTW; Sunny Side Reservoir and Low cost housing in De Doorns; Arniston WWTW; etc.;
- ISO 14001 Environmental Management Systems e.g: Frandevco Estate, Franshhoek; Mount Royal Estate, Malmesburg; Lourensford, Somerset West, etc.;
- Environmental Management Plans e.g.: Calamatha Estate in Somerset West; Paternoster WWTW; GrainCo Silo Bag Depots; Cathbert development, Paarl; Stuisbaai WWTW;
- Full Biodiversity Management Plans e.g.: Loevenstein & Morelig Farms in Paarl; Bosman Farming in Wellington, Graymead Melsetter Farms in Grabouw; Graaf Fruit in Prince Alfred Hamlet; Kroonpoort Farm in Napier; UVA Farms in Wellington, etc.;
- Botanical assessments e.g.: Betty's Bay urban development; Gansbaai Municipality; Seven Falls Heidelberg; Crystal Creek; Somerset West; Schaapkraal Erf in Cape Town; Kleindrif River Lodges, Wemmershoek Voortrekker Camp Site Upgrade, etc.;
- DWA Wastewater General Authorization or License applications (more than 80 wineries as well as Sewerage Treatment Systems)
- Environmental compliance audits e.g.: Vioolsdrif Border Post Development; Bitterfontein Pipeline; Kennard Pipeline, etc.;
- Development planning and EIA process e.g.: Zuiderkruis Farm in the Hemel and Aarde Valley; Struisbaai WWTW; Groenrivier development in Worcester; etc.;
- Biodiversity & environmental legislation audits (performed more than 400 Woolworths Farming for the Future audits in the agricultural sector)

Appendix D2: Biodiversity Assessment and Botanical Scan (Original report)

KAKAMAS

KEREN ENERGY HOLDINGS

BIODIVERSITY ASSESSMENT & BOTANICAL SCAN

A preliminary Biodiversity Assessment (with botanical input) taking into consideration the findings of the National Spatial Biodiversity Assessment of South Africa.

March 13, 2012

PREPARED BY: PB Consult

PREPARED FOR: ENVIROAFRICA CC

REQUESTED BY: KEREN ENERGY HOLDINGS (Pty) Ltd

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SUMMARY - MAIN CONCLUSIONS

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MAIN VEGETATION TYPES	**Bushmanland Arid Grassland** Described as an open, shrubby thornveld characterized by a dense shrub layer, often lacking a tree layer, with a sparse grass layer. **Least Threatened** But only 4% formally protected (Augrabies Falls National Park)
LAND USE AND COVER	The study area is situated on an Erf within the urban edge of Kakamas, but with little development or agricultural practices (apart from small Municipal works). Natural vegetation forms a sparse cover over the entire area of the study area. The Kakamas waste disposal site as well as sewerage works are located on the same property. Various non-perennial watercourses or drainage lines criss-cross the larger property.
RED DATA PLANT SPECIES	None encountered or expected Protected Trees: Two individuals of the tree *Boscia albitrunca* (Witgat) are located within the boundaries of the final proposed site location (associated with the dry watercourses or drainage lines).
IMPACT ASSESSMENT	Development without mitigation: Sig. rating = 31% Development with mitigation Significance = 5% Where values of ≤15% indicate an insignificant environmental impact and values >15% constitute ever increasing environmental impact.

RECOMMENDATION

From the information available and the site visit, it is clear that the Kakamas final location was fairly well chosen from a biodiversity viewpoint. No irreversible species loss, habitat loss, connectivity or associated impact (apart from a potential impact on a small portion of the dry watercourses) can be foreseen from locating and operating the solar facility on the final proposed solar site. However, there is a significant difference between development without and development with mitigation. As a result it is recommended that all mitigating measures must be implemented in order to further minimise the impact of the construction and operation of the facility.

Although solar energy is presently not seen as a viable stand-alone technology for electricity production it will lighten the pressure on the fossil burning facilities of Eskom and in so doing will add to a more sustainable way of electricity production.

With the available information to the author's disposal it is recommended that the project be approved, but that all mitigation measures described in this document is implemented.

CONTENTS

INTRODUCTION

Renewable energy takes many forms, including biomass, geothermal, hydropower, wind and solar. Of these, solar may be the most promising: it can be used to generate electricity or to heat water, has little visual impact, and scales well from residential to industrial levels. Solar is the fastest growing energy source in the world. It offers a limitless supply of clean, safe, renewable energy for heat and power. And it's becoming ever more affordable, more efficient, and more reliable.

According to various experts (www.thesolarfuture.co.za), building solar plants is in many ways more financially viable and sustainable than erecting coal fired power stations. When a coal power plant has reached its life span, usually after 40 years depending on the technology, it must be demolished and rebuild (at a huge price tag). When panels of a solar plant reach their lifespan, you only need to replace the panels. Replacing panels is becoming cheaper and better in what they do as the technology is continuously improving. South Africa has abundant coal reserves, but its reserves of solar power are even greater, and unlike coal, solar power is inflation-proof and doesn't lead to large scale destruction of landscapes or the pollution of precious water. In addition South Africa is the world's best solar energy location after the Sahara and Australia.

The advantages of Solar and other renewable power sources are clear: greater independence from imported fossil fuels, a cleaner environment, diversity of power sources, relief from the volatility of energy prices, more jobs and greater domestic economic development. All over the world, solar energy systems have reduced the need to build more carbon-spewing fossil-fuelled power plants. They are critical weapons in the battle against global warming. As the cost of solar technologies has come down, solar is moving into the mainstream and growing worldwide at 40-50% annually (www.wikepedia.org).

In 2011, the International Energy Agency said that "the development of affordable, inexhaustible and clean solar energy technologies will have huge longer-term benefits. It will increase countries' energy security through reliance on an indigenous, inexhaustible and mostly import-independent resource, enhance sustainability, reduce pollution, lower the costs of mitigating climate change, and keep fossil fuel prices lower than otherwise. These advantages are global.

Keren Energy Holdings is proposing the establishment of a 10 MW concentrated photovoltaic solar energy facility next to the town of Kakamas (Northern Cape Province, Kai !Garib Local Municipality). The facility will be established on an area of approximately 20 ha, on a portion of Erf 1654 (Kakamas), located adjacent and south-west of Kakamas. The purpose of the proposed facility is to sell electricity to Eskom as part of the Renewable Energy Independent Power Producers Procurement Programme. This programme has been introduced by the Department of Energy to promote the development of renewable power generation facilities.

TERMS OF REFERENCE

EnviroAfrica (Pty) Ltd was appointed by Keren Energy Holdings as the independent Environmental Assessment Practitioner (EAP) to undertake the Scoping/Environmental Impact Assessment (EIA) Process for the proposed development. PB Consult was appointed by EnviroAfrica to conduct a Biodiversity Assessment of the proposed development area.

PB Consult was appointed within the following terms of reference:

- Evaluate the general location of the proposed site and make recommendations on a specific location for the 20
- The study must consider short- to long-term implications of impacts on biodiversity and highlight irreversible impacts or irreplaceable loss of species.

INDEPENDENCE & CONDITIONS

PB Consult is an independent consultant to Keren Energy Holdings and has no interest in the activity other than fair remuneration for services rendered. Remunerations for services are not linked to approval by decision making authorities and PB Consult have no interest in secondary or downstream development as a result of the authorization of this proposed project. There are no circumstances that compromise the objectivity of this report. The findings, results, observations and recommendations given in this report are based on the author's best scientific and professional knowledge and available information. PB Consult reserve the right to modify aspects of this report, including the recommendations if new information become available which may have a significant impact on the findings of this report.

DEFINITIONS & ABBREVIATIONS

DEFINITIONS

Environmental Aspect: Any element of any activity, product or services that can interact with the environment.

Environmental Impact: Any change to the environment, whether adverse or beneficial, wholly or partially resulting from any activity, product or services.

No-Go Area(s): Means an area of such (environmental/aesthetical) importance that no person or activity is allowed within a designated boundary surrounding this area.

ABBREVIATIONS

BGIS	Biodiversity Geographical Information System
DEA	Department of Environmental Affairs
DENC	Department of Environment and Nature Conservation (Northern Cape Province)
EAP	Environmental assessment practitioner
EIA	Environmental impact assessment
EMP	Environmental management plan

NEMA	National Environmental Management Act, Act 107 of 1998
NEM: BA	National Environmental Management Biodiversity Act, Act 10 of 2004
NSBA	National Spatial Biodiversity Assessment
SANBI	South African National Biodiversity Institute
SKEP	Succulent Karoo Ecosystem Project
WWTW	Wastewater Treatment Works

REFERENCES

Acocks, J.P.H. 1953. Veld types of South Africa. *Mem. Bot. Surv. .S. Afr.* No. 28: 1-192.

De Villiers C.C., Driver, A., Brownlie, S., Clark, B., Day, E.G., Euston-Brown, D.I.W., Helme, N.A., Holmes, P.M., Job, N. & Rebelo, A.B. 2005. Fynbos Forum Ecosystem Guidelines for Environmental Assessment in the Western Cape. Fynbos Forum, c/o Botanical Society of South Africa: Conservation Unit, Kirstenbosch, Cape Town.

Government Notice No 1002, 9 December 2011. National list of Ecosystems that are threatened and in need of protections. in terms of section 52(1)(a) of the National Environmental Management Biodiversity Act, 2004 (Act 10 of 2004).

Low, A.B. & Rebelo, A.(T.)G. (eds) 1996. *Vegetation of South Africa, Lesotho and Swaziland.* Dept of Environmental Affairs and Tourism, Pretoria.

Mucina, L. & Rutherford, M.C. (eds.) 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria.

SANBI. 2006. South African National Botanical Institute: Biodiversity GIS Home. http://bgis.sanbi.org (as updated)

SANBI, 2007. South African National Botanical Institute: Red Data Lists. Interim Red Data List of South African Plant Taxa. October 2007.

PROJECT DESCRIBTION

Keren Energy Holdings is proposing the establishment of a 10 MW concentrated photovoltaic solar energy facility near the town of Kakamas (Northern Cape Province, Kai !Garib Local Municipality). The facility will be established on a 20 ha portion of Erf 1654 (Kakamas), adjacent and south-west of Kakamas.

The proposed facility will utilise Concentrated Photovoltaic (CPV) technology, which aims to concentrate the light from the sun, using Fresnel lenses, onto individual PV cells. This method increases the efficiency of the PV panels as compared to conventional PV technology. An inverter is then used to convert the direct current electricity produced into alternating current for connection into the Eskom grid. A single solar generator produces approximately 66kV. In order to produce 10 MW, the proposed facility will require a number of generators arranged in multiples/arrays. The CPV panels will be elevated (2 m above ground) by a support structure, and will be able to track the path of the sun during the day for maximum efficiency. Approximately 1.8 ha is required per installed MW. A 10 MW capacity facility will thus require a development footprint of approximately 20 ha (including associated infrastructure – ancillary infrastructure). Each panel will be approximately 22 m wide by 12.5 m high. When the panels are tracking vertically the structure will have a maximum height of approximately 15 m.

The site can be accessed from the N14 or from Hofmeyer road (within Kakamas), using existing secondary roads. However, additional temporary access roads will have to be established on site. Site preparation will include clearance of vegetation at the footprint of the following infrastructure:

- Support structures (approximately 148 units are proposed) (excavations of 1 m^2 by 5 m deep)
- Switchgear
- Inverters
- Workshops
- Trenches for the underground cabling

The activities may require the stripping of topsoil, which will need to be stockpiled, backfilled and/or spread on site. All in all, the proposed facility can be likened to light agriculture, with the exception that natural vegetation will be allowed to remain on all the non-disturbed areas. All surfaces not used for the facility and associated infrastructure will remain natural.

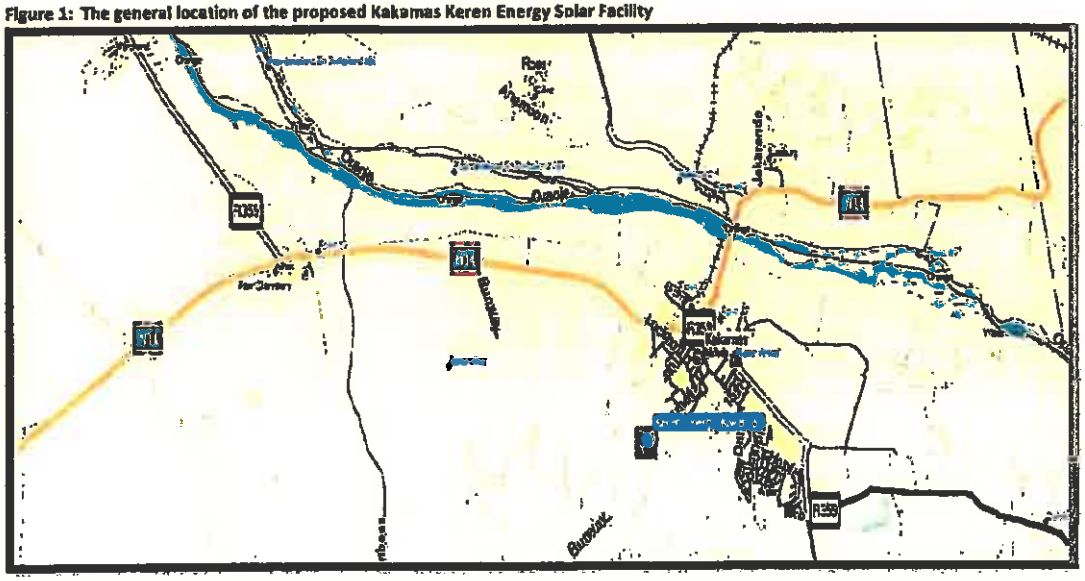
DESCRIPTION OF ENVIRONMENT

The aim of this description is to put the study area in perspective with regards to all probable significant biodiversity features which might be encountered within the study area. The study area has been taken as the proposed site and its immediate surroundings. During the desktop study any significant biodiversity features associated with the larger surroundings was identified, and were taken into account. The desktop portion of the study also informs as to the biodiversity status of such features as classified in the National Spatial Biodiversity Assessment (2004) as well as in the recent National list of ecosystems that are threatened and in need of protection (GN 1002, December 2011), promulgated in terms of the National Environmental Management Biodiversity Act (NEM: BA), Act 10 of 2004.

LOCATION & LAYOUT

Kakamas is located in the Northern Cape Province (Kai !Garib Local Municipality), just north of the N14 approximately 40 km west of Upington (Refer to Figure). The solar facility is proposed to be located approximately 2 km north-east of Kakamas (just east of the Kakamas Golf course) on a 20 ha potion of the Remainder of Farm 666 (refer to Figure 1).

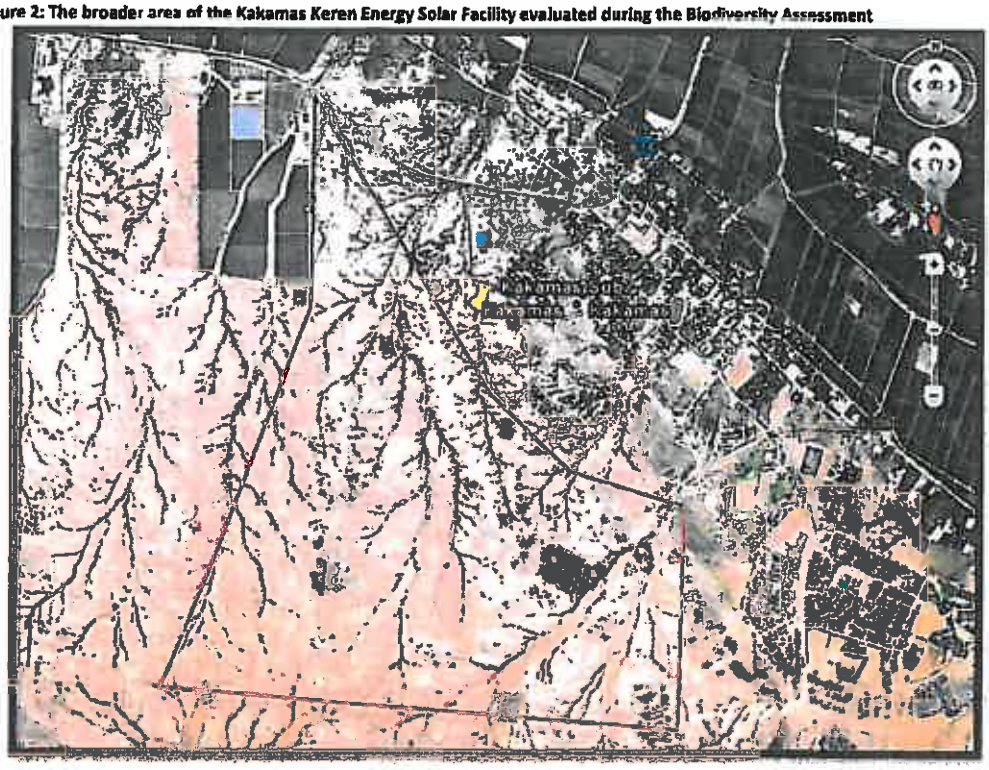
Figure 1: The general location of the proposed Kakamas Keren Energy Solar Facility



During the biodiversity assessment the following general location for the proposed site was evaluated (Refer to Figure 2).

Please note that this area is much larger than 20 ha and the purpose of the biodiversity assessment was to evaluate the larger site and then to choose a suitable area (within this larger site) on which the solar facility can be located, which will minimise significant biodiversity features.

Figure 2: The broader area of the Kakamas Keren Energy Solar Facility evaluated during the Biodiversity Assessment



Biodiversity and other specialist inputs after the physical biodiversity assessment site visit was used to decide on the final proposed location for the solar facility (Refer to Figure 3).

Figure 3: Final proposed site location (approximately 20 ha)

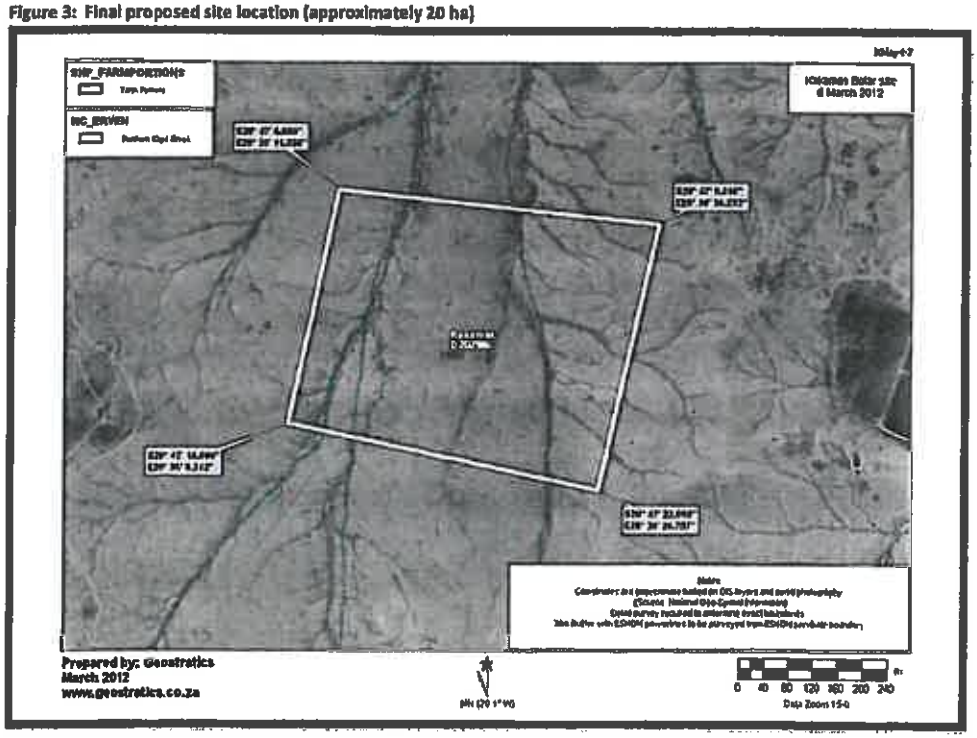


Table 1: GPS coordinates describing the boundaries of the proposed final solar site location (WGS 84 format)

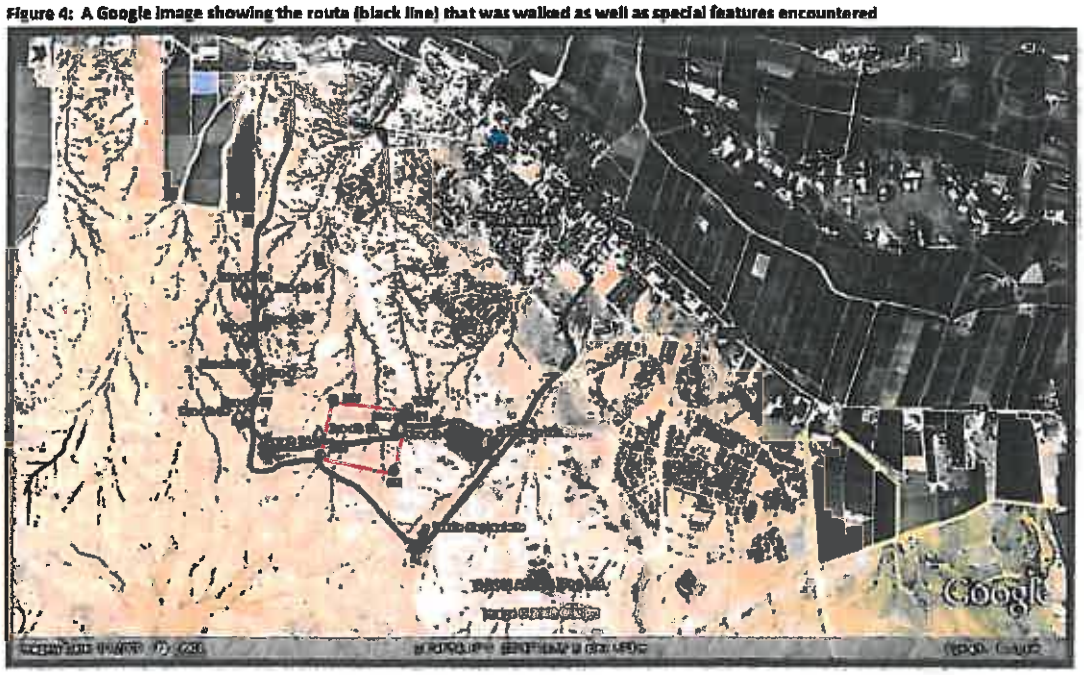
DESCRIPTION	LATITUDE AND LONGITUDE	ALTITUDE
North-west corner	S28 47 06.6 E20 36 11.3	681 m
North-east corner	S28 47 08.4 E20 36 30.2	691 m
South-east corner	S28 47 22.1 E20 36 26.7	694 m
South-west corner	S28 47 18.7 E20 36 08.2	693 m

METHODS

Various desktop studies were conducted, coupled by a physical site visit conducted in November 2011 and further desktop studies. The timing of the site visit was reasonable in that essentially all perennial plants were identifiable and although the possibility remains that a few species may have been missed, the author is confident that a fairly good understanding of the biodiversity status in the area was obtained.

The survey was conducted by walking through the site (Refer to Figure 4) and examining, marking and photographing any area of interest. Confidence in the findings is high. During the site visit the author endeavoured to identify and locate all significant biodiversity features, including rivers, streams or wetlands, special plant species and or specific soil conditions which might indicate special botanical features (e.g. rocky outcrops or silcrete patches).

Figure 4: A Google image showing the route (black line) that was walked as well as special features encountered

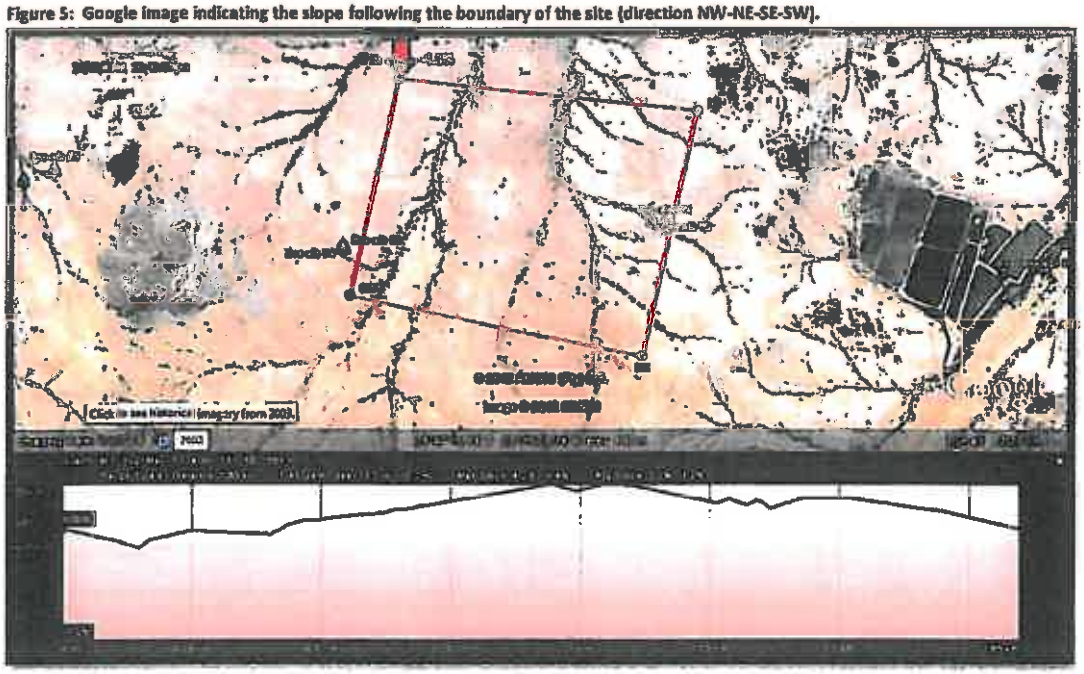


The site visit was also used to inform the client and EAP of potential conflicting areas (e.g. rivers/streams and plant species) in the larger site. This information together with engineering reasoning and other specialist studies was used to tweak the final proposed location indicated by the red block in Figure 4, above.

TOPOGRAPHY

The proposed final site is located on a relative flat, slightly undulating natural area. The elevation data given in Table 1 as well as in Figure 1 indicates an average slope of only 1.1%. It also shows that the site slopes slightly from the highest point (the south-east corner) to the north-west (the lowest corner) in the direction of the Orange River. Watercourses and drainage lines all drains roughly towards the north-west in the direction of the Orange River. However, the natural drainage lines does reach the Orange River directly (as it would originally have done), but is dispersed into a system of formal drainage channels once it reach the intensively cultivated (vines) area next to the Orange River.

Figure 5: Google image indicating the slope following the boundary of the site (direction NW-NE-SE-SW).



CLIMATE

All regions with a rainfall of less than 400 mm per year are regarded as arid. This area normally receives about 106 mm of rain per year (the climate is therefore regarded as arid to very arid). Kakamas normally receives about 62mm of rain per year, with most of its rainfall occurring during autumn. It receives the lowest rainfall (0 mm) in June and the highest (19 mm) in March. The monthly distribution of average daily maximum temperatures shows that the average midday temperatures for Kakamas range from 20°C in July to 33°C in January. The region is the coldest during July when the mercury drops to 3.1°C on average during the night (www.saexplorer.co.za).

The graphs underneath indicate the average climate data for Kuruman (giving an average for the Northern Cape region) (Figure 6 to Figure 9).

Figure 6: Kuruman average minimum and maximum temperatures (www.weather-and-climate.com)

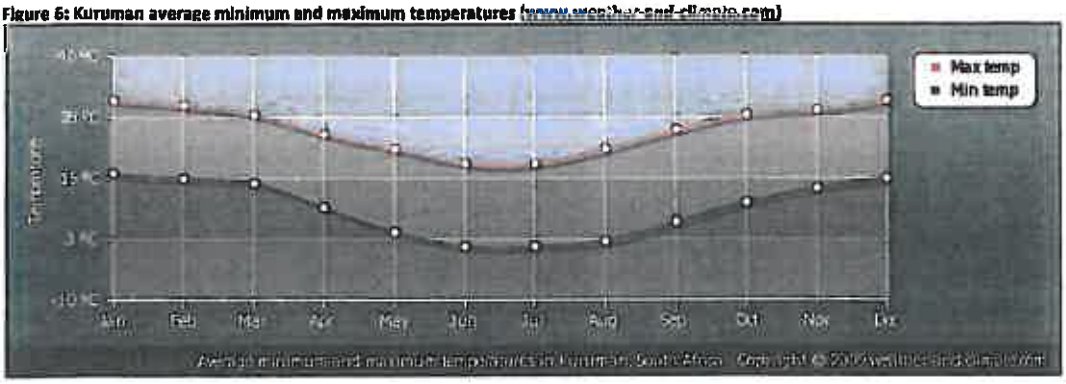


Figure 7: Kuruman average monthly precipitation over the year (www.weather-and-climate.com)

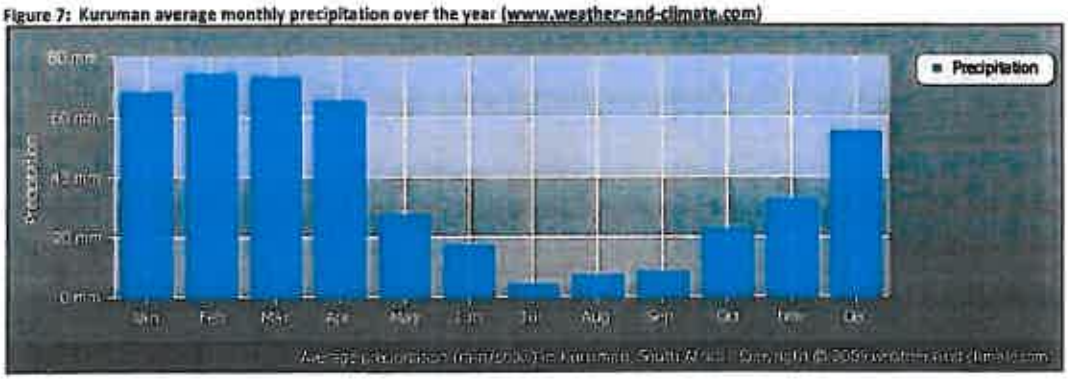
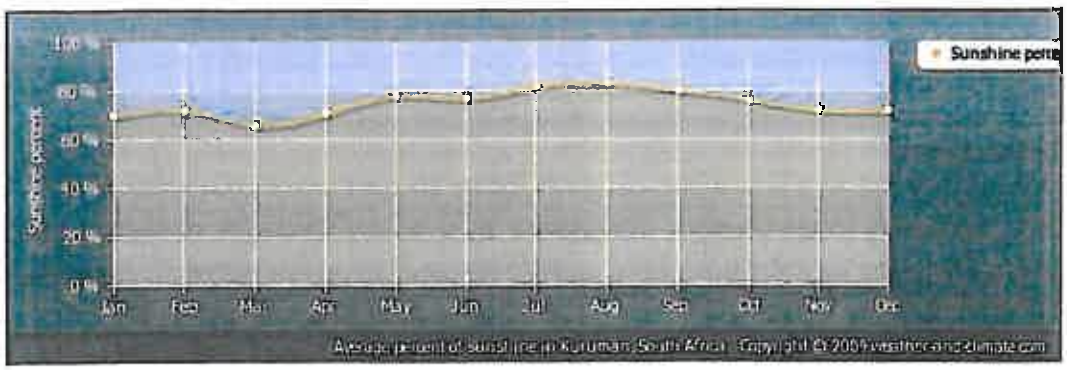


Figure 8: Kuruman average monthly hours of sunshine over the year (www.weather-and-climate.com)

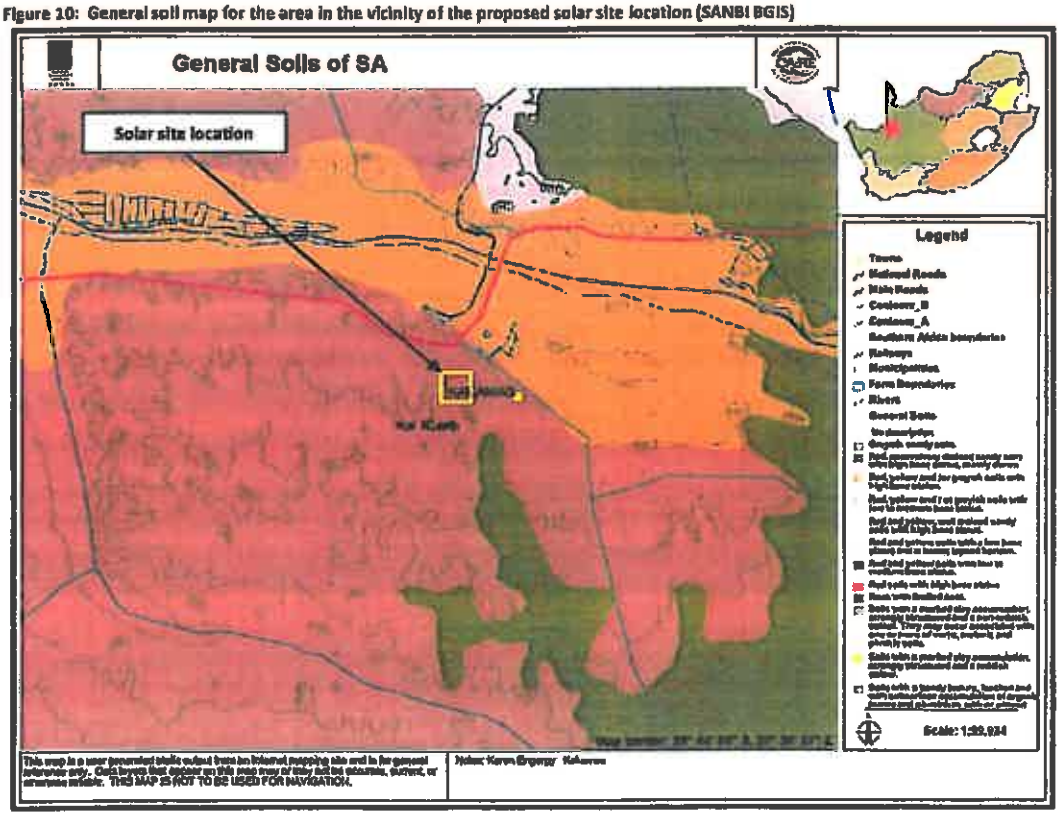
Figure 9: Kuruman average percent of sunshine over the year (mean % of sun hours during the day) (www.weather-and-climate.com)



GEOLOGY & SOILS

Geology is dominated by mudstones and shales of the Ecca Group (Prince Albert and Volksrust Formations) and Dwyka tillites, both of the early Karoo age. About 20% of rock outcrops are formed by Jurassic intrusive dolerite sheets and dykes. Soils (Refer to Figure 10) are described as soils with minimal development, usually shallow on hard or weathering rock, Glenrosa and Mispah forms, with lime generally present in the entire landscape (Fc land type) and, to a lesser extent, red-yellow apedal, freely drained soils with a high base status and usually <15% clay (Ah and Ai land types) are also found. The salt content in these soils is very high (Mucina & Rutherford, 2006).

Figure 10: General soil map for the area in the vicinity of the proposed solar site location (SANBI BGIS)



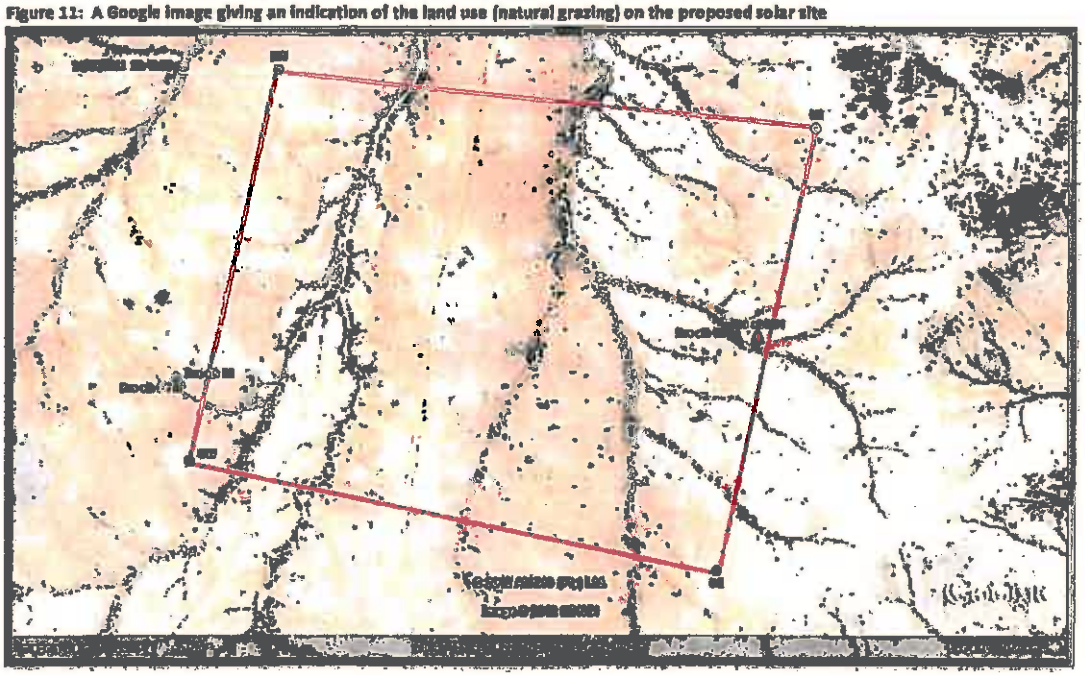
Please note that small areas littered with surface quartz stones have been observed, but they were not extensive and are not regarded as Quartz patches. Quartz patches are usually associated with arid or semi-arid habitats, characterised by concentrations of quartz stones on the surface an in the upper soil layers. Often these patches are cooler than surrounding vegetation and generally dominated by succulent "stone-plants", many of which are endemic. In the study area the quartz stones were found on the surface only and the concentration not such that it dominated any one patch, in fact the scale subsoil mostly still dominated the characteristics of the vegetation. The vegetation did not differ markedly from the surrounding areas and no succulent "stone-plants" were observed. These areas were thus not considered true quartz patches or special habitats of significance.

LANDUSE AND COVER

The study area is situated on Erf 1654, within the urban edge of the town of Kakamas. At present it is used for natural and/or communal grazing and for small Municipal works (the Municipal waste disposal site as well as the Sewerage works is also located on this Erf). To the north of the property, the Municipal Traffic Department test terrain is found, while low cost housing used to be located in this vicinity as well (being removed at present).

The final proposed location for the solar facility is located on a 20 ha portion of Erf 1654, just west of the sewerage works and north-west of the waste disposal site. This portion of the Erf is only used for natural or communal grazing (Refer to Figure 11). Natural vegetation forms a sparse cover over the entire remainder of the Erf. Please note that a number of watercourses and drainage lines criss-cross the Erf (which include the portion of the Erf chosen for the location of the solar site). Unfortunately, due to the distribution of these watercourses and drainage lines it would be impossible to locate a single 20 ha block within the larger Erf without encountering any such watercourse. As a result the final location was chosen to minimise the impact on the major water courses and to con-inside with the flattest terrain.

Figure 11: A Google image giving an indication of the land use (natural grazing) on the proposed solar site

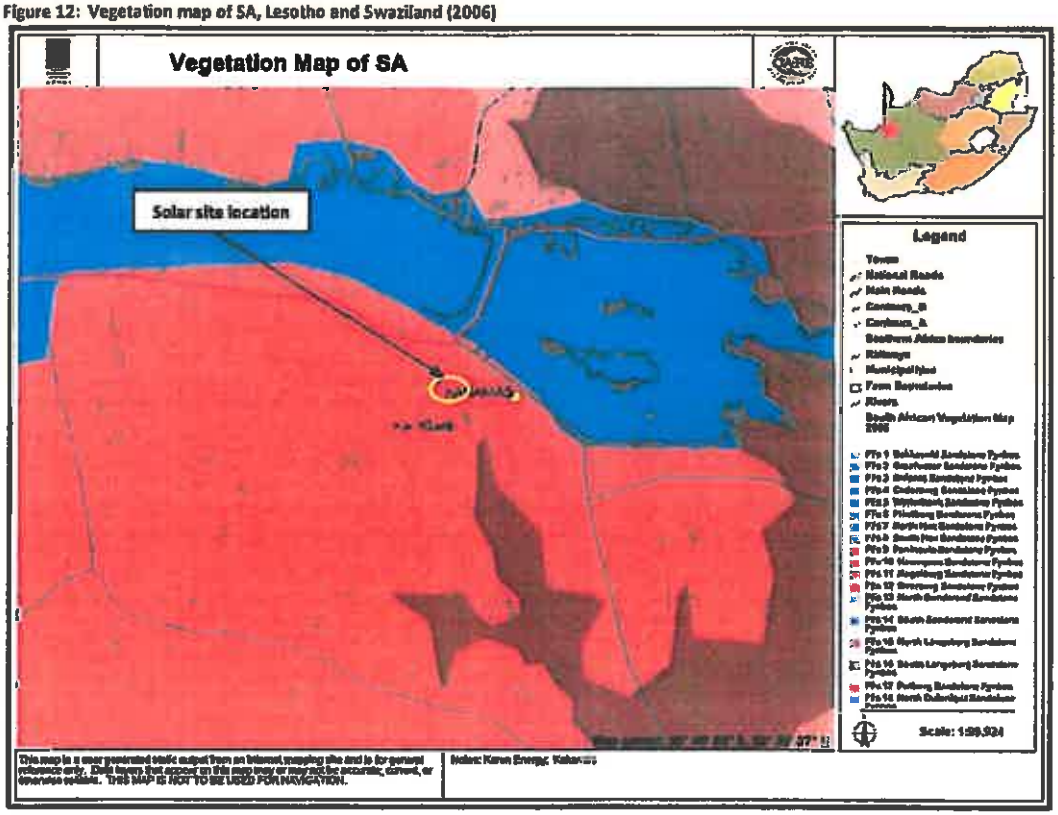


VEGETATION TYPES

In accordance with the 2006 Vegetation map of South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2006) only one broad vegetation type is expected in the proposed area and its immediate vicinity, namely Bushmanland Arid Grassland (Light red in Figure 12). This vegetation type was classified as "Least Threatened"

during the 2004 National Spatial Biodiversity Assessment (NSBA). More than 99% of this vegetation still remains in its natural state, but at present only 4% is formally protected (Augrabies Falls National Park) throughout South Africa. Recently the *National list of ecosystems that are threatened and in need of protection* (GN 1002, December 2011), was promulgated in terms of the National Environmental Management Biodiversity Act (NEM: BA), Act 10 of 2004. According to this National list, **Bushmanland Arid Grassland, remains classified as Least Threatened**.

Figure 12: Vegetation map of SA, Lesotho and Swaziland (2006)



Bushmanland Arid Grassland is found in the Northern Cape Province spanning about one degree of latitude from around Aggeneys in the west to Prieska in the east. The southern border of the unit is formed by edges of the Bushmanland Basin while in the north-west this vegetation unit borders on desert vegetation (north-west of Aggeneys and Pofadder).

The northern border (in the vicinity of Upington) and the eastern border (between Upington and Prieska) are formed with often intermingling units of Lower Gariep Broken Veld, Kalahari Karroid Shrubland and Gordonia Duneveld. Most of the western border is formed by the edge of the Namaqualand hills. Altitude varies from 600 – 1 200 m (Mucina & Rutherford, 2006).

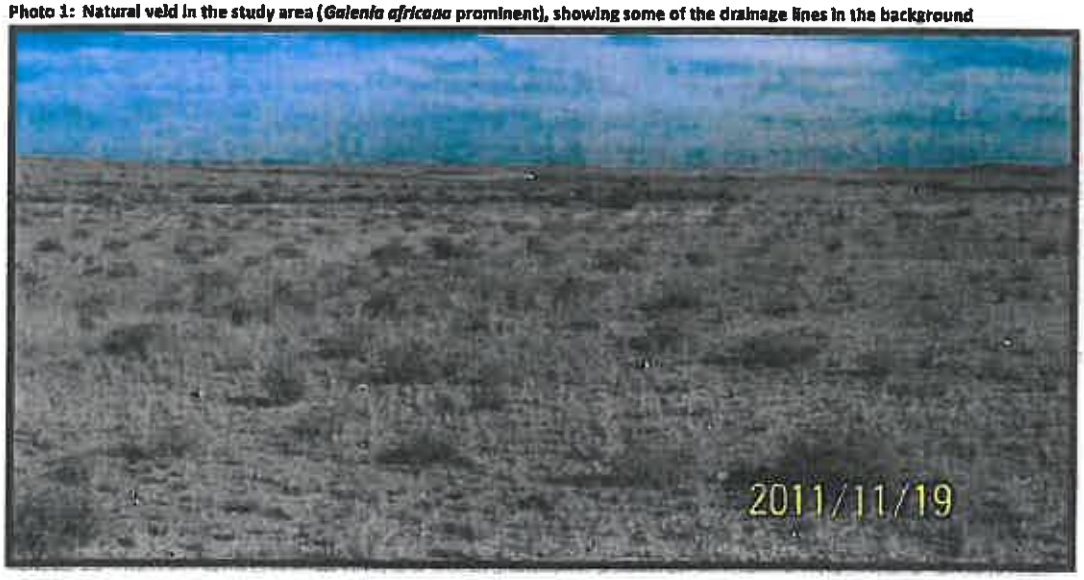
BUSHMANLAND ARID GRASSLAND

Bushmanland Arid Grassland is described as extensive to irregular plains on a slightly sloping plateau sparsely vegetated by grassland dominated by white grasses (*Stipagrostis* species) giving this vegetation type the character of semi-desert "steppe". Sometimes low shrubs of *Salsola* change the vegetation structure. In years of abundant rainfall rich displays of annual herbs can be expected (Mucina & Rutherford, 2006). Acocks (1953) described this vegetation as Arid Karoo and Desert False Grassland or Orange River Broken Veld while Low & Rebelo (1996) described this vegetation as Orange River Nama Karoo.

According to Mucina & Rutherford (2006) important taxa includes the following:

Graminoides: *Aristida adscensionis, A. congesta, Enneapogon desvouxii, Eragrostis nindensis, Schimdtia kalahariensis, Stipagrostis ciliate, S. Obtuse, Cenchrus ciliaris, Enneapogon scaber, Eragrostis annulata, E. porosa, E. procumbens, Panicum lanipes, Setaria verticillata, Sporobolus nervosus, Stipagrostis brevifolia, S uniplumis, Tragus berteronianus and T racemosus.*

Photo 1: Natural veld in the study area (*Galenia africana* prominent), showing some of the drainage lines in the background



Small trees: *Acacia mellifera, Boscia foetida* subsp. *foetida*

Tall shrubs: *Lycium cinereum, Rhigozum trichotomum, Aptosimum spinescens, Hermannia spinosa, Pentzia spinescens, Aizoon asbestinum, Aizoon schellenbergii, Aptosimum elongatum, Aptosimum lineare, A marlothii, Barleria rigida, Berkheya annectens, Eriocephalus ambiguous, Eriocephalus spinescens, Limeum aethiopicum, Polygala seminuda, Pteronia leucoclada, Tetragonia arbuscula, Zygophyllum microphyllum*

Succulent Shrubs: *Kleinia longiflora, Lycium bosciifolium, Salsola tuberculata, S gabrescens.*

Herbs: *Acanthopsis hoffmannseggiana, Aizoon canariense, Amaranthus praetermissus, Dicoma capensis Lotononis platycarpa, Sesamum capense, Tribulus pterophorus* etc.

VEGETATION ENCOUNTERED

The sparse vegetation encountered conforms to that of Bushmanland Arid Grassland. The dominant vegetation is a grassy, dwarf shrubland. Grasses tend to be more common in depressions and on sandy soils, and less abundant on clayey soils. Most of the larger study area was sparsely but fairly uniformly covered by the same vegetation composition and was mostly associated with shallow soils/rocky shales soils. The non-perennial watercourses and drainage lines were mostly associated with slightly deeper soils with slightly denser riparian vegetation (Refer Error! Reference source not found.to Photo 3). Permanent drainage from the sewerage works into some of these water courses has led to significantly denser riparian vegetation in these areas (e.g. south-east of the works).

The shallow soils (covering most of the proposed final location as well as the larger terrain) supports a very sparsely covered grassy/shrub bottom layer with shrub small tree top layer sometimes present (Refer to Photo 2).

Photo 2: An overview of the vegetation on the proposed solar site location (*Euphorbia* sp and *Galenia africana* visible)

The grassy layer includes *Stipagrostis* species, *Aristida* species, *Eragrostis* species, *Schimdtia* species and *Eragrostis* species amongst other. Shrubs included amongst other: *Aloe* species, *Aptosimum spinescens, Delosperma sp., Eriocephalus* species, *Euphorbia* cf. *mauritanica, Euphorbia spinea, Galenia africana, Lycium cinereum, Rhigozum trichotomum and Zygophyllum* cf. *microphyllum*. Small trees (mostly, associated with the riparian vegetation along dry drainage lines) included: *Acacia mellifera, Boscia foetida, Boscia albitrunca, Parkinsonia africana* and *Ziziphus mucronata*.

The upper drainage lines were typically associated with slightly denser vegetation than found in the immediate surroundings, with a much more prominent small tree cover (Refer to Photo 3).

Photo 3: Typical vegetation associated with the upper drainage lines (*Acacia mellifera* prominent)

The tree layer included, *Acacia mellifera* (Swarthaak), *Boscia albitrunca* (Witgat), *Boscia foetida*, *Gymnosporia heterophylla*, *Parkinsonia africana*, *Rhus lancea* and *Ziziphus mucronata* (Blinkblaar wag-'n-bietjie).

Next to the sewerage works a watercourse with much denser riparian vegetation was encountered (Refer to Photo 4). The reason for this much denser vegetation most probably is associated with the fact that overflow from the sewerage works results in almost permanent water run-off encountered in this area. The riparian vegetation becomes much denser (and the trees significantly larger) and includes the following species: *Acacia mellifera* (dominant), *Gymnosporia heterophylla*, *Lycium cinereum*, *Parkinsonia africana*, *Prosopis* sp., *Rhus lancea* and *Ziziphus mucronata* with mistletoe *Moquinella rubra* sometimes present in some of the trees or shrubs.

Photo 4: Dense riparian vegetation encountered next to the sewerage works

ENDEMIC OR PROTECTED PLANT SPECIES

Endemic taxa which might be encountered include: *Dinteranthus pole-evansii, Larryleachia dinteri, L mariothii, Ruschia kenhardtensis, Lotononis oligocephala* and *Nemesia maxi*. None of these species was encountered.

However, the following protected tree species in terms of the National Forest Act of 1998 (Act 84 of 1998) have a geographical distribution that may overlap with the broader study area (Refer to Table 2).

Table 2: Protected tree species with a geographical distribution that may overlap the broader study area

SPECIES NAME	COMMON NAME	TREE NO.	DISTRIBUTION
Acacia erioloba	Camel Thorn Kameeldoring	168	In dry woodlands next to water courses, in arid areas with underground water and on deep Kalahari sand
Acacia haematoxylon	Grey Camel Thorn Vaalkameeldoring	169	In bushveld, usually on deep Kalahari sand between dunes or along dry watercourses.
Boscia albitrunca	Shepherds-tree Witgat/Matopie	130	Occurs in semi-desert and bushveld, often on termitaria, but is common on sandy to loamy soils and calcrete soils.

During the site visit, a number of *Boscia albitrunca* trees were encountered in the larger area of Erf 1654. All of these trees encountered were marked with GPS coordinates (Refer to Table 3) and plotted on a map (Refer to Figure 4). It was also very clear that the location of these trees almost always co-insides with the location of a watercourse or drainage lines. In other words, they were almost always only encountered next to a watercourse or drainage line. Please note, that by locating the solar pylons away from the major watercourses, the impact on any of these trees can be negated.

Table 3: A list of *Boscia albitrunca* trees, and their GPS co-ordinates, encountered during the site visit

NO	SPECIES NAME	LOCATION
1.	*Boscia albitrunca*	S28 47 15.2 E20 36 28.2
2.	*Boscia albitrunca*	S28 47 15.1 E20 36 27.3
3.	*Boscia albitrunca*	S28 47 16.5 E20 36 07.7
4.	*Boscia albitrunca*	S28 47 16.6 E20 36 07.8
5.	*Boscia albitrunca*	S28 47 12.2 E20 35 49.5
6.	*Boscia albitrunca*	S28 47 12.8 E20 35 47.5
7.	*Boscia albitrunca*	S28 47 04.4 E20 35 52.3
8.	*Boscia albitrunca*	S28 47 02.4 E20 35 52.4
9.	*Boscia albitrunca*	S28 46 55.8 E20 35 49.1
10.	*Boscia albitrunca*	S28 46 52.5 E20 35 51.2
11.	*Boscia albitrunca*	S28 46 45.6 E20 35 54.3
12.	*Boscia albitrunca*	S28 46 44.7 E20 35 48.5

MAMMAL AND BIRD SPECIES

Mammal and bird species were not regarded, as the proposed activity should have very little permanent impact on these species. Small game is still expected and droppings have been observed. Some of the smaller game (e.g. klipspringers) found at the nearby Augrabies Falls National Park is also expected to still roam the larger area and surroundings of the proposed site.

At the nearby Augrabies Falls National Park, wildlife includes at least 46 mammal and 186 bird species, as well as a number of reptiles. Most show adaptations to the area's large temperature fluctuations – including smaller animals like slender mongooses, yellow mongooses, and rock dassies – which utilise what little shade there is, sheltering in burrows, rock crevices and fallen trees.

Larger mammals found at Augrabies include steenbok, springbok, gemsbok, kudu, eland and Hartmann's Mountain Zebra (*Equus hartmannae*). The giraffe found at Augrabies are said to be lighter in colour than those found in the regions to the east, allegedly as an adaptation to the extreme heat. One of the most common antelope is the klipspringer, pairs of which are often seen bounding across the rocks by keen-eyed walkers. The main mammalian predators found in Augrabies are black-backed jackals, caracals, bat-eared foxes, African wild cats and an elusive population of leopards.

One reptile here is of particular note: Broadley's flat lizard, locally known as the Augrabies flat lizard, is endemic to this area. It only occurs in an area that is within about 100km of the falls. This reptile is, however, not locally rare and on warm days, the brightly-coloured males can often be seen sparring and dancing for dominance.

Birds in the area includes: Augrabies the black stork and Verreaux's (black) eagles which both breed in the area, and also pygmy falcons. As is common in the Kalahari to the north, pale chanting goshawk is one of the more common raptors, whilst flocks of Namaqua sand grouse are also common. Other species includes peregrine and lanner falcons, and rock kestrels (www.sanparks.org.za).

RIVERS AND WETLANDS

Rivers maintain unique biotic resources and provide critical water supplies to people. South Africa's limited supplies of fresh water and irreplaceable biodiversity are very vulnerable to human mismanagement. Multiple environmental stressors, such as agricultural runoff, pollution and invasive species, threaten rivers that serve the world's population. River corridors are important channels for plant and animal species movement, because they link different valleys and mountain ranges. They are also important as a source of water for human use. Vegetation on riverbanks needs to be maintained in order for rivers themselves to remain healthy, thus the focus is not just on rivers themselves but on riverine corridors.

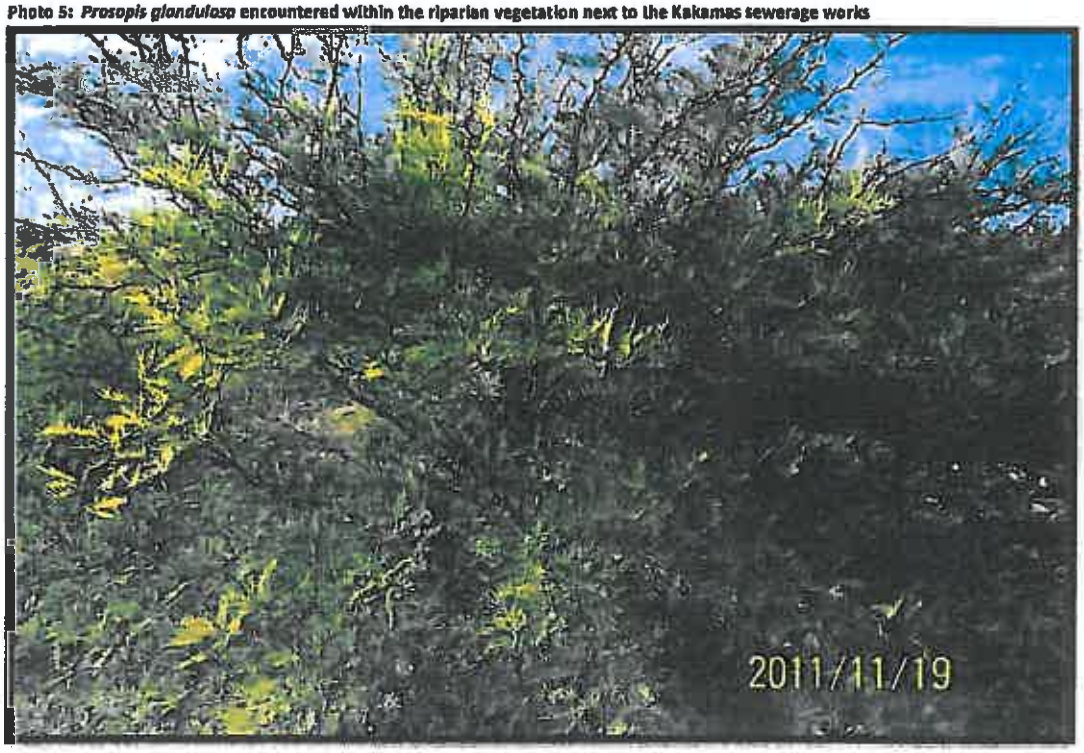
Various non-perennial or dry watercourses and drainage lines have been observed, criss-crossing most of Erf 1654 (Kakamas), which include the portion of the Erf chosen for the location of the solar site. Unfortunately, due to the distribution of these watercourses and drainage lines it would be impossible to locate a single 20 ha block within the larger Erf without encountering any such watercourse. As a result the final location was chosen to minimise the impact on the major water courses and to con-inside with the flattest terrain. By being sensitive with the placement of the access roads and pylons for the solar panels, significant impact on these features can be further minimised.

INVASIVE ALIEN INFESTATION

Most probably because of the aridity of the area, invasive alien rates are generally very low for most of this area. Problem areas are usually associated with river systems and other wetland areas.

Single Prosopis trees have been observed in the wetter area next to the Kakamas sewerage, but not on the rest of the property (Refer to Photo 5).

Photo 5: *Prosopis glandulosa* encountered within the riparian vegetation next to the Kakamas sewerage works



SIGNIFICANT BIODIVERSITY FEATURES ENCOUNTERED

The table underneath gives a summary of biodiversity features encountered during the site visit and a short discussion of their possible significance in terms of regional biodiversity targets.

Table 4: Summary of biodiversity features encountered on Erf 1654, Kakamas and their possible significance

BIODIVERSITY ASPECT	SHORT DESCRIPTION	SIGNIFICANCE RATING
Geology & soils	Geology & soils are seemingly similar almost throughout the property.	No special features have been encountered on the final solar location (e.g. true quartz patches or broken veld). With regards to quartz patches please Refer to Geology & Soils on page 10.
Land use and cover	Mostly sparsely covered natural veld, possibly used for grazing.	Although it is suspected that the property might be used for natural and communal grazing only evidence of smaller game was observed.
Vegetation types	Bushmanland Arid Grassland and riparian vegetation along the myriad watercourses and drainage lines.	Bushmanland Arid Grassland is considered "Least threatened". However, the remaining natural veld shows good connectivity with the surrounding areas, while the riparian vegetation in combination with the watercourses is considered a biodiversity feature of at least medium significance.
Endemic or protected plant species	No endemic species was observed, but a number of the protected tree *Boscia albitrunca* was observed (Table 3).	The placement of the final proposed solar site location within the larger Erf, avoid almost all of these trees. Should the watercourses be avoided the impact to any of these trees can be negated.
Mammal or bird species	Small game is expected and droppings of such game have been observed.	The size and location of the solar facility within Erf 1654 is not expected to have a significant impact on the movement of any game species found on the larger property. Most of the game species encountered (dassies and klipspringer) tend to take shelter within the small rocky outcrops away from the proposed solar site location.
Rivers & wetlands	Watercourses and drainage lines criss-crosses the whole of the Erf.	The main watercourses represent one of the most significant biodiversity features of the property, even though the normal drainage lines have been compromised next to the Orange River.
Invasive alien infestation	Very low alien infestation rates have been observed.	The *Prosopis* trees encountered next to the some of the watercourses must be removed.

In summary, although all natural areas with remaining natural vegetation, especially when these features show good connectivity with the surrounding natural veld (e.g. corridors) should be considered as significant. However, the placement of a 20 ha solar site on the specific location will have very little effect on any significant biodiversity feature or put pressure on regional conservation targets. The impact on populations of individual species is regarded as very low, the impact on sensitive habitats is regarded as very low, the impact on ecosystem function is regarded as very low, cumulative impact on ecology is regarded as very low and finally the impact on economic use of the vegetation is regarded as very low.

BIODIVERSITY ASSESSMENT

Biological diversity, or biodiversity, refers to the variety of life on Earth. As defined by the United Nations Convention on Biological Diversity, it includes diversity of ecosystems, species and genes, and the ecological processes that supp ort them. Natural diversity in ecosystems provides essential economic benefits and services to human society—such as food, clothing, shelter, fuel and medicines—as well as ecological, recreational, cultural and aesthetic values, and thus plays an important role in sustainable development. Biodiversity is under threat in many areas of the world. Concern about global biodiversity loss has emerged as a prominent and widespread public issue.

The objective of this study was to evaluate the biological diversity associated with the study area in order to identify significant environmental features which should be avoided during development activities and or to evaluate short and long term impact and possible mitigation actions in context of the proposed development.

As such the report aim to evaluate the biological diversity of the area using the Ecosystem Guidelines for Environmental Assessment (De Villiers *et. al.*, 2005), with emphasis on:

- Significant ecosystems
    - Threatened or protected ecosystems
    - Special habitats
    - Corridors and or conservancy networks
- Significant species
    - Threatened or endangered species
    - Protected species

METHOD USED

During May 2001, Van Schoor published a formula for prioritizing and quantifying potential environmental impacts. This formula has been successfully used in various applications for determining the significance of environmental aspects and their possible impacts, especially in environmental management systems (e.g. ISO 14001 EMS's). By adapting this formula slightly it can also be used successfully to compare/evaluate various environmental scenario's/options with each other using a scoring system of 0-100%, where any value of 15% or less indicate an insignificant environmental impact while any value above 15% constitute ever increasing environmental impact.

Using Van Schoor's formula (adapted for construction with specific regards to environmental constraints and sensitivity) and the information gathered during the site evaluation the possible negative environmental impact of the activity was evaluated.

Underneath follows a short description of Van Schoor's formula. In the formula the following entities and values are used in order to quantify environmental impact.

$S = [(fd + int + sev + ext + loc) \times (leg + gcp + pol + ia + str) \times P]$ (as adapted for construction activities)

Where

S = Significance value

fd = frequency and duration of the impact

int = intensity of the impact

sev = severity of the impact

ext = extent of the impact

loc = sensitivity of locality

leg = compliance with legal requirements

gcp = conformance to good environmental practices

pol = covered by company policy/method statement

ia = impact on interested and affected parties

str = strategy to solve issue

P = probability of occurrence of impact

CRITERIA

The following numerical criteria for the above-mentioned parameters are used in the formula.

fd = frequency and duration of the impact					
low frequency ; low duration	1	medium frequency; low duration	1.5	high frequency ; low duration	2
low frequency; medium duration	1.5	medium frequency ; medium duration	2	high frequency ; medium duration	2.5
low frequency ; high duration	2	medium frequency ; high duration	2.5	high frequency ; high duration	3

int = intensity of the impact					
low probability of species loss; low physical disturbance	1	medium probability of species loss; low physical disturbance	1.5	high probability of species loss; low physical disturbance	2
low probability of species loss; medium physical disturbance	1.5	medium probability of species loss; medium physical disturbance	2	high probability of species loss; medium physical disturbance	2.5
low probability of species loss; high physical disturbance	2	medium probability of species loss; high physical disturbance	2.5	high probability of species loss; high physical disturbance	3

sev = severity of the impact	
changes immediately reversible	1
changes medium/long-term reversible	2
changes not reversible	3

ext = extent of the impact	
locally (on-site)	1
regionally (or natural/critical habitat affected)	2
globally (e.g. critical habitat or species loss)	3

loc = sensitivity of location	
not sensitive	1
moderate (e.g. natural habitat)	2
sensitive (e.g. critical habitat or species)	3

leg = compliance with legal requirements	
compliance	0
non-compliance	1

gcp = good conservation practices	
conformance	0
non-conformance	1

pol = covered by company policy	
covered in policy	0
not covered/no policy	1

io = impact on interested and affected parties	
not affected	1
partially affected	2
totally affected	3

str = strategy to solve issue	
strategy in place	0
strategy to address issue partially	0.5
no strategy present	1

P = probability of occurrence of impact	
not possible (0% chance))	0
not likely, but possible (1 - 25% chance)	0.25
likely (26 - 50% chance)	0.50
very likely (51 - 75% chance)	0.75
certain (75 - 100% chance)	0.95

EVALUATION OF SIGNIFICANT ECOSYSTEMS

The main drivers in this dry ecosystem would be variations in soil type (e.g. soil depth, moisture capacity, rockiness, mineral composition and acidity), and could largely determine plant community composition and occurrence of rare species. Grazing, especially by small resident antelope may be an important factor in regulating competitive interaction between plants (*Acacia mellifera* encroachment is often a sign of overgrazing or bad veld management). Certain species can act as important "nursery" plants for smaller species and are also important for successional development after disturbance. Tortoises and mammals can be important seed dispersal agents.

Fire is not expected to have any major input in this very dry and sparsely populated vegetation type.

THREATENED OR PROTECTED ECOSYSTEMS

The vegetation itself is not considered to belong to a threatened or protected ecosystem. No special habitats were encountered within the 20 ha final solar site location (e.g. quartz patches or broken veld), which could sustain significant smaller ecosystems.

However, various non-perennial or dry watercourses and drainage lines have been observed, criss-crossing most of Erf 1654 (Kakamas), which include the 20 ha portion of the Erf chosen for the location of the solar site. Watercourses and drainage lines are particularly vulnerable to alien plant invasion, agricultural transformation and or physical disturbance, those found on site should be regarded as at least of medium significance in terms of biodiversity. Unfortunately, due to the distribution of these watercourses and drainage lines it would be impossible to locate a single 20 ha block within the larger Erf without encountering any such watercourse. As a result the final location was chosen to minimise the impact on the major water courses and to con-inside with the flattest terrain. However, by being sensitive with the placement (within the chosen site) of the access roads and pylons for the solar panels and good environmental control during the construction phase, significant impact on these features can be much reduced or negated.

Overall the development of the 20 ha Keren Energy solar facility at Kakamas is not expected to a have a significant impact on threatened or protected ecosystems. The possibility of such an impact occurring is rated as medium-low.

SPECIAL HABITATS

The vegetation itself is not considered to belong to a threatened or protected ecosystem. No special habitats were encountered on site (e.g. quartz patches or broken veld), which could sustain significant smaller ecosystems.

Overall the development of the 20 ha Keren Energy solar facility at Kakamas is not expected to a have a significant impact on any special habitat. The possibility of such an impact occurring is rated as negligible.

CORRIDORS AND OR CONSERVANCY NETWORKS

Looking at the larger site and its surroundings it shows excellent connectivity with remaining natural veld in almost all directions. Corridors and natural veld networks are still relative unscathed (apart from through-road networks). Watercourses and drainage lines on site are still almost pristine, although, these non-perennial drainage lines do not support a major difference in species composition (more a structural difference). In addition these drainage lines drain towards the Orange River, where it is almost totally compromised by intensive agricultural practices next to the river.

Since large areas with good connectivity remains and the site is located in the general area of most disturbance on the Erf (sewerage works and waste disposal site), the 20 ha Keren Energy solar facility development is not expected to a have a significant impact on connectivity of the remaining natural veld. The impact is rated as low.

EVALUATION OF SIGNIFICANT SPECIES

The site visit was performed during November 2011, an area which normally receives some rain from October. At the time of the study the Kakamas area had not received any rains of significance and as a result only the hardened drought resistant plant species were observed, herbs, bulbs and annuals were mostly absent. This might mean that some of the local endemic species were not in growth or could not be identified. However, the author is of the opinion that in the larger context it will not constitute a significant contribution.

THREATENED OR ENDANGERED SPECIES

No threatened or endangered species are recorded for this vegetation type. However, a few local endemic species are associated with the broader vegetation type. During the site visit no such species were observed and in the regional context the author is of the opinion that the development of the 20 ha solar facility will not lead to irreversible species loss. With good environmental control (e.g. topsoil removal, storage and re-distribution) and rehabilitation after construction (leaving the remaining area as natural as possible) the possibility of such an impact occurring could be almost negated.

The possibility of such an impact occurring is rated as very low.

PROTECTED SPECIES

Three protected tree species have a distribution which could overlap with the general site location of the solar facility namely: *Acacia erioloba* (Camel thorn) *Boscia albitrunca* (Witgat) and *Acacia haematoxylon* (Grey camel thorn). Of these 3 species only *Boscia albitrunca* was observed on the larger property, usually associated with the dry watercourses or drainage lines. (All of the trees observed were referenced by GPS and are indicated on Figure 4 and in Table 3). The final site location was specifically chosen to avoid as much of these watercourses as possible. However, 2 individuals of *Boscia albitrunca* will still be located within the proposed final 20 ha location (Refer to the GPS co-ordinates of the trees marked 1 & 2 in Table 3) and two more species on the fringes of the final location (Refer to the GPS co-ordinates for the trees marked as 3 & 4 in Table 3).

With good environmental control and careful placement of the solar pylons and the maintenance roads any disturbance or impact to these trees could be negated, the possibility of such an impact occurring will then be rated as low.

Mitigation: All *Boscia albitrunca* trees and its immediate surroundings (at least a 10 m radius) should be regarded as no-go areas.

PLACEMENT AND CONSTRUCTION METHOD

A single solar generator produces approximately 66kV. In order to produce 10 MW, the proposed facility will require a number of generators arranged in multiples/arrays. The CPV panels will be elevated (2 m above ground) by a support structure, and will be able to track the path of the sun during the day for maximum efficiency. Approximately 1.8 ha is required per installed MW. A 10 MW capacity facility will thus require a development footprint of approximately 20 ha (including associated infrastructure – ancillary infrastructure). Each panel will be approximately 22 m wide by 12.5 m high. When the panels are tracking vertically the structure will have a maximum height of approximately 15 m. The excavation needed for each support structures (approximately 148 units are proposed) will be 1 m^2 by 5 m deep. It means that apart from the associated structures, approximately 148 holes of 1 m^2 by 5 m deep will be excavated. Each hole must be at least 22 m from the next.

Photo 6: Typical layout of such a solar site (image courtesy of Amonix, a leading designer of CPV technology)

The activities will require the stripping of topsoil (for the pylon holes and access roads only, leaving the remainder as natural as possible), which will need to be stockpiled, backfilled and/or spread on site. All in all the proposed facility can be likened to light agriculture, with the exception that natural vegetation can be allowed to remain on all the non-disturbed areas. All surfaces not used for the facility and associated infrastructure can remain natural.

DIRECT IMPACTS

As the name suggest, direct impacts refers to those impacts with a direct impact on biodiversity features and in this case were considered for the potentially most significant associated impacts (some of which have already been discussed above).

Direct loss of vegetation type and associated habitat due to construction and operational activities.

- Loss of ecological processes (e.g. migration patterns, pollinators, river function etc.) due to construction and operational activities. (Refer to page 22).
- Loss of local biodiversity and threatened plant species (Refer to page 22)
- Loss of ecosystem connectivity (Refer to page 23)

LOSS OF VEGETATION AND ASSOCIATED HABITAT

One broad vegetation type is expected in the study area, namely Bushmanland Arid Grassland (Refer to Vegetation encountered on page 14). Bushmanland Arid Grassland was classified as "Least Threatened", but "Poorly Protected" during the 2004 National Spatial Biodiversity Assessment. Within the more recent *"National list of ecosystems that are threatened and in need of protection"* (GN 1002, December 2011), promulgated in terms of the National Environmental Management Biodiversity Act (NEM: BA), Act 10 of 2004, the status of Bushmanland Arid Grassland are still regarded as least threatened. Although only 0.4% of this vegetation type is formally protected, more than 99% of this vegetation type is still found in a relative natural state. Thus the vegetation itself is not considered to belong to a threatened or protected ecosystem. No special habitats were encountered on site (e.g. quartz patches or broken veld), which could sustain significant smaller ecosystems.

Even if all of the 20 ha is transformed (such as for intensive cultivation), the impact on the specific vegetation type would most probably only be medium-low as a result of the status of the vegetation and the location of the final proposed solar location. However, with mitigation the impact can be much reduced.

Mitigation: The following is some mitigation which will minimise the impact of the solar plant location and operation.

- Pylons should be placed at least 32 m away from the main watercourses on the property. Care should also be taken to protect drainage lines (by controlling the pylons placement).
- All *Boscia albitrunca* trees and its immediate surroundings (at least a 10 m radius) should be regarded as no-go areas. Any additional significant plant species that may be encountered must be identified and located (e.g. *Acacia erioloba*) and all efforts made to avoid damage to such species.
- Only existing access roads should be used for access to the terrain (solar site).
- The internal network of service roads (if needed) must be carefully planned to minimise the impact on the remaining natural veld on the site. The number of roads should be kept to the minimum and should be only two-track/twee spoor roads (if possible). The construction of hard surfaces should be minimised or avoided.
- Access roads and the internal road system must be clearly demarcated and access must be tightly controlled (deviations may not be allowed).
- Indiscriminate clearing of areas must be avoided, only pylon sites and sites where associated infrastructure needs to be placed must be cleared (all remaining areas to remain as natural as possible).
- All topsoil (at all excavation sites) must be removed and stored separately for re-use for rehabilitation purposes. The topsoil and vegetation should be replaced over the disturbed soil to provide a source of seed and a seed bed to encourage re-growth of the species removed during construction.

- Once the construction is completed all further movement must be confined to the access tracks to allow the vegetation to re-establish over the excavated areas.

INDIRECT IMPACTS

Indirect impacts are impacts that are not a direct result of the main activity (construction of the solar facility), but are impacts still associated or resulting from the main activity. Very few indirect impacts are associated with the establishment of the solar facility (e.g. no water will be used, no waste material or pollution will be produced through the operation of the facility).

The only indirect impact resulting from the construction and use of the facility is a loss of movement from small game and other mammals, since the property will be fenced. However, it is not considered to result in any major or significant impact on the area as a whole.

CUMULATIVE IMPACTS

In order to comprehend the cumulative impact, one has to understand to what extent the proposed activity will contribute to the cumulative loss of this vegetation type and other biodiversity features on a regional basis. Bushmanland Arid Grassland was classified as "Least Threatened", but "Poorly Protected" during the 2004 National Spatial Biodiversity Assessment. Within the more recent *"National list of ecosystems that are threatened and in need of protection"* (GN 1002, December 2011), promulgated in terms of the National Environmental Management Biodiversity Act (NEM: BA), Act 10 of 2004, the status of Bushmanland Arid Grassland is still regarded as least threatened. Although only 0.4% of this vegetation type is formally protected, more than 99% of this vegetation type is still found in a relatively natural state. Thus the vegetation itself is not considered to belong to a threatened or protected ecosystem. No special habitats were encountered on site (e.g. quartz patches or broken veld), which could sustain significant smaller ecosystems.

Even if all of the 20 ha is transformed (such as for intensive cultivation), the impact on the regional status of this vegetation type and associated biodiversity features would likely still be only medium-low. No irreversible species-loss, habitat-loss, connectivity or associated impact can be foreseen from locating and operating the solar facility on the final proposed solar site. However, all mitigation measures should still be implemented in order to further minimise the impact of the construction and operation of the facility.

THE NO-GO OPTION

During the impact assessment only the final proposed site (which was identified after inputs from the various appointed specialists) as described in Figure 3 and Table 1 is discussed. From the above, the "No-Go alternative" does not signify significant biodiversity gain or loss especially on a regional basis. In this case the no-go options will only ensure that the status quo remains, but it is expected that urban creep will anyway impact on the proposed final solar site location over time.

The site visit and desktop studies described and evaluated in this document led to the conclusion that the "No-Go Alternative" alternative will not result in significant gain in regional conservation targets, the conservation of rare & endangered species or gain in connectivity. At the best the No-Go alternative will only support the "*status quo*" of the region. On the other hand the pressure on Eskom facilities, most of which are currently still dependant on fossil fuel electricity generation, will remain. Solar power is seemingly a much cleaner and more sustainable option for electricity production.

QUANTIFICATION OF ENVIRONMENTAL IMPACTS

Taking all of the above discussions into account and using Van Schoor's formula for impact quantification, impacts of the following can be quantified as follows:

NO DEVELOPMENT

The no development scenario can only take regional biodiversity into account. In this instance national biodiversity (and even possibly global diversity) may, however, show significant gain over time, if for instance fossil burning electricity generation could be reduced and or replaced by cleaner energy production methods. Although solar energy is presently not seen as a viable stand-alone technology for electricity production it will lighten the pressure on the fossil burning facilities of Eskom and in so doing will add to a more sustainable way of electricity production.

DEVELOPMENT WITHOUT MITIGATION

The purpose of this scenario is to illustrate, using Van Schoor's formula, the loss should development be allowed <u>without any mitigation measures</u>. It is assumed that the 20 ha will be totally developed into hard surfaces, but still in context of the regional importance of the biodiversity associated with the area.

$$S = [(fd + int + sev + ext + loc) \times (leg + gcp + pol + ia + str) \times P]$$ (as adapted)

$$S = [(1.5 + 1.5 + 1.5 + 1 + 1) \times (1 + 1 + 1 + 1 + 1) \times 0.95] = 31\ \%$$

In the above any value of 15% or less indicates an insignificant environmental impact, while any value above 15% constitutes ever increasing environmental impact.

DEVELOPMENT WITH MITIGATION

The purpose of this scenario is to illustrate, using Van Schoor's formula, the environmental gain should development be allowed <u>with all proposed mitigation measures implemented</u>. It is assumed that the 20 ha will be developed, but that all areas not directly impacted by infrastructure placement will remain as natural as possible.

$$S = [(fd + int + sev + ext + loc) \times (leg + gcp + pol + ia + str) \times P]$$ (as adapted)

$$S = [(1.5 + 1 + 1 + 1 + 1) \times (0 + 0 + 0 + 1 + 0) \times 0.95] = 5\ \%$$

In the above any value of 15% or less indicates an insignificant environmental impact, while any value above 15% constitutes ever increasing environmental impact.

RECOMMENDATIONS & IMPACT MINIMIZATION

From the information discussed in this document it is clear to see that the Kakamas final location was relatively well chosen from a biodiversity viewpoint. Even if all of the 20 ha is transformed (such as for intensive cultivation), the impact on the regional status of this vegetation type and associated biodiversity features (e.g. watercourses and drainage lines) would likely still be only medium-low. No irreversible species-loss, habitat-loss, connectivity or associated impact can be foreseen from locating and operating the solar facility on the final proposed solar site.

Photo 7: *Boscia albitrunca* on the larger property

The site visit and desktop studies described and evaluated this document led to the conclusion that the "No-Go Alternative" alternative will not result in significant gain in regional conservation targets, the conservation of rare & endangered species or gain in connectivity. At the best the No-Go alternative will only support the "status quo" of the region. On the other hand the pressure on Eskom facilities, most of which is currently still dependant on fossil fuel electricity generation, will remain. Solar power is seemingly a much cleaner and more sustainable option for electricity production. However, the No-Go scenario can only take regional biodiversity into account. In this instance national biodiversity (and even possibly global diversity) may show significant gain over time, if for instance fossil burning electricity generation could be reduced and or replaced by cleaner energy production methods. Although solar energy is presently not seen as a viable stand-alone technology for electricity production it will lighten the pressure on the fossil burning facilities of Eskom and in so doing will add to a more sustainable way of electricity production.

Photo 8: Euphorbia spinea

Finally, when quantifying the development options, the Van Schoor's formula for impact quantification still shows a significant difference between development without and development with mitigation. As a result it is recommended that all mitigating measures must be implemented in order to further minimise the impact of the construction and operation of the facility.

With the available information at the author's disposal it is recommended that the project be approved, but that all mitigation measures described in this document is implemented.

IMPACT MINIMIZATION

GENERAL

- All construction must be done in accordance with an approved construction and operational phase Environmental Management Plan (EMP), which must be developed by a suitably experienced Environmental Assessment Practitioner.
- A suitably qualified Environmental Control Officer must be appointed to monitor the construction phase of the solar plant in terms of the EMP and the Biodiversity study recommendations as well as any other conditions which might be required by the Department of Environmental Affairs.
- An integrated waste management system must be implemented during the construction phase.
- All rubble and rubbish (if applicable) must be collected and removed from the site to a suitable registered waste disposal site.
- All alien vegetation should be removed from the larger property.
- Adequate measures must be implemented to ensure against erosion.

SITE SPECIFIC

- Pylons should be placed at least 32 m away from any of the main watercourses on the property. Care should also be taken to protect drainage lines (by controlling the pylon placement).
- All *Boscia albitrunca* trees and its immediate surroundings (at least a 10 m radius) should be regarded as no-go areas. Any additional significant plant species that may be encountered must be identified and located (e.g. *Acacia erioloba*) and all efforts made to avoid damage to such species.
- Only existing access roads should be used for access to the terrain (solar site).
- The internal network of service roads (if needed) must be carefully planned to minimise the impact on the remaining natural veld on the site. The number of roads should be kept to the minimum and should be only two-track/ twee-spoor roads (if possible). If possible the construction of any hard surfaces should be minimised or avoided.
- During construction access roads and the internal road system must be clearly demarcated and access must be tightly controlled (deviations must not be allowed).
- Indiscriminate clearing of areas must be avoided, only pylon sites and sites where associated infrastructure needs to be placed may be cleared (all remaining areas to remain as natural as possible).
- All topsoil (the top 15-20 cm at all excavation sites), must be removed and stored separately for re-use for rehabilitation purposes. The topsoil and vegetation should be replaced over the disturbed soil to provide a source of seed and a seed bed to encourage re-growth of the species removed during construction.
- Once the construction is completed all further movement must be confined to the approved access and maintenance tracks to allow the vegetation to re-establish over the excavated areas.