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

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)

ADDENDUM

TO THE BIODIVERSITY ASSESSMENT & BOTANICAL SCAN

Revision 1

for the,

MOUNT ROPER SOLAR PROJECT

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

DATE: 24 MARCH 2017

PREPARED BY: PB CONSULT

PREPARED FOR: ENVIROAFRICA CC

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SUMMARY - MAIN CONCLUSIONS

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MAIN VEGETATION TYPE(S)	**Kuruman Thornveld**: Least Threatened; Not Protected; Remaining 98%, but almost none of this vegetation type is protected at present. **NB: Griqualand West Centre of Endemism**: The site falls within the GWC, but is located on a Kalahari sand intrusion (deep sand suggested by the presence of *Vachellia erioloba*). Thus although it overlaps the GWC of endemism it is unlikely to have a significant impact on the core vegetation type of this centre (The GWC being associated with rocky surface outcrops of limestone, dolomite and quartzite of the Ghaap Group and Olifantshoek Supergroup).
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 falls within the Griqualand West Centre of Endemism (GWC) and is covered by relatively undisturbed natural veld (subject only to livestock grazing). • However, the actual footprint overlays a Kalahari sand intrusion (not a substrate associated with the GWC), which in effect means that it supports vegetation associated with the Kalahari dunes, rather than with the Griqualand West Centre of Endemism. • The vegetation itself is not considered vulnerable, but the larger site shows good connectivity with surrounding ecosystems (e.g. rocky outcrops of the Kuruman Mountain Bushveld). • The site and its surroundings support a number of protected tree species (both Camel thorn and Sheppard's trees). Taken the above into account it was considered unlikely that the proposed footprint would be included into a CBA or ESA on strength of its floristic value alone. But it might have connectivity value (e.g. connecting various elements associated with the GWC) which might warrant its inclusion within a potential ESA. 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 whole of the property site is currently used for cattle grazing. The proposed footprint will only occupy a very small portion of the larger farm and should thus have very little effect on the current land use.
SIGNIFICANT PLANT SPECIES	**No red list plant species were encountered** or is expected (Refer to Heading 5.3.1). **One species protected in terms of NEM: BA was encountered** (Heading 5.3.2). **Two (2) species protected in terms of the NFA** were encountered (Refer to Table 3), most noteworthy a number of Camel thorn trees (*Vachellia erioloba*) and Sheppard's trees (*Boscia albitrunca*). **Four (4) species (Refer to Table 5) protected in terms of the NCNCA** were encountered.
IMPACT ASSESSMENT	Please refer to Table 13.
SUMMARY & RECOMMENDATION	The proposed site (and most of the larger farm) is still covered by natural veld in relative good condition. The vegetation on site was rather homogenous as was the surrounding terrain. It was likely that cattle grazing have impacted the site, but extent and significance there-off is hard to determine. On the other hand, the absence of traditional large herbivores (since intensive farming was introduced) is also likely to have shaped the current plant composition. The most noteworthy environmental features of the site are:

	• The presence of quite a number of medium sized Camel thorn- and Sheppard's trees. Should they have to be removed they will be compromised as both these species rarely (if ever) survives transplantation. But it is considered quite feasible to minimise the impact on these trees to a significant extent; • The fact that the site is located within the Griqualand West Centre of Endemism; • Species protected in terms of the NCNCA was also encountered, but no species was recommended for search & rescue (topsoil protection and re-use will allow for seed protection and re-distribution). No watercourses or wetlands were observed on the property and because of its current landuse (cattle grazing) and its small size, it is 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. The potential veld fire risk is high, and good fire management protocols will have to be implemented **Significance before mitigation:** The impact assessment suggests that the proposed Mount Roper development is expected to have a **Medium cumulative** impact, with the most significant aspects there-off being the potential impact on the protected trees encountered within the site and to a lesser degree potential accidental veld fires. **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. It should be possible to reduce the direct impact on large protected trees significantly (e.g. protecting all Camel thorn trees larger than 6 m by default, avoiding tree clusters as well as trees on the outskirts of the site and minimising the actual development footprint wherever possible). The 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 tree 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 to **Medium-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 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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Registered Professional Environmental and Ecological Scientist

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1. INTRODUCTION

Roma Energy Holdings is proposing the establishment of a solar energy facility on the remainder of Farm Mount Roper No. 321, between Kuruman and Hotazel (Northern Cape Province, Gamagara Local Municipality). The facility will be established on an area of approximately 20 ha, on a portion of the property. 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 27 March 2012) as part an environmental impact assessment application to the Department of Environmental Affairs (in terms of the NEMA EIA Regulations). Also refer to the addendum to this report (dated February 2013) which was done to clarify comments received from the Department of Agriculture, Forestry and Fisheries (DAFF). Environmental authorisation (EA) for this project was granted on the 11th of June 2013 (DEA Ref.: 14/12/16/3/3/1/474 & NEAS Ref: EA/EIA/00001000/2012). However, the EA expired before physical work on the site could commence. The applicant would like to continue with the development and as such reapplication for an EA is required.

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 remained the same.**

1.1 STATUS OF THE ORIGINAL REPORT

In terms of the above a further site visit was performed on the 4th of March 2017, during which the author re-evaluated the site. Most of the Northern Cape and including the Kuruman area recently received good summer rains, which showed in the veld and its conditions. As a result a number of additional plan species (mostly annual species) was recorded. However, 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 proposed site showed a well-developed woody shrub/small tree middle layer (varying between 1-2.5 m in height with a grassy and herbaceous bottom layer. A over layer of larger trees scattered throughout, consisting mainly of *Vachellia erioloba* (Camel thorn) and *Boscia albitrunca* (Shepard's tree).

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 the Griqualand West Centre of Endemism;
- 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.

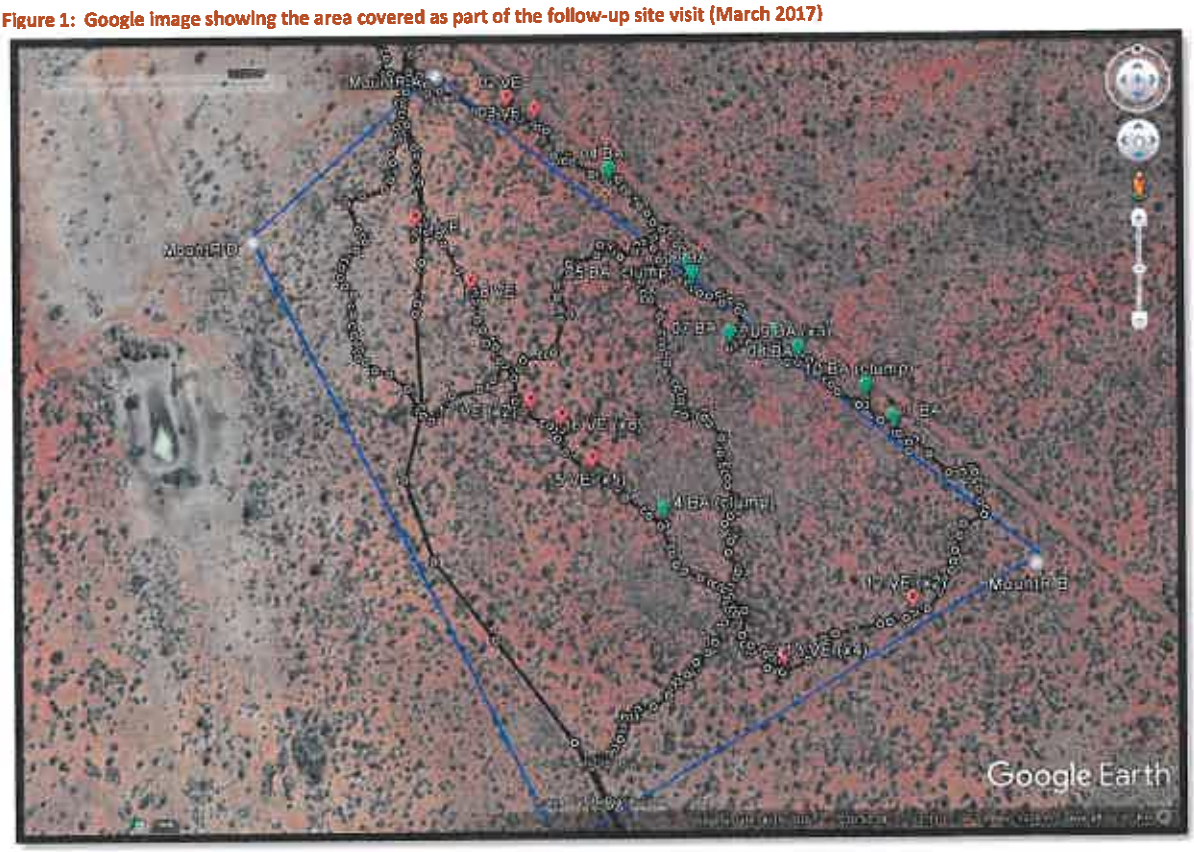
2. METHODS USED

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 on the January 2012. The follow-up site visit was done on the 4th of March 2017, after recent heavy rains. 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)



In Figure 1 above, the red markers refers to *Vachellia erioloba* trees, while the green markers refer to *Boscia albitrunca* locations.

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 original description of the vegetation encountered remains the same (namely Kuruman Thornveld). However, a few additional species was recorded after the recent good rains (mostly herbaceous annuals). The original document describes the vegetation and plant species (flora) encountered but did not list plant species within its own table (which has been added in this addendum). 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 GRIQUALAND WEST CENTRE OF ENDEMISM

Figure 2: GWC taken from Van Wyk & Smith 2001

The Griqualand west centre (GWC) of endemism was named after the Griqua people (who used to live there) and is found in the Hay- and part of the Barkley West districts (Refer to Figure 2) of the Northern Cape Province (Van Wyk & Smith, 2001). The proposed Mount Roper Solar site is located between Kuruman and Hotazel, which falls within this centre of endemism. According to Van Wyk & Smith (2001) the GWC is best described in geological terms, with its core area mostly linked to surface outcrops of the Ghaap Group (notably limestone and dolomite) and those of the Olifantshoek Supergroup (notably quartzite). However, in floristic terms the outer boundaries of the centre are rather diffuse as floristic elements can spill over onto related substrates, especially alkaline substrates rich in calcium. The GWC separates the Kalahari basin from the sediments of the Karoo Supergroup further south and floristically the GWC is sometimes described as a Kalahari-Highveld transition zone (White, 1983).

It is important to note that the nearby Kalahari Desert intrudes into the GWC as pockets and tongues of wind-blown, orange-red Kalahari sand accumulating in valleys between the rocky outcrops and mountains of this region, signified by the presence of the camel thorn tree (*Vachellia erioloba*), which only occurs on deep sandy soils. This is very relevant as the GWC is mainly associated with the rocky outcrops of this region. The presence of deep, red sandy soils and camel thorn trees indicates that the

footprint of the proposed Mount Roper solar site is located on an area with vegetation more associated with that of the Kalahari sands than that which relates to the GWC of endemism. This is further confirmed by the presence of a number of typical Kalahari sand species (e.g. *Senna italica, Sesamum capense* and *Cucumis africanus*). It is thus fair to say that even though the proposed Mount Roper solar site overlaps the GWC of endemism it is unlikely to have a significant impact on the core vegetation type associated with this centre of endemism.

The small size of the proposed development and its location within a sandy valley confirms that it is unlikely to have any significant impact on the Griqualand west 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 (A&I)	Legal requirements
1.	*Asparagus africanus*	ASPARAGACEAE			
2.	*Asparagus capensis*	ASPARAGACEAE			
3.	*Asparagus retrofractus*	ASPARAGACEAE			
4.	*Boerhavia repens subsp. repens*	NYCTAGINACEAE			
5.	*Boscia albitrunca*	BRASSICACEAE	NCNCA, Schedule 2 Protected (all species in this Genus)		Apply for a NFA Tree permit (DAFF) Apply for a NCNCA Flora permit (DENC)
6.	*Chrysocoma ciliata*	ASTERACEAE			
7.	*Cucumis africanus*	CURCUBITACEAE			
8.	*Elephantorrhiza elephantina*	FABACEAE			
9.	*Euclea undulata*	EBENACEAE			
10.	*Fingerhuthia africana*	POACEAE			
11.	*Geigeria ornativa*	ASTERACEAE			
12.	*Gisekia africana* var. *africana*	GISEKIACEAE			

No.	Species name	FAMILY	Status Red list, NFA, NCNCA	Alien & invader species (AIS)	Legal requirements
13.	*Grewia flava*	MALVACEAE			
14.	*Harpagophytum procumbens*	PEDALIACEAE	NCNCA, Schedule 1 protected (All species in this Genus)		Apply for a permit in terms of NEMBA Apply for a NCNCA Flora permit (DENC)
15.	*Heliotropium ovalifolium*	BORAGOMACEAE			
16.	*Hermbstaedtia cf. fleckii*	AMARANTHACEAE			
17.	*Indigofera alternans* var. *alternans*	FABACEAE			
18.	*Indigofera flavicans*	FABACEAE			
19.	*Justicia incana (=Monechma incanum)*	ACANTHACEAE			
20.	*Justicia* species	ACANTHACEAE			
21.	*Kyllinga alba* subsp. *alba*	CYPERACEAE			
22.	*Limeum fenstratum*	LIMEACEAE			
23.	*Lycium cinereum*	SOLANACEAE			
24.	*Lycium hirsutum*	SOLANACEAE			
25.	*Oxalis semiloba*	OXALIDACEAE	NCNCA, Schedule 2 Protected (all species in this Family)		Apply for a NCNCA Flora permit (DENC)
26.	*Oxalis* species	OXALIDACEAE	NCNCA, Schedule 2 Protected (all species in this Family)		Apply for a NCNCA Flora permit (DENC)
27.	*Peliostomum leucorrhizum*	SCROPHULARIACEAE			
28.	*Pergularia daemia* subsp. *daemia*	APOCYNACEAE			
29.	*Ptycholobium biflorum*	FABACEAE			
30.	*Pupalia lappacea*	AMARANTHACEAE			
31.	*Rhigozum trichotomum*	BIGONACEAE			
32.	*Schmidtia kalahariensis*	POACEAE			
33.	*Schmidtia pappophoroides*	POACEAE			
34.	*Searsia dregeana*	ANACARDIACEA			
35.	*Senegalia mellifera (=Acacia mellifera)*	FABACEAE			
36.	*Senna italica*	FABACEAE			
37.	*Sesamum capense*	PEDALIACEAE			
38.	*Stipagrostis uniplumis*	POACEAE			
39.	*Tarchonanthus camporatus*	ASTERACEAE			

No.	Species name	FAMILY	Status Red list, NFA, NCNCA	Alien & invader species (AIS)	Legal requirements
40.	*Tragus racemosus*	POACEAE			
41.	*Vachellia erioloba (=Acacia erioloba)*	FABACEAE			Apply for a NFA Tree permit (DAFF)
42.	*Vachellia hebeclada (=Acacia hebeclada)*	FABACEAE			
43.	*Ziziphus mucronata*	RHAMNACEAE			

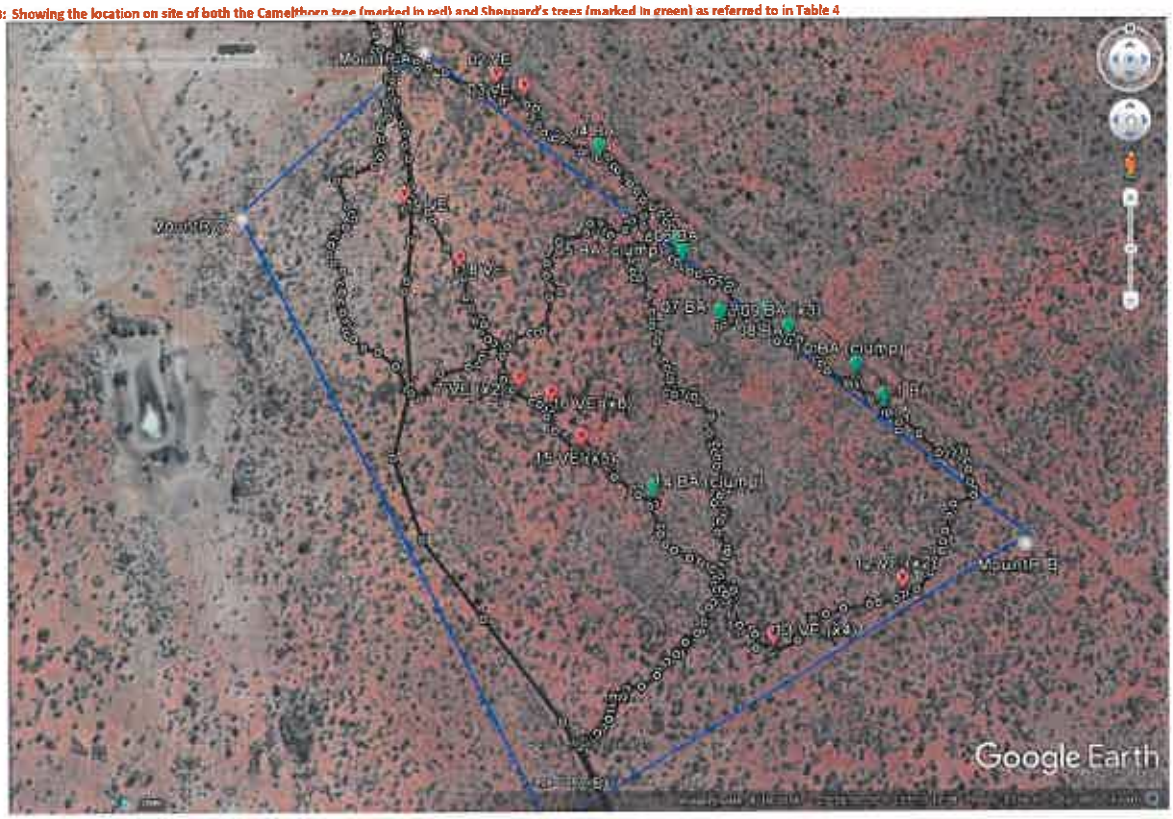
5.3 THREATENED AND PROTECTED PLANT SPECIES

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).

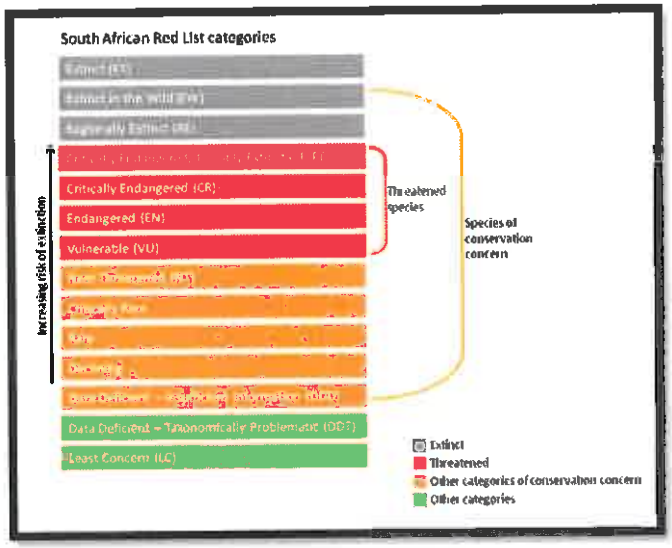
In the Northern Cape, species of conservation concern are also protected in terms of national and provincial legislation, namely:

- 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).

Figure 3: Showing the location on site of both the Camelthorn tree (marked in red) and Sheppard's trees (marked in green) as referred to in Table 4



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 4.

Figure 4: 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 2017/03/22) only one listed plant species is associated with Kuruman Thornveld namely:

- *Glossochilus burchellii* Nees. Status = Least Concern (LC). Described as a widespread and locally common species in the Northern Cape, from Kuruman to Griekwastad. Overgrazing causes habitat degradation across most of this species range, but in spite of this it remains fairly common. The plant was not observed during the site visit and the proposed development is unlikely to have any significant impact on this species.

One species protected in terms of NEMBA (Status = protected species) was encountered on site namely:

- *Harpagophytum procumbens*

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). Two species protected in terms of the NFA was observed (refer to Table 3). Please refer to Table 4, underneath, giving their coordinates and Figure 3, which show their locations on the site (Camelthorn in red and Sheppard's tree in green).

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

NO.	SPECIES NAME	COMMENTS	RECOMENDATIONS
1.	*Boscia albitrunca*	Only one very young individual observed within the footprint.	No mitigation possible (Root system normally to extensive for transplanting).
2.	*Vachellia erioloba*	Four individuals encountered of which 3 are within the footprint. Two individuals over 3m, but less than 6m.	Avoid if possible. No other mitigation possible (not possible to transplant).

Table 4: A list of protected trees encountered during the site visit and their GPS co-ordinates

NO	SPECIES NAME	COMMON NAME	NUMBER OF TREES	LOCATION
1.	*Vachellia erioloba*	Camel thorn	1	S27 20 36.1 E23 11 08.8
2.	*Vachellia erioloba*	Camel thorn	1	S27 20 40.8 E23 11 14.5
3.	*Vachellia erioloba*	Camel thorn	1	S27 20 41.1 E23 11 15.4
4.	*Boscia albitrunca*	Sheppard's tree	1	S27 20 43.0 E23 11 17.8
5.	*Boscia albitrunca*	Sheppard's tree	5	S27 20 45.7 E23 11 20.3
6.	*Boscia albitrunca*	Sheppard's tree	1	S27 20 46.1 E23 11 20.4
7.	*Boscia albitrunca*	Sheppard's tree	1	S27 20 47.8 E23 11 21.6
8.	*Boscia albitrunca*	Sheppard's tree	1	S27 20 47.8 E23 11 23.1
9.	*Boscia albitrunca*	Sheppard's tree	3	S27 20 48.2 E23 11 23.7
10.	*Boscia albitrunca*	Sheppard's tree	11	S27 20 49.3 E23 11 25.8
11.	*Boscia albitrunca*	Sheppard's tree	1	S27 20 50.2 E23 11 26.6
12.	*Vachellia erioloba*	Camel thorn	2	S27 20 55.2 E23 11 26.9
13.	*Vachellia erioloba*	Camel thorn	4	S27 20 56.7 E23 11 23.0
14.	*Boscia albitrunca*	Sheppard's tree	5	S27 20 52.7 E23 11 19.4
15.	*Vachellia erioloba*	Camel thorn	5	S27 20 51.3 E23 11 17.2
16.	*Vachellia erioloba*	Camel thorn	8	S27 20 50.1 E23 11 16.3
17.	*Vachellia erioloba*	Camel thorn	2	S27 20 49.7 E23 11 15.3
18.	*Vachellia erioloba*	Camel thorn	1	S27 20 46.2 E23 11 13.4
19.	*Vachellia erioloba*	Camel thorn	1	S27 20 44.3 E23 11 11.6

In total 26 *Vachellia erioloba* (Camel thorn) trees were encountered, most of which are small to medium sized trees, averaging 3-4m in height. Within the proposed footprint, potentially 23 of trees might be impacted (the other being outside of the current footprint). Twenty nine (29) *Boscia albitrunca* (Sheppard's trees) were encountered ranging from 2-4m in height. Within to the proposed footprint potentially 10 might be impacted.

For impact evaluation purposes it was assumed that all trees within the footprint will be impacted (removed). However, the actual development footprint will only occupy approximately half of the 20 ha site, so micro-adjustments of the layout in order to minimise or even avoid impacts on protected trees should be possible.

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 5) protected in terms of the NCNCA were encountered. Recommendations on impact minimisation also included.

Table 5: Plant species protected in terms of the NCNCA encountered within the study area

NO.	SPECIES NAME	COMMENTS	RECOMENDATIONS
1.	*Boscia albitrunca* **Schedule 2 protected.**	Approximately 29 trees observed, ranging from medium to large trees. Likely to be impacted	No mitigation possible.
2.	*Harpagophytum procumbens* **Schedule 1 protected**	Occasionally observed.	Topsoil conservation and re-use may allow for seed preservation.
3.	*Oxalis obtusa* **Schedule 2 protected**	Occasionally observed.	Topsoil conservation and re-use may allow for seed and bulb preservation.
4.	*Oxalis* species **Schedule 2 protected**	Occasionally observed	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

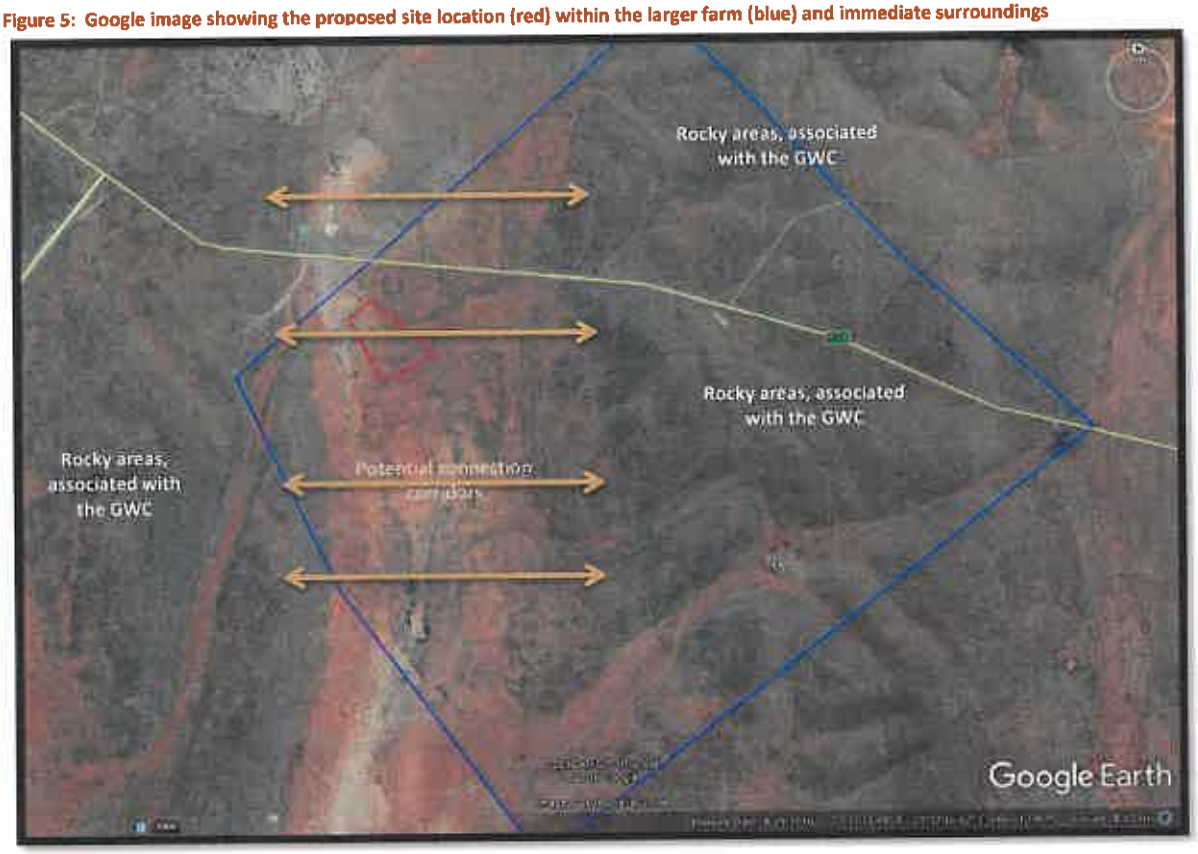
Of importance in terms of consideration for inclusion into a critical biodiversity area (CBA) or ecological support area (ESA) will be the following:

- The proposed site falls within the Griqualand West Centre of Endemism (GWC) (Refer to Heading 5.1);
- The site is still covered by relatively undisturbed natural veld (subject only to continual grazing by livestock (cattle).
- However, the actual footprint overlays a Kalahari sand intrusion (not a substrate associated with the GWC), which in effect means that it supports vegetation associated with the Kalahari dunes, rather than with the Griqualand West Centre of Endemism;
- Also the vegetation itself is not considered vulnerable, the larger area might still be considered for inclusion into migration corridors between the rocky outcrops (the rocky outcrops in turn, might be considered important in terms of its florist value – being part of the GWC).
- The proposed site does include a number of Camel thorn trees, but is not associated with the Camelthorn forests as found at Kathu.

It is thus considered unlikely that the proposed footprint would be included into a CBA or ESA on strength of its floristic value alone. But it might have connectivity value (e.g. connecting various elements associated with the GWC) which might warrant its inclusion within a potential ESA (Refer to Figure 5). On the other hand, the

small size of the proposed development is unlikely to have any significant impact on connectivity within the larger area.

Figure 5: Google image showing the proposed site location (red) within the larger farm (blue) and immediate surroundings



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

No alien plant species was observed within the proposed footprint area (Refer to Table 6).

Table 6: 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).

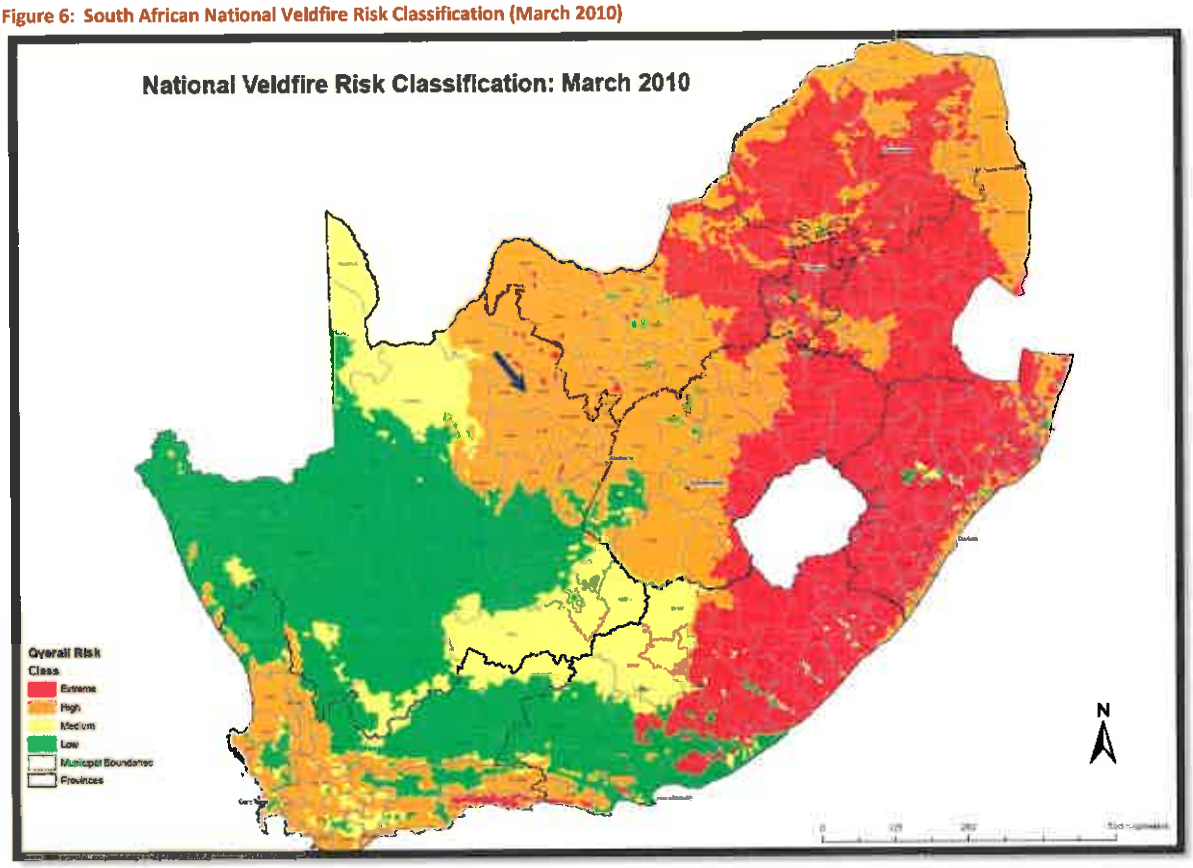
5.6 VELD FIRE RISK

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 medium-high shrubland which has been classified with a **High fire risk classification** (Refer to Figure 6). It is thus 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 6: 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 7 for categories used).

Table 7: 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 8, for categories used).

Table 8: 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 9).

Table 9: 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 10).

Table 10: 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 11).

Table 11: 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 12. 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 12: 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

The Savanna Biome has a relatively low species diversity ration, which is even lower in the southern Kalahari part of this biome (Rutherford et. al., 2006). Soil type and rainfall gradients often define vegetation type. Within Savanna, the co-dominance of tree-to-grass mixture is considered inherently unstable and is likely to be driven by soil type, rainfall patterns, fire and grazing pressure (herbivore), which in turn can largely determine plant community composition. Larger tree (canopies) is considered important micro-habitats and there can be major differences in the herbaceous layer under canopies and the areas between canopies. Grazing has for long been considered an important factor in regulating competitive interaction between plants (e.g. *Senegalia mellifera = Acacia mellifera* encroachment is often ascribed to 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.

The site visit showed no significant geographical features such as watercourses, wetlands, upland- down land gradients or vegetation boundaries on the site or limited to the site. The vegetation was rather homogenous as was the surrounding terrain. Further east, west and north rocky outcrops can be seen, but they did not intrude into the proposed footprint. It was likely that cattle grazing have impacted the site, but extent and significance there-off is hard to determine. The absence of traditional large herbivores (since intensive farming was introduced) is also likely to have shaped the current plant composition, but again this is difficult to determine.

7.1 BIOPHYSICAL ENVIRONMENT

No special habitats, geology or soils were encountered. In terms of land-use, the site is in relative good condition although and even though it is grazed by cattle, no immediate signs of over-grazing are evident. In the Kalahari dense stands of *Senegalia mellifera* ("Swarthaak") and *Rhigozum trichotomum* ("Drie-doring") is sometimes ascribed to overgrazing or bad veld management. In terms of the larger property, the proposed development should have little impact on available grazing land.

7.2 THREATENED OR PROTECTED ECOSYSTEMS

The Kuruman Thornveld vegetation type is not considered vulnerable or threatened with more 98% of this vegetation still remaining in its natural state. However, at present none of this vegetation type is formally protected in South Africa. It is thus important the viable areas are considered for inclusion into Conservation areas or CBA's or ESA's. Even though the site falls within the broad Griqualand West Centre of Endemism (GWC) (Heading 5.1) the proposed site is located on a Kalahari sand intrusion (a substrate not associated with the GWC) and thus unlikely to have any significant impact on the core vegetation type associated with the GWC. It is thus considered unlikely that the proposed footprint would be included into a CBA or ESA on

strength of its floristic value alone. But it might have connectivity value (e.g. connecting various elements associated with the GWC) which might warrant its inclusion within a potential ESA (Refer to Figure 5). On the other hand, the small size of the proposed development is 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 2 species protected in terms of the NFA (Heading 5.3.3) and four (4) species protected in terms of the NCNCA (Heading 5.3.4) was encountered. Of these, the most noteworthy is the presence of quite a number of medium sized Camel thorn- and Sheppard's trees. Should they have to be removed they will be compromised as both these species rarely (if ever) survives transplantation. However, since the actual development footprint only need to compromise about 50% of the total site, it is likely that with micro adjustment of the layout within the site, many of the protected trees can be saved. No species was recommended for search & rescue but topsoil (with its seedbank) protection and re-use will allow seed preservation and thus species distribution/relocation.

No watercourses or wetlands were observed on the property and because of its current landuse (cattle grazing) it is 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. The potential veld fire risk is high, and good fire management protocols will have to be implemented.

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 six renewable energy sites within a 30 km radius of the proposed Mount Roper site (Figure 7).

Of the six sites only one (Site 1 – Whitebank, in Figure 8) will falls within the same vegetation type as the proposed Mount Roper solar site. To the south, the south-west and north-west, 5 further sites are within the 30km radius (Site 3-6 in Figure 8), but they fall either within the *Kathu Bushveld*- or within *Gordonia Duneveld* vegetation types (Figure 8).

Name	Type	MW	Vegetation type
1. Whitebank Solar site on Farm Whitebank No. 379	Solar PV	10	Kuruman Thornveld
2. Kalahari Solar Project on Farm Kathu No. 465	Not listed	Not listed	Kathu Bushveld
3. Solar Power site on Farm Adams 328	Solar PV	19	Kathu Bushveld
4. Solar site on Portion 1 of Farm Shirley No. 367	Solar PV	75	Kathu Bushveld
5. Roma Energy Middelplaats	Solar PV	Not listed	Kathu Bushveld
6. Renewable Energy Project on Portion 2 of Farm East No. 270	Solar PV	75	Gordonia Duneveld

Figure 7: Indicating approved renewable energy sites within 30km radius of the proposed Mount Roper Solar site

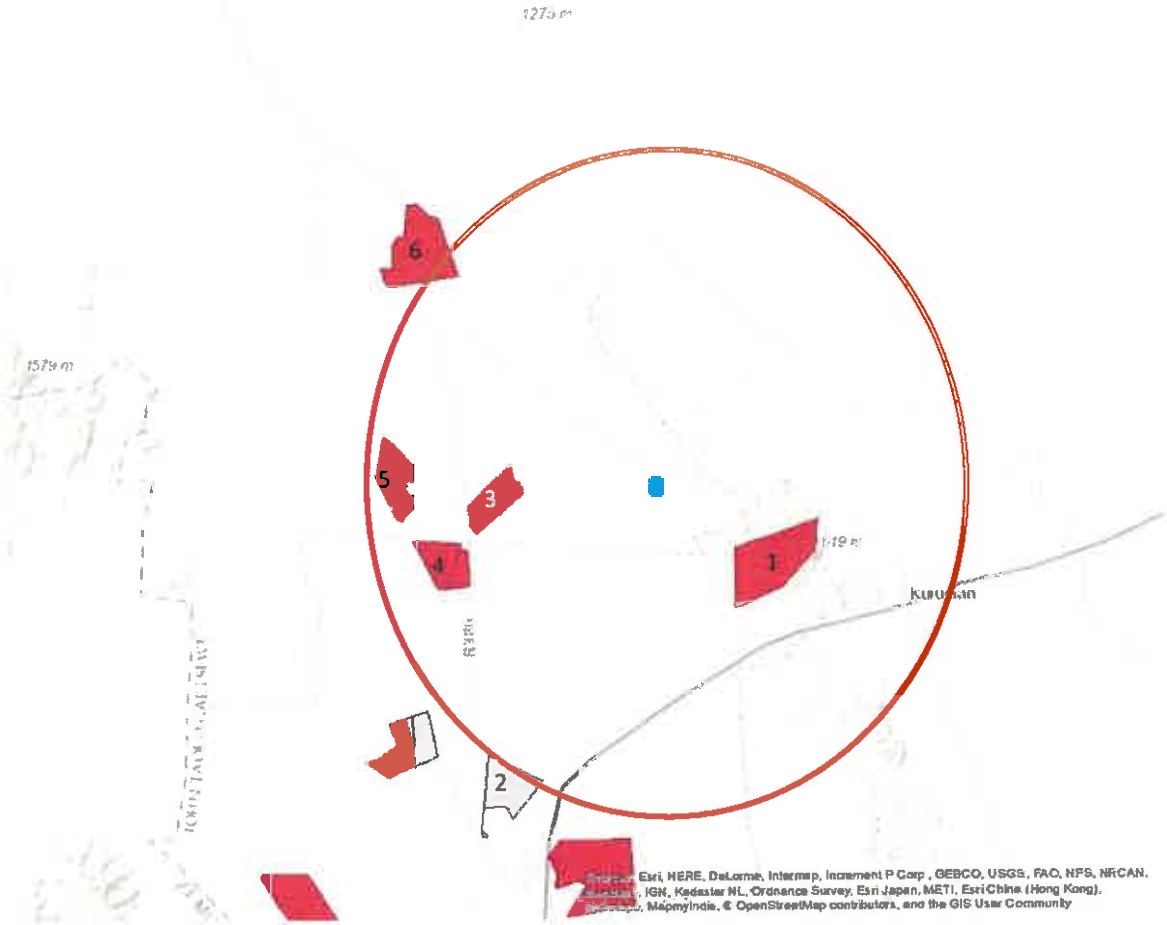
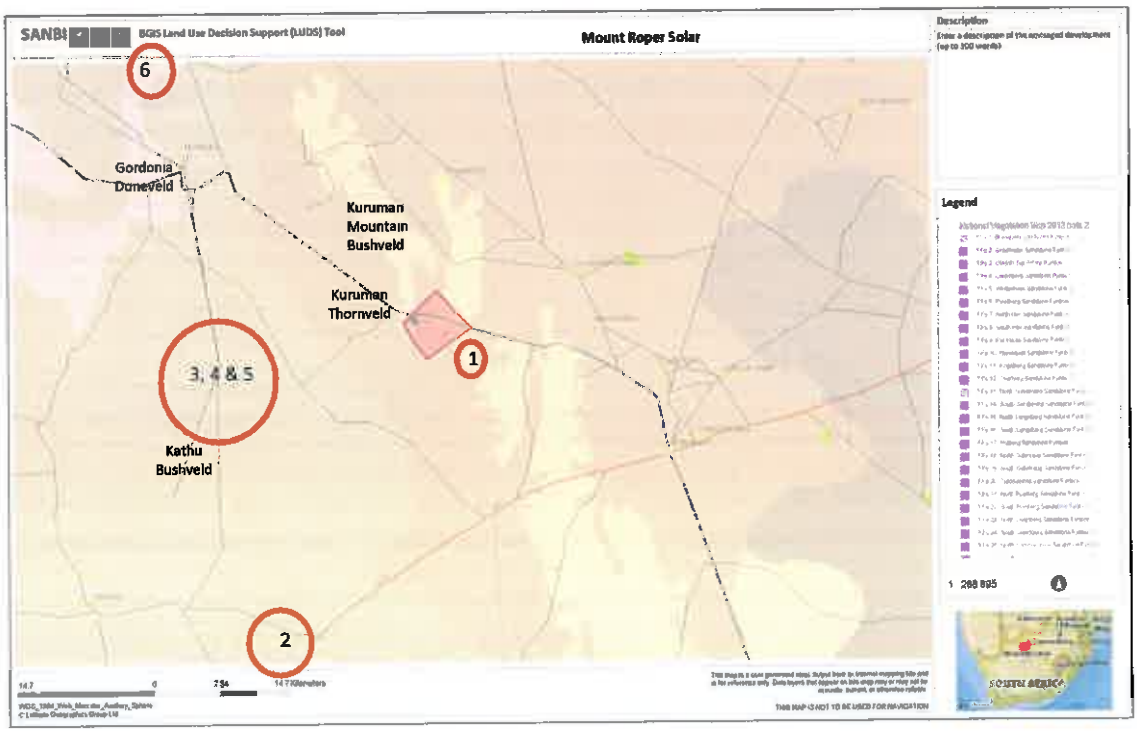


Figure 8: The vegetation map of South Africa (2012, beta version) showing the vegetation associated with the RE sites within 30km



The proposed Mount Roper development is small (<20ha) and will impact on Kuruman Thornveld and possible on the Griqualand West Centre of endemism (GWC). Kuruman Thornveld vegetation type is not considered vulnerable or threatened with more 98% still remaining in its natural state. Ecological connectivity is still very good for most of the Mount Roper 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 impact will be on the Camel thorn- and Sheppard's on the site. In the case of the Mount Roper Solar site, the only other solar sites within 30km that will impact on the same resource will be Site 1 in Figure 7 & Figure 8.

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 13).

7.4 IMPACT EVALUATION

Table 13 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 13: 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	2	8	1	2	3	1	2	8	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.	2	2	3	1	2	16	2	2	2	1	1	12	More than 98% of this vegetation remains in its natural state, but none formally conserved. Mitigation - Minimise impact on large indigenous trees and minimise footprint.
Connectivity	Possible loss of ecosystem function as a result of habitat fragmentation.	2	1	3	1	1	12	2	1	2	1	1	10	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.	2	1	3	1	2	14	2	1	2	1	1	10	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 encountered.
Flora	Possible loss of threatened or protected species.	4	4	4	1	2	44	4	3	3	1	2	36	Protected species of high significance. 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	3	1	1	6	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	2	3	1	1	7	1	2	2	1	1	6	Unlikely to impact significantly on any single species. No mitigation required.
Invasive alien	Possible alien infestation as a	0	0	0	0	0	0	0	0	0	0	0	0	No AIS observed.

Aspect	Short description	CV	Lik	Dur	Ext	Sev	Sig. before Mit.	CV	Lik	Dur	Ext	Sev	Sig. after Mit.	Short discussion
species	result of activities.													
Veld fire	The risk of veld fires as a result of the proposed activities.	2	4	3	3	2	24	2	2	2	2	2	16	Veld fire risk is high and can lead to impacts on the surroundings. Fire protection high priority.
Accumulative	Accumulative impact associated with the proposed activity.	4	4	4	3	2	52	2	3	3	2	2	40	Accumulative impacts should be low as long as risks such as veld fires are managed.
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 Mount Roper development is expected to have a **Medium cumulative** impact, with the most significant aspect being the potential impact on the protected trees encountered within the site and to a lesser degree potential accidental veld fires.

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. It should be possible to reduce the direct impact on large protected trees significantly (e.g. protecting all Camel thorn trees larger than 6 m by default, avoiding tree clusters as well as trees on the outskirts of the site and minimising the actual development footprint wherever possible). The 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 tree 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 to **Medium-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, especially the potential impact on larger Camelthorn and Sheppard's trees;
- possible accidental veld fires; and
- the location of the site within the Griqualand West Centre of Endemism.

However, there is potential of minimising the impacts significantly, 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 & NEMBA, for the removal of any protected species**. But final layout plans must aim at minimising the direct impact on all protected tree species and no *Vachellia erioloba* (Camel thorn trees) tree larger than 6m must be removed.
- 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 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

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APPENDIX 1

Plant species checklist for Kuruman Thornveld (SANBI: BGIS)

FAMILY NAME	GROWTH FORM	SPECIES NAME
FABACEAE	Tall Tree	*Acacia erioloba*
FABACEAE	Tall Shrub	*Acacia haematoxylon*
FABACEAE	Low Shrubs	*Acacia hebeclada subsp. hebeclada*
FABACEAE	Small Trees	*Acacia luederitzii var. luederitzii*
FABACEAE	Small Trees	*Acacia mellifera subsp. detinens*
POACEAE	Graminoids	*Aristida meridionalis*
POACEAE	Graminoids	*Aristida stipitata subsp. stipitata*
ACANTHACEAE	Low Shrub	*Blepharis marginata*
CAPPARACEAE	Small Trees	*Boscia albitrunca*
MALVACEAE	Herb	*Corchorus pinnatipartitus*
ASTERACEAE	Herbs	*Dicoma schinzii*
POACEAE	Graminoid	*Digitaria polyphylla*
FABACEAE	Geoxylic Suffrutex	*Elephantorrhiza elephantina*
POACEAE	Graminoids	*Eragrostis echinochloidea*
POACEAE	Graminoids	*Eragrostis lehmanniana*
GISEKIACEAE	Herbs	*Gisekia africana*
ASTERACEAE	Herb	*Gnaphalium englerianum*
THYMELAEACEAE	Low Shrubs	*Gnidia polycephala*
MALVACEAE	Tall Shrubs	*Grewia flava*
CELASTRACEAE	Tall Shrubs	*Gymnosporia buxifolia*
PEDALIACEAE	Herbs	*Harpagophytum procumbens subsp. procumbens*
ASTERACEAE	Low Shrubs	*Helichrysum zeyheri*
MALVACEAE	Low Shrubs	*Hermannia comosa*
FABACEAE	Herbs	*Indigofera daleoides*
MOLLUGINACEAE	Herbs	*Limeum fenestratum*
SOLANACEAE	Tall Shrubs	*Lycium hirsutum*
POACEAE	Graminoids	*Melinis repens*
ACANTHACEAE	Low Shrubs	*Monechma divaricatum*
ASTERACEAE	Herbs	*Nolletia ciliaris*
ASTERACEAE	Low Shrubs	*Pentzia calcarea*
AIZOACEAE	Low Shrubs	*Plinthus sericeus*
CONVOLVULACEAE	Herbs	*Seddera capensis*
ASTERACEAE	Tall Shrubs	*Tarchonanthus camphoratus*
COMBRETACEAE	Small Trees	*Terminalia sericea*
ASTERACEAE	Herbs	*Tripteris aghillana*
VAHLIACEAE	Herbs	*Vahlia capensis subsp. vulgaris*

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Years Experience: With Organisation:	Since March 2011
In field of Speciality:	Since 1997

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- 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

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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)

MOUNT ROPER
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 27, 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	**Kuruman Thornveld:** Kuruman Thornveld is described as occurring on flat rocky plains and slopping hills with a very well-developed, closed shrub layer and well-developed open tree stratum consisting of *Acacia erioloba*. **Least Threatened:** Although more than 98% of this vegetation type remains, none is formally conserved.
LAND USE AND COVER	The study area is situated in a shallow north-south valley within the northern portion of the Kuruman hills. The property and its immediate surroundings are used primarily as a game camp. Natural game is still present or has been re-introduced.
RED DATA PLANT SPECIES	None encountered or expected Protected Trees: A number of *Acacia erioloba* as well as *Boscia albitrunca* trees have been observed. The final solar site location was chosen to avoid watercourses, but a number of the protected tree species is still located within the proposed final site (and will most probably be compromised). It is imperative that a botanist/ECO be present during the initial layout of the infrastructure in order to reduce the impact on these species and to exercise good environmental control during construction.
IMPACT ASSESSMENT	Development without mitigation: Sig. rating = 40% Development with mitigation Significance = 16% 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 proposed final Mount Roper site location was fairly well chosen from a biodiversity viewpoint. 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, a number of protected tree species will most likely be compromised and 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 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 at the author's disposal it is recommended that the project be approved, but that all mitigation measures described in this document is implemented and that a botanist or suitably qualified ECO be appointed during the initial layout of the structures in order to minimise the impact on the protected tree species.

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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 on the remainder of the Farm Mount Roper No. 321, Kuruman (Northern Cape Province, Gamagara Local Municipality). The facility will be established on an area of approximately 20 ha, on a portion of Farm 321, located approximately 31 km north-west of Kuruman just of (and to the south) of the R31. 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 on the remainder of the Farm Mount Roper, No. 321, Kuruman (Northern Cape Province, Gamagara Local Municipality). The facility will be established on an area of approximately 20 ha, on a portion of Farm Mount Roper no. 321, located approximately 31 km north-west of Kuruman just of (and to the south) of the R31.

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 R31, 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.

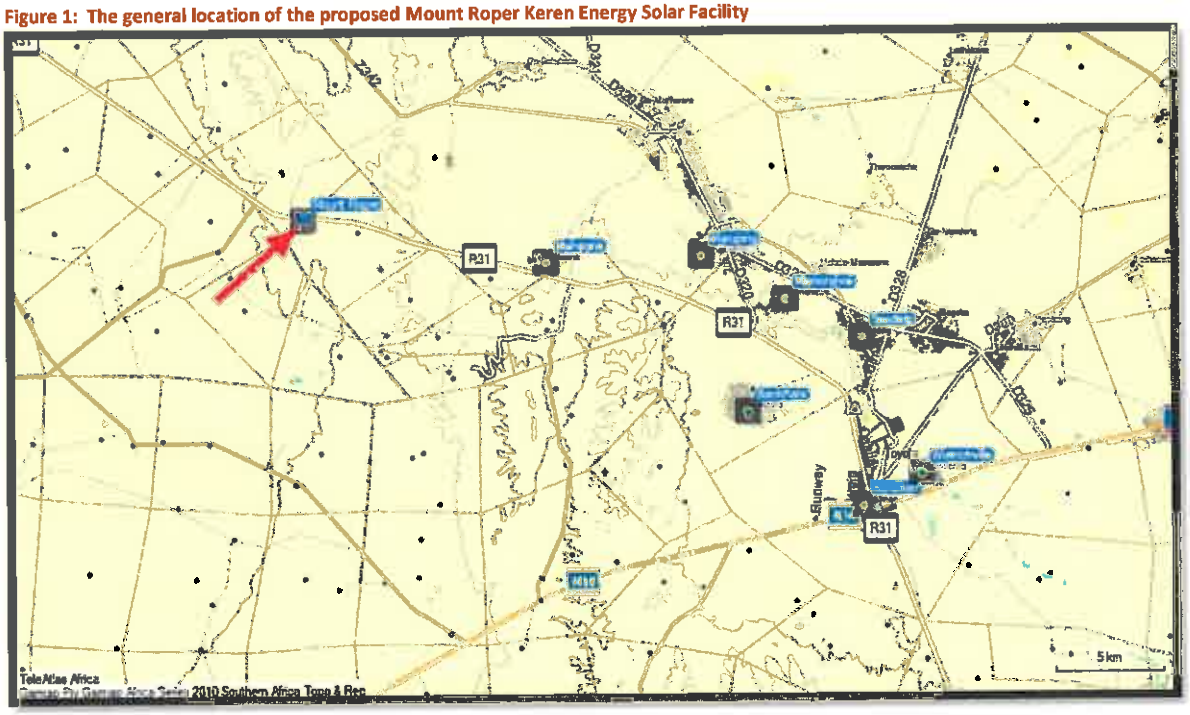
DESCRIPTION OF ENVIRONMENT

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

The proposed Mount Roper Solar Site is located in the Northern Cape Province (Gamagara Local Municipality), on the Remainder of the Farm Mount Roper, No. 321, Kuruman. The facility will be established on an area of approximately 20 ha, on a portion of Farm 321, located approximately 31 km north-west of Kuruman just of (and to the south) of the R31. (Refer to Figure 1).

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



Please note that the original site was larger than 20 ha (Refer to Figure 2). This was also the broad area evaluated during the initial biodiversity assessment. The proposed final solar site was located within this broad site (Refer to Figure 4).

Figure 2: Broad proposed site location for the proposed Mount Roper solar site

Figure 3 and Figure 4 indicates the proposed final site location.

Figure 3: Proposed final site location (showing an overlay of the proposed solar units)

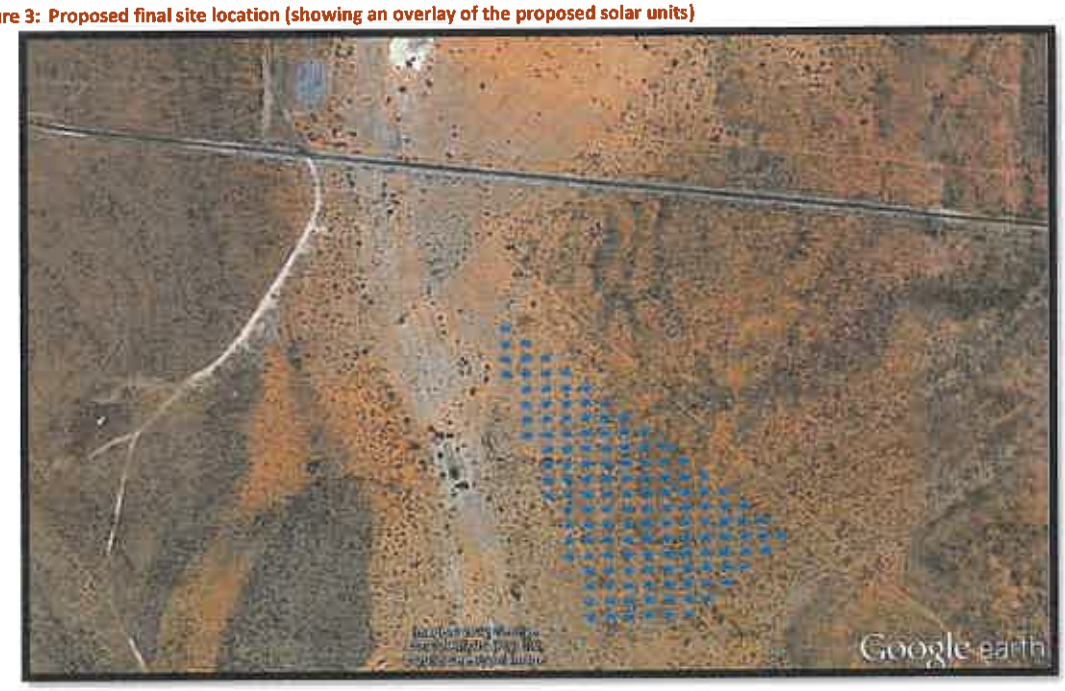


Figure 4: Final solar site location (approximately 20 ha)

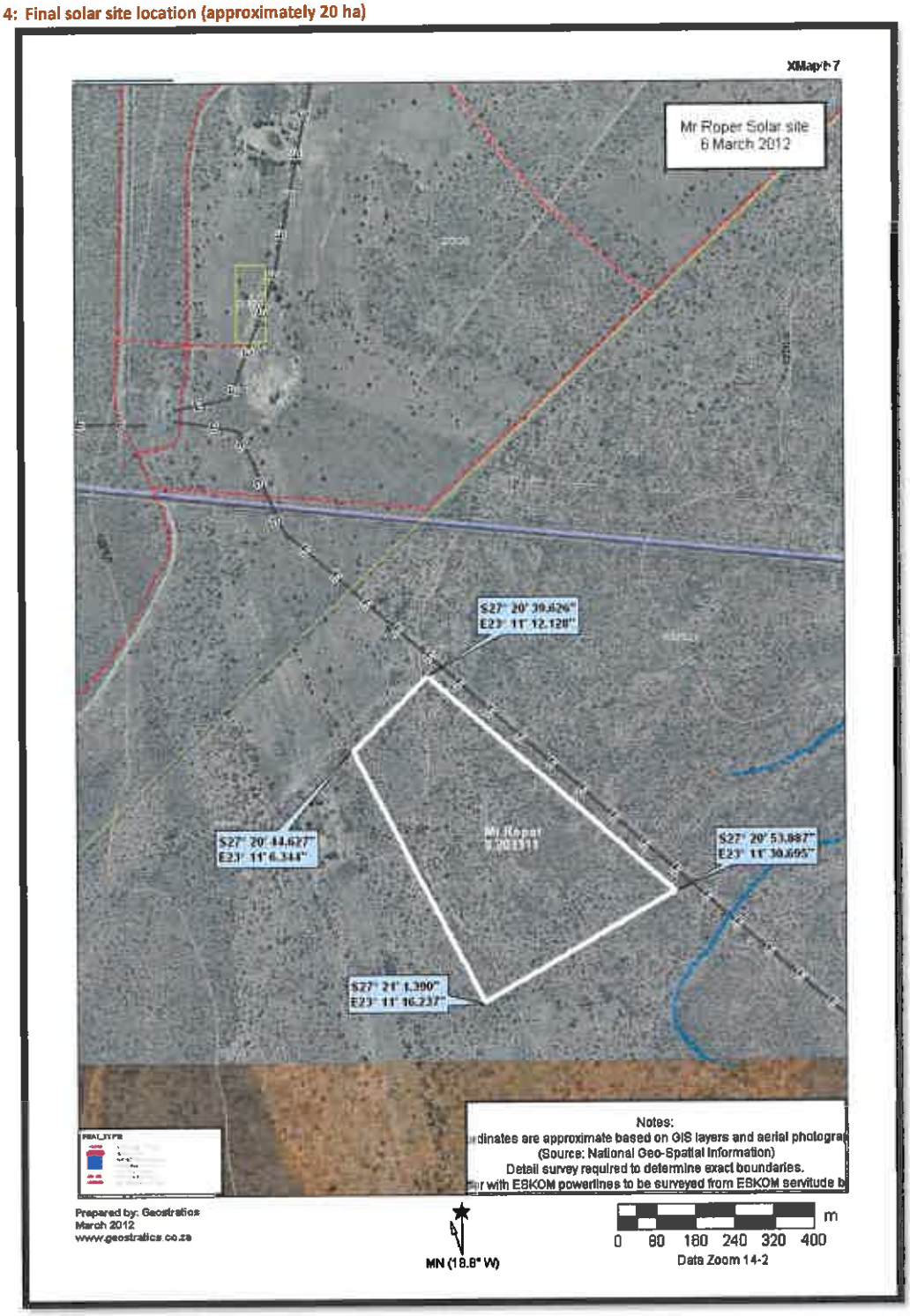


Table 1: GPS coordinates describing the boundaries of the final proposed solar site location (WGS 84 format)

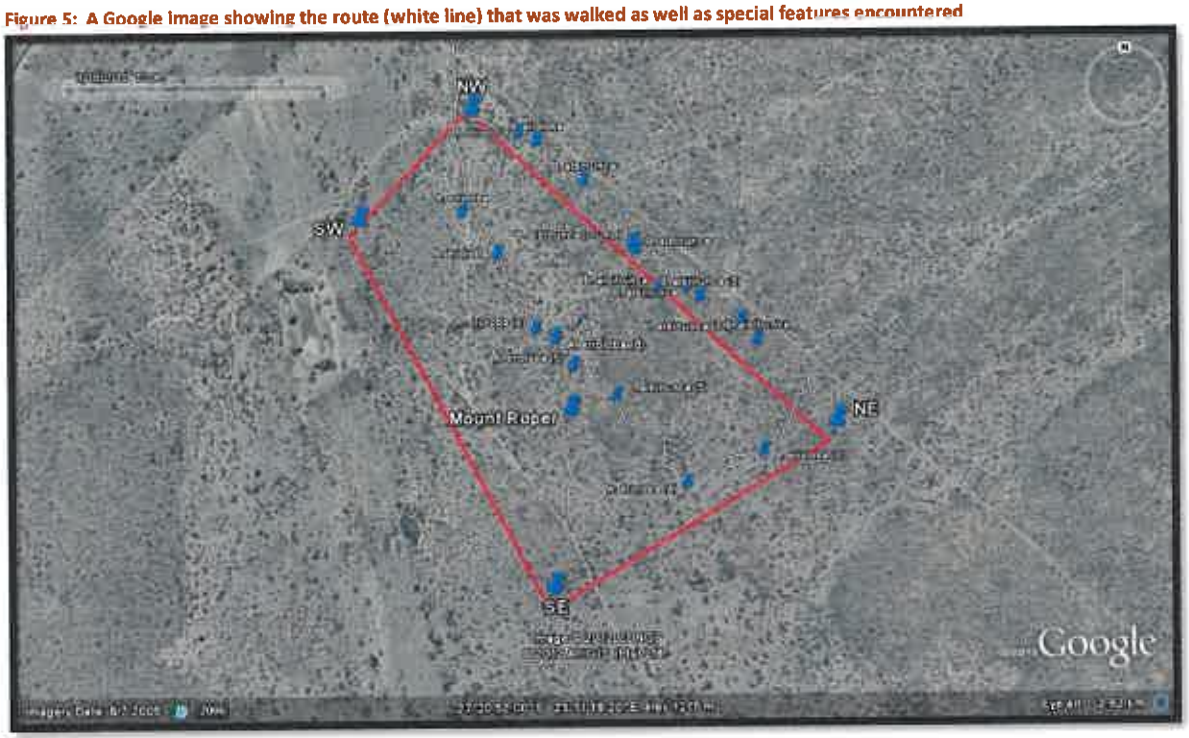
DESCRIPTION	LATITUDE AND LONGITUDE	ALTITUDE
North-west corner	S27 20 39.6 E23 11 12.1	1214 m
North-east corner	S27 20 53.9 E23 11 30.7	1218 m
South-east corner	S27 21 01.4 E23 11 16.2	1214 m
South-west corner	S27 20 44.6 E23 11 06.3	1212 m

METHODS

Various desktop studies were conducted, coupled by a physical site visit at the end of January 2012 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 5) 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 5: A Google image showing the route (white line) that was walked as well as special features encountered



**A. erioloba = Acacia erioloba* (Camel Thorn); *B. albitrunca = Boscia albitrunca* (Sheppard's tree)

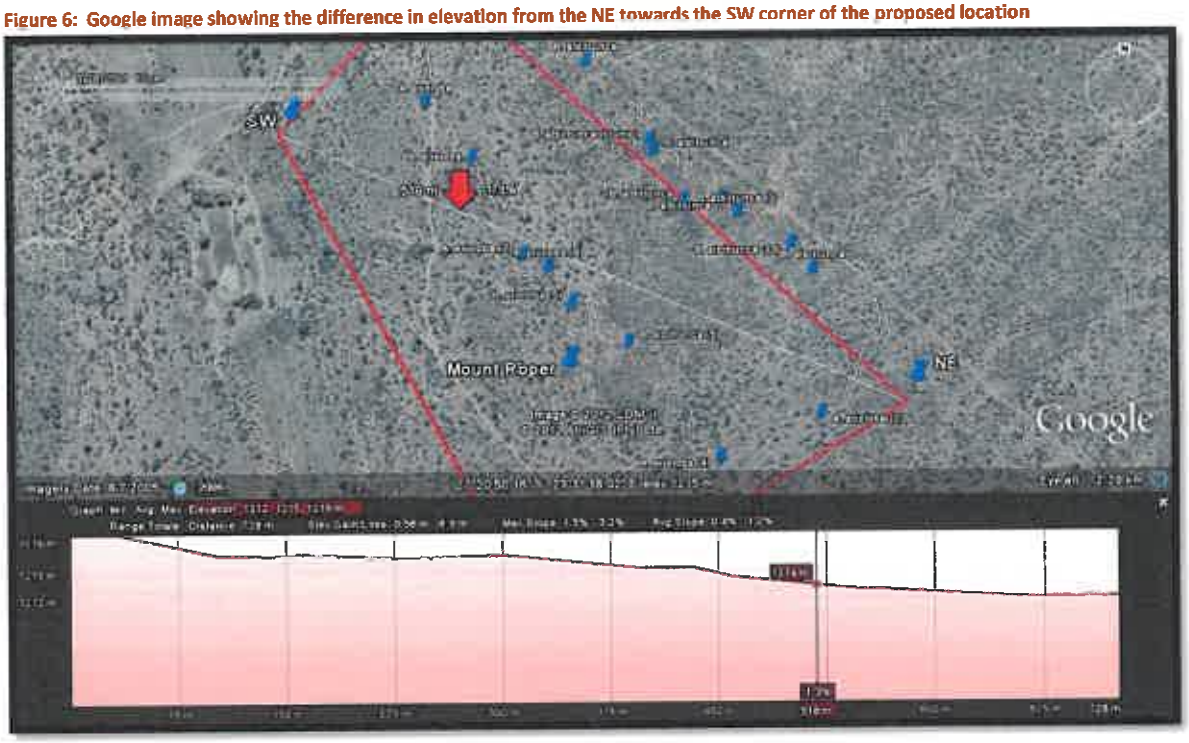
Note that the site visit was based on the original proposed site location (Refer to Figure 2). The final proposed location was situated within this broader site (Refer to Figure 5).

TOPOGRAPHY

The proposed final site is located on an almost level area at the floor of a very shallow north-south valley within the northern portion of the Kuruman hills (north- west of Kuruman). Elevation data in Table 1 and Figure 6, shows that the site slopes very slightly from the north-east towards the south-west (into the valley bottom). Elevation varies from 1218 m (north-east corner) towards the south-west at 1212 m with an average slope of 0.4% and an elevation loss of approximately 7 m.

No natural watercourses or drainage lines have been encountered on the final site location or anywhere near the final site location.

Figure 6: Google image showing the difference in elevation from the NE towards the SW corner of the proposed location



CLIMATE

All regions with a rainfall of less than 400 mm per year are regarded as arid. Kuruman normally receives about 266 mm of rain per year, with most rainfall occurring mainly during summer. It receives the lowest rainfall (0 mm) in June and the highest (58 mm) in February. The monthly distribution of average daily maximum temperatures (centre chart below) shows that the average midday temperatures for Kuruman range from 17.5°C in June to 32.6°C in January. The region is the coldest during June when the mercury drops to 0°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 7 to Figure 10).

Figure 7: Kuruman average minimum and maximum temperatures (www.weather-and-climate.com)

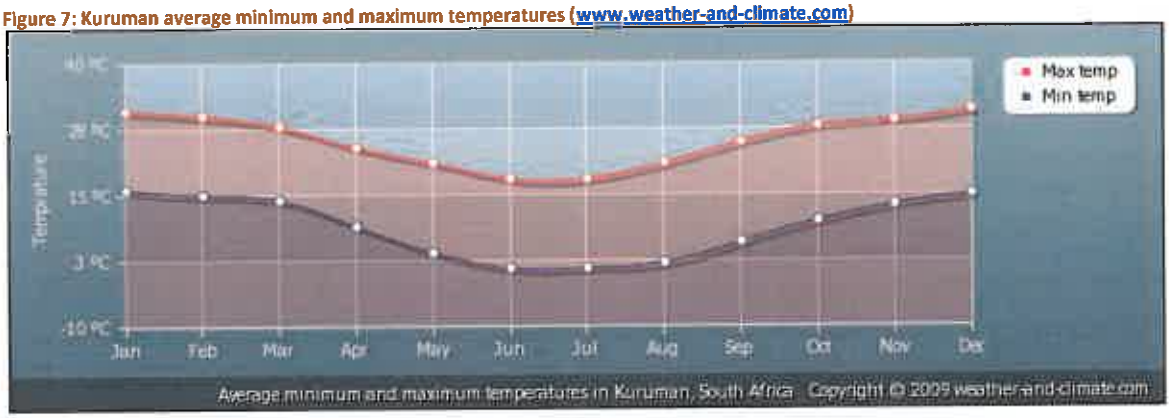


Figure 8: Kuruman average monthly precipitation over the year (www.weather-and-climate.com)

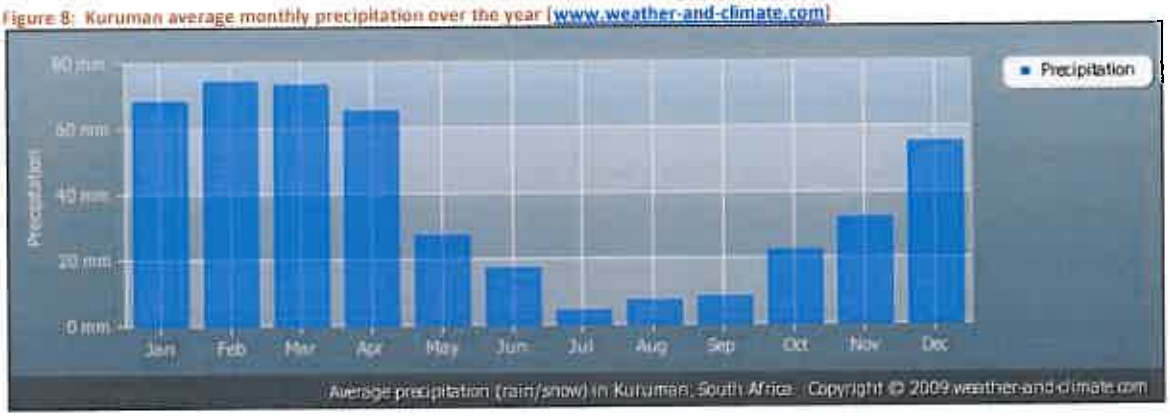


Figure 9: Kuruman average monthly hours of sunshine over the year (www.weather-and-climate.com)

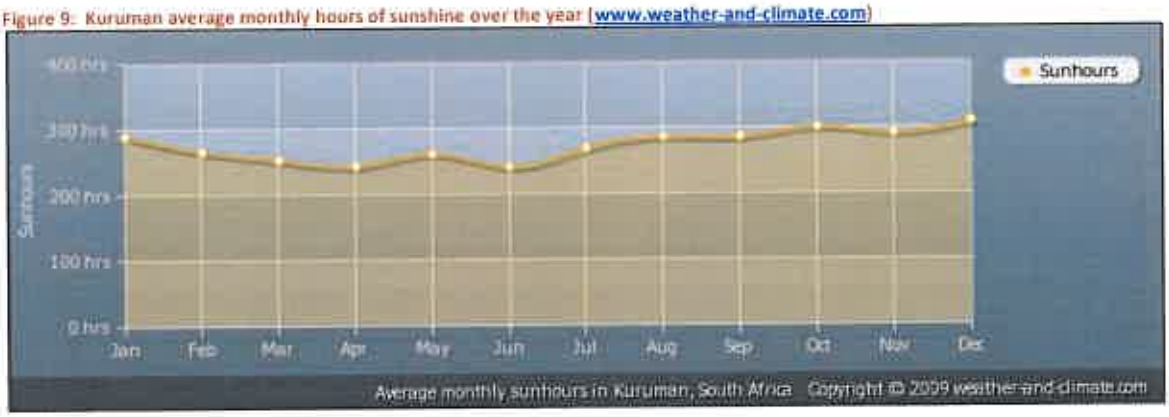
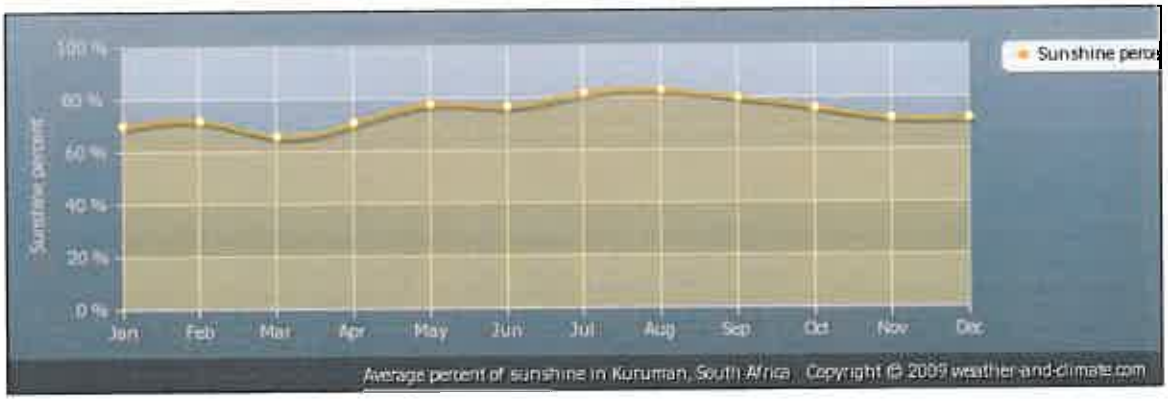


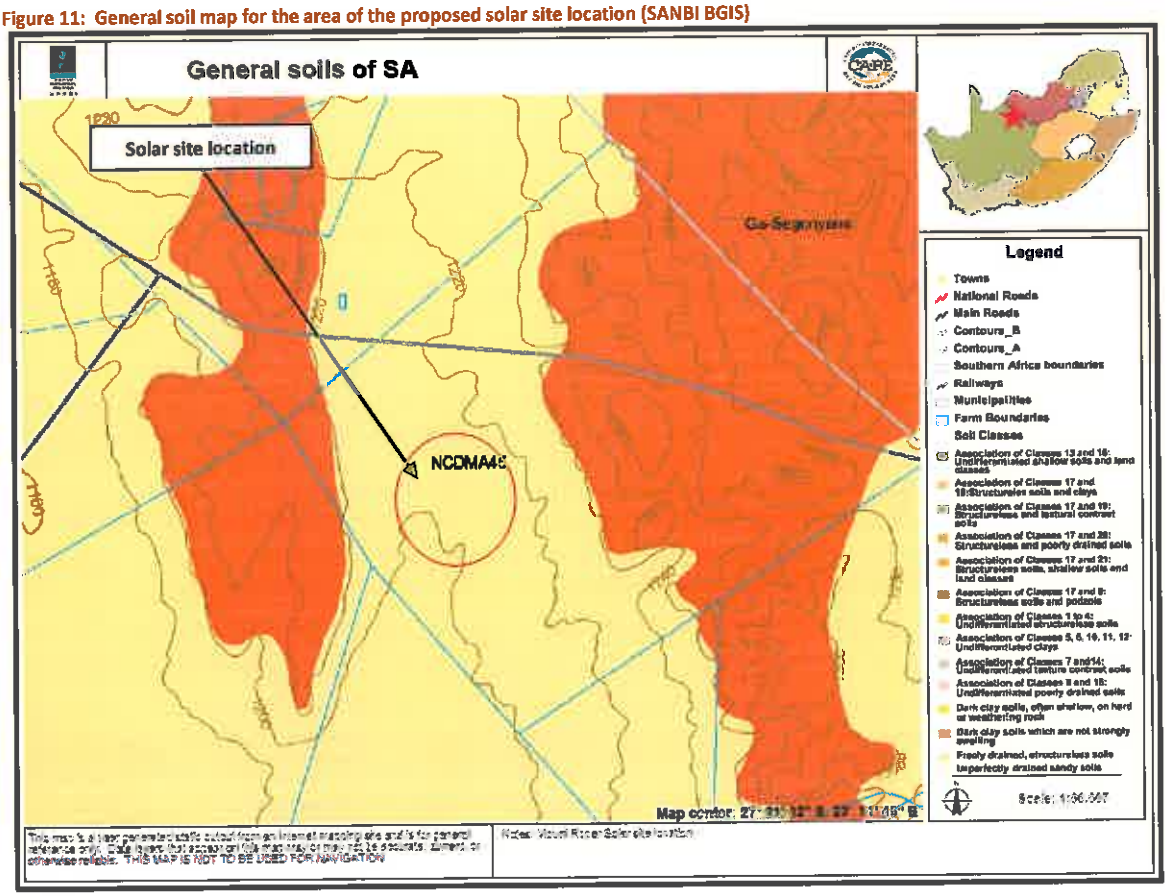
Figure 10: Kuruman average percent of sunshine over the year (mean % of sun hours during the day) (www.weather-and-climate.com)



GEOLOGY & SOILS

According to Mucina and Rutherford (2006) and the SANBI Biodiversity Geographical Information System, the geology is described as some Campbell Group dolomite and chert and mostly younger, superficial Kalahari Group sediments with red wind-blown sands. Locally, rocky pavements formed in places. Soils (Refer to Figure 11) are described as red en yellow well drained structure less sandy soils with a high base status. The soils may have restricted soil depth with excessive drainage, high erodibility and low natural fertility. Land types are mainly Fc with some Ae, Ai, Ag and Ah with Hutton soil forms (Mucina & Rutherford, 2006).

Figure 11: General soil map for the area of the proposed solar site location (SANBI BGIS)



No special soils or geology features (e.g. quartz patches or broken veld), which could support special botanical features, were observed during the site visit (or are expected).

LANDUSE AND COVER

The study area is situated in a shallow north-south valley within the northern portion of the Kuruman hills (north-west of Kuruman). The property and its immediate surroundings are used primarily as a game camp. Various game species have been re-introduced to the site and have been observed (refer to Figure 12).

Natural vegetation forms a medium-dense cover over the entire property, varying in composition from pockets encroached by dense stands of *Acacia mellifera* to areas dominated by a more open woodland with *Tarchonanthus camphoratus, Ziziphus mucronata, Grewia flava* and *Acacia erioloba* forming bush patches. During the site visit the main biodiversity feature of significance observed, was the remaining natural veld (and the presence of various protected trees, *Acacia erioloba* as well as *Boscia albitrunca*). No watercourses or even drainage lines have been observed on the proposed solar site location.

Figure 12: A Google image giving an indication of the land use on the proposed solar site

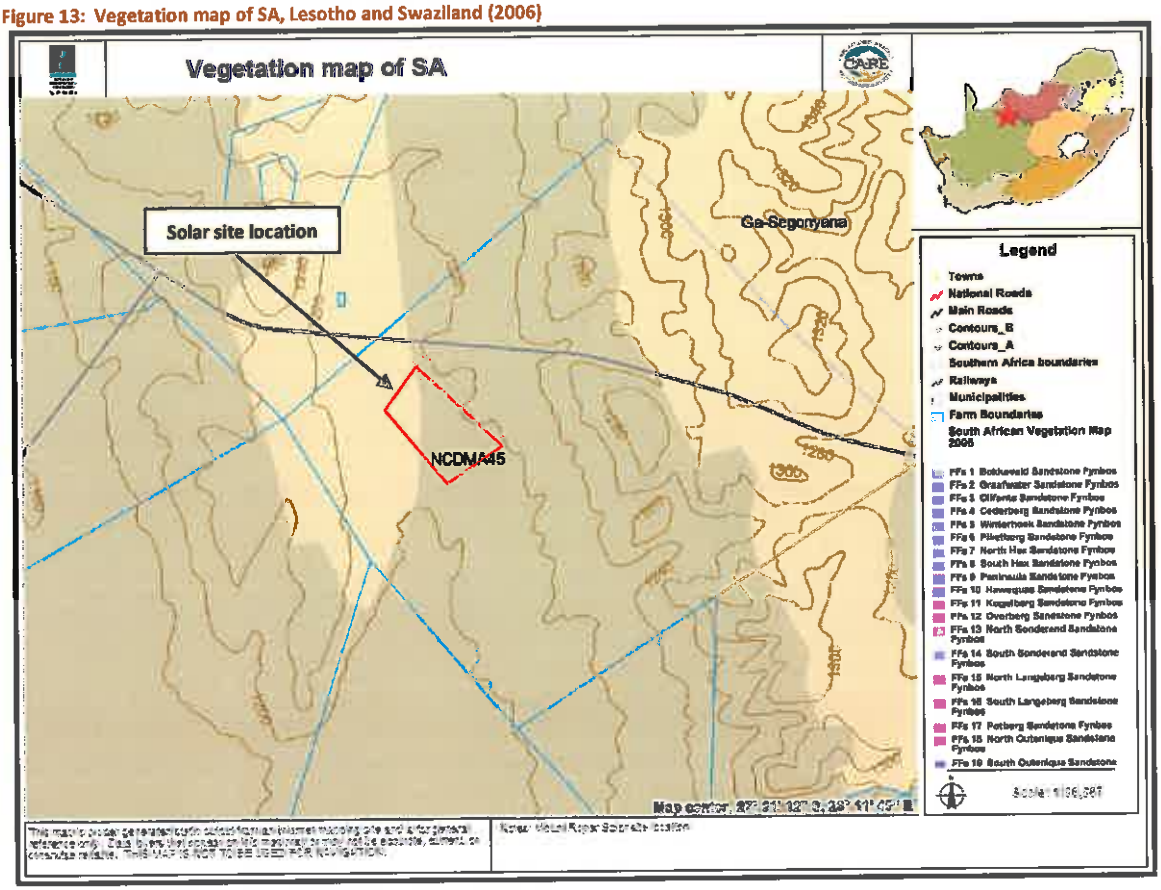
VEGETATION TYPES

In accordance with the 2006 Vegetation map of South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2006) two broad vegetation types is expected in the proposed area and its immediate vicinity, namely Kuruman Thornveld (Darker brown in Figure 13) with the possibility of Kuruman Mountain Bushveld (Lighter brown in Figure 13) to the south-east of the site. However, during the site visit it was confirmed that only Kuruman Thornveld was encountered in the larger study area and that the Kuruman Mountain Bushveld starts some distance to the south (the vegetation distribution conforming much more to that of the soil map than that of the vegetation map in this instance).

As a result only Kuruman Thornveld is discussed in this report. This vegetation type was classified as "Least Threatened" during the 2004 National Spatial Biodiversity Assessment (NSBA). More than 98% of this vegetation still remains in its natural state, but at present none of this vegetation type is formally protected 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, **Kuruman Thornveld, remains classified as Least Threatened**.

Figure 13: Vegetation map of SA, Lesotho and Swaziland (2006)



According to Mucina & Rutherford (2006), Kuruman Thornveld is found in the North-West and Northern Cape Provinces on flats from the vicinity of Postmasburg and Danielskuil (here west of the Kuruman hills) in the south extending via Kuruman to Tsineng and Dewar in the North at altitudes varying from 1 100 -1 500 m.

KURUMAN THORNVELD

Kuruman Thornveld is described as occurring on flat rocky plains and slopping hills with a very well-developed, closed shrub layer and well-developed open tree stratum consisting of *Acacia erioloba* (Mucina & Rutherford, 2006) with *Tarchonanthus camphoratus* prominent in the shrub layer (Refer to Photo 1).

Acocks (1953) described this vegetation as Kalahari Thornveld and Shrub Bushveld while Low & Rebelo (1996) described this vegetation as Kalahari Plains Thorn Bushveld.

Photo 1: Natural veld in the study area, note *Tarchonanthus camphoratus* and *Acacia mellifera* in the dense shrub layer

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

Tall tree: *Acacia erioloba*.

Small trees: *Acacia mellifera* subsp. *detinens and Boscia albitrunca.*

Tall shrubs: *Grewia flava, Lycium hirsutum, Tarchonanthus camphoratus* and *Gymnosporia buxifolia*.

Low shrubs: *Acacia hebeclada, Monechma divaricatum, Gnidia polycephala, Helichrysum zeyheri, Hermannia comosa, Pentzia calcarea* and *Plinthus sericeus.*

Graminoides: *Aristida meridionalis, A. stipitata, Eragrostis lehmanniana, E. echinochloidea* and *Melinis repens*.

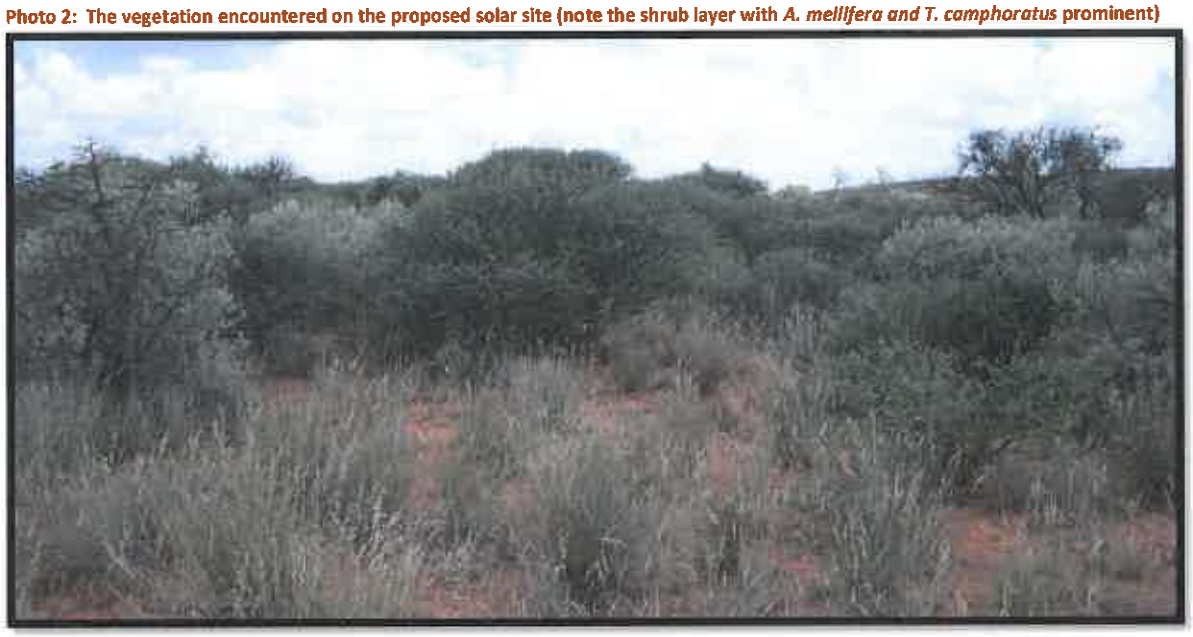
Herbs: *Dicoma schinzii, Gisekia africana, Harpagophytum procumbens, Indigofera daleoides, Limeum fenestratum, Nolletia ciliaris, Seddera capensis, Tripteris aghillana* and *Vahlia capensis*.

VEGETATION ENCOUNTERED

The vegetation encountered conforms (including that of the larger study area) to that of Kuruman Thornveld and supported a well developed woody shrub/small tree layer (varying between 1-2.5 m in height) with open grassy patches in between (probably the result of continual grazing) with occasional individuals of both *Acacia erioloba* and *Boscia albitrunca* commonly present (reaching up to 4 m in height). In fact quite a number of both *Acacia erioloba* and *Boscia albitrunca* trees were observed within the larger study area (a trend which is supported throughout most of the immediate vicinity of the proposed solar site location. In other words moving the proposed solar site location within the larger study area will not lessen the impact on these tree species. The larger study area was fairly uniformly covered by the same vegetation composition. Vegetation cover was between 60-75%.

The woody shrub/small tree layer was dominated by *Acacia mellifera* and *Tarchonanthus camphoratus* (Vaalbos) with *Acacia hebeclada*, *Ziziphus mucronata*, *Searsia dregeana*, *Grewia flava* and *Gymnosporia buxifolia* prominent. Other species encountered includes *Searsia* cf *burchelli*, *Acacia erioloba*, *Asparagus retrofractus*, *Asparagus capensis Boscia albitrunca* and grass species like *Schmidtia-*, *Fingerhuthia-*, *Themeda-*, *Aristida-* and *Eragrostis* species also present. (Refer to Photo 2Photo 3).

Photo 2: The vegetation encountered on the proposed solar site (note the shrub layer with *A. mellifera and T. camphoratus* prominent)



Both *Acacia erioloba* and *Boscia albitrunca* was regularly observed forming an over layer over the shrub layer (Refer to Photo 3), often encountered in clumps.

Photo 3: *Acacia erioloba* clump, commonly found within the larger area

ENDEMIC OR PROTECTED PLANT SPECIES

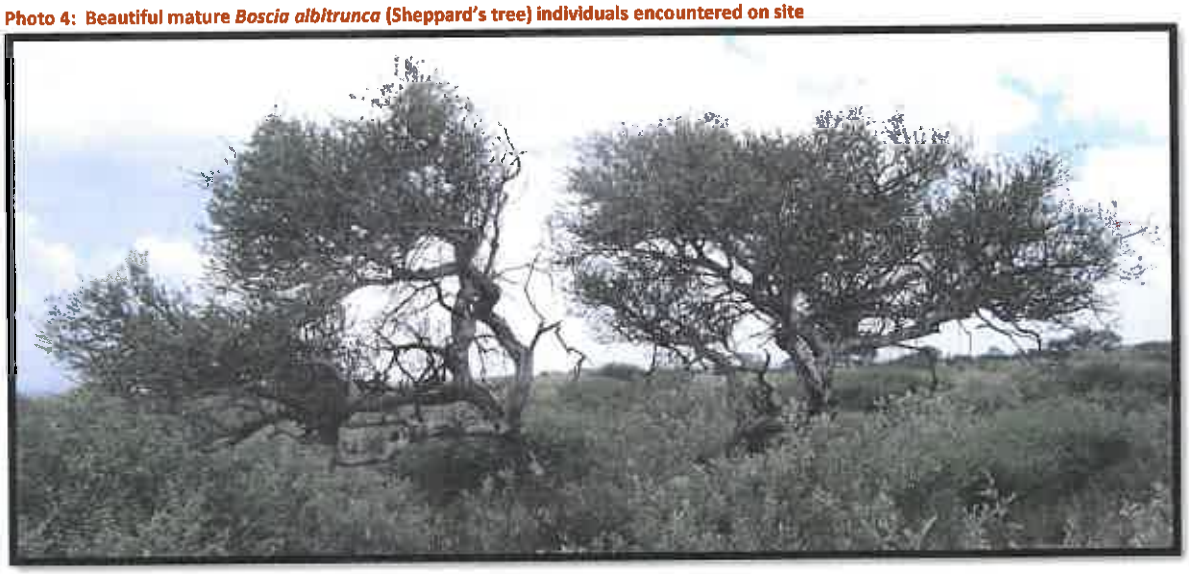
According to Mucina & Rutherford (2006), the only endemic taxon which might be encountered is the herb *Gnaphalium englerianum*. This Asteraceae species was not encountered during the site visit and although it might be present within the area on which the solar site is to be located it is not expected to contribute significantly towards regional conservation targets.

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.

Photo 4: Beautiful mature *Boscia albitrunca* (Sheppard's tree) individuals encountered on site



During the site visit, a number of single trees as well as clumps of both *Acacia erioloba* and *Boscia albitrunca* were encountered distributed throughout the proposed final solar site location. All trees and clumps encountered were marked with GPS coordinates (Refer to Table 3) and plotted on a map (Refer to Figure 5). Although a large number of both species was encountered, the same hold true for the surrounding area (the remainder of the farm in the immediate vicinity).

Moving the site within this portion of the farm will not make any sense since the same pattern of distribution holds true for the immediate surroundings. In addition, moving the sites might mean that some of the watercourses (expected to the east of the proposed final location) might be impacted.

Table 3: A list of protected trees encountered during the site visit and their GPS co-ordinates

NO	SPECIES NAME	COMMON NAME	NUMBER OF TREES	LOCATION
1.	*Acacia erioloba*	Camel thorn	1	S27 20 36.1 E23 11 08.8
2.	*Acacia erioloba*	Camel thorn	1	S27 20 40.8 E23 11 14.5
3.	*Acacia erioloba*	Camel thorn	1	S27 20 41.1 E23 11 15.4
4.	*Boscia albitrunca*	Sheppard's tree	1	S27 20 43.0 E23 11 17.8
5.	*Boscia albitrunca*	Sheppard's tree	clump	S27 20 45.7 E23 11 20.3
6.	*Boscia albitrunca*	Sheppard's tree	1	S27 20 46.1 E23 11 20.4
7.	*Boscia albitrunca*	Sheppard's tree	1	S27 20 47.8 E23 11 21.6
8.	*Boscia albitrunca*	Sheppard's tree	1	S27 20 47.8 E23 11 23.1
9.	*Boscia albitrunca*	Sheppard's tree	3	S27 20 48.2 E23 11 23.7
10.	*Boscia albitrunca*	Sheppard's tree	11	S27 20 49.3 E23 11 25.8
11.	*Boscia albitrunca*	Sheppard's tree	1	S27 20 50.2 E23 11 26.6
12.	*Acacia erioloba*	Camel thorn	2	S27 20 55.2 E23 11 26.9
13.	*Acacia erioloba*	Camel thorn	4	S27 20 56.7 E23 11 23.0
14.	*Boscia albitrunca*	Sheppard's tree	5	S27 20 52.7 E23 11 19.4
15.	*Acacia erioloba*	Camel thorn	5	S27 20 51.3 E23 11 17.2
16.	*Acacia erioloba*	Camel thorn	8	S27 20 50.1 E23 11 16.3
17.	*Acacia erioloba*	Camel thorn	2	S27 20 49.7 E23 11 15.3
18.	*Acacia erioloba*	Camel thorn	1	S27 20 46.2 E23 11 13.4
19.	*Acacia erioloba*	Camel thorn	1	S27 20 44.3 E23 11 11.6

MAMMAL AND BIRD SPECIES

The farm is managed as a game camp and it is clear that the property still supports a number of game species, birds and other fauna. It was noted that the area in which the final proposed site is to be located seems to have be heavily grazed over a long period of time. However, viewed in the larger context of the game reserve, the 20 ha solar facility will not pose a significant loss of grazing and the proposed solar site facility is not expected to have a major impact on regional biodiversity and with mitigating and good environmental control during construction the impact could be minimised.

According to the Sanparks website (www.sanparks.org.za/parks/mokala), the nearby Mokala National Park is host to a varied spectrum of birds which adapted to the transition zone between Kalahari and Karoo biomes. Birds that can be spotted are the Kalahari species, black-chested prinia and its Karoo equivalent rufous-eared warbler as well as melodious lark. In rocky hillocks attract species such as freckled nightjar (vocal at night), short-toed rock thrush and cinnamon-breasted bunting. There are also a number of birds making use of the artificial man-made habitat around accommodations, such as mousebirds, martins, robin-chats, thrushes, canaries and flycatchers. Animal species such as Black Rhino, White Rhino, Buffalo, Tsessebe, Roan Antelope, Mountain Reedbuck, Giraffe, Gemsbok, Eland, Zebra, Red Hartebeest, Blue Wildebeest, Black Wildebeest,

Kudu, Ostrich, Steenbok, Duiker and Springbok are also present in the Mokala National Park. The trees associated with the riverbeds provide locally rare nesting and roosting habitat to birds.

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.

No watercourses or even drainage lines was observed, or are expected, on the proposed final solar site location. Towards the east and south-east of the site drainage lines and or watercourses are, however, expected.

INVASIVE ALIEN INFESTATION

Most probably because of the aridity of the area, invasive alien rates are generally very low for most of this area and no problem plants were observed within the study area (apart from some bush encroachment by the indigenous *Acacia mellifera*).

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, Mount Roper and their possible significance

BIODIVERSITY ASPECT	SHORT DESCRIPTION	SIGNIFICANCE RATING
Geology & soils	The soils are mostly similar throughout the study area, although varying in depth.	No special features have been encountered on the final solar location (e.g. true quartz patches or broken veld).
Land use and cover	Natural veld, used for game grazing.	The property is used as a game camp.
Vegetation types	Kuruman Thornveld.	Kuruman Thornveld is considered "Least threatened". However, the remaining natural veld shows good connectivity with the surrounding areas.
Endemic or protected plant species	No endemic species was observed, but a number of the protected tree species *Acacia erioloba* and *Boscia albitrunca* was observed (Refer to Table 3).	The same species composition is shown throughout the larger study area and its immediate surroundings. Moving the proposed location will not alter the fact that some of these trees will be impacted. However, with good environmental control the impact could be minimised.
Mammal or bird species	The farm is used as a game camp with various game species as well as bird and smaller species present.	The size and location of the solar facility is not expected to have a significant impact on the movement of game species found on the larger area.
Rivers & wetlands	No watercourses or drainage lines were observed on the site.	No impact.
Invasive alien infestation	No alien invasive trees were observed.	No impact.

In summary, all 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, although the placement of a 20 ha solar site will have an impact on a number of protected trees (both *Acacia erioloba* and *Boscia albitrunca*) the proposed location is not expected to have significant impact on any biodiversity feature or put pressure on regional conservation targets. The impact on populations of individual species is regarded as medium-low, the impact on sensitive habitats is regarded as medium-low, the impact on ecosystem function is regarded as very low, cumulative impact on ecology is regarded as medium-low and finally the impact on economic use of the vegetation is regarded as medium-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*) x (*leg* + *gcp* + *pol* +*ia* + *str*) x *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

ia = 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 vegetation type would be fire and grazing pressure (herbivore), and could largely determine plant community composition and occurrence of rare species. Grazing 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. No important components such as watercourses, wetlands, upland- down land gradients or vegetation boundaries were observed during the site visit (associated with the final proposed solar site location). It was also not evident to what extent the fire regime has been altered in order to improve grazing (if at all).

THREATENED OR PROTECTED ECOSYSTEMS

The site visit confirmed that the vegetation conforms to Kuruman Thornveld (Refer to Figure 13). This vegetation type was classified as "Least Threatened" during the 2004 National Spatial Biodiversity Assessment (NSBA). More than 98% of this vegetation still remains in its natural state, but at present none of this vegetation type is formally protected 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, **Kuruman Thornveld, remains classified as Least Threatened**.

The proposed location will impact on a number of protected trees, but the impact on threatened or protected ecosystems is regarded as being low. Good environmental control during the construction phase can ensure further mitigation.

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. In addition, by placing the proposed final site location away from the watercourse the impact is further reduced.

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

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 road networks).

Since large areas with good connectivity remains and the site is located away from the watercourse, the 20 ha Mount Roper 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 at the end of February (2012). At the time of the study the veld in the Mount Roper area was generally in very good condition and most of the species was visible/identifiable. The author is of the opinion that in the larger context almost all significant species were observed and mapped.

THREATENED OR ENDANGERED SPECIES

No threatened or endangered species were recorded during the site visit, however, this does not rule out their presence as they may be subject to seasonable rainfall and may not have been observable during the time of

the site visit. The composition of the herbaceous layer fluctuates with seasonal rainfall (Van Rooyen *et. all*, 1984, *vide* Mucina & Rutherford, 2006). It must be noted that the vegetation type is considered "Least Threatened" (Mucina & Rutherford, 2006) and that this classification is based on plant species diversity and turnover as well as habitat transformation. The number of species per broad geographical levels for the savannah biome is relative low (Van Rooyen, 1988, *vide* Mucina & Rutherford, 2006). It is therefore very unlikely that any red data species will be confined to this site alone.

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 almost be 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 both *Acacia erioloba* (Camel thorn) and *Boscia albitrunca* (Witgat) was observed on the larger property. (All of the trees observed were referenced by GPS and are indicated on Figure 5 and in Table 3). A number of these trees will be impacted by the development.

Acacia erioloba is normally associated with deeper soils. Most of the Acacia erioloba as well as the Boscia albitrunca encountered were registered just north of the proposed site, but a significant number of both these species was observed within the proposed final site location. These trees will most likely be permanently compromised in most cases. It was also noted that this distribution pattern for both these tree species holds true for most of the immediate surroundings (thus changing the location of the site slightly will not necessarily improve the outcome). However, though Acacia erioloba is an important species within Kuruman Thornveld, the number of individuals found on the proposed site would most probably not significantly impact on the gene-pool of this species should it be lost. Still it is important that if this development is approved good environmental control should be exercised and that a botanist or an ECO with suitable experience should be appointed during the initial lay-out of the site. Smaller trees should be rescued where possible while pylon placement should consider clumps of these trees. With good environmental control and careful placement of the solar pylons and the maintenance roads the impact to the trees within the final site location can be greatly reduced or minimised.

The severity of the impact might then be rated as medium to medium-low.

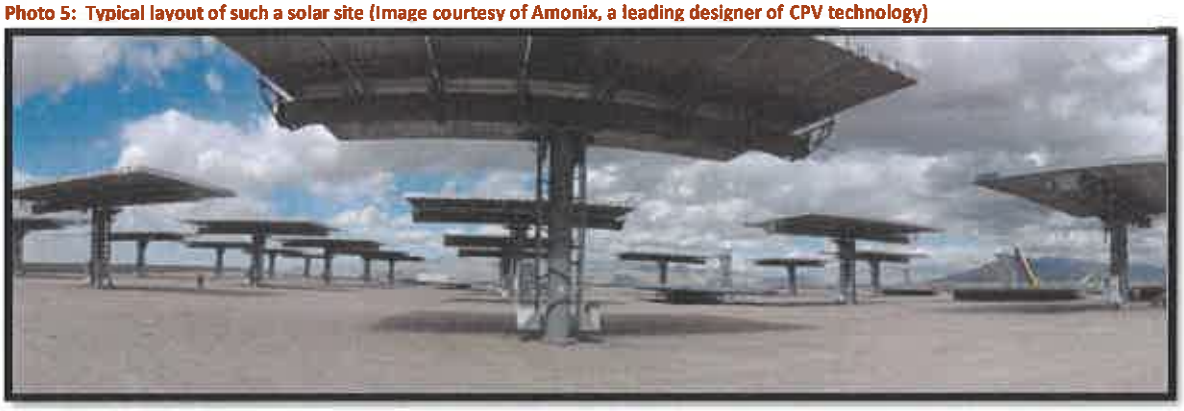
Mitigation:

- A botanist or suitably experienced ECO must be appointed to oversee the initial layout of the construction site, with the aim to identify and minimise the impact on healthy individuals of the above protected trees. Wherever possible the placement of roads and solar structures should endeavour to avoid any of the protected tree species.
- In the case that some of these trees must be removed, permit approval must be obtained beforehand.
- It is also proposed that at least two plants of the same species be replanted for every single tree removed.

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 (Refer to Photo 5). 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 5: 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 Kuruman Thornveld (Refer to Vegetation encountered on page 14). Kuruman Thornveld was classified as "Least Threatened" and "Not 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 Kuruman Thornveld are still regarded as least threatened. Although none of this vegetation type is formally protected, more than 98% 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.

- Refer to the mitigation actions under the heading: Protected species (page 24).
- 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. Kuruman Thornveld was classified as "Least Threatened", but "Not 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 Kuruman Thornveld is still regarded as least threatened. Although none of this vegetation type is formally protected, more than 98% 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 (as described in Figure 4 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. However, a number of protected tree species will not be harmed.

The site visit and desktop studies described and evaluated in this document led to the conclusion that the "No-Go" alternative will not result in significant gain in regional conservation targets, the conservation of rare & endangered species or gain in connectivity, however, a number of protected tree species will be conserved. 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, biodiversity friendly, and more sustainable long term 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 without any mitigation measures. 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.

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

$$S = [(2 + 1.5 + 2 + 1 + 2) \times (1 + 1 + 1 + 1 + 1) \times 0.95] = 40\ \%$$

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 with all proposed mitigation measures implemented. 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.

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

$$S = [(2 + 1.5 + 2 + 1 + 2) \times (0 + 1 + 0 + 1 + 0) \times 0.95] = 16\ \%$$

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 Mount Roper 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 6: Magnificent *Acacia erioloba* tree on site

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, however, a number of protected tree species will be conserved. 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.

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 and that a botanist or suitably qualified ECO be appointed during the initial layout of the structures in order to minimise the impact on the protected tree species.

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

- Only existing access roads should be used for access to the terrain (solar site).
- A botanist or suitably experienced ECO must be appointed to oversee the initial layout of the construction site, with the aim to identify and minimise the impact on healthy individuals of the above protected trees. Wherever possible the placement of roads and solar structures should endeavour to avoid any of the protected tree species.
- Any significant plant species that may be encountered must be identified and located (e.g. *Acacia erioloba* and *Boscia albitrunca*) and all efforts made to avoid damage to such species.
- In the case that some of these trees must be removed, permit approval must be obtained beforehand.
- It is also proposed that at least two plants of the same species be replanted for every single tree removed.
- 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.